Creativity in Action

RePlay: An Embodied Relational Approach to Collaborative Creativity

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Abstract

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This work moves beyond individual, cognitive, and product-oriented accounts of creative process towards embodied, relational, and situated understandings of creative emergence. It addresses practice-based research at the intersection of design research, human-computer interaction, utilizing improvisational theatre as inspiration. It documents RePlay, a framework that adapts the principles of theatrical improvisation into a structured yet open sandbox for facilitating and studying design process.

RePlay was developed iteratively through action research: exploratory studies with improvisers and with design practitioners at Philips Design, followed by three applied case studies with design and technology researchers at Tiree Tech Wave, with children and community members in a participatory urban design project in Bhopal, India (Global Studio), and with young makers in Ottawa, Canada (Bendables) and business partner Maker Junior. This process was informed by action research, participatory design, research-creation, and sensory ethnography. *Sessions generated visual, material, and reflective data (video, fieldnotes, design maps, traces, artefacts, and TAPT accounts), which were interpreted reflexively.*

The studies indicated that RePlay can be adapted to very different contexts while preserving a common structure of improvisation, externalization, reflection, and facilitation, and that it makes the usually tacit, embodied, and relational dynamics of group creativity visible enough to be reflected upon and studied. From this work the thesis develops Creativity in Action: an embodied, relational, and improvisational form of creativity, and a trainable capacity to remain aware of one's own process, of others, and of context while creating. Further contributions are a theorization of the sandbox as a set of conditions for creative emergence and RePlay as both a methodology for studying collaborative creativity and a social technology for cultivating conditions associated with group flow. The thesis closes by considering what these findings imply for hybrid human AI creative ecologies and the potential of further development utilizing RePlay.

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Thirteen Thank Yous.

Ki'il Utz'iil Utzlaj Bey Colo', Nimlaj Taq K'aslimaal, Oxlajuj Matioxiil.

— Martín Prechtel, Tz'utujil Maya blessing

Author's Declaration

I declare that this thesis is my own work and has not been submitted in substantially the same form for the award of a higher degree elsewhere. Some of the research in this thesis has been published or presented previously. These publications are listed in the bibliography. The material has not been submitted, either inwhole or in part, for a degree at this, or any other university.

Use of generative AI. ChatGPT (OpenAI) was used to generate the images identified in figure notes as "Made by the author using ChatGPT", to assist in compiling Table 9.1, and to build the RePlay Creativity Companion described in Chapter 9. AI tools were also used to support editing and formatting during the revision of this thesis.

A rough estimate of the word count
is: 108,000

An exception to the word limit has been requested due to the extra Literature Review Chapter on Oct 10, 2026

Layda Gongora

Date: Oct.19.2026

Chapter 1: Introduction and Conceptual Background

"The best moments usually occur when a person's body or mind is stretched to its limits in a voluntary effort to accomplish something difficult and worthwhile."

— Mihaly Csikszentmihalyi, Flow

1.1 Introduction

Individual Creativity is often treated as something that that belongs to exceptional people, emerges in moments of inspiration, or results from deliberate cognitive effort. Yet in professional practice in HCI, creative work is frequently collective, embodied, and responsive. It unfolds between people, through gestures, timing, risk, and attunement. This research starts with the premise that collaborative creativity can be understood as something that happens in action, through improvisational interactions, and within conditions of co-presence. This thesis explores collaborative creativity in an applied HCI/design process framework which can be, studied, and cultivated through an embodied improvisational practice. It introduces **Creativity in Action**, as a trainable form of embodied creative awareness which can support moments of innovation within inter-disciplinary teams. The way this was achieved was through the development of *RePlay an embodied framework to explore and research improvisational creativity in practice and collaborative design contexts especially, where technology is involved.*

> **RePlay investigates how embodied improvisation, and relational dynamics contribute to creative emergence in collaborative settings.**

The case studies presented in this thesis, investigate how embodied improvisation, and relational dynamics contribute to creative emergence in collaborative settings These questions are increasingly important as contemporary life becomes more digital, distributed, and mediated, raising urgent concerns about how we connect, attune, and make meaning together across physical and virtual spaces. By examining creativity not just as a trait or product but as a process shaped by presence, responsiveness, and interaction, this study contributes to a broader shift toward relational frameworks of creative practice. It considers the implications of designing systems that foster human-technology collaboration, including agentic AI, as a collaborative creative process. Ultimately, this work seeks to advance creativity research by deepening our understanding of how humans collaborate creatively. In doing this we can learn how to co-create in adaptive, collaborative design contexts.

To frame this inquiry, Chapter 1 provides a conceptual overview of creativity. It begins with historical models and psychological foundations and then moves to contemporary approaches that

emphasize embodiment, performance, neurocognition, and social context. It introduces the core theoretical contribution of this thesis **Creativity in Action** and closes by positioning the project within current debates in creativity research and design studies.

1.2 Historical Perspectives on Creativity

The study of creativity has evolved through distinct phases, beginning with foundational models that emphasized individual cognitive processes and progressing toward more complex, multi-factor approaches. This section traces this evolution to establish the theoretical foundation for understanding creativity as both a psychological phenomenon and a collaborative process.

1.2.1 Defining Creativity: From Big-C to Little-c Creativity

As part of the theoretical foundation for this thesis, it is important to distinguish between different levels of creative achievement. Craft, Jeffrey, and Leibling (2001) distinguish between "Big-C" and "little-c" creativity.

Big-C creativity refers to forms of creativity associated with exceptional achievement, such as the work of Mozart, Picasso, or Einstein. These achievements are socially recognized as original, valuable, and historically significant.

Little-c creativity, by contrast, refers to everyday forms of creative thought and action. It involves the capacity to find new, useful, or effective solutions to ordinary problems and is not limited to people regarded as exceptionally gifted or intelligent. In some ways the case studies explored here could be described as concerned with little-c creativity as they occur in applied, collaborative, and everyday design contexts.

A similar distinction is made by Shneiderman (2000), who differentiates between **revolutionary creativity**, associated with major historical breakthroughs, and **evolutionary acts of creativity**, such as a doctor making a diagnosis or a practitioner developing a useful solution in context. This thesis is mainly concerned with these applied and situated forms of creativity: creativity as it emerges through practice, collaboration, reflection, and action.

1.3 Mapping the Field: Major Approaches to Creativity Research

Creativity research is a broad and interdisciplinary field, shaped by psychology, philosophy, education, design, computer science, neuroscience, the arts, and social theory. Sternberg and Lubart (2010, pp. 4–9) categorize several major approaches to the study of creativity, including **mystical**, **psychoanalytic**, **pragmatic**, **psychometric**, **cognitive**, **social-personality**, **environmental, and historiometric** approaches. This list is not exhaustive. It illustrates the range of traditions through which creativity has been studied.

For this thesis, this breadth is important because RePlay does not sit neatly within one tradition alone. It draws from cognitive and psychological models of creativity, but also from systems thinking, philosophy, human computer interaction, design research, embodied cognition, improvisational theatre, and collaborative practice. My own way of understanding this field is systems-oriented: I am interested in how creativity emerges through relationships between people, bodies, tools, environments, practices, and social contexts.

This mapping of the field provides a context for the sections that follow. This chapter first considers early process models of creativity, then cognitive, computational, confluence, ecological, and embodied approaches. These frameworks establish the theoretical basis for RePlay as a method and methodology for studying collaborative creativity in action.

1.4 Early Foundations: The Traditional Model of the Creative Process

> "Creative Ideas reveal to us unsuspected kinships between other facts well known but wrongly believed to be strangers to one another" (Poincare, 1913, p.115).

Approaches to the study of creativity and innovation have been varied; however, contemporary thought in the field defines creativity as an ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e., useful, adaptive, and considers constraints). (Lubart,1994), (Ochse, 1990), (Sternberg, 1988), (Sternberg &Lubart, 1991, 1995, 1996) define innovation as the implementation of new ideas to create something of value, proven through its uptake in the marketplace. An innovation can be seen as a new idea being launched on the market for the first time. In western thought historically creativity was perceived as a god-like quality, whereas in oriental culture Hindu, Taoist and Buddhist, creativity was understood as mimicry and discovery (Albert & Runco, 1999). (Ferrari, Anusca & Cachia, Romina & Punie, Yves, 2009). Eastern culture tends to attribute success to effort, while Western cultures relate success to ability (Ng and Smith 2004), (Ferrari, Anusca, Cachia et al., 2009).

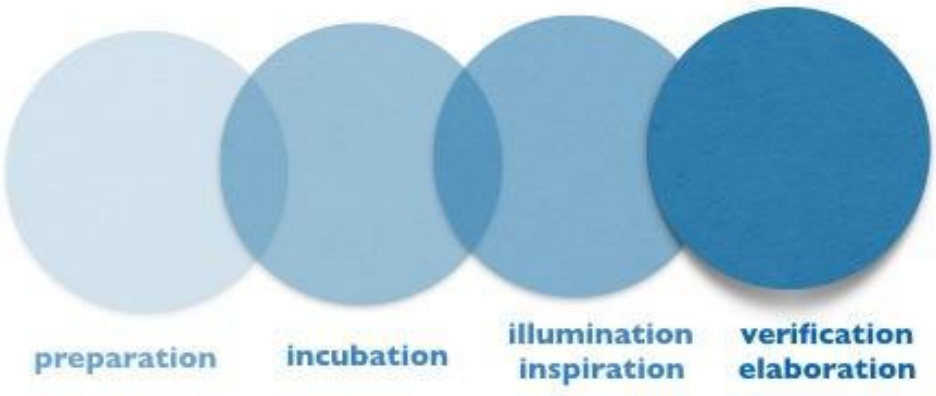
Creativity Researcher Keith Sawyer (1982), in his book titled '*Explaining Creativity*', records that in 1913, the mathematician Henri Poincare no stranger himself to innovation, presented his famous lecture Mathematical Creation. In this historical Paris lecture Poincare outlined a four-stage process of consciousness which involves unconscious incubation, illumination, and verification (Poincare, 1913).

Figure 1.1 Poincare's Model



Researchers Hemholtz and Wallas present these phases as Preparation, Incubation, Illumination/Inspiration, Verification/Elaboration:

Figure 1.2 *Wallas and Helmholtz Model of Creative Process*



Preparation: This phase is characterized by thinking about or learning the mental elements that might be relevant to the problem at hand. The solution is not found at this stage unless the problem was trivial to begin with (Hemholtz 1896).

Incubation: At this stage the problem is set aside and after some time the solution triggers an illumination/inspiration phase. During this phase dreaming, reverie, sports, and even other daily tasks such as showering or brushing teeth play a role in allowing the mind to process unconsciously.

After an incubation period one usually experiences a moment of illumination, inspiration or what has been called in creativity research an "insight" or an "aha moment" when the unconscious thought becomes conscious. Poincare for example made his discovery of a new expression for Fuschsian functions while stepping onto a bus. Kelkule had key insights into the molecular structure of benzene after dreaming of coiled snakes that represented ring shaped structures (Ward, Smith, and Finke, 2010, p. 194). Consensus is that conscious thought inhibits the unconscious forming of connections that underlies insightful leaps. Koestler thought that given that creative insights occur in often sudden, and unpredictable ways and that conscious thought inhibits insights, one might wonder how these unpredictable moments could ever be studied under controlled laboratory conditions (1964).

Illumination/Inspiration: The Illumination phase has many misnomers and there is much debate about how and whether what we experience is happening, reflects a longer unconscious process. Now it may feel as though a solution or strategy has been discovered for further exploration as described in the previous paragraph however there is still debate amongst researchers whether the insight moment is as spontaneous as first-hand experience might indicate.

Verification/Elaboration: At this stage the idea is subject to logical scrutiny before it is then put into its final form. This could be a painting, a book, a model, a mathematical equation or a scientific theory Hemholtz (1896), Wallas (1926/2014).

1.5 Cognitive and Psychological Models of Creativity

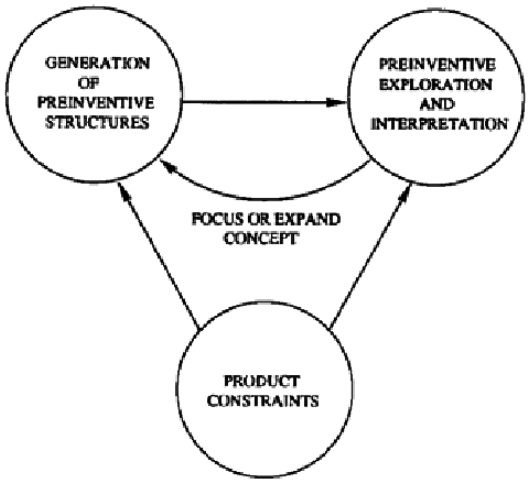
While the four-stage model provided an important foundation, researchers soon recognized that creative processes are rarely linear. This realization led to the development of more sophisticated psychological and cognitive approaches to creativity: approaches that explain creativity through the individual mind, psychological traits, cognitive processes, and forms of creative thinking. While psychological approaches often focus on the creative person, motivation, personality, or creative potential, cognitive approaches focus more specifically on how ideas are generated, explored, transformed, and evaluated.

The limitations of early-stage models led to the emergence of more sophisticated cognitive approaches in the 1970s and 1980s. This second wave of creativity research focused on understanding the specific mental processes involved in creative thought, offering insights that were often modelled using computer simulations and problem-solving frameworks (Sternberg & Lubart, 2010). Unlike earlier views that positioned creativity as an elusive or mystical trait, cognitive approaches conceptualized it as a thinking skill that can be studied, practiced, and refined (Sternberg & Lubart, 1999).

1.5.1 Cognitive Models of Creativity: The Geneplore Model

One of the most influential models from this tradition is the Geneplore Model (Finke, Ward, & Smith, 1992), which frames creativity as a two-part cycle: a generative phase, where mental representations called pre-inventive structures are produced, and an exploratory phase, where those structures are elaborated, interpreted, and assessed. The two phases of generation and exploration are not linear; rather, an unsatisfactory output can trigger a return to the generative phase through refocusing, reinterpretation, or expansion of the original concept.

Figure 1.3
The Geneplore Model



Note. Adapted from Sawyer (2012, p. 215).

Within this model, key mental operations include retrieval of prior knowledge, association of disparate concepts, synthesis of ideas into new configurations, transformation of mental imagery, analogical transfer from one domain to another, categorical reduction, and combinational creativity, which involves forming novel ideas by blending existing ones (Finke et al., 1992). These mechanisms underscore the view that creativity is rooted in cognitive effort and iterative exploration, rather than random inspiration alone.[2]

These mental processes may be understood as follows:

[2] In this thesis I both explore and develop some of these concepts through exploratory research and design focused case studies with the aim of developing both a method and methodology for researching collaborative creativity in situ.

i. **Retrieval**: Accessing prior knowledge or memories from long-term memory (e.g., recalling how a tent is structured when trying to design a portable shelter)
ii. **Association**: Linking seemingly unrelated ideas or concepts together (e.g., associating "umbrella" and "parachute" to imagine a floating umbrella device)
iii. **Synthesis**: Combining multiple elements or ideas into a novel configuration (e.g., merging elements of a bicycle and a treadmill to invent a stationary fitness bike)
iv. **Transformation**: Altering the form, scale, function, or configuration of an idea or object (e.g., rotating or inverting a shape mentally to see new patterns or affordances)
v. **Analogical Transfer**: Mapping a structure or process from one domain onto another (e.g., using the structure of a beehive to inspire modular housing units)
vi. **Categorical Reduction**: Stripping away conventional category constraints to allow reinterpretation (e.g., thinking of a "chair" not just as furniture, but as "a support device," opening new design possibilities)
vii. **Combinational Creativity**: Generating novelty through new combinations of familiar elements (e.g., combining "music" and "AI" to invent a system that composes ambient soundscapes in real time based on human movement.

Building on these mental processes, researchers identified related forms of generative creative thinking. **Combinational creativity** *involves combining two concepts to form a new idea, for example "crazy glue."* **Analogical creativity** *takes properties from one mental model and transfers them to another;* for example, de Mestral developed the idea for Velcro when he wondered why burrs stuck to his clothes (Hill, 1978). In the 1960s, the consulting firm Synectics Inc. used four forms of analogy to support idea generation: personal analogy, direct analogy, symbolic analogy, and fantasy analogy (Gordon, 1961, pp. 36–55).

While the Geneplore model and related forms of generative thinking explain how ideas are produced, combined, and explored, they do not fully account for how creators become aware of their own process. Reflection accounts for this gap as it helps explain how creative practitioners evaluate, redirect, and learn from creative activity as it unfolds.

1.5.2 Reflection and Creative Process

While I agree with some of Wallas and Helmholtz's model of creative process in broad terms, as well as the Genplore model. I think that the underlying processes and techniques used within each stage require further research and elaboration, particularly the role that reflection plays in creative process. This is one of my motivations for developing RePlay as a framework for qualitative research into collaborative creativity. The "Re" in RePlay stands for reflection, while "Play" refers to the importance of playfulness, experimentation, and process.

My position is that a creative mindset can be taught and learned through action and reflection, eventually leading to what I call **Creativity in Action**, a concept developed through this research

and elaborated in later chapters. Award-winning film director David Lynch describes a related process as "catching the big fish." In his account, creative intuition and consciousness are capacities that can be developed, but that may also be blocked by stress, lack of sleep, self-sabotage, and other forms of mental interference. Lynch refers to these blocks as negative forces that cloud the mind. Instead, he recommends bringing energy and awareness to one's process, likening creative practice to fishing, where the creative idea is the "big fish." His account suggests a connection between creativity, consciousness, intuition, and awareness: a connection that is central to my own interest in reflection as part of creative process (Lynch, 2006).

1.5.3 Margaret Boden and Computational Models of Creativity

The cognitive paradigm found one of its most influential voices in Margaret Boden, whose work bridges psychology, philosophy, artificial intelligence, and computational creativity. Boden (2004) proposed that creativity involves the exploration and transformation of structured conceptual spaces: mental models shaped by cultural, biological, and individual constraints. Her approach is closely aligned with symbolic and computational models of thought because it treats creative processes as, at least in principle, describable through formal mechanisms, rules, and transformations.

Boden's framework distinguishes between P-creativity and H-creativity:

i. **P-creativity**, or psychological creativity, *refers to ideas that are novel to the individual who produces them.*
ii. **H-creativity**, or *historical creativity, refers to ideas that are novel in human history.*

She also distinguishes between forms of creativity that operate within or transform conceptual spaces:

i. **Combinational creativity** *brings familiar ideas together in unfamiliar ways.*
ii. **Exploratory creativity** *investigates the possibilities within an existing conceptual space.*
iii. **Transformational creativity** *changes the rules or boundaries of the conceptual space itself, making new kinds of ideas possible.*

Boden's framework has been foundational for computational creativity and early artificial intelligence research because it suggests that creativity can be understood as the manipulation, exploration, and transformation of structured representations. However, it has also been critiqued for privileging internal cognition and symbolic manipulation over embodied, affective, material, and socially situated dimensions of creativity.

For this reason, Boden's work provides an important conceptual bridge between classical cognitive science, computational models of creativity, and the embodied and enactive paradigms that this

thesis later develops. RePlay accounts for embodied, material and socially situated dimensions as well as co-presence as part of collaborative creativity.

1.5.4 Summary: The Limitations of Cognitive Approaches to Creativity

The limitations of early-stage models led to the emergence of sophisticated cognitive approaches in the 1970s and 1980s such as the Geneplore model and Margaret Boden's symbolic framework. This second wave of creativity research focused on understanding the specific mental processes involved in creative thought, offering insights that were often modeled using computer simulations and problem-solving frameworks (Sternberg & Lubart, 2010).

Unlike earlier views that positioned creativity as an elusive or mystical trait, the cognitive approach conceptualizes it as a thinking skill that can be studied, practiced, and refined (Sternberg & Lubart, 1999).

Cognitive approaches include several interrelated strands, such as phase-oriented models, pragmatic methods, and theories of thinking strategies. Phase-oriented studies attempt to map creativity as a multi-stage process, emphasizing that it is not a sudden, irrational event but rather unfolds over time. The most influential being the Geneplore Model (Finke, Ward, & Smith, 1992) that frames creativity as a two-part cycle: a generative phase, where mental representations called *pre-inventive structures* are produced, and an *exploratory phase,* where those structures are elaborated and assessed. Key mental mechanisms underscore the view that creativity is rooted in deliberate cognitive effort, however this doesn't account for random inspiration which seems to characterize the more emergent qualities of improvisational creativity this this research hopes to elucidate upon.

1.6 The Confluence Approach: Integrating Multiple Factors

Building on earlier cognitive and psychological models, the confluence approach proposed by Sternberg and Lubart (1999) introduced a more integrative account of creativity. Rather than attributing creative output to a single cause, such as intelligence, divergent thinking, or personality, confluence theories suggest that creativity results from the interaction of multiple components, including cognitive abilities, domain-specific knowledge, thinking styles, motivation, personality traits, and environmental support. This represented an important shift in creativity research because it moved the field away from single-factor explanations and toward a more complex understanding of the conditions that support creative work.

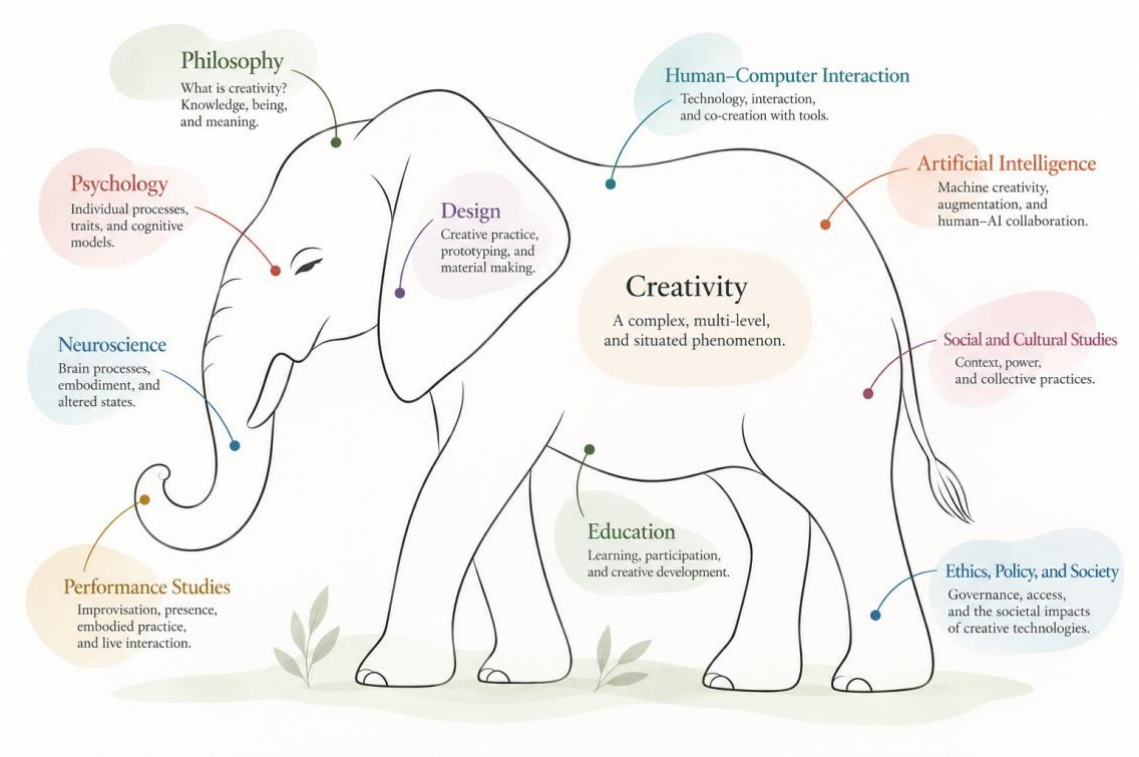
At the same time, confluence theories often remain oriented around the individual creator and the psychological conditions that support creative output. For the purposes of this thesis, they are therefore useful but not sufficient.

RePlay is concerned not only with the factors that enable creativity, but with how creativity unfolds through embodied interaction, co-presence, improvisation, material context, and collaborative process. The confluence approach therefore provides an important bridge into the more ecological, systemic, and relational models discussed below.

1.6.1 The Confluence Model: Toward Interdisciplinary Integration

The proliferation of approaches to creativity research created a need for more holistic and multidisciplinary accounts. Sternberg and Lubart (2010) describe this need through the idea of confluence: the recognition that creativity cannot be adequately explained through a single disciplinary lens. Wehner, Csikszentmihalyi, and Magyari-Beck (1991) illustrate this problem through the fable of the blind men and the elephant, in which each person touches a different part of the animal and reaches a different conclusion about what it is. The fable captures the difficulty of studying creativity when each discipline attends only to one part of a much larger phenomenon. Below is the author's illustration, adapted from the analogy discussed by Csikszentmihalyi and Magyari-Beck (1991)

Figure 1.4
Disciplinary Perspectives on Creativity



Note. Made by the author using ChatGPT.

This interdisciplinary challenge is central to the present thesis since creativity research spans psychology, philosophy, design, performance studies, neuroscience, human-computer interaction, and artificial intelligence. While this breadth makes creativity difficult to study with the granularity

of a single discipline, it also opens the possibility of understanding creativity as a complex, multi-level, and a situated phenomenon.

1.6.2 Core Components of Confluence Theories

Among efforts to move beyond single-factor explanations of creativity, the confluence approach offers a particularly influential integrative model. Rather than attributing creativity to one dominant cause, it proposes that creativity results from the interaction of multiple factors. These include cognitive abilities, domain-specific knowledge, thinking styles, motivation, especially intrinsic motivation, personality traits, and environmental support.

Confluence theories offered an integrative approach to creativity by moving beyond single-factor explanations. Gruber and Davis (1988), as cited in Sternberg and Lubart (2010, p. 10), identify several important features of creative work, including a cognitive style capable of working with complexity and breaking mental sets during problem solving; knowledge of heuristics for generating novel ideas, such as trying counterintuitive approaches; and a work style characterized by concentrated effort, the ability to set aside problems, and high energy.

This integrative orientation is echoed by Feldman, who argues that confluence theories are promising because they are grounded in psychological theory, open to experimental testing, and multidisciplinary in scope. As Feldman writes, confluence theories "call upon various aspects of psychology" while resisting the tendency to reduce creativity to ordinary representation and process alone (Feldman, 1999, p. 181).

I extend this observation to suggest that the disciplinary possibilities of creativity research are broader still. Because creative process underlies many aspects of human experience, it cannot be fully understood through psychology, cognition, computation, design, or performance studies alone. This recognition sets the foundation for the embodied and relational approach to creativity that this thesis develops through the RePlay framework.

While the confluence model represented a significant shift in creativity research by bridging earlier cognitive theories with a broader appreciation of the sociocultural and contextual influences, it largely maintained a psychological orientation, focusing primarily on internal traits and capacities. This limitation did not satisfy my need for developing RePlay as not only an internalist approach but also as a systemic, ecological, and relational understanding of creativity.

1.6.3 Moving Beyond Confluence: Toward Embodied and Relational Approaches

Although the confluence approach provides a more holistic account of creativity than earlier single-factor models, it does not fully account for the embodied, performative, material, and relational dimensions of creative activity. Collaborative creativity does not simply occur inside individuals

who then exchange ideas. Rather, creative activity emerges through patterns of interaction between people, bodies, tools, environments, materials, technologies, and social contexts.

This thesis therefore moves from confluence as a multidisciplinary orientation toward an ecological and relational account of collaborative creativity. In this account, creativity is not treated as a private mental event or as a linear movement from problem to solution. It is understood as a dynamic process that unfolds through responsiveness, interaction, co-presence, and situated action. This provides the conceptual transition into systems thinking and ecologies of creativity.

1.7 From Confluence to Systems and Technological Ecologies of Creativity

The confluence approach is useful because it moves creativity research beyond single-factor explanations and toward a more integrative account of creative process. However, while confluence theories recognize the interaction of multiple factors, they often remain oriented around the individual creator and the psychological conditions that support creative output. For this thesis, it is necessary to extend this movement further: from creativity as the product of multiple internal and contextual factors toward creativity as an ecological, relational, and systemic process.

Gregory Bateson's theory of an ecology of mind (1972) provides a useful foundation for this transition. Bateson challenges the idea that mind is contained within the individual person alone. Instead, he emphasizes pattern, communication, feedback, difference, and relation as central to thinking and learning. From this perspective, creativity is not simply the production of novel ideas by an isolated mind, but the emergence of new patterns within a relational system. This is closely aligned with the concerns of this thesis, which investigates creativity as something that unfolds through embodied interaction, improvisation, co-presence, and responsiveness.

Building on this ecological orientation, systems thinking offers a way to understand creativity as emerging through relationships among people, bodies, environments, tools, materials, technologies, and social contexts. In this sense, creativity is not simply a property of an individual mind, but a dynamic process that arises through interaction. Fritjof Capra's work on living systems is useful here because it distinguishes between structure and pattern: structure refers to the material components of a system, while pattern refers to the relationships and processes that connect those components. This distinction is important for creativity research because creative emergence often depends less on isolated elements than on the changing relationships between them.

This systems perspective helps bridge earlier confluence theories and later embodied, relational, and ecological approaches. While confluence theories identify the multiple factors that contribute to creativity, systems and ecological approaches examine how these factors interact over time. They shift the focus from listing components to understanding relations, feedback loops, contexts, and emergent patterns. This is especially important for collaborative creativity, where ideas do

not simply originate in one person and then transfer to others, but emerge through ongoing responsiveness, negotiation, movement, and shared attention.

In the case of the development of RePlay, this ecological framing was central. RePlay does not treat creativity as a private mental event or as a linear movement from problem to solution. Rather, it creates conditions in which creativity can be studied as an unfolding system of bodies, gestures, speech, roles, objects, constraints, environments, and emerging ideas. It therefore aligns with Bateson's and Capra's emphasis on pattern, relation, and feedback, while extending these ideas into embodied and improvisational design practice.

This ecological perspective also becomes increasingly important in contemporary contexts where creative practice is shaped by digital tools, artificial intelligence, networked environments, and human-machine collaboration. In such contexts, creativity is no longer adequately described as either individual cognition or human collaboration alone. It increasingly takes place within hybrid creative ecologies, where human and non-human actors, embodied practices, computational systems, and material environments participate in the production of meaning. Bateson's ecology of mind therefore provides a conceptual foundation for understanding creativity as systemic, relational, and emergent.

Creative process is not limited to visual art or to explicitly artistic practice. It appears across many forms of human experimentation, learning, problem-solving, design, performance, and innovation. From a systems perspective, these activities can be examined for recurring patterns: how people generate possibilities, respond to constraints, externalize ideas, collaborate with others, and revise their actions through feedback. These patterns are important for this thesis because they suggest that creativity can be studied not only through finished products, but through the processes, interactions, and conditions that allow creative work to emerge.

1.8 The Socio-Cultural and Environmental Turn in Creativity Research

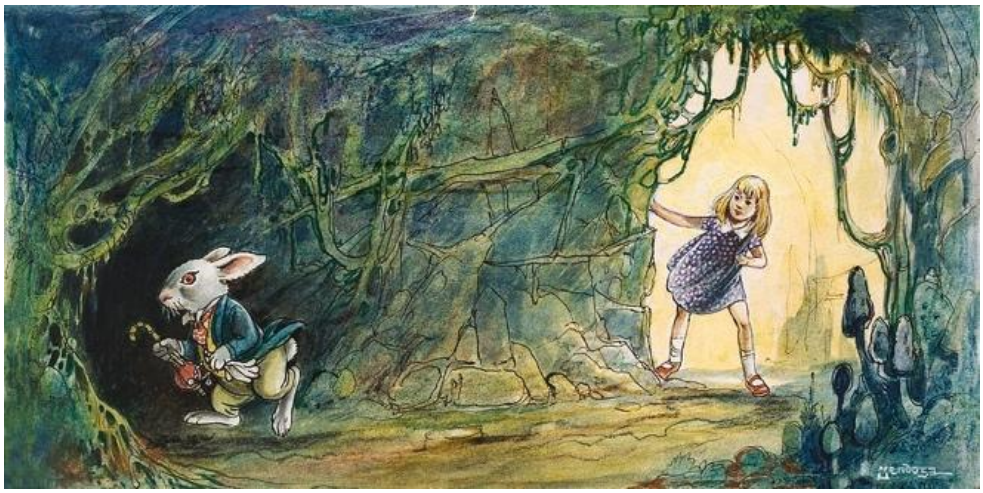
Building on Bateson's foundational insights, 1980's and 90' a socio-cultural approach emerged engaged in understanding creative social systems, the social context, the dynamics of interaction, as well as the processes and techniques employed by practitioners. This approach is also known as an environmental approach. In many ways this approach is similar to how Fritjof Capra (1997) physicist, systems theorist and deep ecologist describes "Systems Thinking" as an approach to knowledge where by instead of looking linearly to reduce a phenomenon to it components we look deeper to study the interactions between these different components and to seek out patterns within a system, Deep ecological awareness recognizes the interdependence of all phenomena and the fact that, as individuals and societies, we are all embedded in and dependent on the cyclical processes of nature. Scientists who have been instrumental to this shift, include Nobel Prize-winning chemist Ilya Prigogine, Chilean neuroscientist Humberto Maturana, fractal mathematician

Benoit Mandelbrot, microbiologist Lynn Margulis, and geochemist James Lovelock. A socio-cultural approach and in essence a systems thinking approach, that was engaged in understanding creative social systems, the social context, the dynamics of interaction, as well as the process and techniques employed by practitioners (Capra,1997).

1.8.1 Systems Theory and Creative Process

Creativity researcher Csikszentmihalyi's and Keith Sawyer's (1995) systems approach highlight the interaction of the individual, domain and the field. This environmental approach contrasts with dissecting the structure of creativity which not surprisingly, the more we take apart, we find that the phenomena itself is more difficult to pinpoint and may even all together disappear. Consider the analogy of Alice in Wonderland, whereby no matter how close Alice thinks she is to finding answers through speaking to the white rabbit she is never quite able to catch up to him. I interpret Alice's exchanges with the rabbit meaning, that she is no closer to finding out what has happened to her because the answers are in the relationships between phenomena rather than the phenomena itself which in essence is enactive perceiving.

Figure 1.5
Alice Chases the White Rabbit



Note. Illustration by Philip Mendoza (2018).

1.8.2 Structure and Pattern in Living Systems

Capra (1997) argues that the key to a comprehensive understanding of living systems lies in the synthesis of two distinct yet complementary perspectives: the study of structure (focused on substance, matter, and quantifiable properties) and the study of pattern (concerned with dynamic relationships among parts). This dual perspective aligns holistic understanding with models of creativity, such as Boden's (1990) classification of exploratory, combinatorial, and transformational creativity, or the Geneplore model (Finke, Ward, & Smith, 1992), which emphasizes iterative cycles of generation and exploration. While these cognitive-level frameworks offer important insight, Capra's perspective invites a systemic and ecological framing, positioning

creativity as an emergent phenomenon arising from the interaction between form and flow. A framing that resonates with embodied, relational, and improvisational theories of design and cognition. This idea was inspirational to my development of RePlay as part of this research endeavor.

1.8.3 The Emergence of Systemic, Relational, and Situated Models

Keith Sawyer's work on group creativity provides an important bridge between systems thinking and the study of collaborative creative practice. Sawyer's research shifts attention from creativity as an individual achievement to creativity as an emergent process that unfolds through real-time interaction. His work on improvisation is particularly relevant because it shows how creative outcomes can arise from contingent exchanges, shared attention, responsiveness, and the gradual development of collective patterns.

Taken together, confluence theories, socio-cultural approaches, systems thinking, and Sawyer's work on group creativity mark a wider shift in creativity research: from individualist and internalist models toward systemic, relational, and situated accounts. These models understand creativity as emerging through the dynamic interaction of people, practices, environments, tools, materials, and cultural contexts.

Sawyer's concept of collaborative emergence aligns with the ecological and systems-oriented account. In group creativity, ideas are not simply generated by one person and then passed to others. They are co-constructed through interaction, timing, listening, gesture, language, constraint, and response. This makes Sawyer an important link between systems approaches to creativity and the embodied, improvisational concerns of this thesis.

RePlay builds on this trajectory by extending the study of collaborative emergence into embodied and design-oriented contexts. It treats improvisation not only as a performance technique, but as a way of making creative process observable, discussable, and researchable in situ.

Greg Judelman's work building ReGenAI offers another example of design at the intersection of ecological systems thinking and artificial intelligence. ReGenAI describes itself as a regenerative venture studio developing AI tools to support decisions about land restoration, food systems, water, and climate resilience (ReGenAI, n.d.).

Its proposed applications include land restoration planning, relational AI, and tools for more resilient urban food systems. The studio connects this work to the *Ecological AI Manifesto*, which it describes as a living document intended to guide the emerging field (ReGenAI, n.d.). ReGenAI illustrates how design research might extend its attention from human needs to the relationships between people, technology, and living systems. Its approach asks how artificial intelligence could support ecological regeneration alongside the communities that depend on it. Their current

experiments include a site-based restoration planner, a relational AI for inner development, and an urban agriculture platform. Each is guided by the principles articulated in the Ecological AI Manifesto, a living document we he wrote with Claude Sonnet and Chat GPT to orient this emerging field. (Judelman, 2025).

In the past design research was focused on human-centered design and systemic transformation. However, one of the shifts that Judelman's industrial research presents are that it aligns artificial intelligence with ecological intelligence so that technology becomes a force for regeneration and resilience across land, food, water, and communities.

1.9 Collaborative Emergence and Group Creativity

After receiving his Ph.D. in 1994, Keith Sawyer dedicated his career to research on creativity, collaboration, and learning. Sawyer has also been a jazz pianist for over 30 years and spent several years playing piano and performing with the Chicago Improv theater groups in the 1990s. During his PhD career, Sawyer used Interaction Analysis to study minute-to-minute interaction and applied these processes to improvisational dialogues to study theatrical improvisation. Interaction Analysis studies verbal gestures, body language, and conversation during collaboration, and according to Sawyer, it takes an hour to analyze about a minute of improvisation (Sawyer, 2017, p. 13).

Keith Sawyer's work is central to this discussion because it connects creativity research, improvisation, collaboration, and interaction analysis. Drawing on his background as both a creativity researcher and jazz pianist, Sawyer examines how creative ideas emerge through real-time interaction. His use of interaction analysis to study improvisational dialogue makes his work especially relevant to this thesis, which is concerned with creativity as an embodied and collaborative process.

In his writing, Sawyer makes three clear distinctions of approaches to creativity research: the personality approach, the cognitive approach, and the sociocultural approach. Sawyer's approach is non-traditional in that he is not studying and evaluating products, artifacts, or services in terms of their inherent novelty or reception by an intended audience; instead, he is interested in the processes leading up to a service or artifact.

This systemic perspective emphasizes the emergent, dynamic nature of collaborative innovation (Sawyer, 2017). Rejecting purely individualist and modular accounts of creativity, Sawyer frames it as a distributed process that unfolds in real time through interaction, responsiveness, and shared intention. His concept of collaborative emergence aligns closely with Capra's systems view, highlighting how creative outcomes are not pre-planned or individually authored, but co-constructed through patterned social exchange. RePlay builds on this foundation by extending

Sawyer's insights into embodied, improvisational contexts, proposing a framework where creative meaning arises not only from social interaction, but also from the sensorimotor, affective, and environmental patterns that shape relational flow.

1.9.1 Theoretical Influences on Sawyer's Group Creativity

Sawyer's theory of group creativity is deeply informed by interdisciplinary influences that converge around social, embodied, and emergent models of cognition. Drawing on Vygotsky's (1978) sociocultural theory, Sawyer emphasizes that creativity is not merely an internal trait but a socially mediated and culturally situated process. From Csikszentmihalyi (1999), he adopts a systems perspective, understanding creativity as an emergent product of interactions between individuals, cultural domains, and social fields. Sawyer also draws from his background in jazz and improvisational theatre, influenced by practitioners like Spolin (1999) and Johnstone (1981), positioning improvisation as a living example of collaborative creativity. His thinking is further shaped by distributed cognition (Hutchins, 1995) and situated learning (Lave & Wenger, 1991), which frame cognition as occurring across networks of people, tools, and environments. These perspectives resonate with complexity theory and constructivist learning, placing Sawyer's work in direct conversation with Capra's (1997) systems approach and with frameworks like RePlay which I developed as part of this research contribution. RePlay also emphasizes real-time interaction, relational flow, and embodied meaning-making.[3]

1.10 Embodied, Enactive, and Relational Creativity

While the confluence approach marked a significant advance by integrating multiple psychological and contextual factors (Sternberg & Lubart, 1999), later frameworks challenge the assumption that creativity can be understood primarily through internal traits, mental representations, or cognitive operations. Embodied, enactive, and relational approaches instead emphasize the role of bodily experience, movement, perception, affect, social interaction, and material environments in creative practice. From this perspective, creativity is not simply the outcome of mental representations or trait combinations but emerges through active engagement with the world.

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[3] Please see the appendix for a chart summarizing Sawyer's stages of creative process alongside those of other prominent research approaches which I transposed from the book 'Explaining Creativity'.

This shift draws on the broader paradigm of embodied cognition. Lakoff and Johnson (1999) argue that abstract reasoning and imagination are grounded in bodily experience, with embodied metaphors shaping thought. Cognition is therefore not understood as detached or purely abstract, but as shaped by sensorimotor experience, spatial orientation, and lived interaction. Gallagher (2005, 2011) extends these ideas through an enactive account of cognition, emphasizing that thinking arises through ongoing bodily engagement with the environment and with others.

These approaches offer an important contrast to symbolic and computational models of creativity. Boden's framework, for example, conceptualizes creativity as the exploration and transformation of conceptual spaces: processes that can, at least in principle, be formalized or simulated. Embodied and enactive approaches do not reject cognition, but they challenge the idea that creative process can be fully explained through internal symbolic manipulation. Instead, they emphasize that creative thinking is shaped by bodily action, affective engagement, social co-presence, and situated interaction.

Maturana and Varela's concept of autopoiesis further supports this shift by describing living systems as self-organizing and relational. Their work provides a biological and philosophical foundation for understanding cognition, and by extension creativity, as something that emerges through interaction rather than as a property contained within an isolated mind. Clark's (1998) account of extended cognition also contributes to this view by arguing that thinking can extend across brain, body, tools, and environment.

This embodied and enactive orientation also resonates with Heidegger's concept of being-in-the-world, where understanding emerges through practical engagement rather than detached reflection. His distinction between the ready-to-hand and the present-at-hand suggests that meaning often arises through immersed activity with tools, materials, spaces, and others. This is particularly relevant to design and improvisation, where creative insight often emerges through doing, adjusting, responding, and sensing.

This distinction is important for RePlay because improvisational creativity depends on more than idea generation alone. It involves timing, gesture, movement, responsiveness, emotional attunement, and shared attention. RePlay therefore builds on embodied and enactive accounts of creativity by treating creative process as something that unfolds through action, relation, and situated experience.

These embodied and enactive approaches offer an important contrast to symbolic and computational models of creativity. Boden's framework, for example, conceptualizes creativity as the exploration and transformation of conceptual spaces: processes that can, at least in principle, be formalized or simulated within artificial intelligence systems. Her framework emphasizes internal cognition, rule-based operations, and representational thinking.

By contrast, Varela et al. (1991) and Gallagher (2005) argue that cognition is fundamentally embodied and enacted through sensorimotor interaction, social co-presence, and affective engagement. From this perspective, creativity is not reducible to internal symbol manipulation, but emerges dynamically through lived, relational experience. This tension between computational and enactive models of mind has important implications for how creativity is understood in this thesis, particularly in relation to improvisation, embodiment, emergence, and collaborative creative practice.

Table 1.1
Comparison of Cognitive and Enactive Models of Creativity

Aspect	**Boden**	**Varela / Gallagher**
Model of Mind	Symbolic, Computational	Enactive, Embodied
Creativity	Internal transformation of conceptual spaces	Emergent in bodily action and relational context.
Use of AI	Compatible with symbolic GOFAI (Good Old-Fashioned Artificial Intelligence) models	Critical of disembodied AI- prefer interactive systems.
Philosophical Roots	Cognitive science, AI	Phenomenology, Buddhist philosophy, neurobiology.

Maturana and Varela (1980) introduced the concept of autopoiesis the self-organizing nature of living systems which laid the biological foundation for viewing cognition (and by extension creativity) as a relational and emergent property of interaction. Clark's (1998) Being There reframes cognition as an extended process that spans brain, body, and environment, offering a systems-level model compatible with improvisational and embodied forms of creativity. Philosophically, this embodied and neurocognitive orientation resonates with Heidegger's (1927/1962) notion of *being-in-the-world*, which asserts that human understanding is fundamentally situated, relational, and action-based. His distinction between "ready-to-hand" and "present-at-hand" implies that meaning and by extension, creative insight arises not from detached mental reflection but from immersed practical engagement with tools, spaces, and others. This embodied turn in thinking about creativity has had a significant influence on creative research in domains such as improvisational performance, collaborative design, and educational practice. RePlay, builds on this foundation by proposing that group creativity is not merely coordinated cognition but an emergent, bodily, and affective process, shaped by rhythm, relational attunement, and shared action.

1.10.1 Implications for Collaborative Creative Practice

These theoretical developments have important implications for understanding and facilitating collaborative creative processes. If creativity emerges through embodied and relational dynamics

rather than through individual cognition alone, then collaborative creativity frameworks must support conditions such as trust, mutual attunement, responsiveness, and shared attention.

If suggestibility represents a creative capacity rather than vulnerability, and if '*collaborative*' creativity emerges through embodied relational dynamics rather than individual cognition, then collaborative creative frameworks must prioritize conditions that support mutual attunement, trust, and responsive engagement.

RePlay is relevant in this context because it creates structured conditions for embodied, improvisational, and relational creativity.

During a RePlay session, participants do not simply exchange ideas verbally; they move, gesture, respond, adapt, and co-create meaning through action. In this sense, RePlay reflects a broader shift in creativity research away from models that locate creativity solely within the individual and toward models that understand creativity as distributed, emergent, and enacted between people, bodies, environments, and tools.

This embodied and relational framing also prepares the ground for the following discussion of flow, suggestibility, and altered states. Within RePlay, an openness to influence is not treated as weakness or passivity, but as a creative capacity: the ability to respond to cues, adapt to others, and participate in collective emergence.

1.11 Flow, Improvisation, and Presence

The performance studies theoretical foundation of RePlay as a framework leads naturally to understanding creativity through the lens of presence and co-presence dynamics, rather than as a solitary or purely internal process. In improvisational practice, particularly within the lineage of Viola Spolin, Improvisational Theatre expert, creativity unfolds in the moment through embodied awareness, deep listening, and mutual responsiveness (Spolin, 1999).

Presence here is not merely cognitive; it is relational, somatic, and intuitive. Co-presence refers to the shared attunement between individuals engaged in a joint activity, where creative insights arise not from isolated ideation but from the interplay between participants, materials, and environment (Sawyer, 2003a). These ideas inform the RePlay framework's emphasis on *Creativity in Action* as a processual, situated, and relational view of creativity grounded in improvisation and real-time interaction. This framing aligns with recent shifts toward systemic and embodied understandings of creativity, in which attention to context, rhythm, and responsiveness is central.

Flow is an important concept for understanding improvisational creativity and its relevance to RePlay. Csikszentmihalyi (2008) who came up with the term **flow** describes it as ***a state of focused motivation and deep immersion in an activity, often informally described as being "in the zone." In flow,***

attention is absorbed in the task, action and awareness begin to merge, and the activity becomes intrinsically rewarding.

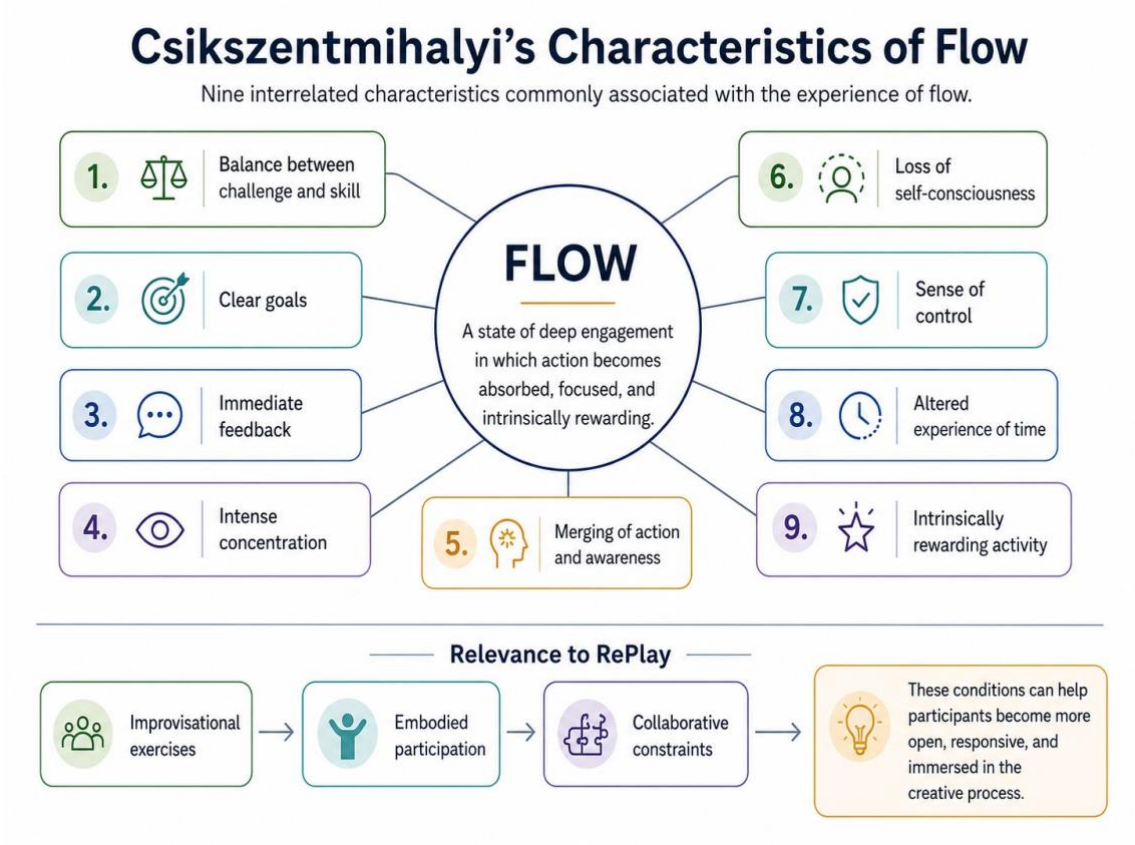
Sawyer's work on improvisational creativity is closely connected to this tradition. His doctoral research, supervised by Mihaly Csikszentmihalyi at the University of Chicago, examined creativity, collaboration, and improvisational interaction. This connection is important because flow is not only an individual psychological state; in collaborative and improvisational contexts, ***but it may also emerge through the timing, responsiveness, and shared attention of a group.***

As creativity researchers have observed in the past, flow research is hard to do because flow is an elusive, ephemeral phenomenon. In the case studies and later iterations of RePlay, flow appeared as a recurring characteristic of improvisational creativity. Participants often seemed to become absorbed in the activity, responsive to one another, and less self-conscious about the creative process. This is significant because flow is difficult to study, especially in group contexts, where the phenomenon is distributed across participants rather than located within one individual alone. RePlay therefore provided a useful context for observing how conditions associated with flow may be cultivated through structured improvisational practice.

Csikszentmihalyi identifies several characteristics commonly associated with flow:

i. A balance between challenge and skill.
ii. Clear goals.
iii. Immediate feedback.
iv. Intense concentration.
v. Merging of action and awareness.
vi. Loss of self-consciousness.
vii. A sense of control.
viii. Altered experience of time.
ix. Experience of the activity as intrinsically rewarding.

Figure 1.6
Csikszentmihalyi's Relevance for RePlay



Note. Made by the author using ChatGPT.

The characteristics of flow are relevant to this thesis because RePlay uses improvisational exercises, embodied participation, and collaborative constraints to create conditions in which participants may become more open, responsive, and immersed in the creative process allowing for a kind of creative emergence. The same conditions of a theatrical improvisation seem to also cultivate an experience of flow. I will develop this claim further in the coming chapters through the exploratory research conducted and case studies conducted in the wild utilizing RePlay.

1.11.1 Performance and Improvisation Studies

Performance studies' offers crucial insights into creativity as collaborative emergence rather than individual cognition through our understanding of flow and embodied creativity. This research project draws from performance studies, particularly traditions of improvisational theatre, music, and dance. Rather than viewing creativity as an individual cognitive trait, improvisational theatre emphasizes action, emergence, and relationality.

Improvisation is understood ***as a collaborative process in which novel ideas arise through shared attention, embodied responsiveness, and mutual adaptation*** (Sawyer, 2003a). Foundational figures

such as Viola Spolin, J.L. Moreno, Keith Johnstone, and Augusto Boal developed practices that frame improvisation not only as a theatrical method but as a social technology for cultivating spontaneity, trust, and collective meaning-making.

Spolin's concept of "Theatre Games" emphasized intuition, focus, and group attunement offering a systemic method to develop creative fluency through embodied play (Spolin, 1999). These insights directly inform the RePlay framework developed in this thesis, which extends improvisational logic into participatory design and creativity research. Within design studies, improvisation has been adopted as a technique for ideation, prototyping, and user engagement, especially in participatory and empathic design contexts (Brandt, 2000; Giaccardi et al., 2012). However, its methodological potential often remains under-theorized. This thesis builds on the lineage of performance-based creativity by articulating improvisation as both an onto-epistemological and methodological foundation for studying a concept I named creativity-in-action. I will unfold this idea further in the methodology chapter of this thesis.

1.11.2 Mindfulness and Flow States in Athletes and Monks

With regards to consciousness research, research on monks has proven that flow states are achievable through intense meditation. Yet these flow states are often achieved in solitude and or over a period of many years making it an unrealistic approach for this research project. Nonetheless, what research on Buddhist monks in the 1990's has shown is that meditation can produce waves in the gamma range which arise when novel ideas come together and form new neural pathways. This is sometimes also referred to as the experience of an aha moment (Kotler and Wheal, 2017, p. 48-49), (2017, p.47). This account is likened to descriptions from the field of action sports. Getting into flow as part of meditation, is marked by focused attention on the present moment. In meditation the breath is utilized as a strategy to get focused attention happening through drawing attention to the present moment.

The way in which flow is detected in neuroscience is by comparing it to waking consciousness which has a predictable and consistent signature in the brain.

Neuroscientists detect widespread activity in the prefrontal cortex and see specific parts of this region either light up and become hyperactive or power down and become hypoactive (Kotler and Wheal, 2017, p. 24).

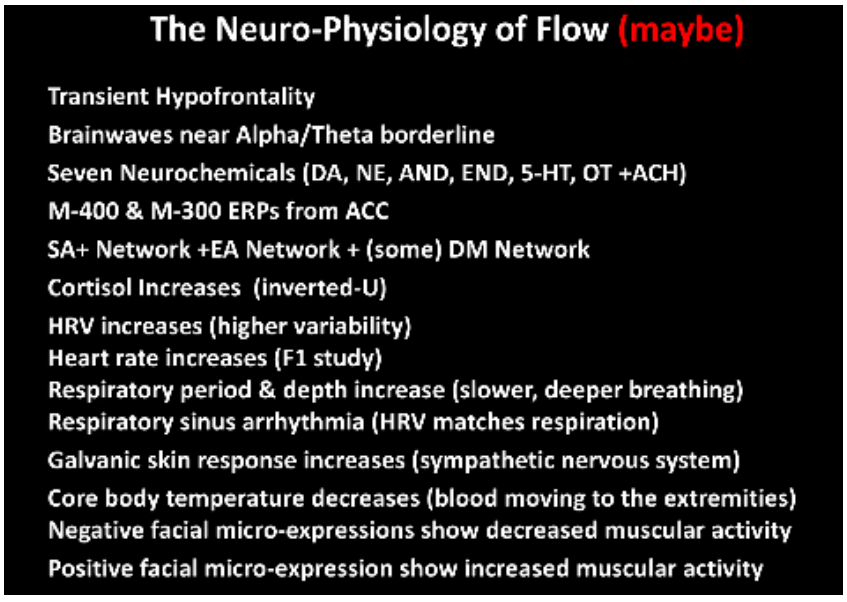
Neuroscientists have also noticed that brainwaves slow from agitated beta to day-dreamy alpha and deeper theta. **Neuro-chemically, stress chemicals like norepinephrine and cortisol are replaced by performance enhancing, pleasure-producing compounds such as dopamine, endorphins, anandamide, serotonin and oxytocin.**

Despite the differences in how these states appear, they are connected by their underlying neurobiological mechanisms and as Kotler states; "the knobs and levers being tweaked in the brain stay the same "(Kotler and Wheal, 2017, p. 24). These findings regarding flow states, has spurred current research utilizing transcranial magnetic stimulation, to induce flow.

1.11.3 Neurocognitive, Feminist, and Post humanist Extensions

Outside academia, often with technology. Kotler and Wheal (2017) describe a growing interest in technologies for reaching flow states. Examples include the "Mind Gym," a military training facility in Virginia that uses EEG, cardiac coherence and motion-tracking sensors to study flow (pp. 25–27), and Google's "G Pause" programme, which uses meditation to keep staff absorbed in their work (p. 28). They also describe Mikey Siegel, an MIT-trained roboticist who uses biofeedback to help groups synchronize brainwaves and heart rate toward group flow, and who co-founded the Consciousness Hacking movement and the Transformative Technology Conference (pp. 147–148). Related ventures, such as Palo Alto Neuroscience, use neurofeedback on brainwaves, heart-rate variability and skin response to guide users back into flow (pp. 59–60). These accounts come from a popular rather than a peer-reviewed source, and I include them to show the cultural interest in engineering flow, not as evidence for it. Figure 1.7 shows Kotler's summary of his hypotheses about the neurophysiology of flow, presented at the Embodiment Conference (Kotler, 2020).

Figure 1.7
Kotler's Keynote at the Embodiment Conference



Note. Screenshot from Kotler (2020).

I would also like to acknowledge unconventional paths which are used to achieve flow and discuss them in relation to RePlay such as meditation (already mentioned, pharmaceuticals, psychedelics, and as transcranial stimulation. Surely there are many others which I cannot explore in just one section of this thesis however I would like to acknowledge them as part of the conversation regarding flow.

Another field which supported my work developing RePlay was contemporary Neuroscience. Research in this area offers complementary observations to the feminist and post humanist perspective that seems to be at the heart of this research. The lens of a networked understanding of creative processes using neuroimaging technologies suggests that creativity arises from the dynamic interaction of multiple brain networks, particularly the **Default Mode Network (DMN)** associated with spontaneous thought, internal simulation, and mind-wandering and the **Executive Control Network (ECN)**, which supports focused attention, planning, and evaluative judgment (Beaty et al., 2016). This interplay suggests that creative processes involve fluid transitions between divergent and convergent thinking, or between generative openness and strategic constraint.

These findings challenge older, modular views of the brain and instead support a networked and systemic understandings of cognition (Fodor, 1983). Jerry Fodor (1983) is most famously associated with this model in psychology and philosophy. In *The Modularity of Mind*, he argued that certain mental processes (like language perception) are "modular" fast, automatic, domain-specific, and informationally encapsulated meaning the brain as composed of discrete, domain-specific regions responsible for distinct cognitive functions. These views were reinforced by early neuroimaging studies that emphasized localized "activation sites" for tasks such as language or memory. However, contemporary neuroscience challenges this compartmentalization, emphasizing instead the brain's networked, integrative architecture (Pessoa, 2014; Bressler & Menon, 2010).

More importantly this approach of networked process aligns with embodied theories of creativity as already mentioned in the previous section by reinforcing that creativity is not simply a linear or rational process, but one that is rhythmic, affective, and context sensitive. A coordination of internal states and external stimuli over time.

1.11.4 Using TMS (Transcranial Magnetic Stimulation) to Promote Flow

TMS uses a weak a weak magnetic impulse to cut out the prefrontal cortex and as a result create a 20-40min flow state. In one study where the 9-dot creativity test was conducted, 40% connected the dots in record time or 8 times better than normal Kotler, 2017, p 48) (Chi and Synder) [4]. I

[4] Although enticing this type of research was beyond the scope of this project as well as my expertise. There was a time during my exploratory research phase of this thesis, I explored the possibility of utilizing sensors as part of one of my case studies however I did not have the skillset necessary or the resources

would also like to mention the work of Balder Orheniem a colleague in my research cohort who teamed up with Neuroscientist Friis-Olivarius, to develop a similar kind of wearable technology for increasing creative productivity. The start-up he co-founded is called Plato Science. The technologies utilized by Orheniem are based on current research in neuroscience regarding creative process (2021) (Simonsmeier, Bianca A et al., 2018) (Stagg, CK, Andrea A, Nitsche, M.A, 2018).

Part of the reason why these technologies have not been as easily adopted is I believe as philosopher Andy Clark's states, that culturally we rank biological matter over that of technology, and this makes it difficult for us to consider humans as a kind of cyborg. As such the adoption of this kind of technological augmentation of ourselves seems suspect. (Clark, 1998). The use of TMS will become important in the discussion part of the thesis which is why I provide a summary here as it reflects what I observed qualitatively using RePlay.

1.11.5 Creativity and Psychedelics

A brief note on psychedelics and pharmacological routes is warranted, as they form part of the longer history of research into altered states. In the 1960s, John Lilly used saltwater sensory-deprivation tanks to switch off the sense of self by removing sensory input and later used them to explore the effects of LSD and ketamine on consciousness. This line of research fell out of favor and was shut down (Kotler & Wheal, 2017, pp. 49–50). Horgan (2004) notes that psilocybin experiences are often described in terms like flow: sacredness, ineffability, distorted time and space, and a sense of oneness. Drug-induced states have also been criticized as too easy and too volatile compared with practices such as meditation. Cultural stigma, which Kotler and Wheal (2017, p. 62) frame as the question of which states of consciousness a culture sanctions, has slowed this research outside clinical medicine.

These routes were never part of my method. I chose theatrical improvisation as my starting point because it was inclusive in three ways: it allowed me to conduct action research, it allowed me to take part in the process myself, and, because my interest was collaborative creativity, it was open to others.

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to pursue this kind of research. I do however think that in the future given what I now know about the creative process, I would like to do isolated studies regarding intuition and suggestibility as part of the creative process utilizing technology as part of the research design and how it affects boundary loss within the creative process.

1.12 A Technological Networked View of Creativity

Before the cognitive approach of studying creative process, creativity researchers did not have the skills, or technology such as biometrics, neuroscience, and evolutionary models of creative process (AI) as well as robust philosophical theory. Now that these approaches exist and what is currently needed is more thought regarding theory, pragmatic approaches and leveraging tools and practices by weaving this knowledge together.

While often discussed as separate strands, embodied, enactive, and neurocognitive approaches to creativity are increasingly seen as interdependent and mutually reinforcing. Embodied accounts emphasize the role of movement, gesture, and physical engagement in shaping thought. Enactive approaches build on this by framing cognition as emergent from real-time interactions highlighting relationality, co-regulation, and situational embeddedness. Neurocognitive models, in turn, contribute insight into the brain dynamics that scaffold and respond to these embodied interactions, such as patterns of attentional shift, motor simulation, and affective arousal.

Rather than treating these domains as discrete, recent research emphasizes integrative, systemic frameworks that attend to how sensorimotor engagement, affective resonance, and neural flexibility converge in creative acts.

> **This convergence reflects a growing movement toward multi-level models of creativity, models that recognize creativity as not just a psychological event, but as a distributed, emergent process shaped by the entanglement of brain, body, and world.**

Table 1.2
Neurological Mapping of Creative Process

Stage	Network Activity
Generating new ideas	DMN ramps up → divergent thinking, novel associations.
Selecting relevant actions	ECN steps in to evaluate, plan, and align with goals.
Switching/adapting in real time	Salience Network toggles between DMN and ECN based on context.
Executing fluidly	Sensorimotor areas handle timing, coordination, responsiveness.
Feeling the moment	Limbic system tracks emotional tone and risk, guiding authenticity.

1.12.1 Transient Hypofrontality, Neural Entrainment, and Co-Creation

Building upon networked creativity models, emerging neuroscience research reveals specific mechanisms underlying collaborative creative states. Arne Dietrich (2004b) proposed *transient hypofrontality* to explain altered states of consciousness like flow, meditative absorption, and even certain aspects of athletic or musical performance. He argued that these states aren't caused by more brain activity but by less activity in the prefrontal cortex, creating space for non-linear and non-judgmental cognition. The prefrontal cortex is the part of the brain responsible for planning, self-monitoring, inhibition, and decision-making. Flow states are often central to improvisation and peak creativity and contrast with transient hypofrontality (Dietrich, 2004b), a state where the prefrontal cortex reduces its top-down control, allowing for more flexible, spontaneous cognition. Transient hypofrontality (Dietrich, 2004b), involves a temporary reduction in activity in the prefrontal cortex, allowing for diminished self-monitoring and increased spontaneity, conditions that support creative flow and improvisational responsiveness.

1.12.2 Why this Matters for Improvisational Creativity

During creative states like flow, improvisation, or deep absorption, the brain briefly down-regulates prefrontal activity. allows for:

- Reduced self-criticism and inhibition
- More spontaneous thinking
- Greater access to intuitive or associative processes
- Less linear control and more openness to emergence

This insight is especially relevant in for improvisational creativity, where overthinking can block responsiveness. Additionally, neuroscientific research has begun to explore interpersonal neural synchrony in collaborative settings, indicating that creative co-presence may involve not only social and embodied alignment, but even neural entrainment (Chabin et al., 2022).

Neural entrainment refers to the phenomenon where brain activity becomes rhythmically aligned or "entrained" with an external or internal rhythm. In the context of creativity and especially collaborative improvisation, it means that two or more people's brainwaves begin to synchronize when they're deeply attuned to each other during a shared task, like music-making, conversation, or dance.

When people are creatively in sync, their brains also start to sync often in the same frequency or rhythm. This can happen:

- Through auditory or visual cues (like shared beats in music),
- Through bodily motion (as in joint movement),
- Or through interactive flow, like in a co-creative design or improv session

This neurological research resonates with the theoretical frameworks discussed in previous sections, suggesting that collaborative creativity may involve not only social and embodied alignment but also measurable neural coordination between participants.

1.13 Suggestibility as Creative Responsiveness: Preview

This thesis also reframes suggestibility as a creative capacity rather than as passive susceptibility. In improvisational and collaborative contexts, suggestibility can be understood as an openness to external cues, relational dynamics, affective shifts, rhythm, and group momentum. This openness is closely related to absorption, co-regulation, spontaneous responsiveness, and the capacity to be influenced without losing agency. In RePlay, this becomes important because participants must remain available to one another's offers, gestures, roles, and emerging interpretations of the problem space. I develop this account of suggestibility as creative responsiveness further in Section 6.12, where I relate it to Creativity in Action.

1.14 Methodological Implication: Situated Knowledge and World-Making

This research began in the spaces between disciplines between design and theatre, computer science, making, parenting and prototyping. Over the years, I found myself drawn not only to the question of what creativity is, but how we come to know it how it moves through bodies, gestures, pauses, and shared moments of "not knowing yet." As a woman working across technical and artistic domains, I've often had to move sideways: improvising through spaces not designed for my voice or my way of working. This sideways movement is what some might call "aesthetic drift", or simple acts of empathy has shaped how I think about creativity. I don't see it as a flash of insight

inside a lone genius, but as something relational, collective, and embodied. This project is deeply personal in that way. It reflects a commitment to valuing emotional labor, co-presence, play, and the slow, uncertain process of making meaning together. It traces how creativity lives in the in-between.

If lability and suggestibility invite us to reconsider what counts as cognitive readiness, then feminist and posthumanist critiques go further challenging the very boundaries of where cognition begins and ends, and whose ways of knowing are recognized as creative at all. Scholars such as Caroline Bassett (2017) offer a feminist and speculative lens on technological futures, challenging the determinism often embedded in cognitive and computational paradigms. Her work explores how acts of refusal, speculative fabulation, and world-building constitute creative resistance within digital cultures. This approach resonates with RePlay's emphasis on improvisation and relational emergence as forms of epistemic disobedience not just as an alternative in methods but also how knowledge is produced and shared.

Feminist and posthumanist theories challenge the separation of mind and body, subject and object, human and non-human. Drawing from Donna Haraway's (1988) concept of *situated knowledges*, I reject the assumption of neutral observation and instead foreground my position as an embodied, relational subject within the research. Similarly, Sandra Harding's (1991) standpoint theory underscores the importance of lived experience particularly for those navigating disciplinary and structural margins as a legitimate site of knowledge production.

Building on these ideas, I also draw from Rosi Braidotti's (2013) work on posthuman subjectivity, which reframes the human not as a bounded, autonomous individual but as a relational, affective, and networked figure. In this view, creativity emerges not from isolated minds but through co-constituted encounters across bodies, technologies, and environments. Karen Barad's (2007) concept of *intra-action* further deepens this orientation, suggesting that agency and meaning emerge from within relational entanglements rather than pre-existing entities. These theoretical commitments shape the RePlay framework as both a method and a worldview one that resists individualism, embraces multiplicity, and values embodied, affective modes of knowing.

Feminist and posthumanist scholars have long critiqued the limitations of traditional cognitive science, particularly its tendency to isolate mind from body, individual from context, and cognition from affect and materiality. Rather than viewing creativity as a purely internal or abstract process, these perspectives emphasize the relational, embodied, and situated dimensions of knowledge-making. Haraway (1988) argues against the myth of objectivity and instead proposes a framework of "situated knowledges" that foregrounds partiality, positionality, and the entanglement of observer and observed. Similarly, Barad's (2007) theory of agential realism dissolves the boundaries between subject and object, suggesting that phenomena emerge through intra-actions and ongoing entanglements of matter, meaning, and practice.

From this standpoint, cognition and creativity are not bounded within the brain or the individual, but are distributed across social, material, and ecological assemblages. Posthumanist perspectives such as those articulated by Braidotti (2013) challenge anthropocentric and individualistic frameworks, calling instead for a transversal understanding of creativity that includes nonhuman agencies, affective intensities, and more-than-human collaborations. These critiques are not simply theoretical they carry practical implications for how creativity is understood, supported, and studied, particularly in fields like design, education, and technology. This thesis draws on these insights to position RePlay not merely as a method, but as a feminist and posthumanist intervention foregrounding embodied participation, relational attunement, and the generative entanglement of bodies, tools, and environments.

This feminist and posthumanist commitments also have methodological implications. They suggest that methods are not neutral instruments used to observe a pre-existing reality from a distance. Rather, methods help shape what can be noticed, felt, enacted, and known. This matters for RePlay because the framework does not simply document collaborative creativity after the fact; it stages conditions in which embodied, relational, and improvisational forms of knowing can emerge. Chapter 4 develops this more fully through the discussion of methodology as world-building and RePlay as an onto-epistemological method.

1.15 Research Gap

The literature reviewed in this chapter shows a broad movement in creativity research from individual, cognitive, and product-oriented accounts toward systemic, embodied, relational, situated and technological understandings of creative process. Yet a gap remains in how collaborative creativity is studied as it unfolds in real time. Many models explain creativity retrospectively, through finished outputs, individual capacities, or abstract stages, but they do not fully account for the moment-to-moment dynamics through which people create together through movement, gesture, affect, timing, improvisation, shared attention, and co-presence.

This gap was compounded by the difficulty of studying collaborative creativity. Creativity does not always produce a stable or immediately visible output, and its significance is often shaped by subjectivity, context, interpretation, and timing. Intuition, emotion, sensory experience, and embodied knowing have also been historically devalued within more Cartesian or reductionist models of knowledge. These obstacles make collaborative creativity difficult to study through purely cognitive, psychometric, or product-based approaches, and they point to the need for methods that can attend to process, relation, embodiment, and emergence.

This gap is especially important in design and human-computer interaction, where creative work is often collaborative, interdisciplinary, and materially situated. Design teams do not simply generate ideas in isolation; they negotiate meaning through artefacts, bodies, tools, spaces, constraints, and social relations. Existing creativity tools and methods can support ideation, but they do not always

provide a framework for observing and analyzing the embodied and relational processes that make collaborative creativity possible.

The central problem addressed by this thesis is therefore methodological as well as theoretical. It raises two guiding questions:

1. How can collaborative creativity be studied while it is happening?

2. How can researchers attend to the tacit, embodied, improvisational, and affective dimensions of creative practice without reducing them to individual cognition or final products?

This thesis responds to these questions through the development of RePlay and the concept of **Creativity in Action.** The formal research questions that guide the research design are set out in Section 4.1.

1.16 Introducing RePlay and Creativity in Action

RePlay is introduced in this thesis as a framework for facilitating and studying collaborative creativity through embodied improvisational practice. It was developed at the intersection of design research, human-computer interaction, performance studies, creativity research, and participatory practice. Rather than treating improvisation as a performance technique alone, RePlay adapts improvisational principles into a research and design framework for making creative process more visible, discussable, and able to be reflected upon.

The concept of Creativity in Action emerged through this work. It names the embodied, relational, and improvisational dimension of creativity that becomes visible when people create together in real time. Creativity in Action does not refer simply to an idea, product, or individual capacity. It refers to the dynamic process through which participants respond to cues shift roles, attune to one another, externalize ideas, and co-create meaning through situated action.

In Chapter 3 I will discuss how RePlay was developed as a creative **sandbox** (a term I will expand upon) and methodological framework, while **Creativity in Action** which is discussed in Chapter 6 in more detail is a theoretical contribution. Together, they offer a way to understand creativity not as a solitary act or fixed trait, but as a distributed and emergent phenomenon shaped by bodies, environments, materials, technologies, and relational dynamics.

I would like to posit that this conceptual framing also has renewed relevance in the context of artificial intelligence, hybrid creative ecologies, and technologically mediated collaboration. As creative work increasingly takes place across human and non-human systems, the thesis offers a way to examine not only what is produced, but how creative agency, responsiveness, embodiment, and meaning are distributed across people, tools, environments, and computational systems. This

future-facing implication is explored in Chapters 8 and 9 and drawn together in the Conclusion (Chapter 10).

1.17 Chapter Summary

This chapter has introduced the conceptual background for the thesis by tracing key developments in creativity research. It began with historical and definitional perspectives, including distinctions between Big-C and little-c creativity, before turning to early process models such as those associated with Poincare, Helmholtz, and Wallas. It then examined cognitive and psychological accounts, including the Geneplore model, reflection, and Boden's computational theory of conceptual spaces.

The chapter then moved from cognitive and computational models toward confluence theories, systems thinking, ecological perspectives, collaborative emergence, and embodied and enactive accounts of creativity. These approaches are important because they shift attention away from creativity as a purely internal or individual process and toward creativity as relational, situated, and emergent. Flow, improvisation, presence, neurocognitive research, and feminist and posthumanist critiques further extend this movement by foregrounding embodiment, affect, co-presence, and situated knowledge as well as its implications as part of an increasingly technologically mediated society.

The chapter has argued that while existing theories provide important foundations, they do not fully explain how collaborative creativity unfolds in action as a form of flow and why. This gap motivated the development of RePlay as a framework for researching embodied collaborative creativity (flow) and Creativity in Action as the theoretical concept that emerged through this work. The following chapter introduces some of theoretical scaffolding of RePlay. In Chapter 3 I detail more about RePlay as a framework and as a kind of metaphorical sandbox developed in part by theory but also through exploratory research. I explore how RePlay is not just another creativity tool but a creative sandbox and methodological framework for studying flow amongst individuals and what this might mean when collaborating with technology such as Agentic AI.

Chapter 4 documents my methodology and Chapter 5 the exploratory research which went into developing RePlay. In Chapter 6 I discuss my theoretical contribution of Creativity in Action, the potential role of suggestibility in creative process, the importance of reflection to creative process, and how one might use a framework like RePlay to facilitate flow in teams. Chapter 7 presents the case studies in which I used RePlay, Chapter 8 discusses what unfolded across them, Chapter 9 sets out future directions for this work, and Chapter 10 concludes.

Chapter 2: Improvisation and Embodiment as Foundations for RePlay

"Everyone can act. Everyone can improvise."

— Viola Spolin, Improvisation for the Theater

This chapter establishes the improvisational, embodied, reflective, and design-practice foundations for RePlay. It introduces Creativity in Action only briefly as a concept that emerged from this work. The full theory of Creativity in Action is developed in Chapter 6.0 The purpose of this Chapter purpose: to show why improvisation and embodiment matter for design creativity, and how these traditions become the foundation for RePlay as a creative sandbox and methodological framework.

Figure 2.1
Flower



"…and then there were little, tiny, delicious explosions... Aha moments... billions of little sunbursts so bright they almost blinded my mind's eye... and a deep feeling of being reunited with a friend... A friend you did not know you had been longing for."

-by author

2.1 Introduction: The Bridge to Studying Embodied Design Thinking through RePlay

While the previous chapter provided a broad review of creativity research and situated RePlay within that field, this chapter turns to a more focused line of inquiry. Here, I examine improvisation and embodiment as a framework for studying and facilitating creativity in design contexts. In other words, whereas Chapter 1 established the conceptual landscape of creativity research, Chapter 2 investigates a specific theoretical and methodological lineage; improvisational theatre and embodied interaction; that directly informed the development of RePlay. This distinction allows me to both trace the historical and philosophical roots of improvisation and to demonstrate how its principles can be adapted into a design research methodology.

In the previous chapter, I located this project within the field of creativity research and discussed both my motivation for conducting this research and my strategy of designing a creativity framework. I provided a general overview of my development of RePlay and how my initial strategy was analogical in nature (Holyoak & Thagard, 1995; Gentner, 1983). Analogical reasoning transfers a structure or logic from one domain to another. In my case, I drew from lived experience and training in improvisational theatre, design research, embodied interaction, and participatory methods. I mapped key concepts from those fields (such as co-presence, spontaneity, trust, rhythm, embodied responsiveness) onto new contexts (e.g., HCI, service design, urban planning, collaborative tech innovation). I developed techniques, some inspired by existing practices and others derived from design process.

RePlay reframes improvisation as both a design method and a research strategy. Fauconnier and Turner's (2002) concept of conceptual blending offers a way to understand this move: elements from different mental spaces. In this case, improvisational theatre and design research are brought together to form a new approach. RePlay acts as an epistemological bridge, bringing together ways of knowing from artistic, scientific, and experiential domains. I treated improvisational practice not just as a technique, but as a way of understanding Creativity in Action across disciplines. The hallmark of analogical innovation is the remapping of meaning to generate conceptual breakthroughs. The applied design goal was to address challenges in participatory design and collaborative creativity, and the conceptual goal was to conceptualize what might be some of the future challenges we face when collaborating with Agentic AI.

In this chapter I lead the reader through the history and deeper technical aspects of improvisation from performance studies. I also present scenarios of how designers have worked in interdisciplinary fashion by applying improvisation to their design process and how improvisation benefits teams engaged in collaborative creativity. This chapter is foundational to the research

project because some of the key concepts presented here are developed further in the case studies and reflected upon in the discussion chapter.

Understanding the benefits of improvisation will help the reader elucidate the development of RePlay. These benefits are linked to embodiment, reflection, early childhood education, and flow in teams, all of which were foundational to my design of RePlay.

My goal is to clarify how and why RePlay fosters creative collaboration by teaching participants how to become creative players. In the literature, other terms for describing creative collaboration include "hive mind" or "group think." Regardless of terminology, many agree that group think is not an easy phenomenon to capture and is even more difficult to inspire and facilitate as part of collaborative creativity.

Throughout my process of developing RePlay and collecting qualitative data regarding the creative process, I realized that I was not only developing a tool but a methodology that could be used as part of a toolkit for further research of collaborative creativity and enriching what is known currently understood in the field.

Since part of contribution of this research is theoretical in nature, I found myself developing terminology for phenomena I observed during RePlay sessions which I felt was missing from the field of creativity research. One such concept is **Creativity in Action**; a term I coined to describe a phenomenon observed during the development and use of RePlay and which reflects a major contribution of this research.

I will also introduce other theoretical ideas such as the **sandbox**, the value of play, and the importance of teaching a creative mindset from an early age.

To set the stage for this journey, I begin with a brief history of improvisational theatre and how it has previously been applied in design process. I will introduce both familiar terms (embodiment, flow, play, reflection) and less familiar ones (traces, design mapping, design flow diagrams, Creativity in Action). The latter are techniques I devised to collect data and will describe in more detail in the methods chapter.

The goal of this chapter is to create the scaffolding for discussing the results of developing and utilizing RePlay, as well as my key observations. As such, it is necessary to introduce not only existing terminology from phenomenology, theatre, and design thinking, but also the terms I developed to explain my observations while using RePlay to research creative process.

2.2 Improvisational Creativity and Flow

The short poem at the beginning of this chapter is a description of my experience listening to a piece of contemporary classical music composed by my friend, mentor, and collaborator, composer Kenneth Newby. As a listener, I felt I had a very surprising, subjective experience of witnessing *flow* while listening to Kenneth's piece which inspired the short piece of writing included at the beginning of this chapter. Similarly, this subjective experience of flow during my exploratory research and case studies made me want to understand why flow seemed to persistent characteristic of improvisational creativity.

For artist and Composer Newby's compositions are improvisational collaborations with the computer. By establishing parameters based on musical theory he collaborates with a system he programmed called *Flicker Generative Orchestra* to create pieces which he then edits as final compositions. An important aspect of Kenneth's musical practice is that his current work is authored in tandem: Kenneth works with the computer system he created, using the software MAX MSP. The environment he has created is somewhat similar in process to that of an early prototype of an AI LLM musical composition system.

Part of Kenneth's work involves drawing from his extensive experience as a professional composer and artist to identify what the mind recognizes as coherent music and then encoding these principles into a *max patch*. A max patch is a pre-programmed set of instances containing specific instructions for the computer to follow, in this case, rules derived from music theory.

Newby then works with the results to compose music as part of a bi-directional conversation with the computer. Newby makes no claims that the music the Flicker Generative Orchestra produces is "good" (since this is a subjective judgment), but I believe it demonstrates coherence, as its dimensions are interconnected by principles grounded in music theory and cognition.

Below is a quote Newby posted on Facebook (Jan 2017), which he often uses as a creative journal. At the beginning of the quote, he describes creating a potential *flow space* to maximize musical potential, "making possible impossible moments." He continues with technical descriptions which, given my lack of background in composition, I cannot pretend to understand. What stood out was that Kenneth has built a framework to study and reflect on his own creative process which was very similar with my intention of developing RePlay for design process.

Tools, Instruments, and Design-space Exploration (Music)

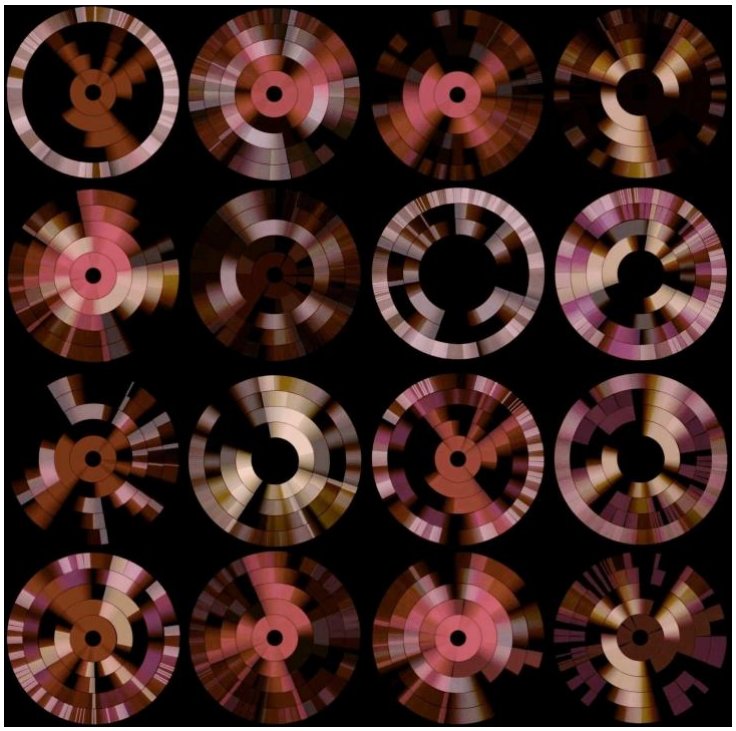
> *I'm impelled to build tools bordering on instruments that can help clarify the materials and maximize the potential for creative flow they enable. I think of this whole computer-assisted, generative approach as a species of design-space exploration—in this case, the infinite design-space of sound-music.*

> *I've got a few promising outcomes of the last few months of research: a few variations on spectral approaches to harmony including this last Tabula Pythagoras approach as well as a useful microtonal quantizer, spectral transposition (a la Harvey), a fundamental-finding algorithm, an FM emulator, and an encoding of Vvier's "couleurs" technique, as well as an event sequencer based on harmonic temporal proportions, and a contour-based melody generation technique. I'm now in the integration phase of the project—trying as best I can to work all this into the existing CAC (aka F.G.O.) environment. These are moments when I wish I had an enthusiastic grad student to work with! (Newby, 2017)*

The following excerpt from Kenneth Newby's Facebook page, which he sometimes utilizes as an art practice journal, describes personal flow experience followed by compositional exploration imagery. The diagram illustrates the compositional potentials of the metric hierarchies Flicker Orchestra produces (December 2019).

> The most profound experiences of meaning I've had have occurred when I've sensed myself dissolving, awareness widening into a world intricate, complex and integrated beyond imagining…My experience playing chamber music has sometimes fallen between these two: I have, on occasion, felt that I am being played by the music, rather than playing it — that I have become a dynamic aspect of a much larger whole whose unfolding both determines and carries my actions. It is as though my hands and heart, my breath and understanding, are the music's, not my own.

Figure 2.2
Artwork by Kenneth Newby



Note. Image courtesy of Kenneth Newby.

What was significant is not simply that Newby's work generated a subjective experience of flow, but that it helped illustrate that a **creative framework can structure conditions for emergence while still allowing indeterminacy.** Newby's generative composition environment provided a bounded field of possibility: a space in which rules, parameters, intuition, and selection interacted over time. This became important for RePlay because I was also trying to develop a framework that could hold creative uncertainty without reducing it to a formula. In this sense, Newby's work helped me think about RePlay as a framework for **creative emergence** rather than as a single technique or tool.

> **Although subjective, this experience inspired me to ponder whether the possibility to untangle the flow experience and thus promote it within a group might not be as difficult as researchers had previously thought.**

Many creativity researchers have remarked that in the field of flow research the experience of flow is hard to isolate. This is because flow is an elusive, ephemeral phenomenon. Often, it's very hard to study amongst individuals and even more challenging in a group. Current flow research addresses individuals but not groups. As introduced briefly in Chapter 1, Csikszentmihalyi's theory of flow has been central to this project. Positioning RePlay within Sawyer's framework highlights

its contribution to the sociocultural approach, since it focuses on group-level interaction, embodied responsiveness, and collaborative flow.

2.3 The Role of Embodiment in Flow States

I believe indeed that there is some crossover between what is described as flow and embodiment in the sense that they both cultivate a sense of being present in the moment. However, beyond knowing within our own subjective bodies it is widely recognized that flow encompasses an elevated sense of engagement and concentration. This can include but also goes beyond extending one's mind through a tool(s) such as a tennis racket, a pencil or an instrument. Flow as an elevated sense of engagement can be likened to a state of deep meditation. Neuroscientist Daniel Levitin (2015) describes it as attention being focused on a limited perceptual field that receives your full concentration and complete investment. Resulting in that action and awareness merge. (Levitin, 2015). Often this state is described as also losing a sense of time, ourselves' and any other problems and becoming blissfully lost. In Stealing Fire, Kolter and Wheal refer to Plato's description of ecstasis as an altered state where our normal waking conscious vanishes completely, replaced by an intense euphoria and a powerful connection to a greater intelligence. What neuroscientists in the field of creativity research have noted about this process is that practice is important, tenacity matters, and talent helps (2017, p. 11).

Below is an image of Glenn Gould in an NPR article about the nature of flow (Krulwich,2014).

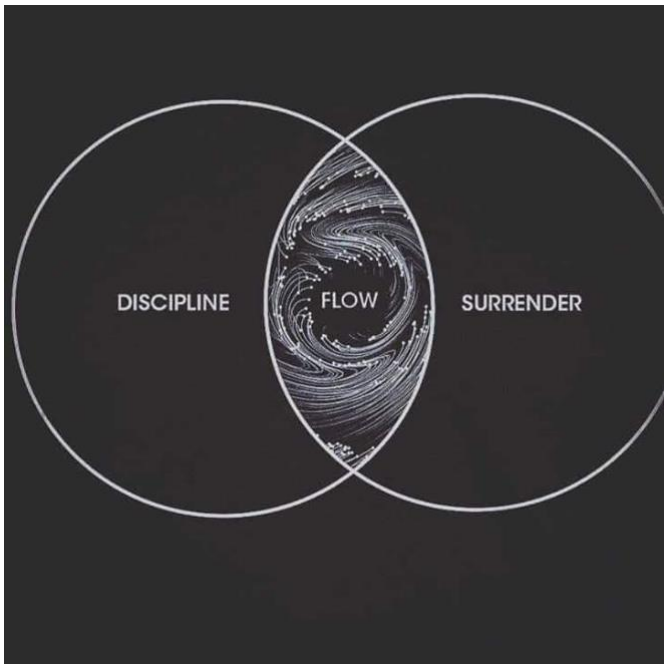
Figure 2.3
Glenn Gould



Note. Photograph by Gordon Parks, from The LIFE Picture Collection/Getty Images. Reproduced from "Glenn Gould in Rapture," by R. Krulwich, 2014, *NPR* (https://www.npr.org/sections/krulwich/2014/09/04/345576795/glenn-gould-in-rapture).

As mentioned already Csikszentmihalyi (2008) describes flow as a state whereby action and awareness come together, and one is immersed in full concentration.

Figure 2.4
Diagram of Flow



Note. Made by the author using ChatGPT

There is still a lot of mystery around the phenomena of flow as an individual experience let alone how the experience permeates within a group. However, this concept of **group flow** is one of the key interests of my research which later developed into one of my key observations with my development of RePlay. Some researchers believe achieving flow involves practice and some believe its determination and repetition which brings it about. Up until the writing of this manuscript, I still find it remarkable that as a researcher I was able to subjectively experience a pre-coded ephemeral experience by listening to Kenneth's work. Perhaps this was due to being so immersed in the research about creative process however this experience encouraged me in my development of RePlay as a framework to qualitatively researching the phenomenon further.

My motivation was not just to expand our understanding of Flow but also come up with a set of design principals for improvisational creativity when it comes to applied design contexts as well as designing technologically mediated creativity frameworks for collaboration such as Kenneth's Flicker Collaboratory.

> **As a result, it was my hypothesis, that as a creativity researcher we can witness even if not be a participant of a flow experiences using RePLay. With one caveat that this is also based on one's knowledge and openness to the experience at hand.**

I liken witnessing a flow experience to what occurs when an audience witnesses an electrifying improvised performance on stage or a particularly energizing jazz performance as a kind of **creative co-presence**...

It was my hypothesis that when a group is performing at its top-level ability, they are merging action and awareness and adjusting immediately by improvising. It was for this reason I suspected that as an audience participant we can witness creative process in action. I became interested in improvisation and how this might bring meaning to creative process in the field of design thinking.

Scientist Robert Krulwich (2014) states that when in "flow," your brain changes:

Dopamine and noradrenaline kick in, GABA neurons get suppressed; sex, hunger, thirst matter less, and you are free to play more deeply with stream-of-conscious associations; you are chemically released and can now roam far and wide. Yes, you have no idea where you are or how this is happening; but that it's happening is one of the most wonderful experiences ever.

Flow researcher Csikszentmihalyi (2008) as already mentioned studied flow in detail and describes flow as a kind of focused motivation characterized by single-minded immersion. When in a state of flow, emotions are positively energized and aligned with the task it is described being "in the zone". Other terms suggested by Kotler and Wheal are trance, ecstasy, and hive mind. (2017)

2.4 Situating RePlay within the Field of Creativity Research

Below is an excerpt of Sawyer's historical timeline of creativity research, and where this project fits within the broader field. In the discussion chapter, I will elaborate on how my findings extend creativity research in the space of improvisational creativity.[5]

2.4.1 Creativity Timeline

1913- Henri Poincare presents his famous lecture "Mathematical Creation" at the Societe de Psychologie in Paris, outlining a four-stage process of conscious hard work, unconscious incubation, illumination, and verification (1913/1982).

1926- Graham Wallas publishes The Art of Thought, presenting an influential stage model (derived from Poincare) of creativity as preparation, incubation, illumination, verification and elaboration (1926/2014).

[5] The entire Creativity timeline can be found in the appendix of this thesis.

1939- Alex F. Osborn conducts his first brainstorming sessions, at New York advertising agency BBDO (Osborn, 1948).

1948- Alex F. Osborn publishes *Your Creative Power,* a successful popular book that presents his brainstorming method.

1988- Founding of the Creativity Research Journal by Marc Runco at California State University, Fullerton. For its first two years, the journal was published independently by Mark Runco and the Creativity Research Center of Southern California; then it was published by Ablex for many years and is now published by Taylor and Francis.

2009- European Year of Creativity and Innovation declared by European Union

2010- The National Science Board publishes *Preparing the Next Generation of STEM Innovators: Identifying and Developing Our Nation's Human Capital* (National Science Board, 2010).

This historical overview shows how creativity research moved from stage-based psychological models toward applied methods such as brainstorming. The establishment of a dedicated research journal marked the field's development, while the European initiative and National Science Board report illustrate growing institutional attention to creativity and innovation. For this project, the timeline highlights both the earlier emphasis on individual creative process and the later interest in collaboration, context, and systemic support for creativity.

For this project, the significance of the timeline I have shared is twofold. First, it highlights a gap: much of the early research conceptualized creativity as an *individual* process. Second, it shows how RePlay aligned with shifts that emphasize collaboration, context, and systemic support for creativity at the time of conducting my first case studies.

The timeline I have presented positions RePlay within the trajectory of creativity research and underscores its innovation as a framework that bridges older psychological models with contemporary sociocultural and embodied approaches.

RePlay extends Sawyer's sociocultural orientation by explicitly operationalizing improvisation as a structured method for collaborative design and group flow.

2.4.2 The 2009 Year of Creativity and Innovation

In March 2000, the European Council set a strategic goal for the next decade: to become the most competitive and dynamic knowledge-based economy in the world. As part of this broader vision, in 2009 the European Union declared a *Year of Creativity and Innovation*. The initiative aimed to raise public awareness, spread information, and promote public debate on creativity, while also supporting research into how creative and innovative attitudes could be fostered in education,

entrepreneurship, and professional development. My development of RePlay emerged during a period when creativity and innovation were becoming explicit priorities in European research policy, while HCI, design research, and cognitive science were also beginning to ask new questions about embodiment, participation, and collaborative innovation. This context helps explain why RePlay developed at the intersection of academic research, design practice, improvisational theatre, and applied innovation.

This year also marked an important turning point in my own academic trajectory, as I became a Marie Curie Research Fellow in the Computing Department at Lancaster University, funded by the European Union to undertake interdisciplinary research as part of an international cohort. The EU's recognition of creativity as a key driver of innovation provided the institutional framework and resources that allowed me to situate RePlay within these wider debates about interdisciplinarity, creativity, and innovation.

The Lisbon Strategy, a program focused on growth and jobs for European competitiveness, emphasized that knowledge and innovation were Europe's most valuable assets. At the time, many of my colleagues were conducting cutting-edge cognitive neuroscience research, including brain imaging of practitioners engaged in creative processes. While this work aligned with a drive toward quantifiable and Cartesian models of creativity, I positioned myself differently. Drawing from my background in improvisational theatre, Design and Media Arts, and design research, I sought to foreground embodiment, improvisation, and relational practice. This stance marked RePlay not only as a methodological tool but also as an epistemological intervention, one that countered the dominance of reductionist approaches and instead privileged embodied, situated, and collective ways of knowing.

My focus was services and products, particularly innovative applications of technology with a social impact agenda. My research strategy led me to an applied action research approach inspired by embodiment philosophy and informed by my media arts and design research training. I was especially interested in human–computer interaction (HCI), including tangibles and physical/contextual computing. My approach included participatory and co-design processes used in developing technology products, educational tools, tangible learning materials, urban planning, services, and cultural artifacts.

After an exploratory phase, I embarked on three in-depth case studies in uniquely different contexts applying RePlay to:

i. Urban planning,
ii. Maker-inspired learning with technology, and
iii. Innovation processes in HCI.

2.5 A Word About the West: Theoretical Obstacles to Creativity Research

Western society has long been driven by Cartesian models of knowledge. Intuition, sensory experience, emotion, and embodied knowing all of which are central to creative practice, are often considered less productive or less valid. Similarly, research linking creativity to spirituality or mysticism has struggled to gain scientific legitimacy.

Historically, creativity has also been connected peripherally to psychology's core concerns, despite its clear relevance. Definitions and evaluation criteria are often intangible, which complicates attempts to study creativity systematically. For this reason, I adopted a phenomenological approach, which I argue is better suited to capture the lived and embodied dimensions of improvisational creativity.

Uni-disciplinary studies frequently fragment creativity into isolated components rather than addressing it holistically. As a result, identifying manifestations of creativity and innovation is challenging for several reasons:

i. Creativity and innovation do not always result in tangible outputs, making them difficult to evidence.

ii. They are shaped by subjectivity and interpretation, which complicates comparison across cases.

iii. Policies promoting creativity are not always matched by practice, as support mechanisms are often lacking

Against this backdrop, RePlay emerged not only as a methodology for facilitating and studying creativity but also as a critique of these limitations. By situating improvisation and embodiment at the center of creative inquiry, RePlay expands the methodological and epistemological vocabulary available to creativity research. This western theoretical obstacle, then, is also a methodological one. If creativity is treated only as an individual mental capacity, then research methods tend to look for creativity inside the person, through traits, outputs, or retrospective explanations. However, If creativity is understood as embodied, relational, and emergent, then methods must be able to observe bodies, materials, gestures, timing, trust, responsiveness, uncertainty, and shared attention. This is why improvisation became so important to the development of RePlay: it provided a practical way to stage and observe creative process as it unfolded, rather than only asking participants to explain it afterwards.

2.6 The Opportunity: Studying Improvisational and Collaborative Creativity Using a Framework: RePlay

In design, improvisation is often used to understand physical aspects of a product or how a service might function. It can also be employed to explore relationships when developing a tangible interface. Social scientist Paul Dourish (2004) coined the term **embodied interaction** to describe *this process of understanding the relationship between a thing and its place in the external world.* This concept has become so central in the HCI community that it appears in the title of a leading conference: the *International Conference on Tangible, Embedded and Embodied Interaction* (TEI).

2.7 Embodiment Philosophy

For the purposes of this research, the key literature on embodiment includes Heidegger's Being and Time (1927/2008) and Merleau-Ponty's Phenomenology of Perception (1945), alongside more contemporary ideas from philosophy of mind (Varela, 1991; Noë, 2004; Clark, 1998). Merleau-Ponty emphasizes that the body has its own way of perceiving the world, inseparable from its environment. Clark (1998) reframes this in his theory of the extended mind, suggesting that cognition extends beyond the body. Noë (2004) builds on Clark's notion, yet it extends this concept in that perception is enacted through sensorimotor activity and that without action, perception itself is not possible.

This framing of embodiment provides the philosophical grounding for RePlay. By situating improvisation as embodied action, RePlay illustrates how creativity is not confined to the mind but enacted through bodily, environmental, and social engagement.

This embodied orientation is central because RePlay treats the body not as an accessory to thinking, but as one of the sites through which thinking, perceiving, and designing occur. Participants learn by moving, positioning themselves, responding to others, handling objects, and testing ideas in space. In this way, RePlay aligns with embodied and enactive accounts of cognition while translating them into a practical design research setting.

2.7.1 The Role of Group Mind in RePlay

The "group mind" that emerges among players during a RePlay can be understood as several bodies and minds becoming part of a single collective action. In *The Singing Neanderthals*, Steven Mithen (1996) argues that early music-making was critical in forging group identity. Along with a particular species of frogs, humans are one of the few creatures capable of synchronized rhythm such as clapping, dancing, or singing in time together. The purpose of such synchronization, Mithen suggests, is to induce *boundary loss*: a sense of being one with others.

This phenomenon is deliberately harnessed in RePlay, for example during the game "design machines," where players improvise together to co-create an object or a data-flow diagram. This collective dimension of RePlay aligns with Sawyer's discussion of creativity as a sociocultural process, emphasizing interaction and relational dynamics.

This idea of group mind should not be understood as a mystical claim, but as a way of describing a temporary alignment of attention, rhythm, movement, and responsiveness. In RePlay, group creativity depends on participants becoming sensitive to one another's cues and adapting in real time. This provides an important foundation for the later discussion of flow, group flow, and suggestibility as forms of creative responsiveness.

2.7.2 Embodied Creativity in RePlay

Unlike traditional improvisation, RePlay incorporates design thinking strategies and facilitates players in using their bodies to conceptualize a product or service.

This type of problem solving encourages players to physically engage with a creative problem rather than relying only on more conventional forms of externalization such as sketching or discussion. In RePlay, rather than using solely epistemic tools such as software or hardware, designers are effectively re-engineering the design process by factoring the body into their understanding of interactions with the world and situating it within a design context. Instead of the pencil or the use of Photoshop software, the body becomes the tool through which designers gain awareness of the context, user, or environment, as well as of the choices available for solving a problem space.

As designers, we need to get back to the basics of interaction and to re-examine our relationship with the world at its most fundamental level. One way of doing this is by considering both externalization and the internal processes I describe as Creativity in Action, a term I coined in developing RePlay to capture how embodied practice connects with and extends existing theories of creative process.

2.7.3 But why Improvisation as Part of Design Process?

Exploring embodied interaction more deeply was one of the motivations for this research: to investigate experiential learning through bodily engagement as a resource for collaborative design. While substantial research exists in related fields, little synthesis has explained *why* improvisation is so useful in design. There is limited research on group dynamics, cognition, and communication during improvisation.

Medler and Magerko (2010) note that improvisation has rarely been analyzed for its underlying mechanisms. While they studied trained improvisation actors, my work focuses on what occurs within RePlay and how this relates to broader theories of creative process. Gerber (2007a; 2007b)

compare improvisation with design, noting its positive impact and proposing parallels with Osborn's (1963) brainstorming rules: *withhold judgment, build on the ideas of others, generate a large quantity of ideas, free-wheel, and identify a leader*.

These principles echo improvisational practice, where "yes, and" and collaborative responsiveness allow ideas to be extended rather than blocked. In RePlay, these principles are embedded within embodied games, giving them both a physical and cognitive dimension.

By foregrounding embodiment's influence on perception, RePlay as a framework integrates improvisational games into design processes. Through RePlay, several characteristics of improvisational creativity essential to design are fostered such as reflection, flow, perceptual shifts, enactive perception, and bodily externalization.

The research gap is therefore not simply that improvisation has been used in design, but that its deeper mechanisms are often under-theorized. Bodystorming, role-play, informance, and embodied narratives show that performance-based methods can help designers imagine use, empathize with participants, and prototype futures. RePlay builds from this lineage but shifts the emphasis toward the study of collaborative creative process itself: how participants become responsive, how ideas are externalized, how bodies and materials shape design thinking, and how groups move toward or away from flow.

2.8 Neuroscience: The Unconscious Aspects of Creative Process

Due to advances in neuroscience and the use of fMRI and PET scans, locating creative thinking in the brain has become increasingly plausible, at least within a neuro-scientific approach. These methods have also influenced the ability of computers to model creative processes, as in the example of the "drawbot" (Bird & Stokes, 2006). At the same time, philosophy and theory of mind have been enriched by the tangibility of this data, which offers concrete evidence for theories regarding embodiment and the role of the unconscious in creativity (Gallagher, 2005, 2007).

A study by De Manzano et al. (2010) linked *dopaminergic neurotransmission* in the thalamus to creative thought and behavior, with particular emphasis on divergent thinking and associative processes. By measuring D2 receptor binding potential (D2BP) in both the thalamus and the striatum, the researchers identified where associative processes were located.

They also measured the number of semantic categories generated by individuals and how extensively participants were able to elaborate upon single words.

The study demonstrated that a decrease in dopamine D2 in the thalamus, coupled with an increase in the striatum, was associated with an increase in what the authors termed "creative bias." This

bias appears to facilitate performance on tasks that require continuous creation and the recombination of mental representations, as well as flexible switching between mind-sets.

2.9 Relational Creativity

Sawyer argues that all creative outcomes are inherently collaborative, even if this dimension is not consciously recognized (Sawyer, 2017). This aligns with embodiment theories that emphasize the environment's role in shaping perception and action.

Thus, the aim of this research is not only to understand creativity at the individual level but also to investigate how it emerges in relation to environment and group dynamics. Collaboration is a vital aspect of design, and the myth of the "lone genius" has been widely challenged. Evidence shows that novelty often depends on collective processes, with more diverse group settings producing more innovative outcomes (Sawyer, 2017).

RePlay builds on this insight by creating conditions for embodied, collective engagement, thereby operationalizing relational creativity as a practical design method. Instead of emphasizing the individual, creativity research must focus more strongly on how environments create spaces and tools for facilitating collective creativity. RePlay represents one such tool.

Taken together, these perspectives on embodiment, group mind, improvisation, and relational creativity show that creative practice cannot be understood in purely cognitive terms. It is enacted through bodies, shaped by environments, and sustained through collective interaction. The focus need not only be on improvisation as an expressive tool, but also on reflection as a critical practice within design. Reflection makes visible what is usually tacit, enabling participants to disentangle, redirect, and deepen their creative processes. It is to this role of reflection in design practice that I now turn.

This is highly relevant because reflection is the mechanism that allows improvisational activity to become researchable.

Without reflection, improvisation may remain an exciting event; with reflection, participants and researchers can notice what changed, what emerged, what was blocked, and how the creative action unfolded. RePlay therefore depends on a cycle of action and reflection: participants act, respond, externalize, and then reflect on what those actions reveal about the creative process.

2.10 Reflection in Design Process: Designerly Ways of Knowing

Besides learning more about flow and the importance of creative frameworks, another motivation for developing RePlay was to explore the value of reflection on one's processes. This follows from

a socio-cultural approach in which an individual's creativity is situated not only in the object of creation but also in the audience, client, and environment that shape and are shaped by the work. Context in this instance refers to situational or environmental conditions, which call for an embodied approach.

Design researcher Donald Schön (1983, 1987) who's work will come up several times in this thesis describes three levels of expert knowing:

i. Knowing in action

ii. Reflection in action

iii. Reflection on action

RePlay provides a vehicle for developing and exploring these valuable types of knowing by drawing attention to the body within design practice. Through embodied activity, designers become aware of their own physicality in ways that support cognitive engagement with a design problem space (Gongora, 2010a; Gongora & Dix, 2012a)

The term *reflection* as utilized in this thesis resonates with meditation and mindfulness training because it implies a sense of awareness about one's thinking processes. Like mindfulness, reflection disentangles thought or emotion from identification with the self, creating space for observation. From a creativity research perspective, it is useful to observe whether inducing reflection early in the creative process influences creativity and creates new directions and requirements (Schön, 1997; Gongora, 2010).

By reflection I refer not only to reflection occurring during the creative process itself but also to the influence of phenomenological aspects on cognition, which in turn shape creative outcomes. Varela et al. (1991) suggest that embodiment is a concept missing in traditional cognitive science.

At the time of writing this thesis there had been a shift in the field of cognitive science to include embodiment research. I was privileged to be a guest researcher at the Creativity Lab, Sussex University, and to meet a vibrant community in philosophy, cognition, and the Department of Evolutionary and Adaptive Systems in Computing.

It is this blending of disciplinary thinking that makes RePlay a useful tool for qualitative design research. It is therefore relevant for creatives, researchers, clients, stakeholders, designers, technicians, engineers, and scientists seeking design methods that foster innovative leaps

The upcoming chapters will explore reflection in more detail, examining its role in the creative process and its relationship to my exploratory research and later case studies "in the wild."

In many ways, reflection and improvisation are intertwined. Both ask participants to attend carefully to process, remain present to what unfolds, and learn by doing rather than by abstract planning. If reflection helps us disentangle thought from immediate identification, improvisation provides the lived conditions for that disentangling to occur in action. For this reason, before delving further into case studies, it is important to trace how improvisational theatre itself developed as a practice of reflection-in-action and to highlight the contributions of key figures, most notably Viola Spolin, whose work shaped not only performance but also broader understandings of creative process.

2.11 Historical Background of Theatrical Improvisation

Improvisational theatre has a long and diverse history, developed across different cultural contexts by key figures who sought to make performance more immediate, participatory, and socially engaged. Among the most influential are Konstantin Stanislavsky in Russia, J. L. Moreno in Austria, Jacques Copeau in France, and Viola Spolin in the United States, some of whom developed their techniques in parallel.

2.11.1 Konstantin Stanislavsky and Lee Strasberg

Stanislavsky (2011), influenced by Freud's theories of the unconscious, wanted actors to focus on developing the feeling and emotional aspects of a character. He introduced a technique called "psychological realism," which aimed to make acting more natural. Lee Strasberg (1987), who encountered Stanislavsky's ideas at the American Laboratory of Theatre in New York, went on to form Group Theatre and the Actor's Studio in the United States. By the 1950s, this approach was widely known as "the method" (Sawyer, 2003a).

2.11.2 J. L. Moreno

Moreno's (2019) techniques were later described as "psychodrama" and "sociodrama." Before these terms became central to his practice, however, he was known for his theatre group *Die Stegreiftheater* ("Theatre of Spontaneity"). A defining aspect of Moreno's technique was his desire to involve the audience. He developed the "ask for," in which the audience provides suggestions that actors then incorporate into performance. Moreno eventually immigrated to the United States and, in 1929, began directing the Impromptu School in Brooklyn (2019; Sawyer, 2003).

2.11.3 Jacques Copeau

Jacques Copeau (1991) experimented with improvisation in 1916 by incorporating *Commedia dell'Arte* into French theatre. *Commedia dell'Arte*, an Italian form, is characterized by plot outlines and stock characters. While the stories were limited, the form allowed actors to focus on performance and character development. Copeau's main contribution was his innovative approach to actor training, incorporating improvisation into rehearsal. His influence spread to modern theatre

groups in England and the United States. Copeau was especially inspired by observing children's play, which he recognized as inherently improvisational (Sawyer, 2003a).

2.11.4 Augusto Boal

In 1974, Augusto Boal (2000) used improvisation to explore political themes such as oppression. His goal was to combat apathy by transforming audiences into active participants in political debate through Forum Theatre. In this format, actors would perform a conventional play, after which the audience was invited to suggest changes and take part in reshaping the narrative in effect, turning the spectator into an actor.

Boal's emphasis on empowerment, participation, and the dissolution of audience performer boundaries resonates with the participatory aims of RePlay, although in a different social context.

2.11.5 Viola Spolin

Viola Spolin (1906–1994) was a theatre academic, educator, and acting coach, and is regarded as one of the most important innovators of 20th-century American theatre. She created *Theatre Games*, a system of structured improvisational exercises that helped actors stay present in the moment and generate authentic choices. Her approach is widely considered foundational for modern improvisational theatre.

Spolin's book *Improvisation for the Theatre* (1999) compiled her philosophy, teaching, and coaching methods, and has often been described as the "Bible of improvisational theatre." Alongside this text, she developed a *game file* that circulated among directors and educators, becoming a kind of improvisation "manual" for practitioners. Her influence on the first generation of improvisers at the Second City in Chicago in the 1950s was profound, shaping the trajectory of American improvisation.

Her son, Paul Sills, was the founding director of the Compass Players, which evolved into the Second City. Second City became a major cultural force, popularizing improvisational theatre, particularly in its comedic form. Second City were largely responsible for the popularization of improvisational theater, which became best known as a comedy form called "Improv."

Spolin's methods emerged from her background with the Works Progress Administration during the Great Depression, where she worked under Neva Boyd. Boyd emphasized group leadership, recreation, and the social role of play, particularly with inner-city and immigrant children. Building on this, Spolin developed games that emphasized individual creativity, ingenuity, and inventiveness. She also drew inspiration from J. L. Moreno's psychodrama and sociodrama, incorporating the idea of audience suggestion. Like Moreno, Spolin's work had a therapeutic dimension, helping players overcome creative blocks and self-consciousness.

A distinctive feature of her pedagogy was her shift in terminology. She replaced the word *actor* with *player* to emphasize collaboration and participation rather than performance. Similarly, she substituted *physicalizing* for *feeling*, reflecting her belief that embodied action is more generative than introspection. These shifts supported her goal of freeing participants from what she termed the "Approval/Disapproval Syndrome" defined as a tendency to block one's own creativity to please directors, peers, or audiences. Her exercises created spaces of trust, play, and experimentation that released players from these constraints.

2.11.6 Spolin's Key Characteristics of Improvisational Theatre

Group response and unity: Players experience themselves as part of one body, which generates trust and frees them to play.

Absence of hierarchy: Improvisation requires moving beyond approval/disapproval. Facilitators emphasize process and exploration rather than right vs. wrong.

Embodied presence: The goal of a game is to shift the player out of the head and into the shared space of action.

Spolin's Key Ideas Regarding Improvisational Theatre

Focus: Reframed from "point of concentration" to "focus," emphasizing energy over object. The aim is to stay awake and aware of everything while maintaining attention on the task.

Relation: Instead of focusing on scripted relationships, players attend to energy as a moving force, cultivating deep listening and responsiveness.

Motivation: Players are guided to suspend subjective rationale and engage with "space "meaning, intuition and the unknown.

Space: The unknown, as well as projections of the self into the visible world.

X Area: The undefinable domain of intuition, beyond intellect, memory, or mind. Spolin described this as the "well-spring of inspiration" (Spolin, 1999, foreword).

Follow the Follower: A practice where no one leads. In mirrored exercises, players engage in micro-level imitation until self-consciousness fades, enabling unity and shared flow. Spolin explained: "Played daily this exercise can bring incredible unity and harmony to a group of players; it is a thread woven through the entire fabric of the theater game process" (Spolin, 1999, foreword).

Talent: Defined not as innate skill but as the ability to remain fully present and organically involved with the environment. In being present we often give greater attention to the Intellectual or the physical, yet intuition is usually neglected.

Intuition: A state in which conscious thought recedes, and one is simply experiencing. This spontaneity frees players from constricted intelligence and allows self-expression to emerge.

> *"A way is needed to get to intuitive knowledge. It requires an environment where experiencing can take place…" (Spolin, 1999, p.4).*

Reading these characteristics, it becomes clear how closely Spolin's approach resonates with descriptions of *flow* in creativity research. Her emphasis on presence, unity, and embodied awareness mirrors the conditions that Csikszentmihalyi identifies as central to flow. This alignment was significant for me in developing RePlay, where improvisational games similarly foster a collective state of immersion and creative action. Spolin's importance for this thesis lies in the way her theatre games translate creativity from an internal capacity into an activity that can be practiced. Focus, relation, intuition, physicalizing, and group response are not abstract ideals; they are trained through structured exercises.

RePlay adapts this insight into design research. It asks how similar game-based conditions might help designers, participants, children, and interdisciplinary teams become more present, responsive, and able to explore uncertainty together.

Spolin's Influence on the Development of RePlay

Spolin's method of working with Impro was highly influential in my own exposure to theatrical improvisation. Her book *Improvisation for the Theatre* offered detailed insights into her process of developing theatre games. Although I was aware of her writing early on, I resisted reading it because I wanted to experience improvisation first-hand before encountering her analysis. I felt that reading her too soon might overly influence my own development of RePlay. In many ways, I consider Spolin herself an early creativity researcher, as there are strong parallels between her observations on the structure of Impro and my own observations of creative process through RePlay.

Spolin's games, grounded in playful interaction, emphasized that players could achieve outcomes using their own unique style. This, in turn, developed ingenuity and inventiveness. Through her games, players became flexible in responding to multiple stimuli, which provoked growth (Spolin, 1999, p.6). For RePlay, Spolin's influence lies in how her games modeled the balance of structure and openness necessary to cultivate flow, reflection, and creative collaboration.

2.11.7 Josephine Forsberg

Josephine Forsberg (1921–2011), ex-wife of film director Rolf Forsberg, was hired by Paul Sills and Viola Spolin to join the original Second City in 1959 as a female understudy and as Spolin's teaching assistant. In 1971, Forsberg opened an official school of improvisation called the *Players Workshop*. The Player's Workshop has been described as the first school of Improvisation with a class structure, syllabus, and graduation requirement predating the more loosely organized workshops created in the mid-1970s by Dudley Riggs (Minneapolis, USA) and Keith Johnstone (Calgary, Canada). Keith Johnstone (1989), a respected improviser among professional actors, developed techniques that emphasized directions around what was happening in the scene. Forsberg's school became the largest in the country, training many for the Second City stage. Her son Eric Forsberg later joined as a director and, with David Shepard, developed a competitive Improv format that came to be known as the *Improv Olympiad*.

2.12 The Impro Olympics

When I learned Impro in high school, it was through the *Impro Olympics* model as an extracurricular activity. We competed first locally in my school district, then regionally, and finally nationally with schools across Canada at the National Arts Centre in Ottawa. At the same time, I held a theatre scholarship at the Ottawa School of Speech and Drama, where I was trained in more formal theatre techniques. Concurrently, I participated in a youth Shakespeare troupe and various musical theatre productions in and around Ottawa.

This personal trajectory is significant because it shows that my later development of RePlay grew from a foundation that combined formal theatre training with the collaborative, game-based improvisation of the Impro Olympics.

2.13 Role-play, Bodystorming, and Informance

Improvisation and its many incarnations have been used as design tools in Human–Computer Interaction (HCI) since the 1970s, with papers on the subject appearing in leading conferences by the late 1980s. For example: Sato (1999); Burns, Dishman, Verplank, and Lassiter (1994); Oulasvirta (2003); Giaccardi and Fischer (2008); Iacucci (2002); Gerber (2007a, 2007b); Brandt (2000); Svancæs, Simsarian, and others.

Improvisation has become popular in participatory design, perhaps because it provides an empathic approach aligned with the aims of design thinking. However, its use is highly varied and thus difficult to frame as a consistent methodology. At times, the goal is product- or service-driven, while in other contexts the focus is on idea generation, team building, or communication. In some

cases, the physical requirements of use are central; in others, the socio-cultural context takes priority.

Brandt (2000) and Iacucci (2002) explored improvisation as a tool for making tacit knowledge explicit. Brandt emphasized designers physically engaging with props or movements, for example, acting out tasks like refrigerator repair as a way of surfacing hidden knowledge. Iacucci (2002) recorded improvisations with prototypes using simple plots, noting that performance made everyday situations more vivid and intimate.

In other projects, designers invited users themselves to role-play scenarios or conducted improvisations "in the wild" to situate design in real contexts. Brandt (2000), inspired by Keith Johnstone's work on status (1989), examined how role-playing high- or low-status characters (e.g., boss vs. maid) shaped workplace dynamics. Such explorations helped reveal hierarchy and relationships within user communities. Brandt also experimented with participatory home-based improvisations, asking users to role-play in their own environments. This strategy fostered empathy and provided deeper contextual understanding of product or service use.

2.14 Embodied Narratives

Embodied Narratives are especially relevant because they demonstrate that performative, embodied techniques can help elicit children's experiences and make tacit knowledge more visible. RePlay shares this concern with embodied elicitation, but it also extends the methodological problem further. Rather than using embodiment only to communicate experience or generate design concepts, RePlay uses embodied improvisation to study the dynamics of collaborative creativity itself: the movement from uncertainty into shared action, the negotiation of roles, and the formation of collective meaning.

Giaccardi, Fischer, and Gerhard (2008) were critical of processes such as Brandt's (2000), where the designer is directly engaged in improvisation about the use of a product or service. They argued that this approach risks distorting the authenticity of the user's perspective.

In response, Giaccardi, Paredes et al. (2012) illustrated how improvisation can facilitate participatory design processes that might otherwise be difficult to achieve. They introduced the technique of Embodied Narratives (EN), which provides a window into the perceptions of others by enabling participants to enact their experiences. This method reframes improvisation not only as performance but also as a means of accessing lived perspectives.

In their study, school children were asked to explore the theme of "dangerous scenarios" in their environment. The activity took place in a school, where children enacted situations, they perceived as risky and used digital cameras to capture aspects of their performance.

The researchers found that children's perceptions of danger became vividly apparent through performance and often more visible than they might have appeared in a written manual or report. Giaccardi described this process as performing perception.

Giaccardi's work is notable because it positions users as active participants in design, challenging assumptions about their contexts and realities. The outcome aligns with co-design approaches, in which participants are not merely subjects of research but active contributors in shaping the design process. For RePlay, this resonates strongly: like EN, it treats improvisation as a way of surfacing tacit knowledge and lived perspectives, particularly within collaborative and participatory settings.

2.15 The Benefits of Improvisation as Part of Design Process

Impro can be used in many ways in the design process—as part of team building, as a communication tool, as a participatory design strategy, or even to facilitate co-design. However, to date there are very few researchers linking what we know about Impro with what we know about the creative process. This thesis seeks to address that gap by bringing these strands together and showing how Impro can be formalized as part of a creativity toolkit. Below is a summary of the benefits of utilizing Impro.

2.15.1 Idea Generation

Improvisation relies on being present and in the moment, often utilizing free association like brainstorming. This frees designers from habitual thought patterns that might impede innovation. Games such as those invented by Johnstone (1989) encourage novel associations in a design context, which can lead to innovative reframing of the problem space.

2.15.2 Communication Among Teams

Both Sato (1999) and Simsarian (2003) found that using Impro for idea generation improved communication, reduced hierarchies, and created shared investment among stakeholders. Gerber (2007a, 2007b) describes this as creative collaboration, which benefits design teams since the dominant dynamic is often critique rather than building upon each other's ideas. She summarizes creative collaboration as focusing on the group goal rather than individual aims—an important shift in a field that is usually highly competitive.

2.15.3 Making Tacit Knowledge Explicit

Brandt's (2000) work illustrates that by having designers perform the tasks of refrigerator repair technicians, they developed a richer understanding of the tasks at hand rather than designing artifacts based purely on assumptions.

2.15.4 Empathy and Participatory Co-Design

Giaccardi, Paredes et al. (2012) research illustrated how working with children encouraged designers to understand children's lived perceptions rather than rely on preconceived assumptions. By contrast, in Brandt's study designers initially relied on their own assumptions about repair technicians' work. Impro-based enactments can thus deepen empathy and situate design in real user perspectives.

2.15.5 Thinking in Action

Using props, designers can explore tangible aspects of their designs. In some cases, the physicality of a design artifact may be crucial. Impro-based prototyping can be faster and less costly than building 3D visualizations. As an epistemic action, rapid prototyping supports *thinking through doing*.

2.15.6 Rapid Prototyping

Via the use of props designers explore tangible aspects of their designs and in some cases the physical aspect may be very important to the design artifact. This is something which might normally be time consuming via 3d visualizations and expensive. As an epistemic action rapid prototyping provides the opportunity for thinking through doing.

2.15.7 Exploring Different Contexts

By taking improvisations "into the wild," design teams can explore opportunities or challenges offered within applied contexts. This is especially useful when the context is unique or plays a decisive role in the outcome.

2.15.8 Production Blocking

In improvisation, production blocking occurs when participants do not support the suggestions of others. A simple exercise, *yes, and…*, encourages players to accept each other's offers and expand the scene further. Agreement is not required, but momentum must be maintained by building on what has been introduced. In design, this has a similar purpose to brainstorming discouraging premature critique and keeping the flow of ideas open and allowing for creative emergence.

2.16 Chapter Summary

This chapter has traced the historical development of improvisational theatre from Stanislavski and Moreno to Spolin and Forsberg and shown how its practices have been adapted into design. Drawing on examples from HCI and participatory design, I have argued that improvisation supports idea generation, communication, empathy, tacit knowledge, and embodied reflection, and that Viola Spolin should be regarded not only as a pioneer of improvisation but as an early

creativity researcher. Understood this way, improvisation offers not merely a set of creative tools but a conceptual bridge to flow, reflection-in-action, and collaborative creativity.

Situating this within the wider field, I have argued for approaching creativity through Keith Sawyer's sociological lens. Creativity research spans philosophy, psychology, design thinking, generative art, AI, and business: early psychological studies emphasised the traits of creative individuals (Sternberg, 1991, 1995, 2002), while later work shifted attention toward decision-making within design activity (Ball, 2009). What remains least well understood is how we collaborate both with one another and, increasingly, with agentic technology. It is this gap that the remainder of the thesis addresses.

It does so through RePlay, which I introduce as both a framework and a methodology. RePlay adapts the techniques of improvisational theatre to facilitate collaborative creativity and cultivating group flow and embodied reflection, and offering a low-threshold entry point for diverse teams. It functions at once as a training tool for collaborative creativity and as a method for researching it. Its potential as a methodology became clear once I recognised that the outcome of this work was not only a framework for facilitating collaborative creativity, but a vehicle for studying it as it unfolds. This recognition emerged from an initial period of exploratory research, a review of relevant literature, and practice-based experimentation; although my early motivation was intuitive, the research became more concrete through the formal case studies such as; Tiree Tech Wave, Global Studio, and the Bendables project which together showed that RePlay operates across design, community, and maker settings, and through them, the concept of Creativity in Action.

The chapters that follow develop this foundation. The next chapter develops RePlay as a creative sandbox and framework, and the methodology chapter explains how these foundations became research methods. Chapter 6 then presents the exploratory research through which RePlay was developed and defines Creativity in Action as the theoretical concept that emerged from it, together with its characteristics: improvisational fluency, co-presence, attunement, shared attention, flow and group flow, suggestibility as responsiveness, and trainability. Since improvisational creativity requires openness, trust, and a willingness to respond to others, RePlay is designed to cultivate precisely these conditions and the groundwork for the following chapters.

Chapter 3: RePlay as a Creative Sandbox

"It is in playing and only in playing that the individual child or adult is able to be creative and to use the whole personality, and it is only in being creative that the individual discovers the self." — D. W. Winnicott, Playing and Reality

In this chapter the sandbox metaphor helps clarify how RePlay functions: it creates a structured but flexible environment where participants can externalize ideas through movement, role, gesture, space, objects, and interaction. A sandbox is a bounded but open space in which participants can test possibilities, take creative risks, explore perspectives, and suspend premature judgment. Unlike a prescriptive creativity method, a sandbox does not predetermine the solution. Instead, it establishes conditions for experimentation, reflection, and emergence.

3.1 Introduction

Chapter 1 and 2 situated this thesis within creativity research and identified the need for approaches that can account for creativity as embodied, collaborative, reflective, and emergent. This chapter focuses on RePlay as the practical and methodological response to that gap. It positions RePlay as a creative sandbox: a structured but flexible space in which participants can experiment, externalize ideas, improvise, reflect, and make collaborative creativity visible. This chapter documents how improvisation, embodiment, reflection, externalization, and facilitation were organized into a creative sandbox "RePlay", that could be used across different design and research contexts.

RePlay reframes improvisation not as performance but as both a design method and a research strategy. This is what cognitive scientists such as Fauconnier & Turner describe as conceptual blending: a type of analogical process where ideas from two mental spaces (such as "theatre" and "design research") combine to form a new one.

Throughout my process of developing RePlay and collecting qualitative data regarding the creative process, I realized that I was also developing a methodology that could be used to research the phenomenon of collaborative creativity and enrich what only was recently known in the field of neuroscience at the time of starting this PhD in 2009 with some of the recent developments in neuroscience in 2004 around neural correlates.

The contribution of this research is mainly theoretical in nature. I have developed terminology for phenomena I observed during RePlay sessions as principles of collaborative creativity. One such concept is Creativity in Action; a term I coined to describe a phenomenon observed during the development and use of RePlay and which reflects a major contribution of this research. Other

theoretical ideas developed in this project include such as a sandbox, the value of play, and how at an early age we can begin teaching children to have a creative mindset.

3.2 From Creativity Methods to Creativity Frameworks

I want to be clear in that RePlay should not be described as simply a creativity tool. There are many creativity tools that support ideation, brainstorming, or product development; RePlay however was designed to study and make the process of collaborative creativity itself more visible for observation and reflection to creativity researchers. This distinction matters because the thesis is not only asking whether RePlay helps people produce ideas, but also whether it creates conditions through which embodied, relational, and improvisational creativity can be studied as it unfolds to design better systems for creative collaboration both between humans and other mediated frameworks.

As described in this chapter, a framework is process-oriented and non-prescriptive: it provides an approach that encourages reframing of the problem space rather than offering fixed solutions. My development of RePlay utilized a reflexive, interdisciplinary approach that combined design research (as in research through making) with current theories from the field of philosophy in particular embodied cognition and findings in neuroscience. This dual orientation of RePlay allows the framework to function both as a training opportunity for collaborative creativity and as a methodology for collecting qualitative data on group creative processes.

While developing RePlay I wanted explore whether the phenomena I was observing, Creativity in Action, a type of reflection on one's process, was something that could be taught and potentially trained. My working hypothesis is that Improvisational theatre offers an opportunity to facilitate group flow and to train a kind of embodied reflection, which I call Creativity in Action.

Frameworks such as RePlay, create the opportunity for innovation and greater awareness in creative decision-making. The work of composer Kenneth Newby introduced in Chapter 2 provides a useful parallel. Newby engages in a creative dialogue with the computer and his own creativity framework he developed when composing, selecting, and editing, pushing the boundaries of his practice. Similarly, RePlay is designed so that creative teams can use it to reflect on their processes and generate innovative applications of services or products in applied design contexts. Importantly, participants need not be experienced improvisers or designers. With its low entry threshold, RePlay enables people from diverse backgrounds to engage in facilitated group flow, a process that is both unique and accessible. This is achieved by expanding on techniques from Impro theatre, which when facilitated well, observably promote group flow. One of my goals with developing RePlay was to provide a general reliable format that teams can use to engage with repeatedly to generate collective flow experience. At the same time, RePlay serves as a productive methodology for researching collaborative improvisational creativity.

Table 3.1
Placing RePlay in Relation to Creativity Practice

Category	Typical function	Limitation	How RePlay relates
Tool	A specific device, prompt, card, prop, object, or technique used to support a task.	May support activity without explaining the process it produces.	RePlay uses tools such as props, trigger objects, maps, and exercises, but it is not reducible to them.
Method	A repeatable procedure for facilitating or investigating creative activity.	Can become prescriptive if separated from context, facilitation, and reflection.	RePlay includes repeatable games and exercises, but these are adapted to context and participant needs.
Framework	A conceptual orientation that organizes principles, conditions, roles, and relations.	Can remain abstract unless enacted through practice.	RePlay provides a flexible structure for embodied, relational, reflective, and improvisational creative work.
Methodology	A way of producing and interpreting knowledge through research design, data generation, and analysis.	Requires explicit explanation of what kind of knowledge the method makes possible.	RePlay becomes methodology when it is used to make collaborative creative process observable, discussable, and analyzable.

As creativity research has moved from individual cognitive models toward systemic and relational accounts, researchers and practitioners have also developed tools and methods for supporting creative process. These include pragmatic approaches such as brainstorming and De Bono's Six Thinking Hats (2016), as well as design-oriented methods such as role-play, bodystorming, informance, cultural probes, tangible interaction cards, and embodied narratives. Such methods demonstrate that creativity can be cultivated, facilitated, and studied through structured practices.

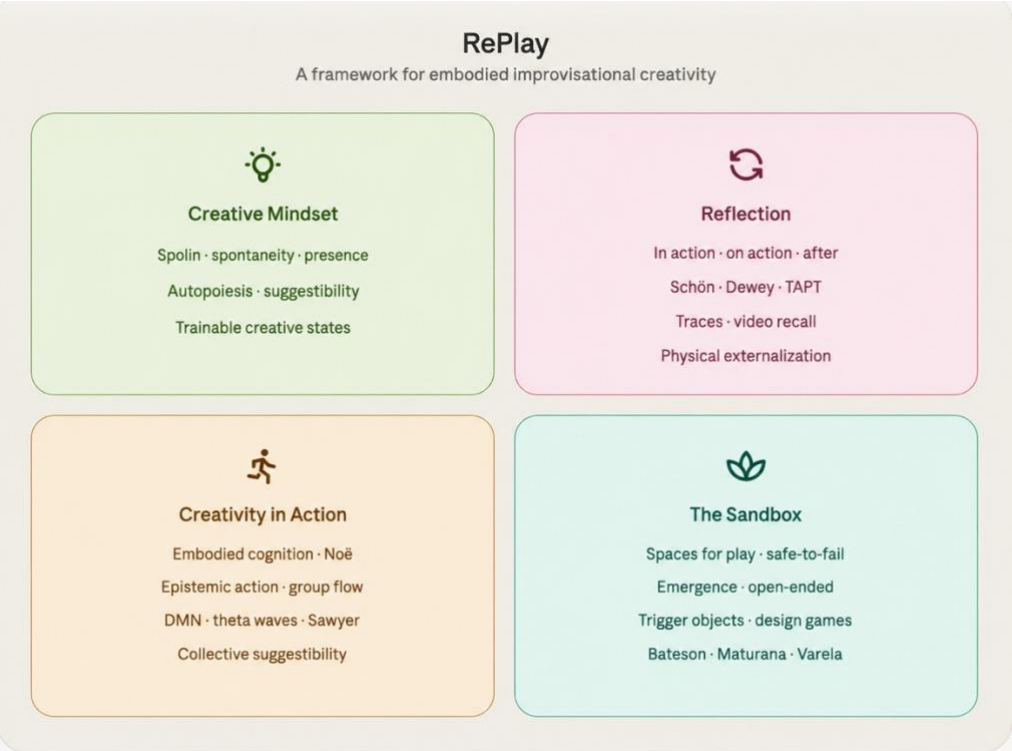
However, many creativity tools remain focused on producing ideas or outcomes rather than studying the process by which creativity unfolds. This distinction is important to consider in the context of a RePlay. RePlay was initially developed as a practical tool for supporting collaborative creativity, but then it also became a methodological framework for researching creative process itself. It therefore sits between tool and methodological framework.

RePlay supports creative activity while also making that activity available for reflection, observation, and analysis by both creatives and those researching the phenomenon of collaborative creativity.

This distinction between tool, method and framework is central to the thesis. A tool may provide a specific technique or procedure, while a framework offers a more holistic orientation that can be

adapted across contexts. RePlay functions as a framework because it provides conditions for embodied, improvisational, and reflective creative engagement for understanding rather than a fixed set of prescriptive steps.

Figure 3.1
RePlay Framework Overview



Note. Made by the author using ChatGPT

The cognitive turn gave creativity research systematic ways of studying creative process, and it has since been joined by biometrics, neuroscience, and computational and evolutionary models, alongside more robust philosophical theory. Now that these approaches exist, what is needed is less the tools themselves than a clearer theoretical and pragmatic account of what makes them useful within creative process.

> *We have come to recognize, then that the study of creativity and its development is one of the broadest and largest topics for research: The analysis of creativity in all its forms is beyond the competence of any one accepted discipline. It requires a consortium of talents, Psychologists, biologists, philosophers, computer scientists, artists, and poets would all expect to have their say. (Feldman, 1999, p.181).*

3.2.1 RePlay as a Safe Space for Creative Risk and Experimentation

RePlay extends existing design practices of externalization by treating the body itself as a medium for reflection and creative inquiry. In design practice, ideas are often externalized through

sketches, diagrams, prototypes, post it notes, journey maps, or artefacts. RePlay adds another layer: participants externalize ideas through embodied enactment, spatial arrangement, vocalization, gesture, rhythm, and relational response. This makes aspects of collaborative creative process visible and available for reflection.

3.2.2 RePlay, Externalization, and Embodied Reflection

A method usually names a specific procedure or technique. A framework offers a wider orientation that can be adapted across contexts. RePlay includes games and exercises, but it is not reducible to those activities. It provides a way of facilitating, observing, reflecting on, and researching collaborative creativity in action. This is why RePlay should be understood as a methodological framework rather than simply as a design activity.

3.3 Pragmatic Creativity Methods

The pragmatic tradition is important because it shows that creativity can be supported through structured practices. However, it also reveals one of the limitations that RePlay responds to.

> **Brainstorming, thinking hats, and similar methods often emphasize the generation, sorting, or evaluation of ideas. They are less able to account for the micro-processes through which a group becomes attuned, loses or gains momentum, blocks or accepts offers, negotiates uncertainty, and begins to think through action. RePlay emerged as a response to that gap: it combines the usefulness of structured creativity methods with a stronger focus on embodied process, relationality, and reflection.**

Pragmatic approaches to creativity emerged in the mid-20th century as practitioners sought actionable methods for fostering innovation in workplace settings. In 1939, Alex Osborn conducted various brainstorming sessions at an advertising agency in New York, marking an important milestone in understanding the creative process as it shifted from mystical, cognitive, or psychoanalytic approaches to teachable workplace methods. In 1948, Osborn published Your Creative Power, a still popular book that outlines the brainstorming method he developed (Osborn, 1948). This method of brainstorming has since become one of the hallmark strategies used during the creative process.

Another prominent example of a pragmatic creativity methodology is Edward De Bono's lateral thinking approach called the "Six Thinking Hats" (De Bono, 2016). The catalog of such pragmatic approaches is extensive, each offering proprietary methods for structured creative thinking. While these popularized techniques exist outside the primary focus of this research project, they provide important context for understanding applied creativity frameworks.

Osborn's brainstorming method, which to this day is used in the workplace as part of a toolbox of methods, celebrates non-criticality, freewheeling, welcomes wild ideas, quantity, and the combinations of previous ideas. The highly successful innovation company IDEO takes brainstorming seriously by devoting 5-10 percent of their innovation process to brainstorming (Sawyer, 2017, p. 60). The value of brainstorming is widely recognized, as well as the virtues of utilizing improvisation techniques as part of innovation process. This is in part thanks to the work of Keith Sawyer and others; however, there needs to be further research about what it is about improvisation as part of a design process that makes it unique compared to other strategies such as drawing or interviewing.

Considering how creativity might be applied to real-world issues facing society such as climate change, social innovation, and the rethinking of education and working alongside computers is what motivated me to develop RePlay to understand some of the complex systems we have developed as well as the forces within those systems and how to evolve them for the challenges we face in contemporary society that uses artificial intelligence.

My current start-up Brigado leverages ai tools to challenge vertical and hierarchal systems of organizing human capital as part of fast-paced back of house operations in restaurants with the goal of a more inclusive, accountable, harmonious, horizontal and improvisational way of understanding the dynamism of a kitchen environment. Brigado innovates upon the traditional brigade system incorporating modern techniques to develop a more inclusive and supportive environment to support the creativity of culinary work.

Figure 3.2
Brigado Ensemble



Note. Photograph by the author.

De Bono's Six Thinking Hats method exemplifies structured parallel thinking, where participants adopt specific perspectives simultaneously within time-limited sessions. This process encourages systematic consideration of ideas from multiple viewpoints, moving beyond traditional debate-style discussion. The method employs six distinct thinking modes, each represented by a colored hat (De Bono, 2016).

Figure 3.3
De Bono's Six Thinking Hats



Note. Illustration by the author using ChatGPT, based on the Six Thinking Hats method described in De Bono (2016).

De Bono's approach prioritizes practical efficacy over theoretical foundation, enabling participants to explore different problem-solving perspectives through solution-focused methodology. This method contrasts perspectives such as intuitive thinking versus critical thinking to stimulate alternative viewpoints, incorporating elements reminiscent of archetypal roles like explorer, artist, judge, and warrior (De Bono, 2016). However, Sternberg and Lubart (2010) critique De Bono's method for being difficult to verify empirically, particularly when compared to psychometric approaches that use paper-and-pencil tasks to measure divergent thinking through associational fluency a generally accepted method for studying creativity in psychology. Initially, De Bono's approach helped develop RePlay initially as a tool by utilizing a pragmatic approach like "thinking hats" for creating heuristics regarding the creative process. However, as the investigation deepened, and I have mentioned, RePlay evolved beyond a tool

to become a research methodology and framework for expanding in-situ knowledge in collaborative creativity research. Pragmatic creativity methods like De Bono's are useful because they make creative activity actionable, repeatable, and teachable. However, they often operate as discrete tools/ techniques rather than as broader frameworks for studying embodied, relational, and improvisational creativity.

3.44 Participatory Design and Social Innovation Contexts

In participatory settings, creativity is rarely only about producing a novel object. It is often about making situated knowledge visible, building trust, negotiating power, and translating lived experience into shared forms that can be acted upon. RePlay contributes to this tradition by giving participants a playful but structured way to externalize experience through movement, props, diagrams, stories, maps, and embodied scenarios.

The sandbox metaphor is useful here because participatory design often requires a space in which people can explore possibilities before they are formalized into plans, products, services, or institutional decisions. In Global Studio, for example, children's local knowledge could be translated into maps, walkthroughs, photographs, and later architectural proposals. In the Bendables work, children's ideas could move through drawings, circuits, materials, 3D-printed prototypes, and reflective prompts. These examples are discussed in detail later in the thesis, but the conceptual point belongs here: RePlay creates a temporary ecology where local knowledge and creative possibility can be safely tried out.

As such these theoretical foundations find practical application in contemporary participatory design and social innovation work. Presently, as society undergoes transition from industrial paradigms, playful activity has evolved beyond childhood domain, with industry recognizing economic benefits of playfulness in innovation processes. This encompasses experimentation and exploration addressing major contemporary challenges including environmental sustainability, overpopulation, pandemics, and our evolution in harmony with our planet.

Co-creation, co design, participatory approaches, and various design practices have gained social importance as society moves towards not only designing infrastructure but also by developing systems which adapt, evolve and are self-sustaining without causing further capitalization on resources that are either dwindling or harming the planet.

Drawing from ethnomethodology and situated action theory, Mark Rouncefield's work (e.g., Crabtree, Rouncefield, & Tolmie, 2012) critiques the abstraction of cognitive models that ignore the practical reasoning and tacit knowledge embedded in everyday interaction. His contributions to CSCW offer methodological insights for studying improvisational collaboration in real-world

settings, which supports this thesis's move toward embodied, relational, and performative approaches to creativity.

In with Forward a social innovation consultancy in Vancouver, Canada defines their approach as informed by anthropology, sociology, and psychology. As a consultancy their approach is phenomenological in that they seek to understand what people think, feel, say, and do in the places that they live and work. Their approach to doing this type of work is ethnographic fieldwork. They collect qualitative data and engage in an iterative design process. Utilizing the lens of service design allows them to create systems and interactions which are geared towards serving a specific community.

Some design research methods which they use are storyboards, mock-ups, journey maps, wireframes, experience prototyping, and beta testing. They also engage in community outreach and the study of real-life contexts. By utilizing a strategy of transformative leadership, they are not only challenging assumptions but opening themselves up to un-learning and relearning about a specific community or context.

Industrial tools and methods like RePlay that facilitate creative processes hold relevance in these contexts, where developing products and services efficiently while preserving creative process knowledge becomes crucial. Design's inherently interdisciplinary nature, intertwined with industry, has generated substantial energy and funding investment in creativity method development for approaching design tasks, since developing products and services in a timely manner while at the same time not risking a loss of knowledge generated during creative process is of great importance.

Tools of the trade, such as moods boards, sketching and personas as well as many other tools as mentioned by the social innovation design consultancy In with Forward have been devised to assist the workflow of a design team; a team that at times consists not only of designers but stakeholders from various disciplines such as technology, business and engineering. Many of these methods have evolved out of related human focused disciplines such as sociology or psychology and then been developed and repurposed for the purpose of design research. One such example is the use of cultural probes which has been commonly used in sociology and anthropology (Gaver, 1999). Similarly, eye tracking methods originating in psychology are used as part of usability research (Schrammel, 2009). A number of these methods can be taught, learned or experienced as the designer becomes more conscious and or aware of their design process.

3.6 The Use of Design Methods for Reflection

The "Re" in RePlay is therefore not decorative. It signals that reflection is built into the framework. RePlay asks participants not only to act, but to return to what has happened: to notice offers,

blocks, status shifts, assumptions, materials, roles, and moments of flow or breakdown. This reflective return is what distinguishes RePlay from improvisation used only as warm-up, performance, or ideation. The activity becomes researchable because participants and researcher can examine the process after it has been embodied and externalized. As discussed in Section 2.10, reflection, understood through Schön's (1983) distinction between reflection-in-action and reflection-on-action, is central to RePlay; the methods below are considered in that light.

It has been argued that explicit reflection on one's actions leads to a higher level of design (Schön, 1983), echoing the importance of metacognitive skills in general (Flavell, 1979). Collaboration necessarily involves some form of external representation of ideas, concepts, and thoughts so that they can be communicated within a team (Ramduny-Ellis, 2010). Likewise, personal reflection, while possible through introspection alone, is often enabled or prompted by external representations or artefacts (Dix, 2008). This focus on external artefacts as an active part of cognition leads naturally to cognitive and philosophical accounts of embodiment (Gibson, 1979; Gallagher, 2007; Gallagher & Zahavi, 2007).

One of the challenges in collaborative design is communicating across disciplines and creating a common language. Creating a space of non-judgment can also be challenging in this context. Sato (1999) used what he called a focus troupe, a facilitated focus group that uses improvisational theatre techniques. In a focus troupe, actors role-play predetermined scenarios around a product in front of an audience; Sato's example is a Palm Pilot. The performance then opens a later conversation about the product or service using De Bono's Six Thinking Hats method, which divides a conversation into parts according to the type of comment a person makes. The scenarios are performed by actors and can draw on different theatre techniques. Sato (1999) contrasts this method with traditional focus groups, arguing that it creates more investment in the final product because participants compare it with their own experiences and contexts of use, and that it supports idea generation within teams better than traditional brainstorming. Simirsan (2013) also used role-play and bodystorming in a recorded workshop format at IDEO and argues that it can be used throughout the design process, from visualization to evaluation and refinement, and finally implementation. She uses the term informance, also used by Burns et al. (1994), to describe communicating designs and ideas to an audience through role-play.

Still to do: Simirsan (2013) needs a full bibliography entry, since there's only a placeholder now. If you want a year on De Bono here, use the original 1985 edition and add it to your bibliography.

3.7 Improvisation in Design Practice

Approaches such as bodystorming, informance, and Embodied Narratives already use improvisation in design (see Sections 2.13 and 2.14). However, improvisation in design has lacked a formal methodology for understanding the process itself. Its techniques have been difficult to repeat and have often been one-off applications in which the focus is on the product or service rather than the method. As a creativity researcher, I found this both challenging and an opportunity. I compared knowledge of theatrical improvisation with its application in design, and related both to existing knowledge about creative process. My aim in developing RePlay was to deepen methodologically what is known about collaborative creative process and to create a shared language for the use of Impro in collaborative design. RePlay does this by formalizing improvisational principles within a broader creative sandbox: a structure that includes facilitation, reflection, externalization, documentation, and adaptation to context.

RePlay is related to Embodied Narratives, but it is not identical to it. Embodied Narratives uses performance to elicit lived experience and perception, especially from children (Giaccardi et al., 2012). RePlay also values embodied perception, but its focus is broader: it uses improvisational games to support collaborative creativity, systems thinking, externalization, and reflection across design contexts. This distinction is important because RePlay is not only a technique for eliciting stories. It is a sandbox for exploring how creative process emerges through bodies, relations, materials, and shared attention.

3.8 The Sandbox as a Creative and Methodological Space

What links Newby's compositional framework, Coltrane and Alexander's use of jazz and physics, Pat Kane's third space, Froebel's kindergarten, maker spaces, participatory design spaces, and RePlay workshops is not their discipline but their structure. Each creates a protected but generative space in which rules, constraints, play, and experimentation allow new forms of thinking to emerge. The table below illustrates some of the benefits of RePlay as a creative Sandbox.

Table 3.2
RePlay as a Creative Sandbox: Core Conditions and Methodological Functions

Sandbox condition	What it does in RePlay	Why it matters?
Bounded openness	Creates a temporary space with rules, time, roles, and facilitation, while leaving outcomes open.	Allows emergence without becoming chaotic or over-prescribed.
Permission to play	Suspends premature judgment and allows exaggeration, humour, metaphor, failed attempts, and unusual combinations.	Supports risk-taking and makes tacit possibilities easier to surface.
Embodied action	Moves participants from discussion into gesture, movement, role, tableau, mapping, and spatial arrangement.	Makes creative process visible through bodies and relations, not only words.
Externalization	Turns inner assumptions and group dynamics into scenes, diagrams, artefacts, props, traces, and maps.	Produces material, visual, verbal, and embodied data for reflection and analysis.
Relational attunement	Requires participants to respond to offers, timing, cues, energy, and shared attention.	Creates conditions for group flow, co-presence, and Creativity in Action.
Reflective return	Builds in moments where participants and researcher can replay, discuss, notice, and interpret what happened.	Connects play to learning, analysis, and methodological rigor.

The use of a framework or an analogy to understand a difficult question is not new. My aim with RePlay, however, was to develop a framework for understanding collaborative, situated creative process, rather than another tool for generating ideas.

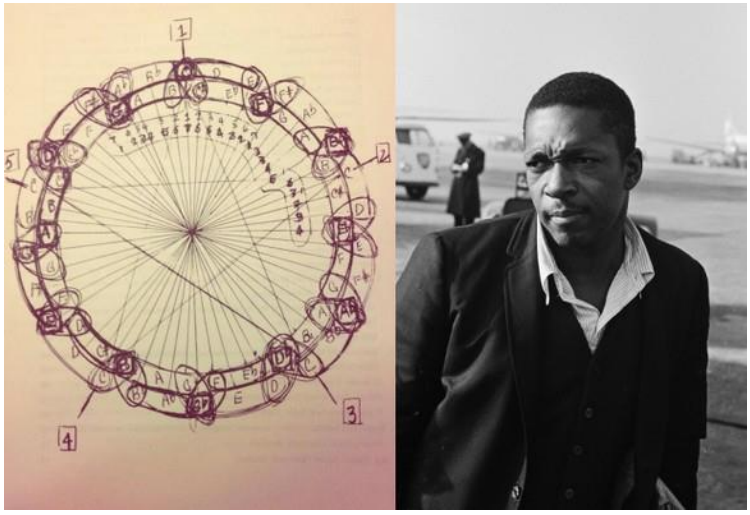
Kenneth Newby's practice, discussed in Section 2.2, helped me think through this distinction. Drawing on his knowledge of composition, he sets parameters for the Flicker Generative Orchestra and then works with what the system produces. His framework gives him a way to explore possibilities and reflect on the results. My purpose with RePlay is different: I use my knowledge of Impro and design research to create conditions in which collaborative creativity can be enacted, observed, and reflected upon. The question is not only what participants produce, but how they respond to one another and develop a shared direction.

Pat Kane's account of a "third space" offers another way to understand why such conditions matter. He describes a shared space in which people can play and exercise agency beyond the demands of everyday work (Kane, 2011, pp. 112–113).

I found that during my case studies as well as in other iterations of RePlay a persistent state of flow is a characteristic of improvisational creativity. As a listener, I felt I had the subjective experience of witnessing *flow*.

> *I began to see that players need to create their shared playgrounds to confirm themselves, just as much as workers use the shop floor to recognize their mutual power. Workers fought to wrest control of their bodies away from the routine of the factory system. Players, on the other hand need a new space- as the PlayStation 2 ads would have a "third space"- in order to exert control over their minds again, to build up spiritual strength and mental autonomy (2011, pp 112-113)*

Figure 3.4
John Coltrane's Diagram of the Mathematics of Music



Note. Drawing by John Coltrane (1967), published in Y. Lateef, *Repository of Scales and Melodic Patterns*. From "John Coltrane Draws a Picture Illustrating the Mathematics of Music," by J. Jones, *Open Culture* (https://www.openculture.com/2024/12/john-coltrane-draws-a-picture-illustrating-the-mathematics-of-music.html).

RePlay, at its most fundamental level, is a sandbox, a protected space in which ideas can be explored, tested, and discarded without the consequences that attend real-world decisions. The concept of the sandbox as a creative space is not new, but it is undertheorized in the creativity literature, and I believe it deserves recognition as an essential condition for creative emergence rather than a luxury or an afterthought.

Kotler and Wheal (2017) argue that, just as society needs spaces for home and work, it also needs spaces for informal play. They describe the Burning Man festival as a large-scale sandbox: a temporary community where ideas are dreamt up, tested, and shared collectively, and where participants frequently report lasting transformative effects (pp. 160–161). Larry Page has

described it in similar terms, as a place to try out new things and see their effect on society without deploying them to the whole world (Kotler & Wheal, 2017, p. 161).

RePlay, although on a considerably smaller scale, offers something structurally similar: a highly accessible space for exploration and creative risk-taking in which judgment is withheld, and the focus is on experimentatw1ion rather than evaluation. The sandbox does not need to be physical, it can be virtual or conceptual, just as in the work of composer and technologist Kenneth Newby, or jazz musician Stephon Alexander, who uses the analogy of jazz improvisation to test and extend his theories around quantum physics. What these sandboxes share with RePlay is their quality of protected openness: a space in which the normal rules of consequence are suspended, and the creative mind is free to wander.

Froebel (2012) opened the first kindergarten in 1837 as precisely this kind of space, a place where children would blossom like flowers, given paints, clay, and tactile materials he called play gifts, so that they could externalize concepts rather than have facts imprinted on their brains. Yet as adults, this desire for a sandbox largely goes unfulfilled. The popularity of coworking spaces or even a Starbucks suggests that adults crave something between the obligations of work and the privacy of home: a space that is neither fully purposive nor fully leisure. Starbucks offers refuge without risk, comfort without creative challenge.

Jean Piaget regarded child's play as natural and necessary but nonetheless a primitive stage of development which adults put behind them (Mooney, 2013, p. 44). Yet we have undergone a significant sociological shift from the industrial age in which playful activity was considered the province of children towards a recognition that playfulness is central to innovation. Pat Kane (2011) describes this cultural turn as a move away from a clockwork Newtonian model of the universe toward an understanding that our reality is creative, dynamic, and far less fixed than we once assumed. Kane argues that societies' justification for playful activity has made it acceptable to cross the boundary between work and play, exploring how the two might merge into what he calls the play ethic. He calls for spaces where one can engage in playful discovery without consequence, spaces he describes as a deep resource for understanding the nature of reality (Kane, 2011).

The etymology of play is suggestive here. One of the Latin roots of play is plevium, meaning to pledge; an earlier derivation from the Indo-European root dlegh suggests indulgence, to indulge. Play, at its root, involves a kind of commitment, a pledging of oneself to the activity, alongside a permission to indulge, to move beyond the constraints of the merely practical. This dual quality is exactly what RePlay is designed to cultivate: a committed, structured engagement with the creative process that nevertheless remains genuinely open and indulgent of possibility.

Maker spaces, creative retreats, co-working spaces, fix-it cafes, DIY culture all these alternative spaces share a quality of openness in which communities are allowed to share, experiment, and

fail without the fear of judgment or the weight of real-world consequence. I believe that part of the project of creativity research, and of fostering creative moments in design practice, necessarily involves attending to these spaces. RePlay creates a temporary version of this kind of space wherever it is conducted, on a remote Scottish island, in a community park in Bhopal, in a maker workshop in Ottawa. The sandbox is not a building; it is a set of conditions. And creating those conditions, through facilitation, through the right constraints, through the communitas and lability that RePlay cultivates, is itself a creative and methodological act.

The sandbox concept also connects directly to the autopoietic understanding of creativity. An autopoietic system requires the right environmental conditions to sustain itself. It cannot be forced into existence from outside but must be allowed to emerge from within a supportive relational ecology. The sandbox is that ecology: the structured yet open environment in which the self-organizing, self-renewing dynamics of creative process can operate freely. In this sense, the sandbox is not merely one of the four themes of RePlay it is the condition that makes the other three possible. Without a sandbox, there is no safe space for a creative mindset to develop, no protected environment for reflection to deepen, and no relational field in which Creativity in Action can emerge collectively. The sandbox should be understood as an active condition, not merely a metaphor. It is the relational environment that allows creativity to become self-organizing. Participants are not simply placed inside a neutral room; they are invited into a set of relations, constraints, permissions, objects, roles, and reflective practices. In this sense, RePlay stages the conditions for creative emergence without determining the outcome in advance.

3.9 RePlay: Origins and Core Principles

RePlay grew from the recognition that improvisational theatre already contains a sophisticated practical theory of creativity: accepting offers, building on what is given, attending to status, responding in the moment, staying present, and treating failure as part of process. RePlay translates these principles into design research without turning them into rigid rules.

Some of the core principles of RePlay are reflection, play, embodied action, externalization, facilitation, a safe space for experimentation, responsiveness, and iterative return.

The framework is therefore deliberately low threshold. Participants do not need to be trained performers. The point is not theatrical excellence, but the creation of conditions in which participants can become “players”: people willing to test, respond, elaborate, shift perspective, and notice what happens in the process. This player orientation is essential to the sandbox, because it changes the participant’s relation to uncertainty.

RePlay is inspired by embodiment thinking, which I already mentioned in previous chapters. (Husserl 1952), (Heidegger, 1927/1962), (Merleau-Ponty, 1945), (Gibson 1979), (Magnusson

2009), (Noe, 2004) (Varela, Thompson, and Rosch, 1991). I utilize an analogical creative approach upon reflection, inspired by Impro theatre (Johnstone) (Spolin 1999) (Cremer, 2009) to develop RePlay.

Previously in Chapter 1-2 I discussed embodiment literature and the role of the body in perception. After firsthand experiences of participating in Impro workshops as part my research process, I decided to adapt some of the games and theories of Impro for conducting my own design research and developed several hybrid games that could be conducted during a RePlay session. Via case studies, I explored the richness of the body as part of the design process and developed the RePlay framework iteratively and collaboratively to collect data regarding the phenomena I was observing and relating this to what I learned about creative process. At the time of conducting a literature review for this topic, as already mentioned, design researchers had utilized Impro as part of design process to develop products or services with great success. (Simsarian 2003), (Salvador, and Howells 1998), (Sato and Salvador 1999), (Gerber 2007a), (Gerber 2007b), (Ehn and Sjögren 1991), (Brandt, E., and Grunnet 2000), (Burns, C., Dishman, E., Verplank, W., Lassiter, B, 1994), (Caroll, and Tobin, D 2003). However, from what I came across during my literature review current research had not made explicit what it was about using Impro which made the outcomes successful. I felt RePlay might be a way of encapsulating some of these games within a framework which could be used at various points during the design process as well as a tool for conducting creativity research regarding collaborative design process. RePlay facilitates participants to reflect on their design process, the choices they have made, as well as where they might struggle in their own design practice and explore alternative strategies and solutions.

3.10 What happens during a RePlay session

A RePlay session can be understood as a temporary creative ecology. It brings together a facilitator, participants, prompts, objects, constraints, roles, space, time, and reflection. The session does not merely apply games to a pre-existing problem; it reorganizes the conditions under which participants encounter the problem. This is why RePlay can produce insights that may not emerge through discussion alone: participants are invited to think with their bodies, with each other, with objects, and with the unfolding situation.

3.10.1 Game of the Scene

The “game of the scene” is a concept borrowed from Impro theatre and occurs when players identify key attributes that allow a story to unfold such as character traits or interpersonal conflicts. The game of the scene provides creative constraints that frame the action and shape how players relate to one another. Once identified, the challenge is to endow the other player without resolving the conflict, since tension drives the narrative. In design, this approach can be used to explore constraints or requirements of a product or service, or to identify factors shaping user experience.

Impro facilitators sometimes call out the game of the scene explicitly to focus attention and ensure players accept what has been offered.

3.10.2 Endowment

Endowment is the process by which one player attributes characteristics to another such as a name, age, mood, or activity. This creates perceptual shifts and conceptual reframing within the action. In design, endowment can be useful for exploring potential features of an interface or for envisioning different types of users. Impro terms this process "the offer," which suggests new directions for participants to pursue.

3.10.3 Status

Status refers to the social hierarchy of characters within a scene. For example, a maid might be considered low status, whereas a boss represents high status. In design, exploring status dynamics can be a useful way of understanding the needs and concerns of different community members and surfacing hidden power relations.

3.10.4 Raising the Stakes

Raising the stakes is a technique used to heighten drama and move a story forward. For instance, a character might lose their car keys just as they are about to drive away. In design, raising the stakes can be used to test scenarios under increased pressure and to explore how systems or services respond to critical conditions.

3.10.5 Yes, and...

Like raising the stakes, *yes, and…* drives the narrative, but it is particularly central to dialogue between players. It emphasizes acceptance, co-construction, and forward momentum.

3.11 RePlay Games

The RePlay games described below should t be understood as both creative exercises and data-generating techniques. They were designed to elicit movement, dialogue, improvisation, reflection, role-taking, material engagement, and group responsiveness. They generated embodied, visual, verbal, spatial, and affective data that could be interpreted in relation to creativity, flow, blocking, externalizations, suggestibility, and collaborative design process.

As a creativity research framework, RePlay has a function to document qualitatively externalization in the design process by recording video, questionnaires, collecting traces and conducting reflective as well as contextual interviewing about the experience. Some RePlay scenes are video-recorded and then discussed in terms of what the participants felt was effective, the thought process behind their offers, and what they felt was and wasn't working in the scenes. For

example, a team might via discussion draw analogies between what was happening in a RePlay and how this relates to working within their team or the development of their product or service.

The results of each case study were new combinations of Impro/Design games such as design machines, tangible heroes, design mapping, and others. As creativity research framework it documents qualitatively externalization in the design process and generates knowledge about these activities. Below are descriptions of the games which are played during a RePlay as well as how they might assist a design activity.

3.11.1 Tell Me More

In Tell Me More, the facilitator prompts the participant to literally tell she/he more. In certain contexts, this technique can be utilized to gather information about the specific needs or technical requirements of a product or service. This game is based upon a traditional Improv game called advance and expand. I utilized this technique during some of the exploratory workshops as well as the Tiree Tech Wave. During a RePlay "Tell me more" is applied with the intention of conducting participatory design to find out more about users and or the environment in which a product or service might be used. The facilitator will periodically say tell me more about you… or tell me more about where you are. In this case the players need to expand upon details regarding the location or the product or service the user might be embodying.

Figure 3.5
RePlay Game: Tell Me More



Note. Made by the author using ChatGPT.

3.11.2 Playback

Play back occurs when you re-enact a RePlay scene and then slow it down either to create a moment for reflection or perhaps add new information to the scenario. I explored this technique during a workshop I conducted at Tudor Innovation Labs and during the Tiree Tech Wave. In this scene players can replace each other's actions. The focus could be on object work or building various use cases. This game can also be used to get a better grip spatially or contextually on the object or service which is being designed to encourage reflection and awareness.

Figure 3.6
RePlay Game: Playback



Note. Made by the author using ChatGPT.

3.11.3 Embodied Design Mapping

Design Mapping functions as a visual and spatial method for externalizing participants' understanding of creative and design processes. Rather than relying only on verbal interviews, Design Mapping invites participants to arrange elements of a process, identify relationships between them, and reflect on how changes to the map affected the overall system. In this sense, it functioned both as a participatory design method and as a qualitative research technique. In the Philips/TU Eindhoven exploratory work, Design Mapping also functioned as a form of breaching experiment, drawing on Garfinkel's ethnomethodological approach (Garfinkel, 1966). By progressively removing or altering parts of a mapped design process and asking participants to respond, the method disrupted taken-for-granted assumptions about what belonged in the process. This created a moment of reflective estrangement and made implicit structures, dependencies, and values more visible.

Design mapping can be used in several ways. In some cases, for example during the Tiree Tech Wave and at The TEI workshop, we used design mapping as way to physicalize one's creative process. The participants moved around the room embodying feelings, sounds, and movement that expressed how they felt as well as the various activities they did at different phases in their creative process. They then created tableaus as way to discuss with one another their process. They were asked to reflect upon which phases they found more challenging. During one RePlay session at the Tiree Tech Wave, we used design mapping to create a full body data diagram of a digital

library that playfully involved all the players (design team) in illustrating the backend tech stack as a data diagram of this service.

During the global studio case study, design mapping was used both to create body maps to reimagine the location as well as a resource for the children to later create their own '*design mapping*' *drawings*.

Figure 3.7
RePlay Game: Design Mapping



Note. Made by the author using ChatGPT.

3.11.4 Design Tableaus

In this exercise one player assumes the role of a narrator and his/her task is to describe the product that is being illustrated via a design tableau. This might be done in the form of a sales pitch, an eye in the sky, or as a product manager. Design Tableaus can also be used to discuss design choices as well as interpretations of the narrator's description. The players creating the tableau are mostly static however there may be a sound or movement which accompanies their position. Depending on what the narrator describes they might change positions to make the tableau more faithful to the narrator. If the players/facilitator feel inclined, the tableaus may later break into short scenes. During the Bendables case study this game was used to explore bend interaction as a design affordance as well as for the children to experientially understand the concept of cause and effect as part of interaction design. For example, I bend this lever, and it

triggers this sound, vibration or LED to light up. The children used this game to explore the concept of bend interaction, by collectively building tableaus of an imagined prototype which later became a design machine.

Figure 3.8
RePlay Game: Design Tableaus

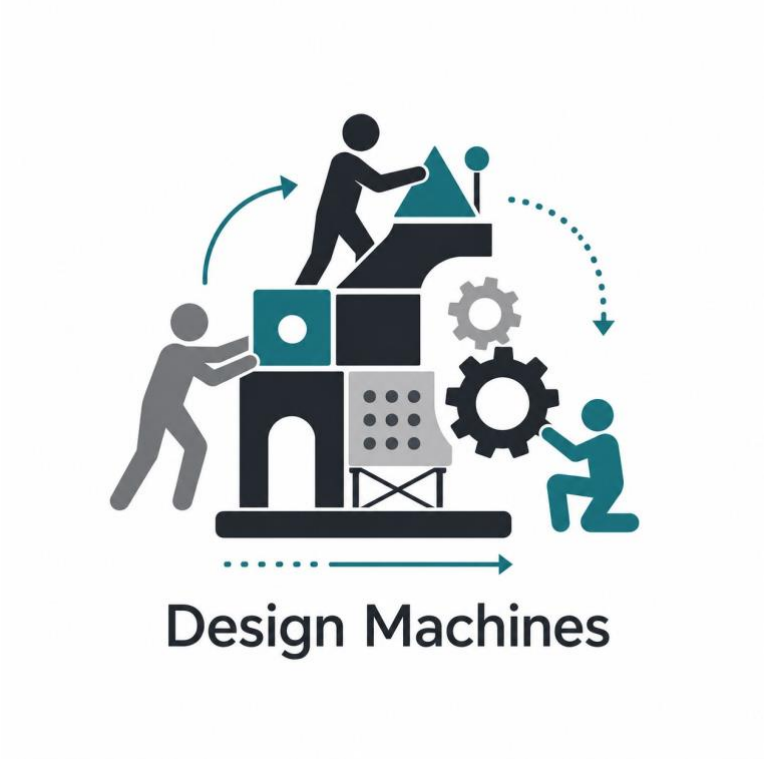


Note. Made by the author using ChatGPT.

3.11.5 Design Machines

Design Machines were especially important because they transformed systems, processes, or interaction flows into embodied group compositions. Participants used their bodies, voices, gestures, timing, and spatial relations to model how a product, service, interface, or system might work. Methodologically, this made relational dynamics visible: who initiated, who followed, how timing was coordinated, where breakdowns occurred, and how participants negotiated collective action.

Figure 3.9
RePlay Design Mapping Game



Note. Made by the author using ChatGPT.

I used design Machines in conjunction with Design tableaus, however, the difference in this case is the design machine included some type of movement or sound. In this game the players use their entire bodies to illustrate an object or service. One part of the body must be touching another player, and each player also must be paying attention to the other players' offer as part of the design machine. It's best when there is also minimal discussion amongst the players. Noises and movement can be incorporated and are encouraged.

3.11.6 Tangible Heroes

This game was explored at the Tudor innovation labs workshop and during the Tiree Tech wave case study whereby the participants used their tool, service or product to 'save the day'. In this game a basic interaction is given. This might center around a particular device or technology such as mobiles, RFIDs, sensors, or tracking technology or the use of a 'trigger object' (discussed in following section). On the "stage" the players then create a scene whereby there is a crisis. The player who is off stage enters the scene utilizing their service or object to "save the day". During the exploratory phase of this research, I also experimented with this concept as a game with the improvisers at Lancaster. It was during this study that I first began to develop the use of 'trigger objects' as part of design process. 'Trigger Objects' is discussed in the next section as one of the other techniques I developed for data collection.

Figure 3.10
RePlay Game: Tangible Heroes



Note. Made by the author using ChatGPT.

Table 3.3
RePlay Games, Techniques and Sandbox Functions

RePlay element	Game /Technique	Sandbox function	What becomes visible
Tell Me More	Game	Extends offers, slows down assumptions, and encourages participants to elaborate ideas before they are judged.	Emergent narratives, hidden assumptions, tacit meanings, and associative thinking.
Playback	Game	Allows participants to replay, mirror, or reinterpret what has just occurred.	Process awareness, reflection-in-action, blocking, acceptance, and shifts in interpretation.
Design Tableaus	Game	Uses still images or embodied arrangements to represent relations, tensions, roles, or possible futures.	Spatial relationships, status, affect, embodied understanding, and group sense-making.
Design Machines	Game	Asks participants to embody components of a system or process as if collectively forming a machine.	Systems thinking, interdependence, timing, feedback, flow, and breakdown points.
Tangible Heroes	Game	Uses character, role, or metaphor to explore needs, agency, constraints, or values around a design situation.	Empathy, perspective-taking, narrative framing, and values embedded in design choices.

RePlay element	Game /Technique	Sandbox function	What becomes visible
Trigger Objects	Technique	Introduces props or open-ended material prompts that catalyze interpretation and embodied making.	Affective responses, metaphor, affordances, interaction possibilities, and material thinking.
Traces	Technique	Captures residue of process through notes, photos, drawings, artefacts, maps, postcards, or participant outputs.	Ephemeral process, patterns over time, situated observation, and reflective interpretation.
Design Flow Diagrams	Technique	Represents the sequence, rhythm, and relation of activities within a design process.	Process structure, bottlenecks, collaboration patterns, movement, and decision points.
Embodied/ Design Mapping	Game / technique	Externalizes relationships among actors, objects, places, actions, and design possibilities.	Systems relations, spatial knowledge, assumptions, community needs, and points of intervention.

3.11.7 Summary of Games and Research Design

RePlay was developed to fulfill the research requirements for this project alongside the requirements and needs for each community I worked with. All the communities I worked with during my case studies required a low barrier framework for conducting collaborative creativity. RePlay was initially developed to observe in situ collaborative design process amongst mixed design teams with the goal of encouraging reflective practices within the creative process. Informed by theories around enactive perception and learning via bodily movement as part of design process it was utilized to collect first person data. I then utilized this qualitative data to compare insights gathered via utilizing and developing the framework as part of co-design, action research, and participatory design process. The process provided a cross- disciplinary understanding of the benefits of conducting RePlay as part of design process.

The context in which a RePlay is done is dependent on the needs and the requirements of the community and stakeholders however the workshop structure is generally the same. In phase 2 of this research project, 3 case studies were conducted as I have already mentioned. The first was part of a research/artistic residency called the Tiree Tech Wave on the Isle of Tiree in Scotland, which was geared towards academics and artists interested in making practices for the purpose of research creation. The second case study was conducted as part of an event called global studio which was attended by policy makers, novice and experienced architects, and urban planners in the field of inclusive urban planning in Bhopal, India. Participants for this workshop were architects as well as children in the Kabadkhana housing community. The third and final case study was conducted as part of an industrial collaboration with the company Maker Junior and Carleton University in Ottawa Canada. Participants in this case study were once more children however in

this context RePlay was a compliment for participants engaged in maker inspired learning which I curated to explore bend interaction.

For each of the case studies there was one facilitator and at least four participants. As part of each case study, I was grateful to also have a small research team either collecting data or supporting the facilitation of RePlay. Before each workshop there was a debriefing with the key stakeholders to get a sense of their unique needs and requirements.

In the second and third case study a participatory or co-designing strategy was applied and therefore before beginning the study stake holders in the community were identified as well as potential participants. The lead researcher and design team took time before conducting a RePlay, to inform themselves regarding the community, processes, materials and goals of conducting a RePlay via in depth research regarding existing policies and the issues of that community. In the second case study with Global Studio, I was part of a huge consortium of participants which meant having the unique privilege of other researchers who were dedicated to researching the issues, politics and social realities of that community. We also identified some key stake holders such as the principal of the school and interviewed her about some of the concerns and issues within this specific community.

My industrial collaboration with Maker Junior and Carleton University was more specific in that we were also stakeholders for the project, so it required a product design approach which eventually also included a business proposal. However, there was still a great deal of material research, research into organic user interfaces, early childhood development, maker culture and market research which was done as part of the research planning as well as working with the community partner to gain a better understanding of their goals. Before a RePlay session and after conducting some planning and understanding regarding the requirements of a specific community a set of specific games were selected by the facilitator to either be conducted or developed further and explored as part of a RePlay session.

A workshop begins with a series of traditional Impro warm up exercises. These quick Impro icebreakers are introduced to bring to the forefront trust, awareness, and physicality. Examples of such games are clapping exercises, pointing exercises, and mirroring exercises as well as others which bring attention to what is happening in the room and focusing one's attention.

Depending on the group dynamic the activity then moves into more tailored RePlay games which are inspired by Impro Theatre yet have been tweaked to fit a design research context and the questions or concerns of the group. At this stage RePlay games included design machines, tangible heroes, design mapping, as well as others. In the next section of this chapter, I will describe in more details some of the games as well as how they benefited the design process.

In some contexts, as was the case in the first and third case study there was an emphasis on encouraging and developing reflection as part of design process. After conducting RePlay there was an opportunity for the design team to reflect on the process and either highlight ideas, experiences or ways in which RePlay could be improved.

Unlike traditional improvisation, RePlay incorporates design thinking strategies and facilitates players in using their bodies to conceptualize a product or service.

These games encourage players to engage physically with a creative problem solving rather than relying only on sketching or discussion; as discussed in Section 2.7.2, the body becomes a tool for understanding the context, the user, and the choices available in a problem space.3.12 RePlay as a Framework, Not Just a Method

The games and techniques listed above should therefore be read as components of the sandbox, not as the whole of RePlay. Tell Me More, Playback, Design Tableaus, Design Machines, Tangible Heroes, Trigger Objects, Traces, Design Flow Diagrams, and mapping-based exercises are flexible structures through which the larger framework is enacted. They are not meant to be used mechanically. Their value depends on facilitation, context, participant readiness, and reflective interpretation.This also prevents a common misunderstanding: RePlay is not simply "Improv for design."

> **RePlay is a framework for organizing embodied improvisational activity so that creative process can be supported, slowed down, made visible, and reflected upon. When used in research, it becomes a methodology; when used in practice, it becomes a design and facilitation framework; when used pedagogically, it becomes a way of training creative responsiveness**

The design firm IDEO is often quoted as making statements such as "stay focused, one conversation at a time, use space, be visual, be physical "all of which suggest giving value to an external approach to creativity. Commonly, creativity methods or tools are used to assist the creative process such as the De Bono Six Thinking Hats method I have mentioned already. Yet I would like to make a distinction regarding method and framework in that I view a framework as being holistic and providing an approach which is not reduced to a structured set of rules. Rather than being prescriptive, a framework encourages taking a different perspective of the problem space.

For example, Hornecker's framework named "Tangible Interaction" explores embodiment and its relationship to the design of tangible interfaces. Inspired by the work of other tangible interface researchers such as Hiroshi Ishii, Hornecker created a framework called "The Tangible Interaction Framework" that focuses on the materiality, bodily aspects, the physical representation of data, and how tangibles are embedded or might augment a physical space. The tangible interaction

framework brings together concepts from architecture, product design, interactive art, and human computer interaction. Utilizing the framework, Hornecker's research led to the creation of a set of cards to be used as part of a design process called the Tangible Interaction Card Game, utilized as part of early brainstorming (Hornecker, 2006, 2010). Instead of being prescriptive, Hornecker's cards hint at different ways of perceiving a problem space through gestalt thinking

The potential of RePlay as a methodology became clear once I realized that the outcome of this work was not only the development of a framework, but also the creation of a vehicle for studying flow among diverse teams engaged in innovation. This recognition emerged from an initial period of exploratory research, a review of relevant literature, and practice-based experimentation. Although my early motivation was driven by intuition, the research became more concrete through formal case studies such as Tiree Tech Wave, Global Studio, and the Bendables project. These experiences demonstrated that RePlay was not only a method but also a methodology for studying creative processes among mixed design teams. In the following chapter I will discuss in more detail how RePlay functions as a methodology, situating it in relation to existing literature and research approaches, and presenting findings from both exploratory and case-based studies.

3.13 RePlay, Externalization, and Embodied Reflection

Externalization is one of the main ways the sandbox becomes analytically useful. In ordinary conversation, many aspects of creative process remain tacit: an assumption, a hesitation, a sense of hierarchy, an emotional response, a bodily orientation, or a half-formed idea. RePlay asks participants to put these into the world as movement, gesture, scene, object, diagram, trace, map, or tableau. Once externalized, the process can be seen, discussed, remembered, compared, and interpreted.

This is also why props and objects matter. They are not simply accessories. Trigger objects, drawings, maps, prototypes, circuits, postcards, and other artefacts help participants move between feeling, thinking, making, and reflecting, and they catalyze a shift from abstract explanation to situated action. In this sense, objects participate in the sandbox as emotional and material supports for creative process (Dix & Gongora, 2011).

Technologically assisted creativity can extend this, because such systems use media and materials as an extension of our physical interaction with the world. Embodiment theory and enactive perception suggest that developing useful and contextually appropriate outcomes requires externalization within the context of use as part of the creation process. This is particularly relevant in social innovation, where the aim is to understand a community’s needs and context of use. If perception is embodied, frameworks such as RePlay become important

because they allow a team to explore different contexts and perspectives in the wild, with the various stakeholders in a community.

Delete everything else that was in 3.13. That's the Schön/Flavell paragraph, the Sato and Simirsan paragraphs (now in 3.6), and the "In some contexts, as was the case in the first and third case study…" paragraph (in 3.11.7). Then check that your bibliography has the Dix and Gongora (2011) entry.

3.14 The Role of a Facilitator

Facilitation is the mechanism that holds the sandbox open without allowing it to collapse into either chaos or over-control. The facilitator manages pacing, safety, permission, status, and the transition between play and reflection. This role is especially important because improvisational work can expose uncertainty, vulnerability, humor, awkwardness, and group dynamics. The facilitator does not direct the creative outcome but shapes the conditions under which participants can take creative risks.

During a RePlay, the facilitator pays particular attention to the process which is unfolding and some of the current theories discussed in Impro. Observations made by experienced improvisers during an Impro are given particular emphasis such as production blocking, game of the scene, and endowment described in the literature review of this thesis and how they are useful techniques that can be transposed to assist the design process. The goal of the facilitator is to understand RePlay as a creativity method that can be used when needed to effectively run an improvisation session geared towards idea generation and reflection. The facilitator uses RePlay to guide and evaluate when a team's affinity is either too high or too low and utilize simple techniques to adjust team dynamics. Most importantly the facilitator helps the team to integrate basic service design techniques into their design process to account for context of use and multiple perspectives.

3.15 Benefits of RePlay Summary

The benefits of RePlay can be described at three levels. Practically, it helps groups generate ideas, communicate, prototype, and explore contexts. It can make tacit aspects of a user's workflow explicit, help a facilitator notice when a team's affinity is too high or too low and adjust the group dynamics, and bring service design techniques into the process so that the context of use and multiple users are considered, rather than a single user operating a product. Methodologically, it helps researchers observe and document collaborative creativity through embodied, visual, verbal, and material data, including video, traces, questionnaires, and reflective interviews (see Section 3.11). Theoretically, it supports the thesis claim that creativity

is not only an individual cognitive capacity but an emergent relational process that can be cultivated through structured conditions of play, reflection, and co-presence.

3.16 RePlay as a Sandbox for Creative Risk and Experimentation

The important point is not that RePlay removes risk altogether. Rather, it changes the quality of risk. In ordinary design meetings, participants may hesitate because ideas can be judged too early, because status differences are present, or because a proposed direction may appear impractical before it has been explored. RePlay relocates risk into a temporary space of play. In that space, participants can test possibilities through action, exaggeration, role, movement, and metaphor before the ideas are translated back into more conventional design language.

This also explains why RePlay can support flow. The sandbox provides clear goals, immediate feedback, a balance of challenge and skill, reduced self-consciousness, and intrinsic engagement, all conditions associated with flow (Csikszentmihalyi, 1990). This chapter does not fully theorize flow; that work is taken up in Chapter 6. Here, the key point is that RePlay creates a safe and structured ecology in which flow-like collaborative states become more likely and more observable.

As discussed in Section 3.8, the sandbox is a set of conditions rather than a place, and creating those conditions through facilitation, appropriate constraints, and the communitas and lability that RePlay cultivates is itself a creative and methodological act. Its significance here lies in how RePlay changes the experience of creative risk: participants can act on uncertain ideas together, notice what emerges, and reflect on that process before deciding what to carry into design practice.

3.17 Chapter Summary

In this chapter, I introduced RePlay as a creative sandbox, a framework, and a methodology. RePlay adapts techniques from Impro theatre to facilitate group creativity, cultivate embodied reflection, and provide a low-threshold entry point for diverse teams. It functions both as a training tool for collaborative creativity and as a method for researching creative processes. The chapter situated RePlay within broader debates in creativity research, building on pragmatic creativity methods, participatory design, improvisation, reflection, externalization, and embodied design practice, while extending these traditions into a framework for studying collaborative creativity. In doing so, it positioned RePlay as a contribution that connects

improvisation, flow, and design research, with implications for current research on human AI creative collaboration.

RePlay's role as a methodology emerged over time. Although my early motivation was largely intuitive, exploratory research, a review of the literature, and practice-based experimentation showed that RePlay was not only a framework but also a vehicle for studying flow and creative process among diverse teams. The case studies at Tiree Tech Wave, Global Studio, and Bendables made this concrete. Chapter 4 sets out this methodology in detail, Chapter 5 presents the exploratory research through which RePlay was developed, and later chapters present the findings from the case studies.

Chapter 4: Methodology

"…the only way to find a larger vision is to be somewhere in particular."

— Donna Haraway, "Situated Knowledges"

This chapter explains the methodological design of the research and clarifies how RePlay was developed, used, documented, and analyzed as both a design method, framework and eventual research methodology. The chapter focuses on how the research was conducted: the research questions, the overall research design, the two research phases, the methodological traditions that informed the work, the role of RePlay, the data collection methods, the interpretive approach to analysis, and the ethical and reflexive considerations that shaped the project.

The previous chapters established the conceptual and practical foundations for the study. Chapter 1 situated the project within creativity research and identified the need for approaches capable of studying creativity as embodied, relational, and emergent. Chapter 2 examined improvisation and embodiment as foundations for RePlay, and Chapter 3 developed RePlay as a creative sandbox and framework. This chapter now turns from theory and framework development to research design: how RePlay and related techniques were used to generate knowledge about collaborative creative process. The techniques such as Design Flow diagrams were developed as research instruments, data-generating methods, and analytic supports as part of conducting RePlay to collect data.

The central methodological challenge addressed by this thesis is that collaborative creativity is difficult to study while it is happening. It is often tacit, embodied, affective, improvisational, and distributed across people, tools, materials, spaces, and moments of interaction. A conventional interview or post-hoc reflection can capture some aspects of experience, but it often misses the timing, gesture, responsiveness, externalization, flow, and co-presence through which collaborative creativity unfolds. The methodology therefore had to support creative activity while also making that activity available for observation, reflection, documentation, and analysis.

RePlay was developed in response to this challenge. It began as a way of adapting improvisational theatre techniques for design and participatory contexts, but through the research process it became more than a facilitation tool. It became a framework for staging, observing, and reflecting on Creativity in Action. The methods described in this chapter therefore include RePlay itself, the RePlay games and exercises, and a wider set of supporting techniques such as Trigger Objects, Design Flow Diagrams, Design Mapping, Traces, shadowing, TAPT, Bad Ideas, video reflection, interviews, fieldnotes, and material artefact analysis.

4.1 Research Questions and Methodological Problem

The research questions were framed by the development of RePlay first as a tool and later as a framework and then also methodology for researching collaborative creativity. They are included here because they directly shaped the research design and the choice of methods:

i. Is there a way to create a framework for facilitating the qualities of improvisational creativity that make it useful for design process as well as implementable and transferable?
ii. How does this enrich what we already know about creativity and add to our understanding of collaborative creativity?
iii. Given that a large component of improvisation involves physical externalization of ideas as a form of Creativity in Action, what is it about this embodied approach that distinguishes it from more internal or representational methods such as drawing or writing?

These questions required a methodology that could do three things at once:

i. First, it had to support the development of a repeatable but adaptable framework.
ii. Second, it had to allow collaborative creativity to be observed in situated contexts rather than only described retrospectively.
iii. Third, it had to generate multiple forms of data that could capture embodied, verbal, material, visual, and reflective dimensions of creative process.

For this reason, the research did not treat RePlay only as an object of study. RePlay was also a way of producing the conditions through which the phenomenon under investigation could become visible. The methodology therefore combines exploratory research, action research, participatory design, co-design, research-creation, sensory and reflexive ethnographic approaches, and qualitative analysis of visual, material, verbal, and embodied data.

4.2 Scope and Overall Research Design

This research was qualitative, practice-based, exploratory, action-research-informed, participatory, embodied, and reflexive. It was qualitative because the project sought to understand meanings, processes, experiences, interactions, and situated practices rather than measure creativity as a fixed variable. It was practice-based because the development and use of RePlay was itself part of the research process. It was exploratory because the project involved testing, adapting, and refining new methods for studying collaborative creativity. It was participatory and co-design oriented because several studies involved stakeholders, communities, children, designers, makers, and researchers as active contributors to the design process. It was

embodied and reflexive because the research attended to bodies, movement, gesture, sensory experience, material engagement, and the researcher's role as facilitator and participant-observer.

The thesis presents the research as two analytically distinct phases, although in practice these phases overlapped. Phase 1 involved exploratory research and framework development. During this phase, I investigated improvisational creativity, design practice, embodied research methods, artistic process, and early RePlay techniques. Phase 2 involved applied case studies in which RePlay was used in situated design, participatory, and co-design contexts. This separation helps clarify the structure of the thesis, even though RePlay continued to develop across both phases.

Table 4.1
Research Phases

Research Phase	Purpose	Examples	Primary output
Phase 1: Exploratory Research and Framework Development	To explore improvisational creativity, design practice, embodied methods, and qualitative ways of documenting creative process while developing RePlay.	Impro workshops in Lancaster/Berlin/Brighton; Philips/TU Eindhoven interviews and design mapping; SÍM residency in Iceland; Traces; shadowing; early RePlay experiments; conference/workshop trials.	A developing RePlay framework; early games and techniques; reflective notes; design maps; postcards; process artefacts; publications/presentations.
Phase 2: Applied Case Studies	To apply and examine RePlay in situated design contexts and study how collaborative creativity unfolded across different communities and design problems.	Tiree Tech Wave; Global Studio in Bhopal; Bendables (with Maker Junior and Carleton University).	Workshop documentation; participant reflections; TAPT responses; photographs/video; maps; drawings; prototypes; architectural proposals; case study findings.

This two-phase structure makes it possible to distinguish between the development of RePlay and its later application. The exploratory phase shows how RePlay emerged through transdisciplinary practice, while the applied case studies show how it functioned across different design contexts.

4.3 Research Sites, Studies, and Data Sources

The research involved a constellation of exploratory activities, workshops, collaborations, and applied case studies. Not all of these were formal case studies. Some were developmental sites where RePlay, Traces, Design Mapping, Trigger Objects, and other techniques were tested, refined, or discussed. Others were applied case studies in which RePlay was used to address a specific design or community problem. The table below separates these roles so the reader can see which activities helped develop RePlay and which later tested or applied it in practice.

Table 4.2
Summary of Research Sites, Studies and Data Sources

Setting	Status in	Participants / Sessions	Methods and Activities	Data/Artefacts	Methodology
Lancaster, Berlin, Brighton improvisation communities	Exploratory Action Research	[AUTHOR: participants / sessions]	Improvisation, Workshops Training, Observation, Reflection, and the Adaptation of Theatre Games for design.	Fieldnotes, Reflective Notes, Observations, and Games.	Understanding improvisational practice and translate its qualities into a design research framework.
PhilipsDesignTU Eindhoven	Exploratory study	A small group of designers	Interviews with designers, Design Flow Diagrams, Design Mapping, Breaching-Style Techniques.	Design Maps, Diagrams, Interview notes and Process reflections.	Making tacit assumptions in professional design process visible and testing visual/spatial ways of discussing creative process.
SÍM Residency, Reykjavik	Exploratory Research-creation	[AUTHOR: participants / sessions]	Consent-based Shadowing inspired by Vito Acconci, Observation, Photographs, Notes, and Traces as Postcards	Postcards, Visual traces, Notes, Photographs, Reflective Interpretations.	To test how ephemeral creative process could be translated into shareable research artefacts.
Tiree Tech Wave	Applied case study	Two RePlay sessions; 11 participants, 8 completed TAPT	RePlay workshops, Trigger Objects, TAPT, Observations and Debriefing.	Workshop Artefacts, TAPT, Photographs/Video, Participant Feedback, Researcher Notes	To explore RePlay as a method for supporting and studying creative process in a mixed HCI/innovation setting.
Global Studio, Bhopal	Applied case study	participants / sessions]	Interviews/conversations with principal and community members, Children as community informants, Walkthroughs, Child-led photography/cultural probes, Design Mapping, RePlay Prototyping.	Photographs, Maps, Workshops Documentation Fieldnotes, Design Proposals, and Architectural drawings.	Translate children's and community knowledge into urban/social design proposals for planners.
Bendables (with Maker Junior and Carleton University)	Applied case study	Two workshops; groups of six to ten children aged 7–9	Maker-based Co-Design, Drawings, Art Supplies, Simple circuits, Bendable Materials, 3D printing, TAPT, Video Reflection, RA fieldnotes.	Drawings, Circuits, prototypes, TAPT, RA fieldnotes, Photographs/Video, 3D-printed Artefacts.	Study embodied creativity, flow, tangible interaction, and child-centred co-design through making.
Tudor, Deutsche Telekom, TEI,	Developmental Dissemination		Workshops, Talks, Presentations, Toolkits	Workshop Feedback,	Refine RePlay language, test transfer potential, and situate the

Setting	Status in	Participants / Sessions	Methods and Activities	Data/Artefacts	Methodology
Sussex, and others.	and Transfer contexts	workshops /participants ,	Discussion, Informal Testing and Refinement.	Proposed Work Packages	work within wider research and innovation networks.

4.4 Methodological Traditions Informing the Research

The methodology draws on several overlapping traditions rather than one single method. This reflects the nature of the research problem: collaborative creativity is not only cognitive, not only social, not only embodied, and not only material. It is produced through relations among participants, bodies, tools, artefacts, spaces, prompts, constraints, and reflective practices. The following subsections clarify how action research, participatory design, co-design, arts-led research/research-creation, sensory ethnography, and feminist/posthumanist methodology informed the project.

4.4.1 Action Research

Action research was important because the project was process-driven and intervention-based. Rather than observing a situation from a distance, the research involved entering communities, workshops, design settings, and creative contexts to facilitate, reflect, and learn through action. In community-based action research, participants are not treated only as subjects; they are active participants in the research process, and the work often aims toward some practical outcome related to participants' lives, work, or community context.

This orientation was especially relevant in Global Studio, where my role involved facilitating participatory engagement with children and community stakeholders as part of a wider urban and social design process. It was also relevant in the Bendables case study, where the research involved children, researchers, and industry/community partners working through ideas, drawings, circuits, prototypes, and reflective activities. In these settings, RePlay operated as a catalyst for participation, reflection, and design development.

4.4.2 Participatory Design

Participatory design has roots in Scandinavian design traditions and seeks to involve users and stakeholders in the design process. Within participatory design, end users are understood as experts in their own tasks, practices, and contexts. Their tacit knowledge can therefore shape design requirements, concepts, and prototypes. This was important for the research because RePlay was designed to support stakeholders in expressing and externalizing knowledge that might not emerge through conventional verbal interviews alone.

During the literature review and early research, I noticed parallels between the language of improvisational theatre and the aims of participatory design. Improvisation emphasizes responsiveness, acceptance of offers, embodied action, shared attention, and collaborative emergence. Participatory design similarly requires processes that allow diverse participants to contribute, negotiate, and externalize ideas. RePlay developed at this intersection: as an embodied and playful way of supporting participants to generate, communicate, and reflect on design possibilities.

4.4.3 Co-Design

Co-design overlaps with participatory design but places greater emphasis on shared authorship, joint exploration, and the redistribution of design agency. In the Bendables case study, co-design was especially important because the children were not only users of a possible learning tool; they were also contributors to the development of its concepts, materials, interactions, and meanings. Their drawings, circuits, material experiments, and explanations became part of the design knowledge generated by the study.

In this context, RePlay helped create conditions in which children could become creative participants rather than passive respondents. It supported movement between imagining, drawing, making, testing, explaining, and reflecting. This made the co-design process more materially and bodily active, and generated data about how children explored interaction, cause and effect, and embodied design possibilities.

4.4.4 Arts-Led Research and Research-Creation

Arts-led research and research-creation informed the project because the development of RePlay was itself a creative and reflective process. Rather than treating method development as separate from creative practice, this thesis recognizes that the making of RePlay, Traces, Design Mapping, Trigger Objects, and related techniques was part of the research. These methods were not simply selected from an existing toolkit; they were developed through iterative experimentation, observation, reflection, and application.

The SÍM residency in Iceland is the clearest example of this research-creation orientation. During this residency, I explored shadowing, observation, and Traces as ways of translating creative process into postcards and other shareable artefacts. These artefacts did not simply represent findings; they functioned as a way of thinking through how ephemeral creative process might be documented, interpreted, and communicated.

4.4.5 Sensory, Embodied, and Reflexive Methodology

Improvisational creativity is situated, embodied, relational, and co-produced. Drawing from sensory ethnography, embodiment theory, and reflexive approaches to qualitative research, this methodology does not treat the researcher, participants, tools, bodies, environments, and artefacts

as separate from the research situation. Instead, it recognizes that knowledge emerges through the relations created during workshops, facilitation, making, movement, documentation, and reflection.

This orientation is aligned with Sarah Pink's account of sensory ethnography, in which knowledge is produced through embodied, sensory, and situated engagement. It is also consistent with Amanda Coffey's argument that the bodies of researchers and participants are central to the practical accomplishment of fieldwork. In this project, the body was not only a topic of analysis; it was part of how the research was conducted. My own background in improvisation, design, media arts, and HCI shaped what I noticed, how I facilitated, and how RePlay developed.

This sensory and reflexive orientation matters because RePlay studies phenomena that are difficult to capture through language alone: timing, gesture, shared attention, hesitation, blocking, acceptance, flow, creative risk, and responsiveness. Video, photographs, maps, drawings, props, prototypes, fieldnotes, and participant reflections were therefore treated as complementary data sources that helped make embodied and relational aspects of creativity more visible.

In this sense, methodology becomes a form of world-making. The methods used in this thesis did not simply record an already-existing creative process; they staged conditions through which creative process could emerge, be externalized, reflected upon, and interpreted. This is particularly important for RePlay because the framework produces situations in which creativity, flow, responsiveness, suggestibility, and embodied reflection can become more observable.

In many ways the research I conducted with RePlay shares similarities to the work of ethnographic researcher Pink (2015). In her work, Pink (2015) acknowledges the researchers background as well as their own inherent bias. Pink's strategy is concerned with understanding some of the more ephemeral qualities to an experience such as sensory perception and how groups or individuals interpret these experiences. Pink's methods go beyond just listening or watching (2015). For example, the results may come in the form of a film, a video or a recipe. In the case of this thesis, one of the exploratory studies resulted in a set of postcards which were then displayed in a gallery illustrating some of my observations regarding on the artist's Monica's creative process. In doing this type of qualitative research, the problem space is investigated through a holistic lens. Sensory ethnography views the senses as interconnected and in many ways in line with what embodiment theory states about perception not just as a mental activity but also connected to our bodies. Ethnographer Stoller's (1989, 2004) work illustrates how anthropological practice can be a corporeal process in that it involves the ethnographer engaging not only with the ideas of others but also learning about their understandings through her/his own physical and sensorial experiences.

In her book Pink (p.5, 2015) refers to Karen O'Reilly's (2005) description of sensory ethnography as:

…iterative inductive research (that evolves in design through the study), drawing on a family of methods, involving direct and sustained contact with human agents, within the context of their daily lives (and cultures), watching what happens, listening to what is said, asking questions, and producing a richly written account that respects the irreducibility of human experience, that acknowledges the role of theory as well as the researcher's own role and that views humans as part object/part subject.

As a framework my goal with RePlay, was for it operate as a vehicle to understand one's own creative process and in the process develop a playful forum for reflection and troubleshooting the design process. Pink characterizes ethnography as a reflexive and experiential process through which understanding is produced. Ethnography is open to multiple ways of knowing, and to the exploration of and reflection on new routes to knowledge. I feel in many ways this describes my approach with developing RePlay.

The anthropology of the senses was established in the 1980's and 1990's preceded by and related to embodiment work (Howes, 2003 pp. 29-32). Led by the work of scholars including Howes (2003), Stoller (1989), Seremetakis (1994), Feld and Basso (1996), and has involved the exploration of both sensory experiences and classification of systems of others and of the ethnographer's self (Hexfeld 2001). All these scholars played a key role in agenda setting for anthropological studies of sensory experience, and their ideas continue to shape the work of contemporary ethnographers.

Anthropology of the senses is characterized by three debates:

i. Exploring the relationship between sensory perception and culture.

ii. Questioning the status of vision in relationship to the other senses.

iii. Demanding a level of reflexivity that goes beyond the interrogation of how culture is written to examine sites of embodied knowing (Pink, 2015, p.9).

As a researcher I was utilizing these opportunities to develop a language and characterize further the RePlay framework. By developing RePlay, I was creating a framework which could be reused over and over- and towards developing a common language with regards to the field of research on improvisational creativity. This includes but is not limited to, flow, experiential learning, and design thinking.

Amanda Coffey (1999) states about ethnographic research, that our bodies and the bodies of others are central to the practical accomplishment of fieldwork. We locate our physical being alongside those of others as we negotiate the spatial context of the field we are studying. "We concern ourselves with the positioning, visibility and performance of our own embodied self as we undertake participant observation." (Coffey, 1999, p.59) In many ways Coffey's ideas are central

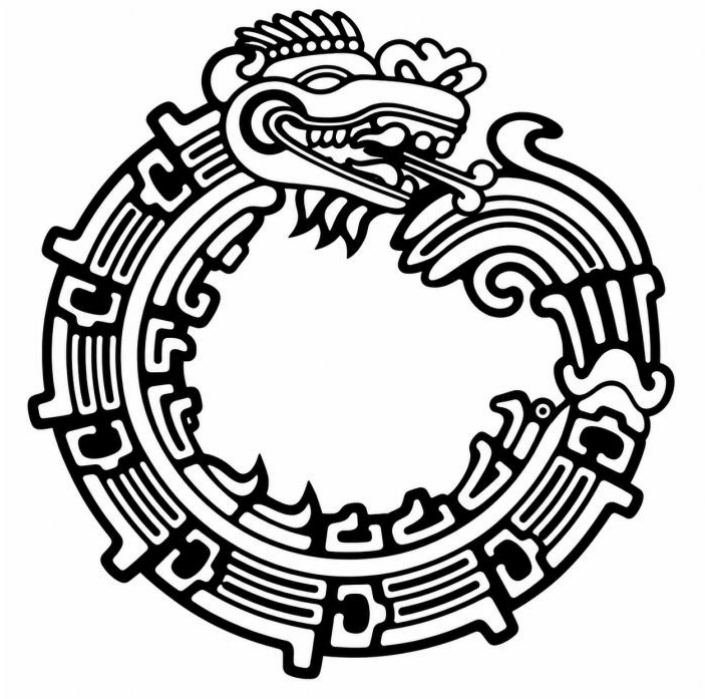
to how I approached this work in that as much as theory played a role my embodied experiences of conducting RePlay and participating in Impro, workshops also informed my insights into the research space.

It would be an oversimplification to state that I used specific design research methods as my sole method of enquiry. Instead, I credit intuition and the creative process itself as the main device for informing the direction I took in developing RePlay. I did not know or plan on creating a framework let alone a methodology. I do feel however, that somehow my own bias as a researcher and my educational background in design research, and arts informed the organic way in which this research unfolded. Pink's writing about sensory ethnography acknowledges that a researcher's background as well as the researcher's own inherent bias form part of the research design (Pink, 2015).

I therefore approached the problem space by creating tools and methods such as RePlay. This approach in many ways is reflective of my training at art school as I was encouraged to explore the problem space through externalizations such as sketches, prototypes, models and iterations. Rather than seeking out formal research methods, I explored opportunities to develop my research through interacting with different materials and media. The focus as such being to conduct enquiry via experiential interactions with materials and design research and or, research creation. This unconsciously was one of the well-springs from which RePlay came to be and the main directive behind my research methodology.

As much as I set out to collect data about creative phenomena, I also used the phenomena I observed as material for developing RePlay. I liken this process to the ouroboros, the ancient image of a serpent biting its own tail, which appears across many cultures as a symbol of cycles, continuity, and self-renewal. The ouroboros appears primarily in ancient Gnostic texts. They generally take on a circular form. The symbol itself represents many broad concepts such as; time, life continuity, completion, the repetition of history, the self-sufficiency of nature, and the rebirth of the earth. This is symbolized by the circular boundaries of the ouroboros. In this research, the ouroboros represents how the process folds back into itself: observations from each iteration of RePlay fed back into its design, so that the research process and its result shaped one another. This reflexive loop is characteristic of action research and reflective practice, in which acting, observing, and reflecting form a continuing cycle rather than a linear sequence (Schön, 1983).

Figure 4.1
Aztec Ouroboros Tattoo



Note. Made by the author using ChatGPT. [

Pink (2015) describes ethnographic research as perception, knowing and practice as she understands humans as part object and subject. I often turned to my experience of designing RePlay and the existing literature about creative process to inform my development of RePlay. Yet one must be cautious in utilizing our senses to understand other people's worlds, in that we must also be accountable for how those sense perceptions inform our participation. In many ways different ways, in contrast to traditional data collection, sensory ethnography offers a record or a window into an experience and as such it does not offer concrete data however it offers us a better understanding of the inter subjectivities of an experience. Pink (2015) explains this as a full-bodied understanding of culture as opposed to one modelled by linguistics (p. 23).

This sensory and reflexive orientation matters because the research does not separate the researcher from the creative process being studied. My background in improvisation, design, media arts, and HCI informed both the development of RePlay and my interpretation of what occurred during workshops and case studies. This is also a rather salient concept when it comes to our use of LLM's.

4.4.6 Feminist/Posthumanist Methodological Orientation

The feminist and posthumanist critique introduced in this thesis also has methodological consequences for this research. Rather than treating creativity as a property located inside an

isolated individual mind, this project understands creativity as situated, relational, embodied, affective, and materially entangled. Knowledge is not produced by a detached observer looking at passive subjects. It emerges through situated practices, relations, bodies, tools, environments, and forms of participation.

Methodologically, this means that RePlay is not approached as a neutral instrument applied to participants. It is a situated research practice in which researcher, facilitator, participants, props, prompts, spaces, technologies, and artefacts all help shape what can be known. This matters because the thesis is not only asking what collaborative creativity is; it is also asking how collaborative creativity can be made visible, felt, reflected upon, and studied.

4.5 Methodology as World-Building

In this thesis, methodology is understood not only as a set of procedures for collecting data, but as a form of world-building: a way of creating the conditions through which certain forms of knowledge, relation, embodiment, and creative action can become possible. The methods used in this research did not simply record an already-existing creative process. They staged environments in which participants could move, play, respond, externalize, reflect, and co-create.

This world-building orientation is central because the research investigates creative process as something that unfolds in action. To study such a process, the methodology had to create situations in which creativity could be enacted, observed, documented, and reflected upon. RePlay sessions therefore functioned as structured but open-ended worlds: temporary creative spaces with rules, prompts, roles, objects, bodies, and shared attention. Within those worlds, participants could try out ideas, notice assumptions, respond to one another, and generate data through action.

Figure 4.2
Embodied Relational Creativity

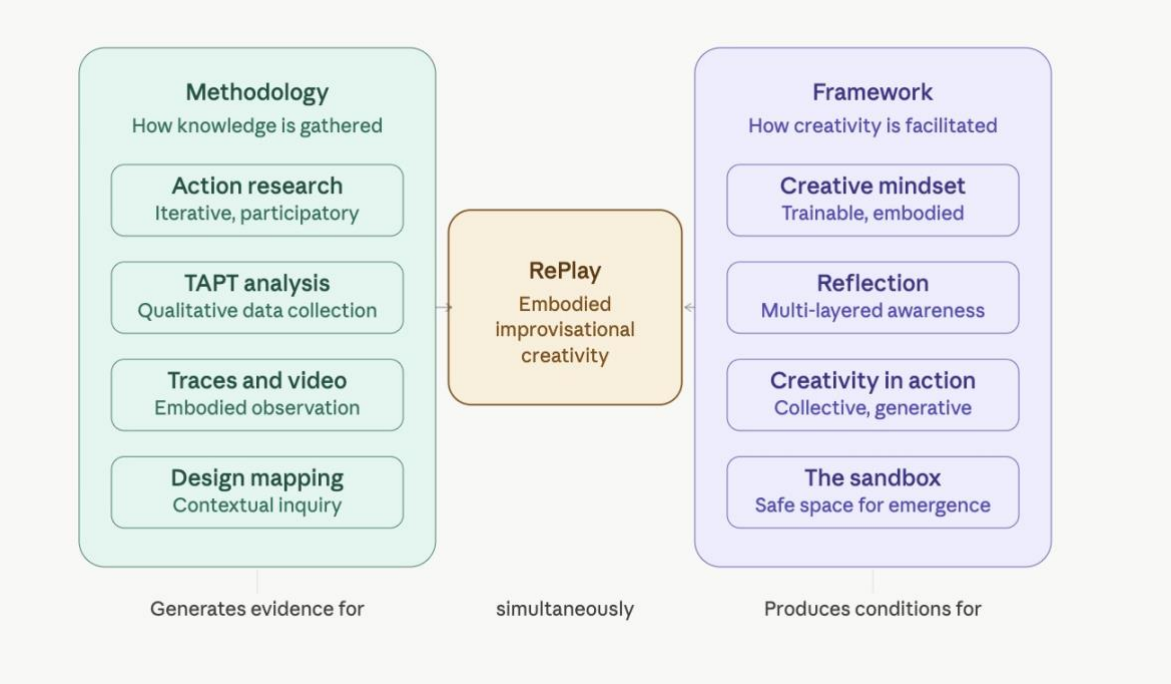


Note. Made by the author using ChatGPT.

This does not mean that RePlay artificially produces findings detached from reality. Rather, it acknowledges that all methods shape what they can reveal. Interviews reveal some kinds of knowledge; surveys reveal others; embodied improvisational workshops reveal yet others. RePlay was developed because the research required a method capable of revealing embodied, relational, and improvisational dimensions of collaborative creativity that are often missed by more static methods.

4.6 RePlay as Method, Framework, and Methodology

Figure 4.3
RePlay Framework and Methodology



Note. Made by the author using ChatGPT.

RePlay operates at three related levels. It is a method when used as a workshop technique or exercise. It is a framework when it organizes principles, games, prompts, and conditions for embodied collaborative creativity. It becomes part of a methodology when it is used to generate, document, analyze, and interpret data about collaborative creative process. This distinction is important because RePlay is not only a set of activities. It is also the means through which collaborative creativity becomes researchable.

Table 4.3
RePlay as Method, Framework and Methodology

Level	**What RePlay Does…**	**Example in the Research**
RePlay as Method/Technique/Tool	Provides specific games, exercises, prompts, and workshop structures that participants can engage with.	Design Machines, Design Tableaus, Tell Me More, Playback, Tangible Heroes, Trigger Objects.
RePlay as Framework	Creates a structured creative sandbox that supports play, embodied externalization, reflection, responsiveness, and safe creative risk.	Used across design, community, and maker contexts to scaffold collaborative exploration.
RePlay as Methodology	Generates data about collaborative creativity through movement, dialogue,	Used to study flow-like conditions, responsiveness, group mind, externalization, and Creativity in Action

Level	What RePlay Does…	Example in the Research
	artefacts, reflection, video, fieldnotes, maps, and participant responses.	across exploratory research and case studies.

RePlay can also be understood as onto-epistemological in orientation: it does not separate what is known from the conditions through which knowing becomes possible. Drawing from Barad's insight that methods are not neutral tools but participate in producing the phenomena they study, RePlay helps produce the creative situations through which collaborative creativity can be observed and interpreted.

From this perspective, RePlay participates in producing the knowledge it makes available. A RePlay session brings together participants, tasks, prompts, props, spatial arrangements, movement, facilitation, video documentation, and reflection. These relations shape what emerges. The data generated through RePlay is therefore not treated as a detached record of a pre-existing process, but as evidence of creativity as it is enacted within a situated methodological environment.

RePlay is also a methodology for researching phenomena that are difficult to capture directly, including flow, group flow, responsiveness, suggestibility, blocking, and embodied externalization. This does not mean that RePlay measures flow in a psychometric or neuroscientific sense. Rather, it provides a qualitative and embodied way to detect, document, and interpret flow-like conditions as they become visible through behavior, reflection, timing, energy, attention, and participant descriptions.

4.6.1 Requirements of RePlay as a Research Method

For RePlay to operate as a research method, several conditions were required. Participants needed a safe enough environment to take creative risks. The facilitator needed to establish clear prompts, constraints, and boundaries while remaining responsive to the group. The activity needed to generate observable action, not only discussion. The process needed to be documented through fieldnotes, video, photographs, artefacts, maps, or participant reflections. Finally, the activity needed space for debriefing so that participants could reflect on what happened, what shifted, and what became visible.

The workshop context was adapted depending on the community and research aims. In some contexts, RePlay supported reflection on an individual or group creative process. In others, it supported participatory design, community engagement, or co-design with children. Although the specific games and prompts varied, a RePlay session generally included warm-up exercises, tailored games or prompts, documentation, and reflection or debriefing.

4.6.2 What Happens During a RePlay Session

A RePlay session typically begins with short improvisational warm-up exercises designed to bring attention to trust, awareness, physicality, listening, and responsiveness. These warm-ups help participants shift from discussion into embodied participation. Depending on the group and research context, the session then moves into more tailored RePlay games inspired by improvisational theatre but adapted to design research questions, community needs, or co-design problems.

The session may involve participants using their bodies to represent a system, product, service, process, or community issue; using objects or props to trigger ideas; slowing down or replaying a scene; mapping a process; developing a tableau; creating a design machine; or reflecting on the process through TAPT or another reflective structure. Documentation may include video, photographs, fieldnotes, sketches, maps, artefacts, or participant writing. A debrief then creates space to discuss what occurred, what was noticed, and how the activity supported or changed the creative process.

In the second and third case studies, RePlay was used within participatory and co-design settings. Stakeholders were identified before the workshops, and the RePlay activities were adapted to fit the needs of the community or project. In the Bendables case study, the process also involved product design aims because the collaboration with Maker Junior and Carleton University was oriented toward exploring a tangible learning toolkit involving bendable interaction, simple electronics, and maker-based learning.

4.6.3 The Role of the Facilitator

The facilitator plays an important methodological role in RePlay. The facilitator introduces prompts, frames the activity, protects the creative space, attends to group dynamics, and helps participants move between play, reflection, and design thinking. The facilitator also observes how the creative process unfolds: when participants accept or block offers, how they use props or space, when energy rises or falls, when participants appear absorbed, and how ideas shift through embodied action.

Because RePlay involves improvisation, the facilitator cannot fully control what will happen. Instead, facilitation involves holding enough structure for participants to feel safe while leaving enough openness for emergence. This balance is methodological as well as practical. Too much structure can close improvisation; too little structure can leave participants confused or exposed. The facilitator therefore helps create the conditions in which creativity can become visible without forcing a predetermined outcome.

4.7 RePlay Games and Related Research Techniques

Detailed descriptions of the RePlay games can be found in Chapter 3, where RePlay is developed as a creative sandbox and framework. In this chapter, the games and techniques are described in terms of their methodological function: what they were used for, what forms of data they generated, and how they supported the study of collaborative creativity.

Table 4.4
RePlay Games and Research Techniques

Game/ Technique	**Purpose**	**Data**	**Methodological Value**
Tell Me More	Prompt elaboration, clarification, and deeper articulation of an idea, need, story, or design possibility.	Participant speech, Explanations, Follow-up reflections, and Contextual details.	Helped surface tacit assumptions and encouraged participants to expand ideas without immediately judging them.
Playback	Re-enact, slow down, or revisit a scene or moment to generate reflection.	Re-enacted movement, Dialogue, Video/photo documentation, Participant interpretations.	Made process visible by allowing moments to be replayed and examined.
Design Tableaus	Represent a product, service, system, or situation as a still embodied scene.	Spatial arrangements, Gestures, Narration, Participant explanations, and Photographs.	Externalized ideas through bodies and space, making relationships and assumptions visible.
Design Machines	Represent systems, interaction flows, or processes through moving embodied group compositions.	Movement, Sound, timing, Coordination, Video debrief, reflections.	Made system dynamics, flow, interdependence, and group coordination observable.
Tangible Heroes	Use a tool, service, product, or object to "save the day" within an improvised scenario.	Narratives, Object use, Gestures, Participant explanations, Design possibilities.	Supported imaginative exploration of affordances, user needs, and product/service roles.
Trigger Objects	Use props or material prompts to catalyze association, storytelling, problem framing, or embodied design thinking.	Object interactions, Participant explanations, Photos, Video, material.	Helped move participants from abstract discussion into material and embodied exploration.
Design Flow Diagrams	Visually map a design process, workflow, or creative sequence.	Diagrams, annotations, Participant explanations Interview notes.	Generated visual data about process, sequence, decision points, and tacit assumptions.
Design Mapping/ Embodied Design Mapping	Spatially or visually map relationships, systems, steps, stakeholders, or process elements.	Maps, and Reflections.	Supported externalization and, in some cases, breaching-style disruption of assumptions.
Traces	Document creative process through consent-based	Postcards, Photos, Notes, Visual traces, Reflective interpretations.	Explored how ephemeral creative process could become shareable research artefacts.

Game/ Technique	Purpose	Data	Methodological Value
	shadowing and translation into visual/reflexive artefacts.		
TAPT	Tease apart an experience and piece it together in a new context; support reflection on effects and experiences.	TAPT Worksheets, Participant Reflections, Discussion, and Photos.	Helped make flow-like conditions, experiential qualities, and design effects discussable.
Bad Ideas	Use deliberately silly or bad ideas to loosen judgment and provoke critical reflection.	Idea lists, discussion, participant responses, reframing.	Supported divergent thinking, reduced inhibition, and opened alternative perspectives.
Video, Photographs, Fieldnotes, Vignettes	To document embodied, visual, material, and reflective aspects of workshops.	Video, images, RA notes, Researcher notes, Vignettes, Artefact records.	Supported triangulation and later interpretation of embodied and relational process.

4.7.1 RePlay Games and Techniques

The RePlay games described in Chapter 3 were used in the research as data-generating techniques. Tell Me More, Playback, Design Tableaus, Design Machines, and Tangible Heroes each created structured opportunities for participants to externalize ideas, respond to others, make tacit knowledge visible, and reflect on design possibilities. In this methodology chapter, the important point is not only what each game looked like, but how each game generated evidence of creative process.

For example, Design Tableaus and Design Machines generated visual and embodied data by asking participants to represent systems, services, or interaction flows through the body. These activities produced observable arrangements, gestures, timing, sound, and group coordination. Playback generated reflective data by allowing a scene or moment to be revisited and slowed down. Tell Me More generated verbal and interpretive data by inviting elaboration. Tangible Heroes generated narrative and material data by asking participants to explore how a tool, product, service, or object might intervene in a scenario.

4.7.2 Bad Ideas

Bad Ideas, developed by Alan Dix, was used as a technique for loosening judgment and supporting creative reframing. The method invites participants to generate deliberately "bad," silly, or impractical ideas. Rather than treating these ideas as failures, the process uses them to reveal assumptions, hidden constraints, and unexpected possibilities. In this research, Bad Ideas informed early exploratory work and helped shape my understanding of how playful disruption can support design thinking.

Methodologically, Bad Ideas mattered because it challenged the tendency to evaluate too quickly. It created a temporary suspension of correctness and allowed participants to explore the edges

of a problem space. This aligns with RePlay's broader emphasis on play, safety, and creative risk: a seemingly unproductive idea can become a route into deeper reflection, alternative framing, or more generative design possibilities.

4.7.3 Trigger Objects

Trigger Objects were used as open-ended props within RePlay and related workshops to catalyze creative process, support embodied interaction, and generate research data. Rather than functioning as finished prototypes, trigger objects acted as material prompts. They invited participants to handle, reinterpret, project meaning onto, and build stories around objects. This helped participants move from abstract discussion into embodied, situated, and material exploration.

Trigger Objects generated several kinds of data: how participants touched or moved objects, the associations they produced, the stories they told, the roles they assigned to objects, and the design ideas that emerged through interaction. They also helped create what might be called "emotional making tools" (described in Chapter 3)(Dix, Gongora, 2011), as objects that catalyzed affective, imaginative, and relational responses rather than only technical problem solving.

Figure 4.4
RePlay Game: Trigger Objects



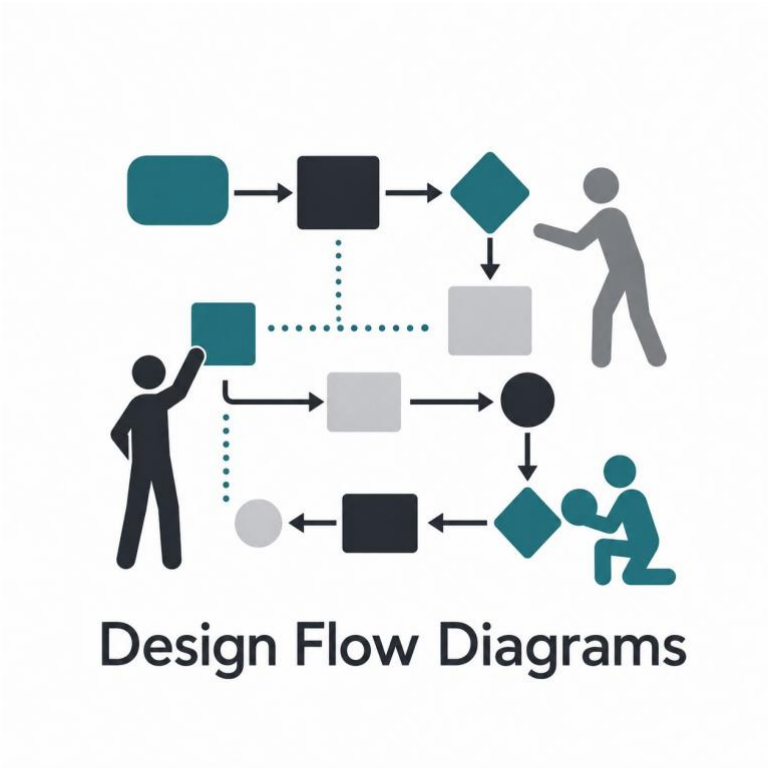
Note. Made by the author using ChatGPT.

4.7.4 Design Flow Diagrams

Design Flow Diagrams were used to visually collect data about design process alongside informal interviews. Because designers often work visually, this strategy created a more comfortable and concrete way for participants to describe process, sequence, decision points, constraints, and changes over time. The diagrams provided visual artefacts that could be discussed with participants and later interpreted as evidence of how they understood creative and design process.

Methodologically, Design Flow Diagrams helped externalize process. Rather than asking participants only to describe what they do, the diagrams invited them to map it. This made it possible to identify where participants located key transitions, uncertainties, collaborations, decisions, and moments of iteration. The diagrams also created opportunities for follow-up questions and comparison across accounts.

Figure 4.5
RePlay Design Flow Diagrams



Note. Made by the author using ChatGPT.

4.7.5 Design Mapping

In the Philips/TU Eindhoven exploratory work, Design Mapping functioned as a form of breaching experiment, drawing on Garfinkel's ethnomethodological approach. By removing, altering, or questioning parts of a mapped process, the technique disrupted taken-for-granted assumptions and prompted participants to articulate why certain elements mattered. This made tacit structures

more visible and created opportunities to examine creative process as a situated and negotiated activity.

Design Mapping also appeared in later research contexts, including Global Studio and Tiree, where mapping helped participants externalize community, process, or design relationships. Because the term appears both as a RePlay game and as a research technique, it may be useful to rename or distinguish the two uses in the final thesis.

Figure 4.6
RePlay Design Mapping



Note. Made by the author using ChatGPT.

4.7.6 Traces, Shadowing, and Postcards

Traces were developed during the SÍM residency as a research-creation method for documenting creative process. Through a consent-based form of shadowing inspired by Vito Acconci's Following Piece, I followed and observed an artist's creative process over time. Unlike Acconci's work, this adaptation was explicitly consent-based and research-oriented. The aim was not surveillance, but a delicate exchange through which creative process could be noticed, interpreted, and translated into visual and reflective artefacts.

The postcards produced during the residency functioned as research artefacts. They translated observations, moments, images, and reflections into a shareable format. This process helped me explore how ephemeral creative activity might leave traces that could be collected, reflected upon, and analyzed. It also informed the later development of RePlay by deepening my interest in how creative process can be made visible without reducing it to a single outcome.

Shadowing was later explored in the Bendable study's context when research assistants observed children during workshop activities and collected notes about their engagement, interactions, and making processes. In both contexts, shadowing provided a way to attend to creative process as it unfolded in time.

Figure 4.7
RePlay Game: Traces



Note. Made by the author using ChatGPT.

4.7.7 TAPT

TAPT, or Teasing Apart and Piecing Together, was developed by Clare Hooper as a method for redesigning experiences for new contexts. It involves identifying the surface elements of an experience, teasing apart its experienced effects, and then piecing those effects together in another context. In this thesis, TAPT was used not only as a reflective design tool but also as a qualitative method for exploring whether participants were experiencing conditions associated with flow when I began to observe these phenomena.

Drawing on Csikszentmihalyi's description of flow, I looked for qualitative indicators such as focused attention, loss of self-consciousness, altered sense of time, intrinsic engagement, and responsiveness to feedback. TAPT gave participants a structured way to discuss the experience of a RePlay session and helped make aspects of flow experience more visible and discussable. It did not function as a

quantitative flow measure. Rather, it functioned as a reflective prompt that supported interpretation of embodied and collaborative experience.

Teasing Apart, Piecing Together (TAPT) was developed to redesign experiences for new contexts, e.g. taking picnics to the web, or web-based social networking to care homes [x]. It falls into two phases, Teasing Apart (experience analysis) and Piecing Together (experience redesign).

Teasing Apart helps gain insights into subjective experiences. It involves:

i. Briefly describe the experience. For example, if we were analyzing photo-sharing on Facebook, we might write: "Facebook lets users upload and caption photos, which can be commented upon by the photo's owner or others. Viewers can 'tag' friends in photos, adding metadata linking images with people's profiles.
ii. List the 'surface elements' of the experience. These are nouns and adjectives relating to the design. E.g.: a somewhat complex photo upload process; the option to annotate images with text; the option to 'tag' images, indicating who is shown and the ability to view photos.
iii. List 'experienced effects. These are physical, social, intellectual and emotional. They tend to be abstract nouns, noun/verb pairs and adverbs.

They are:

a. External: concrete items e.g. 'share memories'
b. Internal: e.g. 'anticipation of discussion', 'reminiscence'. This step is important.

iv. Identify effects that seem especially important, unique or key. For example, 'broadcasting visual information', 'openness' and 'reminisce icing'.
v. Describe the abstracted experiences in a neutral sentence. For example, mention 'broadcasting' data, not 'playing' it, as 'playing' implies an audio-visual mode. One might write of photo-sharing: 'A way to share and annotate imagery from the user's past; their audience can access and annotate that imagery.' (Hooper, 2011)

TAPT was especially important in the Tiree Tech Wave case study, where participants reflected on their individual creative processes and considered where they were within a larger process. It also informed analysis in the Bendables study by helping connect participant reflection, workshop observation, and artefacts produced through making.

4.7.8 Video, Images, Audio, Fieldnotes, and Vignettes

Because RePlay involves embodied action, movement, gesture, timing, and group interaction, video and photographic documentation were important data sources. Video was used both as documentation and, in some cases, as a reflective tool during debriefing. Photographs documented trigger objects, maps, prototypes, drawings, workshop arrangements, children's activities, and material artefacts. These visual records allowed aspects of the creative process to be revisited after the workshop.

Fieldnotes were also important. I took researcher notes across workshops and exploratory activities, while research assistants took fieldnotes during the Bendables workshops. These notes provided an additional observational layer and helped document participant engagement, workshop flow, moments of difficulty, and observable patterns of interaction. Vignettes were used at times to capture moments, insights, or reflections that illuminated the research themes.

Interviews, informal conversations, and debriefs complemented these visual and embodied data sources. They allowed participants to articulate experiences that could not be inferred from observation alone and helped triangulate what was seen, made, said, and reflected upon.

4.8 Context-Specific Method Clusters

Several case studies combined RePlay with other research and design methods. This section briefly summarizes these method clusters so that the reader can see how RePlay was adapted to each context. Fuller accounts of what happened in each setting are provided in the exploratory research and case study chapters.

4.8.1 Global Studio: Community-Based and Child-Led Design Methods

In the Global Studio case study, RePlay was combined with a wider set of participatory and community-based design research methods. These included interviews and conversations with the school principal, local community members, and other stakeholders; walk-throughs and site visits with children; spatial observation through fieldwork; community mapping; and photographic documentation of children's daily routines. The children's photographs functioned similarly to cultural probes, allowing participants to document aspects of their everyday environment and communicate spatial, social, and material concerns through images rather than verbal explanation alone.

RePlay mapping exercises and embodied design activities were then used alongside paper maps, mind maps, and low-fidelity prototypes to identify key community concerns such as open spaces, play areas, gardens, garbage removal, and access to clean water. The work also generated architectural drawings and design proposals that were presented to planners. These drawings functioned as research-informed design artefacts: they translated children's observations, spatial mappings, community concerns, and RePlay-based design activities into visual proposals that could circulate beyond the workshop setting.

4.8.2 Bendables: Maker-Based Prototyping and Material Artefacts

In the Bendables case study, RePlay was extended into a maker-based prototyping context developed through collaboration with Maker Junior and Carleton University. This context brought together Child-centered Co-Design, Tangible Interaction, Digital Fabrication, and hands-on

prototyping. Children worked with drawings, art supplies, simple electronic components, circuits, bendable materials, and digital fabrication tools including a 3D printer.

These activities generated visual, material, verbal, and observational data, including participant drawings, prototypes, workshop artefacts, photographs, video, TAPT responses, research assistant fieldnotes, and 3D-printed artefacts. The prototypes were not treated only as outputs. They were research artefacts that made visible how children understood interaction, materiality, cause and effect, embodied design possibilities, and collaborative making.

4.9 Data Sources and Data Collection

Across the research, data was generated through multiple forms: bodies, objects, images, drawings, maps, prototypes, electronic components, 3D-printed artefacts, video, photographs, fieldnotes, interviews, participant reflections, TAPT responses, vignettes, and design proposals. This broad understanding of data was necessary because the research investigated creativity as embodied, relational, and material rather than purely verbal or cognitive.

Table 4.5
Data Sources and Their Roles in the Research

Data source	Examples	Analytic Use
Embodied and Interactional Data	Movement, Gesture, positioning, Timing, Turn-Taking, Acceptance/Blocking, and Group Co-ordination.	Used to interpret Creativity in Action, responsiveness, co-presence, and group flow-like conditions.
Verbal Data	Interviews, Informal Conversations, Debriefs, Participant Explanations, and Tell Me More prompts.	Used to understand participant interpretation, tacit assumptions, and reflective accounts.
Visual Data	Photographs, Video, Design Maps, Children's Photographs, Diagrams, Postcards.	Used to revisit embodied process, analyze spatial/material arrangements, and trace process development.
Material Data	Trigger Objects, Props, Prototypes, Circuits, Bendable Components, 3D-printed Artefacts, Architectural Drawings.	Used to analyze how ideas were externalized, transformed, and materialized.
Reflective Data	TAPT Responses, Fieldnotes, Researcher Notes, RA Notes, Vignettes, and Post-session Reflections.	Used to identify patterns of flow, reflection, learning, engagement, blocking, and creative risk.

This triangulated approach allowed me to interpret collaborative creativity from several angles. No single data source was treated as complete. Instead, video, photographs, fieldnotes,

participant reflections, artefacts, and maps were read together to understand how creative process unfolded across a session or case study.

4.10 Data Analysis and Interpretation

Data analysis in this thesis was iterative, interpretive, and reflexive. I reviewed fieldnotes, visual materials, workshop reflections, photographs, video documentation, participant comments, TAPT responses, design maps, prototypes, postcards, and other artefacts generated across the exploratory research and case studies. The aim was not to isolate creativity as a measurable variable, but to understand how collaborative creativity unfolded through action, relation, embodiment, material engagement, and reflection.

Analysis involved reading across multiple data forms rather than treating any single source as definitive. Video and photographic data were reviewed alongside fieldnotes, TAPT responses, design maps, trigger objects, prototypes, and participant reflections. This was especially important because participants sometimes articulate one version of a process verbally while their bodily engagement, interaction with objects, or collaborative movement reveals another dimension of the experience.

Across the case studies, I looked for recurring patterns including ***externalization, flow-like engagement, blocking, acceptance of offers, group mind, use of props, creative risk, embodied reflection, responsiveness, shared attention, and shifts in participation.***

I also paid attention to differences across contexts. For example, ***the role of language and visual/embodied methods was especially important in Global Studio; the role of material making and child-centered co-design was central in Bendables; and the role of reflective evaluation and flow-like experience was particularly visible in Tiree***.

In analyzing TAPT material, I looked for qualitative indicators of flow using Sawyer's definition alongside other patterns of collaborative creativity. These included focused attention, loss of self-consciousness, altered time experience, immediate feedback, participant energy, and intrinsic engagement. Because this was not a psychometric study, these indicators were interpreted cautiously and in relation to other data sources rather than treated as direct measures.

In practice, the analysis was an interpretive, cross-case reading guided by sensitizing concepts drawn from improvisation and creativity research: offers accepted or blocked ("yes, and"), the game of the scene, indicators of flow, and forms of externalization. Consistent with sensory ethnography (Pink, 2015), these concepts oriented my attention rather than serving as a fixed coding scheme, and interpretations were checked across video, fieldnotes, artefacts and participants' own accounts. The analysis of TAPT responses at the Tiree Tech Wave (Section 7.1,

Tables 7.1 and 7.2) provides a worked example of this process: participants' descriptions were grouped into surface, external and internal elements, counted across respondents, and then compared with the dimensions of flow.

4.11 Ethics and Researcher Positionality

Ethical considerations varied across the different phases and sites of the research. For the Bendables case work, ethics approval was obtained through Carleton University. This was particularly important because the study involved children, photography, video, drawings, prototyping, and maker-based activities. Parent/guardian consent was collected where required, and participants were informed about the use of visual documentation.

In the Global Studio case study, ethical engagement was supported through the existing structure of the Global Studio collaboration. Global Studio had already been working with urban planners and community partners in Bhopal, India. Parents signed forms before the workshop indicating that data would be anonymized and that photographs and video of participants could be used as part of the workshop documentation and research context. The use of children's photographs and workshop images therefore required careful attention to consent, anonymization, and respectful representation.

Across workshops where visual documentation was used, participants and, where relevant, parents or guardians were informed that photographs and video might be taken as part of the research process. Consent was treated as an ongoing ethical concern rather than a single administrative step. This mattered because the research involved embodied participation, collaborative workshops, photography and video, children, community contexts, and the researcher acting as facilitator.

My positionality also shaped the research. I approached the work as a researcher with experience in design, media arts, improvisational theatre, HCI, and embodied practice. Rather than presenting this background as a source of neutrality, I treated it as part of the research situation. My ability to facilitate RePlay, notice improvisational dynamics, and interpret embodied interaction was shaped by this background. This reflexive position is consistent with the broader methodology, which understands knowledge as situated and co-produced.

4.12 Challenges, Limitations, Reflexivity, and Generalization

A major methodological challenge is that many of the phenomena central to this thesis such as; flow, suggestibility, attunement, creative risk, group responsiveness, and Creativity in Action, are difficult to capture directly. Creative process is ephemeral. It can disappear when over-analyzed, and participants may not always be able to describe what happened while it was happening. This

is why the research relied on multiple forms of documentation and reflection rather than a single method.

Another challenge was participant pleasing and retrospective rationalization. I encountered this issue early in the exploratory research with designers, where participants could sometimes describe an idealized account of how they worked. Similar issues appeared in the Bendables study, where children at times seemed eager to please the researchers or provide answers, they thought adults wanted to hear. This required careful interpretation and reinforced the value of triangulating verbal accounts with observation, artefacts, fieldnotes, and video.

The choice to conduct research "in the wild" created further complexity. The benefit of situated research is that participants engage in contexts that matter to them: community centers, design workshops, maker settings, urban/community sites, and professional or semi-professional creative environments. However, these contexts are not easily controlled. Groups differ, activities shift, time is limited, and community needs may take priority over research ideals. For this reason, the thesis does not claim universal generalizability in a positivist sense. Instead, it offers transferable methodological insights about how RePlay can support and study collaborative creativity across varied contexts.

The case studies were deliberately diverse: Tiree Tech Wave focused on RePlay as a reflective method in an HCI/innovation context; Global Studio used RePlay within participatory urban/community design; and Bendables explored co-design, tangible interaction, and maker-based learning with children. This diversity limits direct comparison, but it also demonstrates the adaptability of RePlay as a framework. The analysis therefore prioritized rich, situated interpretation and cross-case pattern recognition rather than experimental control.

Finally, because I acted as researcher, facilitator, and method developer, reflexivity was essential. RePlay developed through the same creative processes it was designed to study. This creates methodological complexity, but it is also part of the contribution. The research demonstrates how a framework can be developed through embodied practice, applied across contexts, and used to generate knowledge about collaborative creativity in action.

4.13 Chapter Summary

This chapter has outlined the methodology used to develop and study RePlay. It situated the project as qualitative, practice-based, exploratory, action-research-informed, participatory, embodied, and reflexive. It clarified the two research phases: exploratory research and framework development, followed by applied case studies using RePlay in design, participatory, and co-design contexts.

I also explained the methodological traditions that informed the research, including action research, participatory design, co-design, arts-led research/research-creation, sensory ethnography, and feminist/posthumanist approaches to situated knowledge. It then positioned RePlay as a method, framework, and methodology, and explained how RePlay games and related techniques functioned as data-generating instruments.

The data sources and interpretive approaches used in the research: embodied interaction, verbal accounts, visual documentation, material artefacts, reflective tools, fieldnotes, maps, diagrams, prototypes, and participant reflections were also presented. Finally, it addressed ethics, researcher positionality, limitations, and the challenge of studying ephemeral creative phenomena such as flow, responsiveness, and Creativity in Action.

The next chapter turns to the exploratory phase of the research and examines how RePlay was developed through workshops, informal trials, artistic research, design interviews, and iterative practice-based experimentation.

Chapter 5: Exploratory Research

"*All doing is knowing, and all knowing is doing.*"

— *Humberto Maturana and Francisco Varela, The Tree of Knowledge*

5.1 Introduction

This chapter documents the exploratory research phase conducted in tandem with the literature review, representing an iterative and experimental process whose outcomes directly informed the development of the RePlay research method. To better understand improvisational creativity in design contexts, this phase comprised experimental studies exploring action research at the intersection of design process, creative process, and improvisational theatre. These exploratory investigations addressed the central research questions guiding this project:

5.2 Research Questions

i. Is there a way to create a framework for facilitating the qualities of improvisational creativity that make it useful for design process as well as, implementable and transferable?
ii. How does this enrich what we already know about creativity and furthermore add to our understanding of collaborative creativity?
iii. Given that a large component of improvisation involves physical externalization of ideas as a unique form of creativity-in-action, what distinguishes this embodied approach from more internal methods such as drawing or writing?

The exploratory phase served as foundation for the second research phase, where RePlay was applied through case studies addressing specific design concerns including community architecture, maker-inspired learning, Montessori education, and toy design. Throughout this research period, opportunities emerged to conduct workshops and participate in presentations at conferences, design offices, innovation spaces, universities, and artistic residencies. These engagements proved valuable for receiving feedback on RePlay facilitation while testing developing techniques and strategies. This initial exploratory phase particularly enhanced skills as a researcher while cultivating embodied understanding of creative process, which integrated with theoretical knowledge from existing literature.

5.3 Overview of Exploratory Studies

This chapter presents three distinct yet interconnected exploratory studies, each contributing unique insights to RePlay framework development:

Case Study 1 involved a pilot study with an improvisation troupe in Lancaster, UK. As this was the first study conducted as an early-stage researcher, this investigation focused on developing RePlay while exploring improvisation alongside embodiment literature, particularly the work of biologist, neuroscientist, and philosopher Francisco Varela (Varela et al., 1991). This study established initial parameters for combining improvisation techniques with design thinking approaches.

Case Study 2 comprised in-depth interviews and visual mapping exercises with design practitioners at Philips Design and Technical University Eindhoven. This study employed interviews alongside ad-hoc methods like breaching experiments, which were termed "design mapping," triangulating results from both processes with direct observations (Gongora, 2010). The primary motivation involved understanding tools and processes designers utilize in professional practice while assessing receptivity to RePlay and examining externalization's role in design process.

Case Study 3 consisted of arts-led research conducted during a month-long residency at SIMS (The Association of Icelandic Visual Artists) in Iceland. This study employed a shadowing technique inspired by performance art practice, where the researcher shadowed an artist and created visual art based on this research process. This approach provided unique perspectives distinct from facilitator or creative practitioner roles, offering insights into embodied creative process through direct immersion.

5.4 Methodological Development Through Action Research

Alongside these formal exploratory studies, this phase involved participating in numerous workshops and joining improvisation groups in Lancaster, Brighton, and Berlin. This engagement employed an action research methodology combined with a co-design strategy, working directly with actors to develop the RePlay framework. Gaining subjective understanding of improvisation practices, theories, and themes within the improvisational theatre community proved essential, particularly regarding the role of facilitator. This aspect to RePlay was facilitated would be central to subsequent case studies. Professional improvisers provided valuable feedback during early research stages, while professional designers offered perspectives on what worked and what required further development, informing published research outputs (Gongora, 2010a).

The research approach drew from both design and arts backgrounds, incorporating a research-creation methodology using "making" as strategy for understanding creative process. While unaware at the time of Pink's (2015) work in sensory ethnography as research method, the visual research study at SIMS combined sensory ethnography with research-creation as predominant approach. Utilizing media and form to articulate and explore ideas enabled research exploration in ways formal techniques might not have permitted, providing opportunities to express and engage with research abstractly and intuitively (Bolt & Barrett, 2007). Significantly, parallels

emerged between formal Philips study results (Gongora, 2010a) and SIMS residency findings, which this chapter discusses alongside detailed results descriptions.

5.5 Scope and Duration of Exploratory Research

The exploratory research phase spanned approximately two years of conducting weekly workshops and, and at certain points, intensive multi-day or week-long sessions between the UK and Germany for the most part. Initial participation involved workshops in Lancaster, UK with a small improvisation group. At this stage early development of the RePlay framework gathered improviser feedback at these workshops. Later as guest researcher at Sussex University's creativity lab, weekly drop-in sessions were attended with an experienced local professional improvisation group called "The May Days." During this period, additional workshops were taken including Improlоgy sessions led by Remy Bertrand and an intensive five-day retreat with The May Days in Dorset, UK. When not in Sussex, workshops continued with a Berlin improvisation group called Fluxus in Germany.

These trainings and regular improvisation sessions we aimed not only to develop the framework but also gain experience with facilitation and learn more about improvisation as a technique. It was experimenting with short-form improvisation games, which later inspired the RePlay games which were invented for subsequent case studies. Participation in this kind of hands-on training proved essential for learning improvisation processes, including techniques such as production blocking and "yes, and" acceptance (Johnstone, 1979). Much of this training work contributed to developing and co-designing the RePlay framework with other players. Each study also encouraged writing about the process resulting in several publications.

5.6 Development of Complementary Tools and Techniques

While overall research goals centered on developing the RePlay framework, additional strategies emerged during both exploratory and formal case study phases. These processes developed in situ or shortly before studies, were often inspired by a concurrent literature review process. The first study introduced "trigger objects", a technique described in the methods chapter and further developed during Tiree Tech Wave workshops (see case studies chapter). Another technique, "design mapping," visualized design process during Philips Design interviews, and resurfaced again during the Global Studio case study (see case studies chapter) where mapping served to support co-designing processes between the architects and the community.

The third exploratory study in Rejavik, Iceland at an artist's residency utilized "shadowing" a technique inspired by the performance art, of Vito Acconci. Alongside this process were the creation of "traces", which were simultaneously art pieces, functional objects, and creative process remnants. Traces expanded how external representation of the research process were presented and,

resulted in reflective artifacts for consideration and larger discussions not only in research but also a gallery context. Alongside these techniques, hybrid games evolved from existing improvisation games, tailored to contexts within RePlay. Given facilitation's centrality to RePlay, established facilitation strategies included terminology like “advance/expand, playback, and freeze frames” were explored (Johnstone, 1979). Some facilitation techniques evolved into unique games such as "design machines," discussed in the methods chapter and as part of the Bendables case study.

This research would not have been possible without the openness and expertise from various improvisers, researchers, professional designers, and artists to whom deep gratitude is owed. The following sections detail each exploratory study, examining their specific contributions to RePlay development and collective insights regarding embodied creativity in collaborative design contexts.

5.7 Case Study 1: Scanning the Terrain — Creativity and Embodiment: Exploring BadIdeas, Improvisation, Reflection, and the Development of RePlay

5.7.1 Introduction

Design thinking offers several methods for giving designers richer contextual information about the values and needs of a target group, including user scenarios, personas, use cases, and cultural probes (Kumar, 2013). Scenarios, personas, and use cases are useful, but they rest on the designer’s interpretation of how a design might be used, and can therefore diverge from an embodied, collaborative understanding. Cultural probes such as diaries, blogs, or cameras raise a related problem: what is selected may reflect the designer’s aesthetic judgment more than users’ actual needs (Gaver, 1994), although Gaver (2004) later defended this subjectivity as a source of playful, exploratory design. The aim here is not to rank these methods, but to understand what makes embodied approaches such as role-play useful, and at which stages of the design process. Methods that let a group explore scenarios and possibility spaces together are particularly valuable, because they challenge the team’s perceptual assumptions and build a shared language around what is being designed.

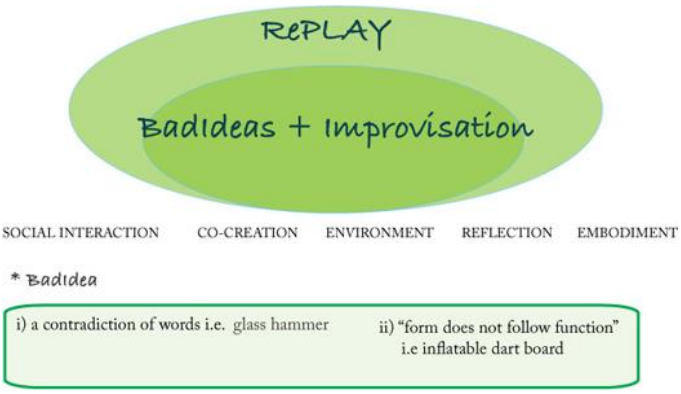
Sawyer’s work on group creativity suggests why. Deep listening and building on one another’s ideas can produce group flow, but not automatically: groups without familiarity or a shared goal perform worse, while diverse groups with shared knowledge, clear goals, autonomy, close listening, and full participation perform best (Sawyer, 2000, 2017). IDEO, for example, has invested heavily in facilitated group brainstorming (Simsarian, 2003). Yet how improvisation contributes to this process remains an open question. Time also matters. Simonton (1998), building on Wallas’s (1926) stage model, suggests that more novel ideas may need longer

incubation, which industrial settings rarely allow. Methods that economize time and prevent fixation, the mental block that keeps a concept locked in familiar interpretations (Duncker, 1945), are therefore valuable. Improvisation may help by prompting reflection-in-action, a dialectical exchange between perception and expression (Schön, 1983).

RePlay, as its title suggests, is a relaxed, playful, and reflective approach to collaborative creative process. For this study, I drew on my supervisor Alan Dix's BadIdeas method (Dix et al., 2006), which uses a deliberately "bad" or "silly" idea as a starting point, encouraging divergent thinking before leading participants into convergent, analytical reflection. One of its suggested prompts is role-play, in which participants imagine a use case where a BadIdea might be useful.

My aim at this early stage was to create a playful environment in which creativity could be observed in action, scanning the terrain of the creative process much as one does when first embarking on a project. I wanted to test whether reflection and context could be brought into the early stages of creative work rather than left until later, by coupling improvisation with reflection through an audio protocol and a prop, and to explore whether this would strengthen the embodied dimension of the process. Because improvisation is ephemeral, RePlay generated video traces to create opportunities for reflection. It thus functioned as a probe, as an intervention for studying creativity, and as a starting point for a creativity support tool. The study took the form of an Impro session with five actors, with reflection built in both during and at the end of each session.

Figure 5.1
Early RePlay Diagram 1



Note. Made by the author.

Combining BadIdeas with improvisation and verbal externalization was intended to induce reflection early in the creative process and to observe whether it opened new directions or

requirements (Dix et al., 2006). Informed by Sawyer's (1999) research on jazz improvisation, one actor was embedded in the group as a reflector, verbally externalizing what was happening as a running protocol. A prop acted as a constraint, steering the improvisation toward the properties of a particular BadIdea. The broader aim was to hybridize and extend BadIdeas through improvisation, iteratively developing RePlay into a process in which players work playfully through a brainstorming scenario and then play it back, reflecting on which strategies worked and which concepts needed further development.

5.7.2 Research Goals and Objectives

The goals of this pilot study were to observe group Creativity in Action using an action research approach. Key areas of interest included observing the creative process in groups, exploring the benefits of body storming, and investigating whether introducing reflection early in the creative process influences creativity and generates new directions and requirements (Schön, 1997). I proposed that by emphasizing context and reflection through improvisation and the use of a props, there would be a stronger emphasis on an embodied approach to the creative process and, by extension, an enhanced creative experience.

The study also explored two specific research themes. The first concerned how individual creativity is situated in relation to the object being created, the audience or client, and the environment. In other words, the contextual and environmental dimensions of creativity that call for an embodied approach. The second asked whether introducing early reflection influences creativity and creates new directions, with reflection understood not only as a process concern but also as an engagement with embodiment, experience, and the phenomenological dimensions of cognition. As Varela et al. (1991) argued, embodiment was a concept that had been largely missing from traditional cognitive science.

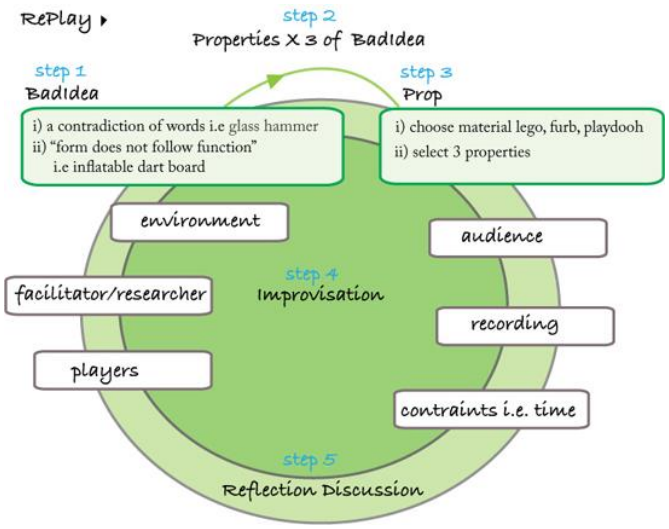
The specific objectives of the study were: to explore improvisation as a reflection technique incorporating both physical and verbal externalization; to learn more about the use of cultural probes; to test the use of video recall and how to codify results; and to explore the role of a reflector within a group.

5.7.3 Research Design

Using a prop as a catalyst, participants were asked to improvise use cases based on the BadIdeas method (Dix et al., 2006), exploring which materials best served the process and how to make effective use of a prop. Improvisation was used to extend upon Dix's approach to random association and reflection by embedding a reflector in the group, whose role was to verbally externalize what was happening in the scene as a kind of running protocol. The prop functioned as a constraint, guiding the improvisation toward exploring the properties of a given BadIdea. The

aim was to hybridize and expand upon the BadIdeas method through improvisation to iteratively develop RePlay.

Figure 5.2
Early RePlay Diagram 2



Note. Made by the author.

This pilot study was conducted at a local community center with a group of local improvisation actors. The troupe, that had been working together weekly for several months. Normally the group worked on long-form improvisations with an expert improviser as facilitator, meeting regularly to develop technique as well as for enjoyment. Long-form improvisation focuses on building story and character through extended dialogue. The pilot study involved two teams of approximately three to five members each. Teams were first asked to brainstorm a scene based on a bad idea, identifying the qualities of the idea and exploring how it might function as a good one. In the first set of scenes, participants were encouraged to use props such as Lego and a Furb. The facilitators being myself the lead researcher, and an experienced improviser called out the cues "expand" and "advance," techniques drawn from Impro practice (Johnstone, 1998): "expand" to broaden the context or environment, and "advance" to push the story forward. After performing the scenes, actors were asked to reflect on the method and discuss how it might be improved. The bad ideas used in this session were: underwater karaoke, fluorescent camouflage, a black light bulb, and an icicle fireplace.

The exercise was time-limited to approximately five minutes, consistent with the short-form Impro framework. The goal was to test out the BadIdea method as an improvised scene, observe the process, and use actor feedback to adapt and develop the RePlay method for later use in applied design contexts. The exercise involved four to five actors and one reflector, and the five-minute performance was videotaped for later discussion and evaluation.

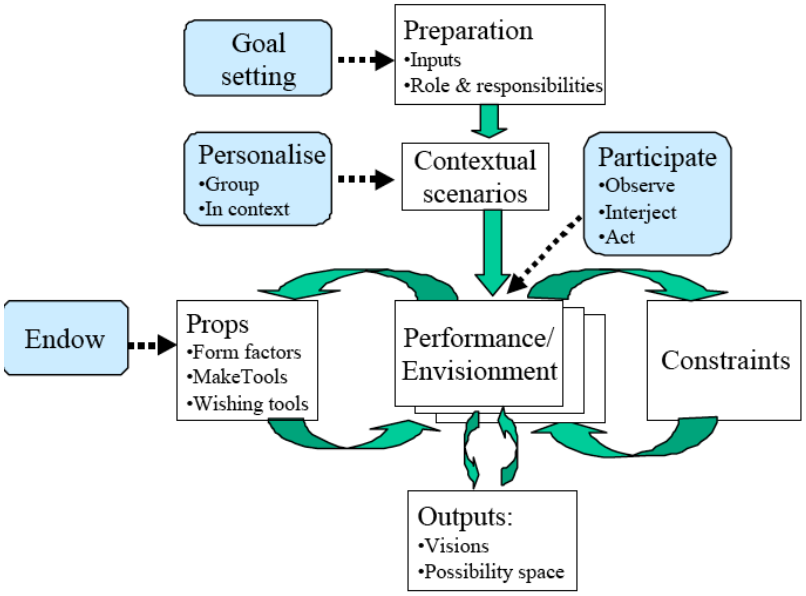
5.7.4 Risks

i. It was not clear how well this study would translate across disciplines such as art, design, and computer science.
ii. Due to the performative nature of the process, it might not be suitable for participants who are shy or self-conscious.
iii. Due to personality traits and group dynamics, some ideas might be overwhelmed
iv. by more dominant voices.

5.7.5 Props in Design

Props have a history of use in design research to collect feedback and other pertinent information. Carroll and Tobin (2003) have used props and body storming as part of their research on design innovation through technology, referring to this process as "envisionment" meaning, a user-centred design approach focused on the interaction between users and technology (see Figure 5.3). The props in their framework were endowed with technological functionalities such as GPS, video, and audio, and the design team provided constraints through real-time input to players regarding the props being used in the performance.

Figure 5.3
The Revised Envisionment Process



Note. Adapted from Caroll and Tobin (2000).

Carroll and Tobin (2003) suggest that "emotional make tools" meaning items such as scissors, glue, scrapbooks, cameras, stickers, Lego, and building blocks enhance the envisionment process. As they describe it, these tools are either emotional or cognitive in nature: they are used to create artefacts that show or tell stories, through which users can express feelings, dreams, fears, and aspirations. This resonates closely with the spirit of cultural probes. By selecting props with open-ended

materials, the aim was to facilitate rather than narrow the possibilities of interaction, which informed the following criteria for prop selection in this study.

5.7.6 Props Key Criteria

i. Universal design and flexibility, with little or no strong cultural references that could impose a fixed symbolic language.

ii. Tactile quality and structural adaptability, allowing for fast prototyping given Impro's time constraints.

iii. Experiential associations with "play," to foster a relaxed and open atmosphere.

Figure 5.4
Furb



Note. Photograph by the author

With these criteria in mind, four materials were considered. Felt was the first option — easy to use and flexible for mock-ups due to its softness. The second was the Furb, a squishy ball with rubber spikes that invites tactile play and carries few cultural associations beyond a general connection to childhood. The third was Lego, which, while culturally familiar, carries strong associations with childhood creativity and allows for rapid structural prototyping. The fourth was Play-Doh, a malleable clay-like material well suited to quick modelling, though its stickiness and odor can make it harder for participants to engage with comfortably.

5.7.7 Results

The participants and I observed that the BadIdeas method offered a productive starting point for exploring improvisation and developing RePlay. One key finding, however, was that the props

namely, Lego and the Furb, did not support the process as much as initially expected. This may have been because the actors, being experienced improvisers, did not require a prop as an anchor.

In the first session, players improvised the BadIdea "underwater karaoke" using Lego as a prop. The facilitator called out "expand" and "advance" as prompts, but in the reflection phase the other facilitator noted that actors tended to ignore these cues, preferring to improvise freely. This was seen as potentially detrimental to the conceptual development of the bad idea, as actors were more drawn to storytelling than to exploring the idea's properties. The prop also proved more of a hindrance than a help as actors struggled to incorporate it into the scene. In the reflection component of the study, the improvisers discussed contextual choices such as a swimming pool versus the ocean and found it difficult to move beyond comedic or superficial interpretations of the bad idea.

Figure 5.5
RePlay Scene 1: Using a Prop



Note. Photograph by the author.

In the second scene, actors attempted to convince an audience about their product but again struggled with the prop and became more focused on its materiality than on what it was meant to represent. In reflection, participants noted that they were distracted by the "advance" and "expand" prompts and found it hard to make the bad idea believable. They felt that some context-setting beforehand would have helped even though this would go against the traditional Impro principle of jumping into a scene without preparation.

The second set of sessions worked considerably better. Participants were asked to discuss not only the properties of their bad idea but also its possible contexts, location, time of day, use case. The third scene, improvising the black light bulb as a product commercial, was notably more successful. The actors brainstormed a range of uses for the product, including: a means to trick a child into sleeping during the day; an inexpensive substitute for painting white walls; and an atmospheric device for those wishing to mourn or create a gothic ambience.

The final scene, centred on the icicle fireplace, generated particularly rich discussion. The actors explained the technology behind the idea and noted that the melted water could be channelled into a garden, reframing the bad idea as an environmentally conscious product. The conversation expanded to comparisons with air conditioning, aesthetic customisation (a "Gucci fireplace"), and backlighting strategies. In reflection, participants noted that some pre-planning had been very helpful, that letting go of strict realism presented a wider range of possibilities, and that they had already prepared multiple contexts in anticipation of the "advance/expand" prompts.

Overall, the second half of the pilot study demonstrated that creative potential was better facilitated when groups had time for some initial planning and when they were given a clear framing prompt such as "sell the product." The exercise also functioned better when participants could reflect immediately after, while the experience was still fresh. The role of the facilitator was important: prompts are sometimes needed, alongside a working knowledge of traditional Impro techniques.

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5.7.8 Discussion: Improvisation and Design Process

The results of this pilot study connect to a broader body of work on the role of the body in design. Loke (2009) argues that design which does not account for the body risks becoming speculative and ungrounded in lived experience. Her work analysing video recordings of body movement in the design of the video game ETOY demonstrates how an embodied approach can surface nuances that might otherwise be missed. Had improvisation been used in the early stages of that project, pitfalls might have been identified before prototyping even began.

A related approach is "place storming" (Anderson and McGonigal, 2004), in which participants construct scenarios in different locations based on specific missions while using a prop. Place storming builds on the concept of "informance" (Burns, Dishman, Verplank, et al., 1994), used by IDEO, as well as "focus troupe" methods (Sato and Salvador, 1999; Salvador and Howells, 1998), which apply drama within a participatory design approach to collect contextual information about a target group. IDEO employs performance techniques, including role play, throughout its design phases — from early brainstorming through to communicating design outcomes to an audience (Simsarian, 2003). When used in the latter capacity, this is termed an "informance" (Burns et al., 1994). Simsarian (2003) notes that recording these scenarios tends to heighten their quality. IDEO's

practice suggests that role play is being used, even if not always explicitly named as such, to build in opportunities for contextual reflection at multiple stages of the design process

The results of this pilot study were consistent with other studies. Props, which embodied enactment, and structured reflection all contributed to the quality of the creative output particularly when the exercise was framed clearly, and participants were given some latitude to plan. This points to the value of RePlay as a structured yet flexible tool for early-stage design ideation.

5.7.9 Props and Embodied Creative Process

Carroll and Tobin's (2003) concept of "emotional make tools" for example materials such as scissors, glue, scrapbooks, cameras, Lego, and building blocks suggest that open-ended props facilitate rather than narrow the possibilities of creative interaction. This informed the criteria outlined above for selecting props in this study, and points to a broader principle: props work best when they invite association and play rather than constraining interpretation.

5.7.10 Reflection on Embodied Creativity

After the session, participants were asked to watch a recording of the improvisation session and listen to the audio recorded by the reflective actor, then comment on the usefulness of RePlay and reflect on the ideas that emerged. Carroll and Tobin (2003) structure reflection by asking actors to consider their actions, goals, and motives. The use of props and whether they assisted or hindered the process was also considered.

The method proposed here acknowledges the importance of situatedness, as articulated by Suchman (1987) in *Plans and Situated Actions*, and the role that embodiment plays in consciousness. It also draws on Schön's (1983) concept of "reflection in action." Varela et al.'s (1991) "middle way" approach bridges both, arguing that mental representation is shaped not only by internal cognition but by its structural coupling with the external environment a process Varela et al. illustrate through the analogy of colour perception, which has both biological and cultural foundations. This has direct relevance to participatory design since the context for which something is designed, and the people for whom it is designed, should be woven into the design process from the outset, not treated as external factors. Varela et al. (1991) draw on Merleau-Ponty's (1945) insight that perception is not purely mental but actively constitutes our surroundings, as well as on Buddhist mindfulness practice as a model for training attentiveness to mental processes.

> *How is it possible for something that exists only in our imagination to become a reality? It is a remarkable quality of the mind that we first create objects with our imagination and then bring them into our everyday reality... In reality the mind is the creator of all experience... If we imagine something that could in theory exist and then familiarize our mind with it for long enough, eventually it will appear directly to our mind, first to our mental awareness and then even to our sense awareness. (Gyatso, 2001, p. 152)*

5.7.11 Conclusion and Future Work

At the time of this study, the variables of RePlay were still being defined, and use cases were still being explored. By keeping things open-ended at this stage, it was possible to involve practitioners from outside the design as a discipline and to focus on developing the framework rather than on solving a specific design problem. By having participants engage in both verbal and physical externalization, my hope was that they would reach a level of brainstorming and reflection that had not previously occurred in their creative process. The use of a prop provided constraints that guided the creative process while at the same time prompting the team to consider context as part of their conceptual thinking. A positive by-product of RePlay, as this study suggested, could be the early flagging of overlooked requirements such as target audience or cultural context before they become costly problems later in the process.

Despite its experimental nature, this pilot study offered important insights into what was and was not working with RePlay. Future iterations might explore a wider range of improvisation techniques, different props and materials, and a design team context in which the BadIdeas method serves as a warm-up before participants tackle applied design problems. In terms of creativity research, further theoretical work on the role of social interaction in the creative process would also be valuable. Future RePlay sessions conducted in an industrial context might explore not only product design but also service design and more complex design challenges such as urban planning. One technique worth exploring is Sawyer's (2003a) "Yes, and..." method, which encourages openness to others' ideas by beginning each contribution with affirmation, preventing premature blocking or evaluation. It would also be interesting to explore vignette-based structures, in which participants work through a rapid sequence of scenes — for example, first describing a context in which the product might be used, then explaining it to a new user, and finally presenting it as a commercial.

5.8 Phillips Study #2: Brainstorming is a Bowl of Spaghetti: An In-Depth Study of Collaborative Design Process and Creativity Methods with Experienced Design Practitioners

5.8.1 Introduction

This study comprised in-depth interviews and a visual mapping exercise conducted at Philips Design Research and the Technical University Eindhoven in the Netherlands with four designers. The goal was to learn more about how experienced designers interact with creativity tools in collaborative, often multidisciplinary teams during the early brainstorming stages of the design process. Key issues covered include the role of conversation, cross-disciplinary collaboration, facilitation, physicality, planning, reflection, and associative thinking.

5.8.2 Background: Creativity and Innovation

Creativity research spans philosophy, psychology, design, generative art, artificial intelligence, and business. Early psychological research focused on the traits of the creative individual (Sternberg & Lubart, 2010), while design research has turned to decision-making within design activity (Ball & Christensen, 2009). AI research seeks to model creative processes computationally (Boden, 2004), as in robots that draw from internal rules and environmental input (Bird & Stokes, 2006; Tresset & Leymarie, 2007). In generative art, creative processes are often modelled mathematically, blurring the boundary between creator and creative product. Net artist Mindaugas Gapševičius's Carpet/?s, for example, lets clients purchase a personalized carpet made from ASCII characters, generated by an application that mines the internet for keywords (Gapševičius, 2006; see Figure 5.6). The project simulates the associative process central to early-stage creativity, although its associations are pre-programmed rather than emergent.

Figure 5.6
Carpet/?s



Note. Artwork by Mindaugas Gapševičius. Used with artist's permission

5.9 RePlay as an Embodied Design Process

Neuroscience has added empirical detail to philosophical accounts of embodiment (Gallagher, 2005, 2007). For example, de Manzano et al. (2010) associated dopamine D2 receptor density in the thalamus with performance on divergent-thinking tasks. In this work, as in the drawing robots and Carpet/?s, creativity is typically modelled as an individual event. Sawyer (2017) argues, by contrast, that creative outcomes are collaborative even when we are unaware of it, and that more diverse groups tend to produce more novel results. This research therefore looks beyond the individual to how creativity is shaped by group dynamics, environment, and the tools and spaces that support it.

Shneiderman (2000) describes four phases of creative work: collect, relate, create, and donate. This case study focused on the create phase, examining RePlay in relation to traditional brainstorming and its potential role in professional design practice. RePlay was used as a meta-design method and probe within an exploratory, descriptive, action-based research strategy. It is meta-design because it operates at a level above designing itself, seeking to understand and better facilitate the internal and external forces at work.

Design is cross-disciplinary in its problems, teams, and methods, and many of its tools are borrowed from other fields, such as cultural probes from ethnography (Gaver et al., 1999) and eye-tracking from psychology (Schrammel, 2009). As discussed in Section 3.6, reflection is often prompted by external representations and artefacts. This study is particularly concerned with how artefacts created during interaction can become resources for explicit reflection. Some traces, such as sketches and mind maps, persist naturally; others, such as conversation and improvised action, are ephemeral and leave no record unless one is deliberately created.

5.9.1 Research Goals

The aim of this study was to learn how experienced designers interact with creativity tools in collaborative, multidisciplinary teams during early brainstorming. The intended outcome was a set of descriptors for the early conceptual stages of the design process, along with feedback on methods such as sketching, Post-it notes, and mind mapping. Key themes of interest included conversation, cross-disciplinary collaboration, facilitation, physicality, planning, reflection, and associative thinking. The study also sought to understand whether role play, or gesture featured in the participants' design processes, and whether designers would be open to trying enacted brainstorming. Data collected was then fed back into the development of RePlay.

5.9.2 Research Design

The study was conducted at Philips Design Research in Eindhoven and at the Technical University Eindhoven, with four volunteer participants three of whom were from Philips Research and one from TU/e. At Philips, design research is conducted by a dedicated department, and results are later shared with the broader design team. All three Philips participants were professional designers. The four participants are referred to here as Beth, Antonella, Luis, and Divo. The study was conducted in two stages: first, a traditional exploratory interview to surface methods and activities used as part of the design process; second, an exercise deliberately designed to disturb participants' assumptions and prompt reflection on those activities.

5.9.3 Interviews – What Happens in Design

Participants reflected on the methods they use in the brainstorming phase of their design process. Key themes that emerged included the importance of conversation, role play, gesture, and associative thinking to early-stage brainstorming.

5.9.4 Reflection – What is Important to Design

In the second half of the study, participants worked with a set of images representing different design activities, arranging them to visualize their design process. The facilitator then progressively removed activities and asked participants to predict how their absence would affect the outcome. Participants also grouped methods into larger categories to identify which tools they used at which stages. Images were removed until the participant indicated they could no longer work without them. Figures 5.7 and 5.8 show one participant's visualization before and after this exercise. Figure 5.8 (b) shows what as left as well as the outcome after removing images from the visualization.

Figure 5.7
Initial Exercise: Luis's Results



Note. Photograph by the author.

Figure 5.8
Second Part of Exercise: Luis's Results



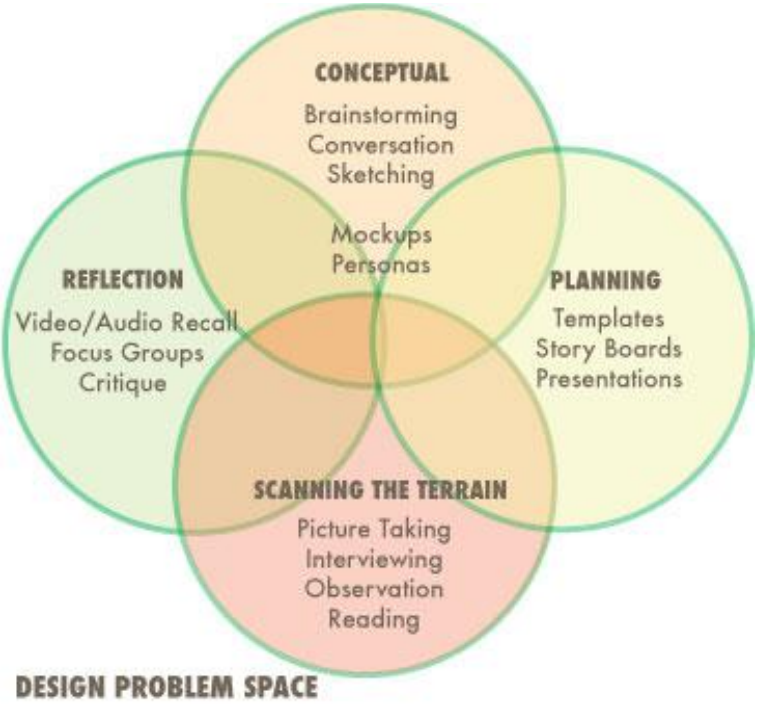
Note. Sorting images during reflection phase: *1- conversation, *2- projecting, *3-brainstorming, *4- sketching, *5- moodboards, *6-storyboards, *7 role-play, *8 prototyping, *9- focus groups, *10- presentations, *11- reflection, *l2- photographs, and *13- daydreaming, *14- user insights

This progressive removal of images is acting as a form of breaching experiment (Garfinkel, 1966) or deliberate estrangement strategy (Dix, 2010): that is by disrupting the designers ordered view of their world forcing a level of reflection on their own general design processes.

5.9.5 Observations and Discussion

Design processes were highly individual, though the most consistent themes across participants were planning, scanning the problem space, brainstorming, and presentation, with different strategies of reflection woven throughout. As shown in Figure 5.9, designers moved fluidly between these phases rather than following a fixed sequence. However, the ways in which each participant collected data was unique, even when a common prescribed workflow existed. Some were more visual in their approach, others more conversational. For the most part, the role of the physical environment seemed to play little conscious role in participants' design processes. Only one indicated that he drew inspiration from his immediate surroundings.

Figure 5.9
Summary of Design Problem Space



Note. Made by the author.

Other RePlay studies have explored prompting designers to interact more with their physical surroundings and bring physicality into their process. In this study, triggering designers to draw on their own tacit knowledge served as a catalyst for the creative process, sparking embodied knowledge in others.

When asked directly about their methods, participants' responses were self-conscious. But during the reflective mapping exercise, the visual aids worked as a distraction from self-consciousness, making the process more informal and authentic. Designers were then able to reflect more openly on their process, mapping it out, discussing missing steps, asking for clarification, and in some cases responding emotionally to the prompts. Everyone named sketching as their primary method of communicating an idea. The importance of the facilitator was consistently underlined: someone with a bird's-eye view of the process who can steer it in particular directions as a guide, not a director.

5.9.6 Brainstorming

Interview questions in the first part of the study focused on early-stage brainstorming, where RePlay is most relevant. Brainstorming is characterized by divergent thinking followed by more convergent thinking that creates categories and themes. While the overall goals are common, the methods used vary considerably. Many were unsurprising such as conversation, mind mapping, Post-it notes, whiteboards. What was notable was how sketching functioned for Beth and Luis not

just as a recording tool but as a form of visual brainstorming, with team members drawing on top of each other's sketches to develop and communicate ideas.

Philips participants distinguished between open-ended thematic brainstorming and brief-driven brainstorming. One interviewee found thematic brainstorming more enjoyable and freer, though another noted its risk: without a clear brief, it can be difficult to channel novel ideas into actual projects.

5.9.7 Facilitation

This observation of the role of the facilitator arose repeatedly: As Luis put it:

"*Yea it's the most important thing for me — there should be one person who is overlooking the process and looking from a place in terms of orchestrating it, because some of the people in the group they need to lose themselves in order to be productive.*"

However, this facilitation process must maintain a delicate balance since as facilitator one needs to be a guide and not a director of the outcome. Later in the interview this point of view came across through Luis making an analogy between designers being like cats. Luis captured this through an analogy:

"*I really like this expression that designers are like cats… they have their own space, their own way of doing things, their own way of playing, and so they need that space — but they also like to play with each other. But if you try to put some sort of ring around them, they will start to resist.*"

There seems to be a catch to the whole process in that as a facilitator one should not be prescriptive with a method such as sketching. However, the facilitator can have the knowledge and experience to understand which method to utilize in the process to push the process in a particular direction or make the team more aware of their own processes.

Luis also cautioned against being too structured, as this can limit the process. This resonates directly with findings from the RePlay pilot study, where the "expand" and "advance" prompts blocked the improvisers' flow rather than supporting it (Johnstone, 1989; Gongora, 2010b). Facilitation is a delicate balance between guiding a process and directing it.

5.9.8 Planning

A surprising theme was the importance participants placed on planning meaning not as project management, but as the initial gathering of background materials and insights before brainstorming begins. Without this preparation, participants felt that brainstorming was essentially useless. At Philips, this planning phase typically involves approximately three months of collecting "user insights" distilled into summaries of research about a target group. These are gathered through cultural probes, diaries, interviews, and personas which are later verified with users and

presented as part of the brainstorming process. Philips is committed to a participatory design approach in which user insights are incorporated from the outset. The TU/e participant similarly recommended the use of personas. In the second half of the study, three of the four participants stated that they could not arrive at a product or service without a prior planning phase; the fourth felt that planning through conversation could substitute for more formal preparation (Fig 1.5, 1.6, 1.7). One said he could do planning through conversation instead see previous Fig 1.4.

Figure 5.10
Second Part of Study: Divo's Results



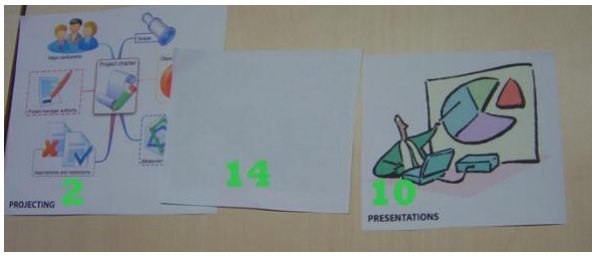
Note. Photograph by the author.

Figure 5.11
Second Part of Study: Antonella's Results



Note. Photograph by the author.

Figure 5.12
Second Part of Study: Beth's Results



Note. Photograph by the author.

5.9.9 Social Dynamic and Divide

When asked to delve into the nature of the creative process all of those interviewed agreed that diversity in disciplines and background was good however that it was important that the group have trust and a good social dynamic. One the interviewees described the process as becoming more "colorful" when there was a history amongst the members of the group. One or two of the designers mentioned that sometimes the engineers due to their educational background may not

value as much the brainstorming process and that at Philips it was a struggle to communicate user insights across teams for example marketing and engineering. This may reflect a broader difference in orientation: designers tend to be problem-space focused, while engineers tend to be solution- and technology-focused.

RePlay is well suited to this kind of cross-disciplinary tension. By putting all participants in unfamiliar territory through embodied, theatrical techniques, it creates a shared experience that bypasses disciplinary defensiveness and opens another level of communication beyond conversation. Beth observed that in brainstorming, language itself works as a perceptual trigger this is what Sawyer (2003b) calls indexical conversation. The question is whether body storming could have the same effect, triggering others' embodied knowledge as well as their verbal associations. This is reflected in Beth's feedback:

"*ye that's the point of collaboration or teamwork. You will talk about something and that will just trigger something else which I won't be able to do by myself.*"

"*It works for me because I need reflection- then the idea comes up more easily or it will just work. I might need that trigger to be more creative in some cases.*"

5.9.10 Role Play and Gesture

Most participants did not formally use role play in their practice, though none were averse to trying enacted brainstorming. In the visual mapping exercise, only one participant included role play among their listed methods. Gesture, however, emerged as a more common and significant part of the creative process, particularly when participants felt relaxed and unselfconscious:

"*.... I use it a lot but I need to forget myself or be really involved in what I am talking about sometimes my friends commenting that I have Kermit gestures. But I need to be really involved and forget how it is that I look. I mean this is also the same situation where I need to be comfortable.*"

Interestingly, the participant who claimed use gesture very little was in fact one of the most gestural throughout the interview. This suggests an unconscious bodily engagement with creative thinking that mirrors earlier observations about the unreflective nature of embodied cognition

5.9.11 Reflection

Like planning, the role of reflection in the design process was consistently underestimated or at least less consciously accounted for. All agreed that reflection was important, with one participant noting she wished she had done more of it. Luis described reflection as embedded throughout his process; Divo used it at staggered points to evaluate what was and wasn't working; Beth used Adobe Illustrator as a tool for organizing and reflecting on her process. Reflection in this context operates in several modes: reflection in action (while designing), reflection on process, and reflection as a form of open-ended daydreaming.

5.9.12 Summary of Results

Design processes were highly individual, though consistent themes emerged: planning, problem-space scanning, brainstorming, and presentation, with reflection woven throughout in various forms. As shown in Fig 1.8 designers moved fluidly between phases. How each interviewee went about collecting data however was unique even though some had a common prescribed workflow they had to follow. Some were more visual and others more conversational. The physical environment played little conscious role in most participants' processes and seemed be of little inspiration to their process. When asked directly about their methods, responses were self-conscious; but the visual mapping exercise loosened this, making reflection more authentic and emotionally engaged. Sketching was universally identified as the primary method for communicating ideas. The facilitator's role as more as guide rather than a director was consistently valued by the participants.

5.10 Case Study 3: Sims

5.10.1 Summary

This study followed the Philips Design study, which focused on the tools and methods designers use as part of their creative process. The motivation here was similar being to gain insight into creative process however in the context of an artist rather than a designer, and with a particular interest in the relationship between materials and form. This research was completed at an artist residency with The Association of Icelandic Visual Artists (SÍM) in Reykjavik, Iceland.

5.10.2 Research Goals

The goal of this research was to explore a visual method of collecting data about creative process, rather than relying solely on interview data. I named this experimental technique "shadowing" and the resulting artistic work "traces." The work was partly creativity research, partly experimental design research, and partly artistic in nature.

5.10.3 What is a Trace?

A trace is a delicate exchange in which the artist shares reflections about their creative process while working, and the researcher/artist shadows them, creating visual snapshots of what the researcher interprets as recurring themes. In this case, those snapshots took the form of postcards. The artist I collaborated with, Monica Holl, was encouraged to share more abstract thoughts about creativity, experience, and her relationship to materials. One outcome was this exploratory research; another was the creation of an artistic work from the data gathered.

5.10.4 Research Design

This work was inspired in part by the performance artist Vito Acconci and his piece Following Piece (1969). Acconci (January 24, 1940 – April 27, 2017) was an influential American performance,

video, and installation artist whose practice also spanned sculpture, architectural design, and landscape design. Following Piece took place on the streets of New York between October 3rd and 25th, 1969, as part of an event sponsored by the Architectural League of New York. Each day, Acconci selected a passer-by at random and followed them until they entered a private space. In doing so, he submitted his own movements entirely to those of strangers, demonstrating how bodies are always subject to external forces beyond our control (McMahon, n.d.).

Following Piece resonated with me because it acknowledges the relationship between the external and the internal and how context and environment shape perception. By shadowing strangers, Acconci steps into their consciousness while remaining within public space and his own. The lines between self, other, and space become blurred.

Figure 5.13
Vito Acconci, Following Piece (1969)



Note. Acconci, V. (1969). *Following piece* [Gelatin silver prints, felt-tip pen, and map on board]. Museum of Modern Art, New York, NY, United States.
https://www.moma.org/collection/works/146947

I applied a similar shadowing strategy with sculptor Monica Holl. At times this meant being present in her studio; at others, following her as she explored Reykjavik. Unlike Acconci's subjects, Monica was aware of being followed, though neither of us had a predetermined agenda. Her practice involves site-specific work, and her choices of materials and installation locations are deeply tied to place. Several interviews were conducted at her studio as well as in informal settings and on site. Photographs and notes were taken, which later informed the creation of a set of postcards displayed in a gallery and subsequently sent to the conceptual artist Dan Graham, whose work

with pavilions in public space engages with notions of space, architecture, reflection, and individual perception. Graham's pavilions explore the boundary between art and architecture.

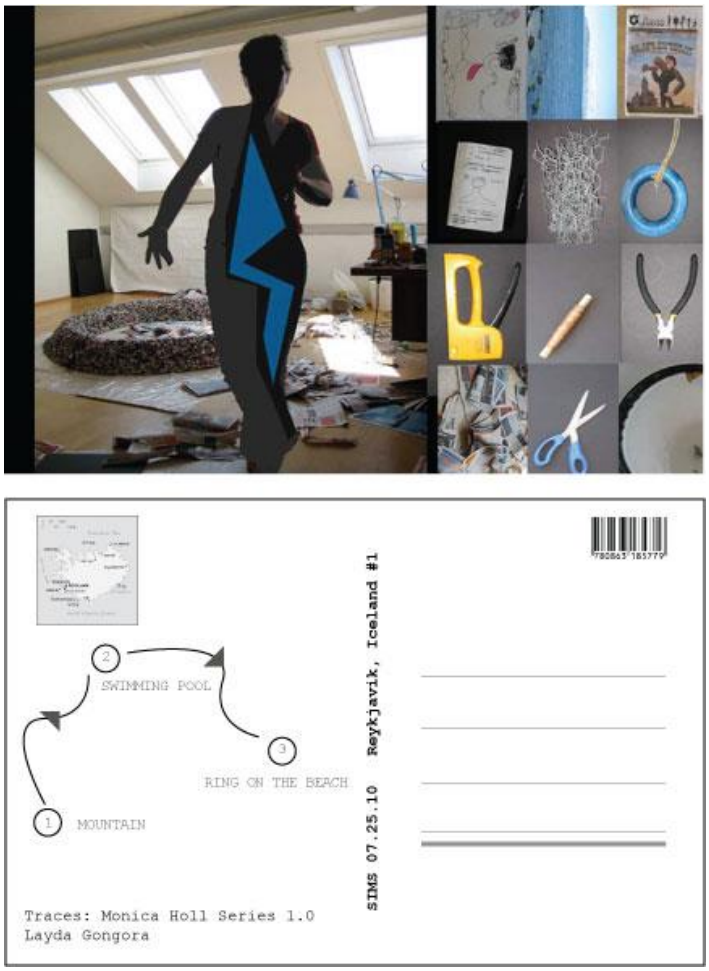
In my conversations with Monica the objects and tools that the artist uses as well as mental models were discussed and how this informed her creative process. The focus of the interview was to encourage the artist to share more abstract thoughts about creativity, experience and their relationship to materials and process. In the role of researcher/artist I then reflected upon the qualitative data gathered and created postcards as an artistic interpretation of what had been shared. Some of the words on the back of the post cards are quotes, reflections or documentation of the event. The postcards themselves embody the ephemeral nature of creative process.

5.10.5 Observations and Discussion

Figure 5.14
Trace 1

It is challenging to discuss the results of this process in writing, since the intended outcome was a visual representation of the data rather than a written analysis. Nevertheless, witnessing another artist's process from the outside was valuable from a research standpoint: it allowed me to observe and articulate what is often overlooked in the making of a product, service, or artwork, precisely because the goal of artistic activity is the work itself, not the processes that lead to it. I was therefore able to offer feedback to Monica about strategies, associations, mental models,

and patterns of working with her tools that she had not previously made explicit.

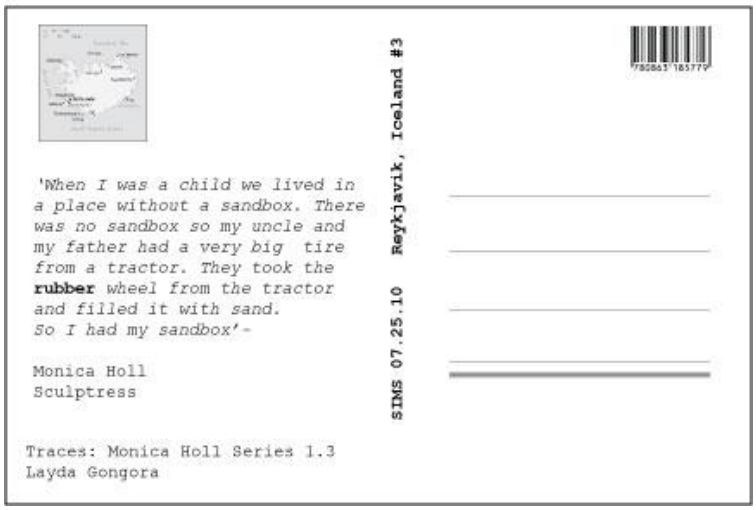


Note. Postcard by the author, 2010.

Figure 5.14 is an interpretation regarding the artist Monica's, description of her relationship to materials, the location and her creative process.

Figure 5.15
Trace 2

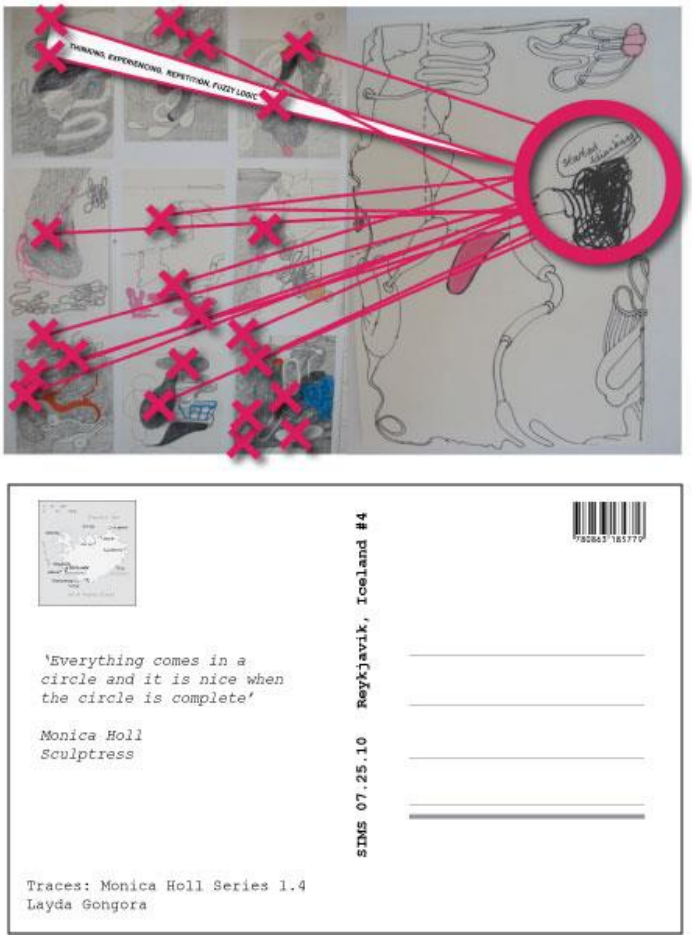




Note. Postcard by the author, 2010.

Trace 2 relates to memory, experience and creativity as an embodied activity.

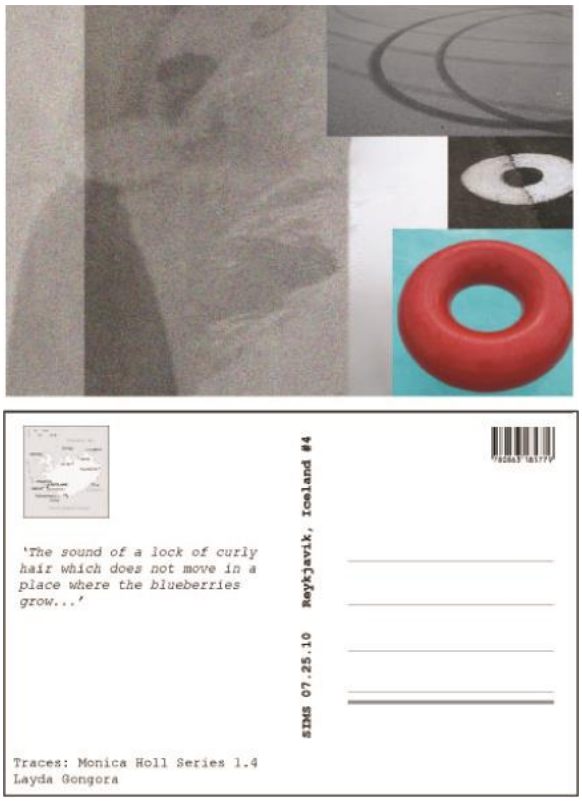
Figure 5.16
Trace 3



Note. Postcard by the author, 2010.

Trace 3 explores repetition and mental models used as part of the creative process.

Figure 5.17
Trace 4



Note. Postcard by the author, 2010.

Trace 4, the final piece in the series, focuses on the role of location and environment in Monica's work in this case, Reykjavik. The images represent concepts such as the unconscious, movement, energy, and association. This trace moves into more metaphysical territory, gesturing toward aspects of creative experience that language can only partially describe. It also depicts the backdrop of our conversations as another layer of the creative process. The final step was to send the postcards to another artist, as an impetus to continue the conversation about creative practice.

5.10.6 Summary of Results

This exploratory research revealed parallels between creative processes in art and design: ideation, planning, preparation, reflection, and evaluation appear across both domains. It was useful to see how an artist works through concerns like those of a designer, using comparable materials and forms. While Monica does not use role play, her work is deeply centered on the relationship between materials and physical environment. Particularly striking was her use of repetition as a tool for working through the creative process. Circles recurred as a motif throughout her drawings, photographs, and final work. In future research, it would be interesting to explore the role of repetition in creative process more broadly, and how it functions to anchor and develop creative thinking.

5.10.7 Summary of Work Presented in this Chapter

This phase of the research project was informed by an action research approach carried out over approximately two years of weekly workshops, intensive workshop periods, exploratory studies, and an artist residency. The first study involved experimental action research with improvisers, using the BadIdeas method as a starting point to develop RePlay and build my facilitation skills. The second study sought to better understand the tools and challenges of professional design practice, and to explore the openness to and opportunities for introducing an embodied approach to design process. The third study took a more experimental, arts-led direction, exploring an artist's creative process and examining how it related to what I had come to understand about design process.

Other techniques developed during this phase included the use of props, which in Phase 2 became the basis for something I called "trigger objects" (discussed in later chapters); design mapping, which resurfaces in the Global Studio case study; and shadowing, inspired by the work of performance artist Vito Acconci, which led to the concept of the trace, a visual interpretation of an artist's creative process and its recurring themes.

5.10.8 Research Questions Answered and Research Objectives Met in this Chapter

This chapter described an exploratory phase of the research project exploratory not only in terms of methodology but also in terms of identifying ways in which an embodied creativity technique might support creative process. The approaches and techniques explored here were informed by the literature review across design, cognition, creative process, human-computer interaction, and philosophy. The chapter focused on how RePlay might support awareness of one's own creative process through what we know about improvisational creativity. It also documented the early development of several of the games and techniques for data collection that would be used in RePlay in subsequent phases of the research.

5.10.9 Considerations for the Next Chapter

The case studies chapter that follows considers ways to evaluate what was happening during a RePlay session, using a method called TAPT, and relates those findings to what was learned about creative process in this phase. RePlay is also applied in a much more direct fashion as a tool for developing a product and for participatory design as part of urban planning. The next chapter also explores more deeply what it is about externalizing with the body that supports the creative process and develops the more theoretical dimensions of this research. While this chapter was experimental and exploratory in character, the case studies chapter makes more concrete the hybrid games developed for use within RePlay, as well as the techniques introduced here such as shadowing, trigger objects, design machines, and design mapping, among others.

Chapter 6: Creativity in Action

"Perception is not something that happens to us, or in us. It is something we do."

— Alva Noë, Action in Perception

6.1 Introduction

The previous chapters established the conceptual, practical, and methodological foundations of this thesis. Chapter 1 situated the research within creativity studies, tracing a movement from individual, cognitive, and product-oriented accounts of creativity toward systemic, embodied, relational, and situated models. Chapter 2 examined improvisation and embodiment as foundations for RePlay, while Chapter 3 positioned RePlay as a creative sandbox: a structured but flexible space for embodied experimentation, externalization, reflection, and collaborative risk. Chapter 4 explained the methodology used to study collaborative creativity, and Chapter 5 described the exploratory research through which RePlay was developed and refined.

This chapter develops the central theoretical contribution of the thesis: Creativity in Action. I use this term to describe the lived, situated process through which creative meaning unfolds between people, bodies, tools, environments, constraints, and emerging possibilities through embodied, relational, improvisational, and reflective engagement.

The purpose of this chapter is to clarify the term Creativity in Action, explain why the concept is needed, and establish how it contributes to creativity research. It also distinguishes Creativity in Action from RePlay, the framework through which this process is facilitated and studied. The chapter examines presence, responsiveness, attunement, suggestibility, improvisational fluency, and embodied reflection within collaborative creative practice, and considers how participants' capacities for this engagement can be cultivated.

6.2 Defining Creativity in Action

In this thesis, Creativity in Action is not offered as a replacement for existing creativity theories but as a bridging concept. It brings together insights from creativity research, improvisation, design practice, embodied cognition, systems thinking, and participatory methodology to describe a form of creativity that is enacted, relational, and emergent. RePlay provides the methodological framework; Creativity in Action provides the theoretical vocabulary for interpreting what unfolds within it.

> ***Creativity in Action refers to an embodied, relational, and improvisational form of creativity that unfolds in real time through responsiveness, co-presence, affective attunement, and***

situated action. It is a form of creative capacity that becomes visible when people engage with one another through movement, gesture, language, rhythm, objects, environments, and shared constraints.

Within this shared process, participants draw on and may develop their capacity to notice emerging possibilities, respond to others, and reflect while remaining engaged in the activity. I use creative capacity to describe this ability to participate in Creativity in Action. Its expression depends on the relationships, materials, constraints, and conditions of the unfolding situation.

Alongside assessments of novelty and value, Creativity in Action focuses on the process through which creative possibilities emerge. It is concerned with what happens before a finished artifact, solution, service, design, or performance takes shape. It asks how participants sense possibilities, respond to one another, shift direction, accept or block offers, externalize ideas, and co-create meaning through action.

Creativity in Action therefore describes a process and a relational phenomenon. It emerges through the interaction between individuals, their bodies, their histories, the material environment, the social context, and the unfolding situation. During RePlay, this phenomenon became visible through moments where participants began to think through action: embodying problems, testing possibilities, responding to others, and discovering meaning through improvisational engagement.

For example, in the exploratory designer study discussed in Chapter 5, Beth and Luis described visual brainstorming in which team members drew over one another's sketches to communicate concepts (Gongora & Dix, 2010). Their account illustrates how externalizing an idea can become part of a shared creative process: a sketch provides material that another participant can respond to and develop. I interpret this as an example of the relationship between externalization and

collaborative responsiveness that informs Creativity in Action. A possibility took shape through shared enactment, discussion, and reflection on the developing idea.

Figure 6.1
Diagram of Creativity in Action



Note. Made by the author using ChatGPT.

Creativity in Action describes the felt, observable, and participatory quality of creativity as it happens. The principles shown in Figure 6.2 below provide a vocabulary for examining this process through the embodied, relational, and improvisational activity of participants.

This focus complements analysis of creative outcomes by attending to the interactions through which possibilities emerge. It asks how creativity becomes possible through shared presence, mutual responsiveness, embodied experimentation, and openness to being changed by others. RePlay

provides a structured setting in which these interactions can be enacted, documented, and reflected upon.

In this thesis, Creativity in Action is proposed as a bridging concept. It brings together insights from creativity research, improvisation, design practice, embodied cognition, systems thinking, and participatory methodology to describe a form of creativity that is enacted, relational, and emergent. RePlay provides the methodological framework; Creativity in Action provides the theoretical vocabulary for interpreting what unfolds within it.

6.3 Why Creativity in Action?

The concept of Creativity in Action brings together existing theoretical resources to interpret the phenomenon observed through RePlay. Creativity research has developed rich accounts of individual cognition, creative process, divergent thinking, flow, group creativity, and embodied action. My contribution lies in connecting these perspectives within a framework for attending to collaborative creative process as it happens.

Flow provides an account of absorption and deep engagement (Csikszentmihalyi, 2008). Sawyer's Group Genius (2017) examines collaborative creativity through interaction and improvisation. Reflection in action explains how practitioners respond to and think within unfolding situations (Schön, 1983). Embodied and enactive approaches locate cognition in the relationship between bodily activity and the experienced world (Varela et al., 1991). These perspectives provide complementary ways of understanding the processes that RePlay makes available for observation and reflection.

Creativity in Action names their intersection within collaborative improvisational design. It directs attention to how participants sense and respond to one another, externalize possibilities, negotiate shared meaning, and reflect while a situation develops. The research question is how these dimensions work together in particular creative encounters, and how RePlay helps participants and researchers attend to them.

Figure 6.2
Creativity in Action Principles



Note. Made by the author using ChatGPT.

Creativity in Action addresses this gap by naming the moment-to-moment creative process that occurs when participants are actively engaged in embodied, relational, and improvisational making. It is a concept for describing the felt, observable, and participatory quality of creativity as it happens.

This distinction is important because much creativity research continues to privilege either the individual creator or the finished creative product. Even collaborative creativity is often studied through outcomes, discourse, or group dynamics rather than through the embodied micro-processes by which creative possibilities emerge. Creativity in Action shifts attention to the lived process itself. It asks how creativity becomes possible through shared presence, mutual responsiveness, embodied experimentation, and openness to being changed by others.

6.4 Creativity as Embodied, Relational, and Emergent

Creativity in Action begins from the premise that creativity is embodied. Creative thinking does not occur only in abstract mental space. It is shaped by posture, gesture, movement, rhythm, sensory perception, affect, tools, spatial arrangements, and bodily engagement with the world. In design and improvisation, people do not merely think before acting; they often discover what they think through action.

This view aligns with embodied and enactive accounts of cognition, which argue that knowing is not detached from bodily experience. In RePlay, participants use their bodies as tools for exploring a design problem. They act out relationships, embody systems, create physical diagrams, perform scenarios, and test possible futures through movement and interaction. These activities reveal forms of knowledge that may not emerge through verbal discussion alone.

Creativity in Action is also relational. It emerges between people rather than only within them. In collaborative creative practice, ideas are shaped by timing, tone, response, trust, misunderstanding, repair, and shared attention. A participant may offer a gesture, phrase, movement, or role that another participant transforms. The creative direction is not fully controlled by any one person. It unfolds through interaction. It cannot be entirely planned. It arises from the dynamic interaction of constraints, participants, environments, and actions. This does not mean that it is random or unstructured. Rather, emergence depends on conditions: a frame, a task, a shared focus, an invitation to play, and enough trust to allow participants to respond without over-controlling the outcome. RePlay provides these conditions by combining structure and openness.

This is why Creativity in Action is connected to systems thinking. The creative process is not found by isolating one component of the system. It becomes visible in the relationships between components: bodies, tools, materials, attention, affect, language, timing, and context. RePlay made these relations available for observation because participants were asked to externalize and enact them rather than only describe them.

6.5 Improvisational Fluency

Improvisational fluency is one of the core capacities within Creativity in Action. It refers to the ability to remain responsive, adaptive, and generative within uncertainty. It is the capacity to work with what is given, accept offers, build on emerging possibilities, and avoid premature closure.

In improvisational theatre, this capacity is often associated with principles such as "yes, and" endowment, status, raising the stakes, and the game of the scene. In the context of RePlay, improvisational fluency is not about theatrical performance for its own sake. It is about developing the ability to engage creatively with a problem space through action, relation, and response.

Improvisational fluency matters for design because design problems are rarely stable. They change as participants understand them, as stakeholders respond, as materials resist, and as contexts shift. A rigid method may fail when the situation changes. Improvisational fluency allows participants to work with ambiguity without becoming paralyzed by it.

Within Creativity in Action, improvisational fluency includes several related capacities: tolerating uncertainty, listening deeply, responding to offers, suspending premature judgment, remaining playful, noticing constraints, and transforming mistakes into possibilities. These capacities are not merely personal traits. They can be cultivated through practice.

6.6 Presence and Co-Presence

Presence is the capacity to be attentive, available, and responsive in the moment. In Creativity in Action, presence is not only mental focus. It is also bodily and relational. A participant is present when they are aware of their own actions, attentive to others, sensitive to the environment, and open to what is emerging.

Co-presence extends this awareness into a shared field. It describes the condition in which participants are mutually available to one another. In co-presence, people do not simply take turns producing ideas. They sense, respond, and adjust together. They become aware of timing, energy, rhythm, and collective direction.

RePlay depends on co-presence because the framework asks participants to create together through embodied action. A RePlay session cannot function if participants remain isolated in their own ideas or overly self-conscious about individual performance. The creative process depends on a shared attentional field in which participants are willing to be affected by one another.

Co-presence also challenges individualist models of creativity. It suggests that creativity is not only a matter of what one person imagines, but of what becomes possible between people when they

are mutually attentive and responsive. In this sense, co-presence is one of the conditions through which Creativity in Action becomes possible.

6.7 Attunement, Responsiveness, and Shared Attention

Attunement refers to the capacity to sense and adjusts to others. It involves noticing subtle cues: a hesitation, a shift in posture, a change in rhythm, a moment of uncertainty, or an emerging possibility. In collaborative creative practice, attunement allows participants to stay connected to the group process without needing everything to be verbally explained.

Responsiveness is the action that follows attunement. It is the capacity to respond in ways that keep the creative process alive. A response may extend an idea, redirect the activity, clarify a relationship, heighten a scene, or make a tacit assumption visible. In RePlay, responsiveness is often embodied: a participant moves closer, changes position, takes on a role, mirrors another player, or physically externalizes an idea.
Shared attention is the collective focus that allows a group to orient toward the same emerging situation. It does not mean that everyone thinks the same thing. Rather, it means that participants are aware of a shared frame of action. They know what is being explored, even if the direction remains uncertain.

Together, attunement, responsiveness, and shared attention form the micro-dynamics of Creativity in Action. These are the small, often fleeting processes through which collaborative creativity unfolds. They are difficult to capture through outcome-based analysis, but they become more visible when participants are asked to move, play, reflect, and externalize their process.

6.8 Group Flow

Flow is an important dimension of Creativity in Action, but Creativity in Action is not identical to flow. *Flow describes a state of deep absorption, focused attention, and intrinsic reward. In individual creative practice, flow is often experienced as losing track of time, merging action and awareness, and becoming immersed in the task.*

In collaborative contexts, flow also involves the relationships between participants. Sawyer (2017) describes group flow through the coordination and responsiveness of people engaged in a shared activity. Participants respond to one another, build on emerging ideas, and adjust their contributions as the situation develops. Understanding this process requires attention to both individual experience and the interaction through which collective momentum takes shape.

RePlay provides a structured context for exploring these relationships. Warm-up exercises, embodied games, playful constraints, and facilitation invite participants into shared creative action.

These conditions may support flow, although their presence does not establish that participants experience it. I therefore use the term *flow-like* when referring to patterns of absorbed and responsive participation whose relationship to subjective flow requires further interpretation.

Within Creativity in Action, flow forms part of a broader creative process that also includes hesitation, breakdown, repair, discomfort, blocked offers, and changes in direction. These moments reveal how participants negotiate uncertainty and sustain or recover their shared activity. Attending to interruptions alongside fluent interaction helps explain how collaborative creativity develops

6.8.1 Flow as a Dimension of Creativity in Action

Flow is central to my interpretation of Creativity in Action because it offers a way to consider the relationship between immersion and responsiveness during creative practice. RePlay brings this relationship into a setting where participants act, respond, externalize ideas, and reflect on their experience.

Studying flow presents a methodological difficulty. Participants' experiences of absorption or altered awareness of time are subjective, while researchers observe their actions and interactions. In a group, these experiences may also vary between participants. A coordinated activity can appear fluid even when some members feel uncertain, distracted, or excluded.

For this reason, shared momentum should be considered alongside participants' accounts of their experience. Timing, responsiveness, co-presence, blocking, and repair can help identify moments for closer examination. Reflection can then explore how participants experienced those moments and whether they understood them as absorbed, effortful, pleasurable, or creatively productive.

Creativity in Action provides a vocabulary for connecting these perspectives. It directs attention to how participants remain engaged with an unfolding activity while responding to others and becoming aware of their own creative process. Flow helps illuminate this engagement, while reflection and attention to its interruptions provide a fuller account of what occurs. RePlay allows for structured improvisational conditions in which timing, responsiveness, co-presence, blocking, repair, and shared momentum can be observed as they unfold.

6.8.2 STER: Selflessness, Timelessness, Effortlessness, and Richness

Kotler and Wheal (2017, pp. 38–45) use STER, meaning selflessness, timelessness, effortlessness, and richness, to describe qualities of altered experience, including flow. I find this vocabulary useful for considering the felt dimensions of creative engagement and their possible relevance to RePlay.

Selflessness: Refers to a temporary reduction in self-consciousness and inner criticism. In collaborative creative practice, this may help participants attend to the shared activity with less concern about how their contributions will be judged.

Timelessness: Flow states are characterized by temporal perception alterations, creating experiences of timelessness or temporal expansion where conventional time sense dissolves.

Effortlessness: Describes the subjective sense that action proceeds fluidly. An activity may feel less strained even while requiring considerable skill, attention, and participation.

Richness: Refers to an intensified experience of the activity, including greater sensitivity to connections, possibilities, and features of the situation.

These descriptions provide a vocabulary for discussing experience. Claims about their underlying neurological mechanisms require greater caution. A systematic review of the neural basis of flow found inconsistent patterns across studies and substantial methodological limitations (Alameda, Sanabria, & Ciria, 2022). Accounts of reduced self-consciousness should avoid assuming that the prefrontal cortex simply shuts down, or that every flow experience involves a fixed sequence of brainwaves or neurochemical changes.

In RePlay, STER can guide questions about participants' experiences: whether they felt less self-conscious, experienced time differently, found participation fluid, or noticed possibilities they had previously overlooked. Such questions need to leave room for experiences that differ from these descriptions. STER is most useful here as an interpretive resource rather than a set of qualities every participant is expected to display.

The relationship between individual experience and the group situation is especially relevant. Another participant's timing, the acceptance of an offer, the arrangement of bodies and materials, and the facilitator's prompts may influence how a person experiences the activity. Creativity in Action draws attention to these relationships.

Kotler and Wheal also present the Ecstasis Equation as a way of considering the time invested in accessing altered states, the rewards associated with them, and their risks (2017, pp. 209–211). Figure 6.3 retains this conceptual relationship.

The mathematical relationship is expressed as:

Figure 6.3
The Ecstasis Equation

Value = Time × Reward / Risk

Note. Adapted from Kotler and Wheal (2017, pp. 209–211).

This equation suggests that flow experiences prove most valuable when the time is invested, and rewards gained significantly outweigh associated risks. For collaborative creative practices like RePlay, this framework provides important considerations for ethical facilitation and participant safety while maximizing creative potential. Understanding this cost-benefit relationship becomes particularly crucial when working with suggestible individuals in group flow states, where both creative capacity and vulnerability may be heightened simultaneously.

6.9 RePlay as a Framework for Facilitating Group Flow

One of the claims of this thesis is that RePlay can facilitate conditions associated with flow. It does this by combining constraint and openness. The games provide enough structure to orient attention, but enough openness to allow emergence. Clear prompts, immediate feedback, embodied action, social responsiveness, and playful risk-taking create conditions that align closely with Csikszentmihalyi's account of conditions associated with flow (2008). Participants know what they are doing, but not exactly where the process will lead.

RePlay may therefore be understood as a low-threshold, socially grounded way of entering flow-like creative states. Unlike extreme sports, psychedelics, neurotechnology, or intensive meditation practice, RePlay does not require participants to pursue high-risk or highly specialized routes into altered creative experience. Instead, it uses embodied play, improvisational rules, and facilitation to create a shared space in which flow may become more likely.

6.10 RePlay as a Methodology for Studying Flow in Groups

RePlay is also significant methodologically because it may provide a way to study flow in groups. Rather than treating flow as an invisible interior state, RePlay makes aspects of flow observable through action. Researchers can attend to *changes in timing, verbal and non-verbal responsiveness, laughter, rhythm, silence, hesitation, offer acceptance, role shifting, bodily orientation, and the degree to which participants appear to move from self-conscious performance into shared creative engagement.*

RePlay creates a researchable setting in which flow-related phenomena can be observed, discussed, documented, and reflected upon. Post-session reflection, participant accounts, video or

photographic documentation, facilitator notes, and analysis of interaction patterns can be used together to examine how flow emerges, breaks down, or is recovered in collaborative creative practice.

The methodological contribution is a structured setting in which creative interaction can be enacted, documented, and examined. It shifts the question from whether flow exists as an isolated mental state to how flow is socially and materially produced through conditions, constraints, facilitation, trust, and mutual responsiveness. RePlay makes it possible to investigate how conditions such as trust, constraints, facilitation, and responsiveness relate to participants' experiences of creative engagement. It also allows attention to moments when shared momentum weakens, changes direction, or is recovered.

6.11 Flow, Risk, and Ethical Facilitation

Reduced self-consciousness and heightened absorption can support creativity, but they may also reduce critical distance or create over-attachment to pleasurable states. This is why RePlay requires ethical facilitation. Participants need enough safety to experiment, but also enough structure, consent, and reflective debriefing to maintain agency and critical awareness.

If RePlay can facilitate group flow, then it may also become a way to study the boundaries between flow, suggestibility, lability, trust, and creative responsiveness. The goal is not to romanticize flow, but to understand how creative states can be supported responsibly within collaborative design and research contexts.

While flow can indeed be rewarding the authors of Stealing Fire suggest that one of the pitfalls of selflessness can be "Jerusalem Syndrome" or messiah complex. Psychologists call it "extreme ego inflation". This is because -dopamine skyrockets while activity in prefrontal cortex plummets. This is where we might believe in conspiracy theories and alien abduction (Kotler and Wheal pp.201-208). There is also a tendency towards apophenia meaning to be overwhelmed by meaningful coincidence and detecting patterns where others see none (Kotler and Wheal,2017, p. 203). When our prefrontal cortex shuts down impulse control, long term planning, and critical reasoning go offline. Due to a sense of perceived timelessness, we may underestimate the amount of time something takes. Feelings of effortlessness during a flow state can make us become bliss junkies, or state chasers as the authors describe in that we start constantly seeking flow without being prepared to do the hard work.

Kotler and Wheal, caution to not dive too deep. Even though most of this research refers to artists, actors, and designers who experience flow states, I do not want to give the impression that this experience belongs to only a few domains. For example, in their research athletes are one of Kotler and Wheal's main subjects of flow research. Athletes such as Kirsten Ulmer (professional mountaineer), describe flow as "being in the zone" Despite the allure of flow this might come with the price of great risk as is the case of extreme sports. (2017, p.209).

This relationship between receptivity and agency leads into the following discussion of suggestibility as creative responsiveness. Within RePlay, responsiveness depends on participants being able to receive and transform contributions while retaining a meaningful choice about how they participate.

6.12 Suggestibility Akin to Creative Responsiveness

One of the more original claims of this thesis is that suggestibility can be reframed as a creative capacity. In many psychological contexts, suggestibility is associated with vulnerability, passivity, or excessive susceptibility to influence. In this thesis, however, I use suggestibility differently. I understand it as the capacity to be affected by cues, offers, rhythms, gestures, environments, and relational dynamics in ways that support creative emergence.

In improvisational and collaborative settings, participants must be open to influence. They must be willing to let another person's action change their own. They must be able to receive an offer, adapt to it, and contribute something that moves the shared process forward. This form of openness is not passive. It is active, skilled, and relational.

Suggestibility, understood as creative responsiveness, is therefore central to Creativity in Action. It describes the ability to enter a shared process without needing to control it completely. It allows participants to become permeable to the group situation while still contributing their own agency. In RePlay, this may occur when a participant accepts a role assigned by another, mirrors a movement, joins a design machine, responds to a prompt, or allows a new interpretation of the problem to emerge through collective play.

This reframing matters, because creativity is often associated with originality, independence, and individual expression. Creativity in Action suggests that creative capacity also depends on receptivity. To create with others, one must be capable of being changed by others. ***Suggestibility becomes the relational counterpart to originality: the capacity to be moved, influenced, and reoriented in ways that generate new possibilities.***

This does not mean that all suggestibility is positive. Openness to influence can also create ethical risks, especially in facilitated group contexts. For this reason, RePlay requires attention to trust, consent, care, and reflective debriefing. Suggestibility becomes creative only when it is held within conditions that support agency, safety, and mutual respect. Suggestibility opens one to absorption, co-regulation, spontaneous responsiveness, and lability. Lability refers to the ease with which a person or group may enter an altered or intensified state of attention, openness, and responsiveness. In the context of RePlay, lability is not treated as pathology. It names a possible readiness for creative responsiveness: the ability to become attuned to others, to follow emerging cues, and to allow the creative direction to be shaped by the group.

6.13 Why Does Suggestibility Matter for Creative Process

This is why suggestibility matters methodologically. If participants differ in their openness to cues, bodily attunement, trust, and capacity to enter shared flow, then RePlay cannot be treated as a mechanical technique that produces identical results in every context. Its effectiveness depends on facilitation, group safety, relational readiness, and the social conditions of the session. This strengthens rather than weakens the methodology, because it makes the relational conditions of creativity explicit.

Research on creative cognition has identified cooperation between default and executive brain networks during creative idea generation (Beaty et al., 2015). Separately, research on spontaneous interpersonal imitation has found an association between coordinated movement and inter-brain synchronization (Dumas et al., 2010). I treat these findings cautiously. They provide context for this discussion, rather than evidence that RePlay produces a particular brain state or that suggestibility operates through these mechanisms. Within this thesis, I understand creative responsiveness as openness to others' contributions and to possibilities emerging through shared action.

6.14 Creativity in Action as a Trainable Creative Capacity

A central claim of this thesis is that Creativity in Action can be cultivated. It is not a fixed trait possessed by only a few creative individuals. It is a capacity that can be developed through practice, reflection, embodied engagement, and collaborative experience.

RePlay was developed partly from the premise that people can learn to become more creative players. This does not mean turning participants into performers. Rather, it means helping them become more comfortable with uncertainty, more attentive to others, more able to externalize ideas, and more willing to engage with creative risk.

Creativity in Action can be trained through repeated exposure to conditions that support improvisational fluency, presence, co-presence, attunement, responsiveness, and reflection. Warm-up exercises help participants become aware of their bodies and one another. Improvisational games help them practice accepting offers and building on emerging material. Design-oriented exercises help them connect embodied play to real problems, systems, users, services, and environments. Reflective debriefing helps them become aware of what happened and how their creative process unfolded.

This trainability is significant for creativity research and design education. If creativity is understood only as a trait or talent, then the role of facilitation is limited. If creativity is understood as a situated capacity that can be supported through conditions, practice, and reflection, then frameworks such as RePlay become valuable tools for teaching, researching, and cultivating collaborative creativity.

6.15 Component Capacities of Creativity in Action

The following table is included as a working synthesis of the component capacities that make up Creativity in Action. It is not intended as a rigid model, but as a way of making the contribution legible for readers and examiners.

Table 6.1
Component Capacities of Creativity in Action

Capacity	What this means	How RePlay cultivates or reveals it
Improvisational fluency	Ability to respond generatively within uncertainty.	Games, Offers, Constraints, Yes-And, and Embodied Scenarios.
Presence	Attentive availability to the moment, body, task, and group.	Warm-ups, physical engagement, focused prompts.
Co-presence	Shared attentional field between participants.	Group exercises, design machines, collaborative enactment.
Attunement	Sensing timing, tone, gesture, and affective cues.	Mirroring, embodied response, facilitator-led reflection.
Suggestibility	Openness to being creatively affected by others and the situation.	Role adoption, offer acceptance, playful risk, group responsiveness.
Externalization	Making tacit ideas visible through action, bodies, tools, and artefacts.	Design maps, tableaus, trigger objects, sketches, props.
Reflection-in-action	Awareness of process while the process is still unfolding.	Debriefing, pause points, reflective prompts, traces.

6.16 The Relationship Between RePlay and Creativity in Action

RePlay is not identical to Creativity in Action. Rather, RePlay is the framework through which Creativity in Action was developed, observed, facilitated, and theorized.

This distinction is important. RePlay is a practical and methodological framework composed of games, exercises, facilitation strategies, reflective practices, and design-oriented activities. Creativity in Action is the theoretical concept that emerged through the use and development of that framework. RePlay creates the conditions in which Creativity in Action can become visible.

In RePlay, participants are invited to externalize ideas through bodies, movement, roles, objects, spatial arrangements, and improvised scenarios. These activities for example using design tableaus, design machines, and trigger objects make the creative process observable in ways that discussion alone may not. Participants do not only talk about a design problem; they enact it, inhabit it, test it, distort it, and reconfigure it. Through this process, the creative dynamics between participants become visible: who leads, who follows, who blocks, who accepts, who hesitates, who transforms, and how the group moves toward or away from shared flow.

Creativity in Action therefore gives language to what RePlay reveals. It names the embodied, relational, and improvisational quality of collaborative creativity as it unfolds in practice. ***RePlay provides the methodological frame; Creativity in Action provides the theoretical vocabulary.***

This relationship is also why RePlay should not be reduced to a set of games. The games are the visible techniques, but the deeper contribution is the way RePlay stages the conditions for creative awareness: bodily participation, relational openness, reflection, improvisational risk, and externalization. Creativity in Action names the capacity that develops when these conditions are held together.

6.18 Creativity in Action's Contribution to Creativity Research

The concept of Creativity in Action contributes to creativity research in several ways:

i. First, it shifts attention from creative products to creative process. Rather than asking only whether an outcome is novel and valuable, it asks how creative possibilities emerge through embodied, relational, and improvisational practice.
ii. Second, it contributes to collaborative creativity research by offering a vocabulary for the real-time micro-dynamics of group creativity. Concepts such as co-presence, attunement,

responsiveness, suggestibility, and improvisational fluency help describe what happens between participants during creative emergence.

iii. Third, it contributes to design research by linking improvisational practice with embodied reflection and externalization. Creativity in Action helps explain why methods such as Role-Play, Bodystorming, Informance, Design Mapping, and RePlay can be generative: they allow participants to think through action and to make tacit assumptions visible.

iv. Fourth, it contributes to embodied and enactive approaches to creativity by showing how cognition, perception, affect, movement, and environment participate in creative practice. Creativity in Action does not treat the body as secondary to thought. It treats the body as one of the central sites through which creative knowing occurs.

v. Finally, Creativity in Action contributes to methodological debates by showing how a research framework can participate in producing the phenomena it studies. RePlay does not merely observe creativity from a distance. It creates conditions in which collaborative creativity can be enacted, experienced, documented, and reflected upon.

The original contribution is therefore not only that RePlay is a useful facilitation method, but that it provides a way to study creativity in situ. It allows the thesis to move from creativity as a static trait or retrospective judgment toward creativity as a lived, trainable, embodied, and relational process and as such, this is the specific contribution made by the concept of Creativity in Action.

6.19 Chapter Summary

This chapter has developed Creativity in Action as a central theoretical contribution of the thesis. It has defined Creativity in Action as an embodied, relational, improvisational, and reflective form of creative capacity that unfolds in real time through co-presence, attunement, responsiveness, flow, suggestibility, and situated action.

The chapter has argued that Creativity in Action is needed because existing terms such as flow, group creativity, improvisation, reflection-in-action, and embodied cognition each capture important aspects of the phenomenon, but do not fully describe the form of collaborative creative awareness that emerged through RePlay. Creativity in Action names this intersection and provides a vocabulary for studying creativity as it happens.

The chapter has also distinguished Creativity in Action from RePlay. RePlay is the framework through which this phenomenon was developed and observed; Creativity in Action is the theoretical concept that emerged from that work. The following chapter examines the case studies and findings through which RePlay was applied and Creativity in Action became visible in practice.

Chapter 7: Case Studies: Introduction and Motivation

"Those who say 'Yes' are rewarded by the adventures they have, and those who say 'No' are rewarded by the safety they attain."

— Keith Johnstone, Impro

As noted in the introduction to this thesis, my strategy for researching this topic was interdisciplinary in nature, leading to an applied action research strategy inspired by embodiment philosophy and informed by my background in media arts and design research. Like the exploratory research phase, this chapter was motivated by a desire to further develop RePlay as a creativity research framework, and to explore what qualities of RePlay make it useful as part of an innovation process particularly within a mixed design team.

It is my hope that in designing RePlay I have developed a framework that utilizes improvisational creativity in a way that is useful for design process and that can be taught or easily transferred to others. Transferability is an important contribution of this research: at the time of conducting my literature review, the use of Impro in design seemed largely to be tied to design activities or product development contexts, rather than constituting a repeatable framework capable of supporting further creativity research. As a creativity researcher, I am interested in observing what happens during a RePlay session and comparing this to what is already known theoretically about the creative process of mixed design teams. I believe this observational lens is valuable because RePlay's embodied approach distinguishes it from other forms of externalization such as drawing, writing, or working on a computer. RePlay offers a different way of approaching the design problem space, and that shift can be productive as sometimes reframing one's perception of a problem is often the first step toward solving it.

Alongside the exploratory research phase, I engaged in theatre workshops, conferences, and presentations, and had the privilege of discussing my work with professionals from theatre, design, creativity, AI, and human-computer interaction. The three case studies presented in this chapter are examples of that kind of exchange. The first, the Tiree Tech Wave, is organized by my former PhD supervisor Alan Dix and is an academic and artistic interdisciplinary HCI residency. By the time I attended, I had already conducted RePlay several times in workshops and informal Impro sessions and had developed a clearer sense of the framework and its potential, as well as some initial observations relevant to my research goals. What follows are the details of the three case studies conducted using RePlay.

7.1 Case Study #1: Tiree Tech Wave

During the Tech Wave I wanted to focus my attention specifically on evaluating RePlay and collecting qualitative data regarding the experiences of participants during a RePlay session. I

also wanted to further develop my use of '*trigger objects*' as a make tool during a RePlay. In this scenario the '*trigger objects*' were the prototypes that the participants had built of their projects as well as objects I had built during a circuit building workshop before the Tech Wave.

7.1.1 Summary of Tiree Tech Wave Research Questions

i. What are the some of the experiences of participants when conducting a RePlay.
ii. How does RePlay foster awareness of one's creative process if so how?
iii. How beneficial is the use of the trigger objects?
iv. What types of Impro games mixed with Design thinking are helpful as part of a RePlay

7.1.2 Research Context: Tiree Tech Wave

The Tiree Tech Wave is the brainchild of one of my supervisors Prof Alan Dix, a professor in Human Computer Interaction and takes place on the remote Isle of Tiree, Scotland. This four-day retreat provides an opportunity for makers from various walks of life from arts to computer science to come together and to discuss and develop their technology-based projects in a focused environment. It appeals to academics, students, artists and those who might consider their projects to be on the fringe and want to engage in some hands on making with peers. During the retreat participants engage in workshops as well as tutorials, open studios, and mentoring sessions.

Figure 7.1
Tiree Tech Wave Participants



Note. Photograph by the author.

7.1.3 Research Design: RePlay and TAPT (Teasing Apart and Piecing Together)

This case study involved developing and using the creativity framework RePlay during a retreat for academics, designers and artists, called the Tiree Tech Wave. The study was conducted as a workshop in a community center during the retreat and involved 11 participants, of whom 8 completed TAPT.Two RePlay sessions were conducted, then phenomenologically explored using an experience-oriented analysis method Teasing Apart Piecing Together, or TAPT developed as part

of fellow Tiree tech wave participant Clare Hooper's (2011) EngD research. The RePlay sessions were based around the participants' projects as well as tangible objects ('*trigger objects*') that I had made and brought to the tech wave. Trigger objects as described in the previous exploratory research chapter are open-ended props that represent tangible interfaces however in this case study these triggers objects also consisted of an electronic component. This study introduced RePlay and utilized the TAPT method to evaluate the RePlay sessions. What follows is a description of the study; detailed participant responses; and a discussion regarding the outcomes of this study. Results from this study were later utilized to structure a second workshop at TEI (Tangible Embodied Interactions) conference in Kingston, Canada. Given what I had learned through conducting the literature review regarding creative process and my experience with developing RePlay I began to consider if what I was intrigued with about improvisational creativity was the ability to witness in real time flow a concept discussed in the field of creativity research [6].

Given the nature of TAPT, I wanted to experiment with it as a method for collecting phenomenological information about the experience of conducting a RePlay.

7.1.4 Using TAPT to Evaluate RePlay

As outlined in previous chapters, RePlay helps designers use reflection and externalization to inform the design of a product or service. It focuses on flow, group mind, improvisational creativity and reflection as part of Creativity in Action. Creativity in Action is based on embodiment and situated action: it describes a reflective and ephemeral bodily creativity inspired by Suchman (1987), Ponty (1945), and Heidegger (1927/1962). RePlay encourages a phenomenological, experience-focused approach

It promotes experiential learning Dewey (1927). TAPT helps gain insight into experiences, particularly social and emotional aspects. For this reason, we chose to use TAPT to collect people's RePlay experiences.

In a RePlay session the facilitator establishes a performance area and draws participants' awareness to the situation, including the context and the physical aspects of the activity they are exploring. This is followed up with warm up games, chosen for the workshop theme.

[6] See Literature review chapter.

Figure 7.2
Participants During a RePlay Session



Note Photograph by the author.

Shown above is an image of two of the eight Tech Wave attendees who participated in the workshop. Participants ranged in age from their early twenties to their late fifties and were from diverse professional backgrounds, from Computer Science to Media Art and Product Design. Participants brought what I have called '*trigger objects*' which in some cases were their own prototypes to the workshop. This included a portable touch surface and a digital light. Participants described their objects and were photographed with them (see Figure 7.3).

Figure 7.3
Trigger Objects



Note. Photograph by the author.

The photographs above are of some of the participants with their '*trigger objects*'. As a part of conducting a RePlay these objects were used alongside some trigger objects which I had brought along. Below is a picture of myself with a '*trigger object*' I had made at previous workshop to use with RePlay.

Figure 7.4
The Author with a Trigger Object



Note. AUTHOR: photographer

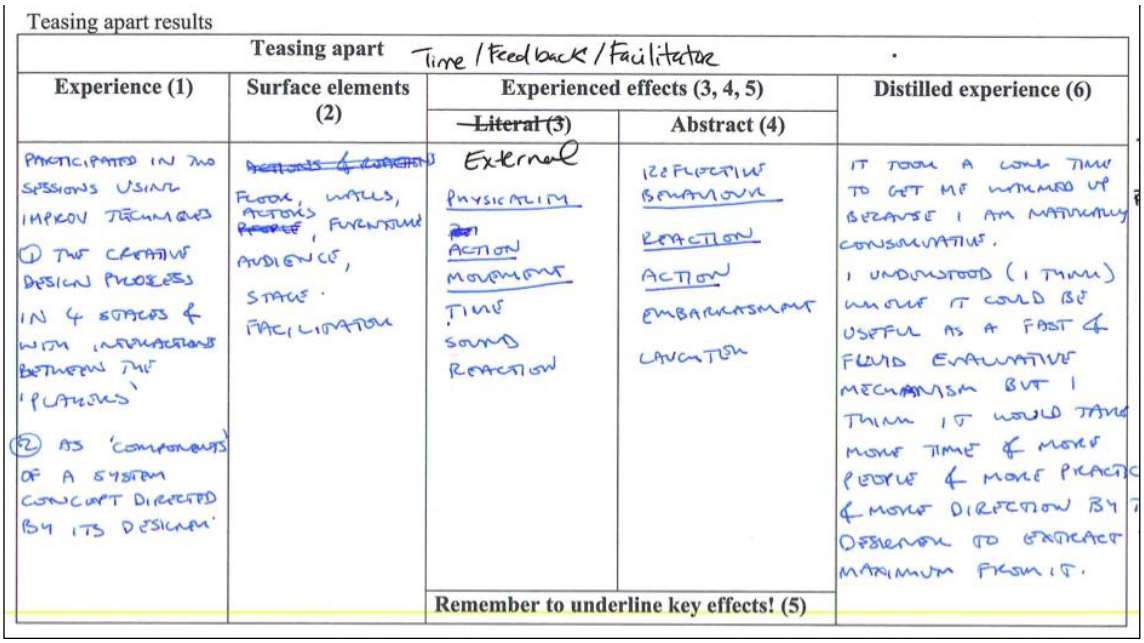
The warm-up games focused on prompting attention and awareness. For example, a clapping game (often used in Impro) in which participants directed claps at one another, creating an atmosphere where participants were mentally present and making eye contact. A second game from professional improviser Cremer (2009) involved pointing at and naming objects, then pointing at objects while naming the preceding objects: this prompted mental focus. The warm - up games were followed up with specific RePlay activities. The first workshop involved exploring use cases and scenarios for trigger objects. Participants acted scenes intended to encourage designerly ways of thinking and Creativity in Action. The second workshop included similar warm-up exercises, focused on abstract aspects such as bodily awareness. Participants conducted a '*design mapping*' [7]exercise which I had developed as part of a RePlay and walked through their creative process based on Wallas' (1926), four-phase model. Players utilized physical movements to embody each phase. They then collectively made tableaus of each phase and were asked about their relationship with the different phases. Their movements were used to create '*design machines* '[8]representing their activities. This increased participant awareness of their own creative processes, and where and why they struggled with, or enjoyed, particular phases. In another scenario, a participant volunteered a design problem for example, building an electronic publishing system. He described his system and acted as director, allocating to participants the role of playing and

[7] See methods chapter.

[8] See methods chapter.

embodying different parts of his system. After the sessions, participants completed TAPT forms about their experiences. Figure 7.5 shows an example of one response.

Figure 7.5
Sample TAPT Response



Teasing apart results

Teasing apart Time / Feedback / Facilitator

Experience (1)	Surface elements (2)	Experienced effects (3, 4, 5)		Distilled experience (6)
		~~Literal (3)~~	Abstract (4)	
PARTICIPATED IN TWO SESSIONS USING IMPROV TECHNIQUES ① THE CREATIVE DESIGN PROCESS IN 4 STAGES & WITH INTERACTIONS BETWEEN THE 'PLAYERS' ② AS 'COMPONENTS' OF A SYSTEM CONCEPT DIRECTED BY ITS DESIGNER'	~~ACTIONS & CONCEPTS~~ FLOOR, WALLS, ACTORS ~~PEOPLE~~, FURNITURE AUDIENCE, STAGE. FACILITATION	External PHYSICALITY ~~Art~~ ACTION MOVEMENT TIME SOUND REACTION	REFLECTIVE BEHAVIOUR REACTION ACTION EMBARRASSMENT LAUGHTER	IT TOOK A LONG TIME TO GET ME WARMED UP BECAUSE I AM NATURALLY CONSERVATIVE. I UNDERSTOOD (I THINK) HOW IT COULD BE USEFUL AS A FAST & FLUID EVALUATIVE MECHANISM BUT I THINK IT WOULD TAKE MORE TIME & MORE PEOPLE & MORE PRACTICE & MORE DIRECTION BY OBSERVERS TO EXTRACT MAXIMUM FROM IT.
		Remember to underline key effects! (5)		

Note. Photograph by the author.

7.1.5 Observations and Discussion: TAPT Responses

When identifying surface elements (physical aspects), participants focused on the presence of people: 5/8 noted the presence of others. The stage/space was also important (mentioned by 7/8). External effects can be observed by an outsider. 5/8 participants spoke of energy or physicality ("'wake up' by activity", "energy in the room", "high energy"). Regarding internal effects, 5 participants mentioned nerves ('anxiety', 'nervousness', 'adrenaline') and 4 described fun, play and excitement. 6 discussed reflection / realization. This reflects a movement from initial self-consciousness to engagement. One participant's description sums this up: "Feeling of letting go of self-consciousness whilst having fun and understanding other people's views on the issues." Table I shows each aspect identified as key: we can see themes of energy, reflection and learning. RePlay helped participants open ("I was […] less anxious to speak.") and gain insights ("it unveiled part of my thoughts in an unexpected way"). We asked participants to share their perceptions of time: the four who did so spoke of time going quickly: "mostly passed quick"; "time moved fast"; "time went fast"; "time: less importance - not so aware".

Table 7.1
Key Elements Identified by Participants

Surface	Loud fan, process, room, stage
External	Acting, action, high energy, movement, physicality, time went fast,
Internal	Acceptance of embarrassment, action, blocked, creative, helpful, learning, open to express myself, participation, realization of own views compared to others, reaction, reflect, reflective behavior

7.1.6 Flow in Design

As previously described flow is a type of focused motivation characterized by single-minded immersion. When in a state of flow, emotions are positively energized and aligned with the task (Csikszentmihalyi, 2008). it is often informally described as being "in the zone". I found that in this case study as well as in other iterations of RePlay flow is a characteristic of improvisational creativity during RePlay. As creativity researchers have observed in the past, flow research is hard to do because flow is an elusive, ephemeral phenomenon which made this observation even more surprising as RePlay seemed to be very conducive to foster flow amongst teams. I would also like to add that current flow research addresses individuals but not groups which makes my work with RePlay very rewarding.

It appears through our use of TAPT that phenomenology is key for studying flow in interaction design, as it concerns subjective experience. We therefore used TAPT to delve into the RePlay experience. Flow is a challenging phenomenon to study as some creativity researchers believe its highly ethereal while other researchers believe it is a process based on repetition and self-determination over a long period of time. To further complicate this design is often a solitary practice mediated by software and screens making it even more challenging to capture amongst a team of mixed design team from various backgrounds. One can see why studying flow might present a challenge due to these characteristics not to mention trying to spark the process amongst a diverse team who may not have worked together for very long. One conclusion based on TAPT is that RePlay facilitates flow however this case study seems to suggest that a lot of what facilitating Impro does is create the possibility for flow depending on the suggestibility, and improvisational nature of the group. What is interesting is that group flow during a RePlay, creates a kind of collective perceptual experience through which a highly embodied way of working like what happens during an improvisation becomes apparent. This case study sheds light on the nature of flow, and how to facilitate it as described earlier in the literature review of this thesis.

Table 7.2 below shows how RePlay and flow are linked: although we lacked data in some categories, participants clearly reported a loss of self-consciousness and time distortion, while the facilitator and goals clearly aligned with three other facets of flow (clear goals, immediate

feedback, merging action and awareness). In the future, it would be interesting to gain data about the remaining three facets of flow now that we have observed a concrete connection between RePlay and a flow experience.

Table 7.2
RePlay and Flow

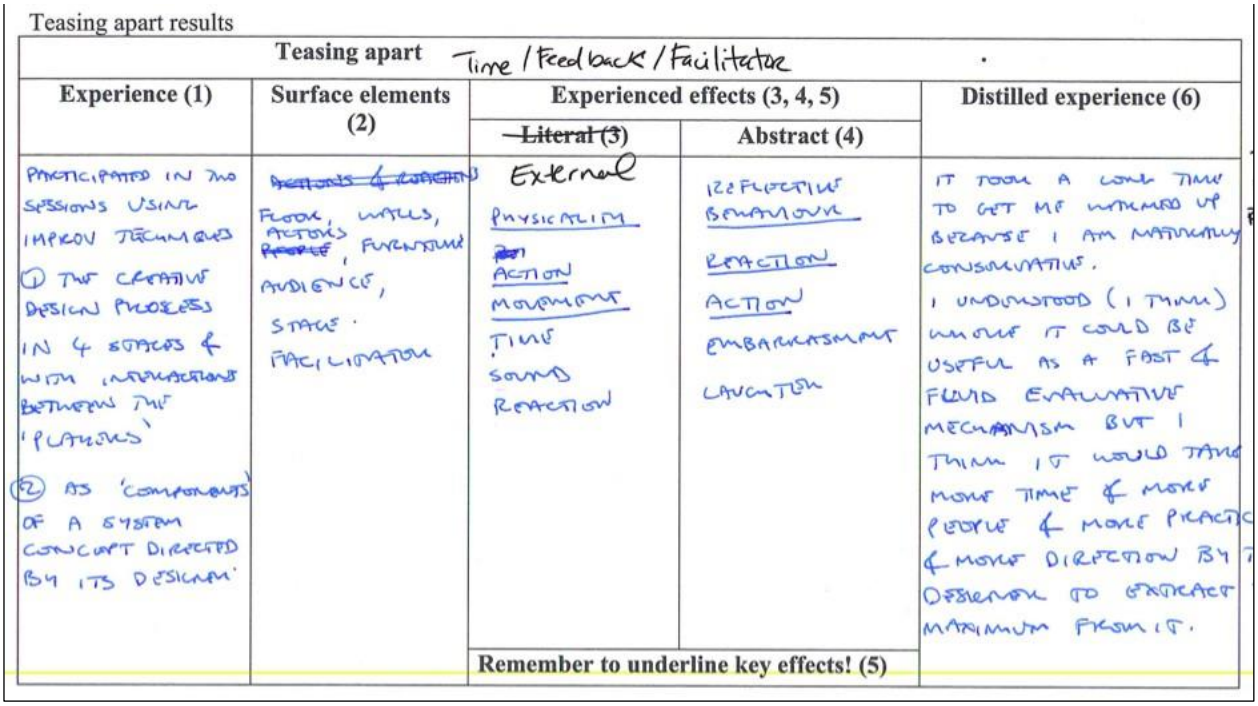
Feature of flow	**RePlay and that feature**
A balance between challenges and skills	(No data)
Clear goals	Provided by facilitator
Immediate feedback	Provided by facilitator
Immense concentration	(No data)
Merging of action and awareness	Exercises intend to ground participants in the moment
Loss of self-consciousness	Yes: 6/8 participants commented on 'letting go', excitement, and play.
A sense of control	(No data)
Time distortion	Yes: 4 participants noted this.
Experiencing the activity as intrinsically rewarding	Yes: Participants commented on fun and play.

Improvisational creativity researcher Sawyer (2000) (20017) also discovered a link between improvisational theatre and flow) therefore it is perhaps not surprising that we should witness it as part of a RePlay. This insight mirrors my thoughts around experiential learning given that after each case study; I had a deeper understanding of flow. This is because I was able to experience it and pair this experience with my theoretical knowledge. Future work into flow in the context of Creativity in Action might help support designers with their processes and in facilitating flow-inducing experiences as part of collaborative design process.

7.1 .7 Reflection and the Body in the Design Process

In the preceding paragraphs the 9 characteristics of flow have been summarized. Table II illustrated how RePlay related to these. The game '*design machines*' often played during a RePlay session created a clear movement-based illustration of a process that is normally technical and hard to follow. Participants came from diverse disciplinary backgrounds and yet understood their roles as part of an electronic publishing system. The exercise generated many questions about data types, information flow and end users, because participants wanted to understand their functions in the system. Participants became better aware of their own design processes and of how bodies can be used in design. They described a distorted sense of time, high arousal states (anxious or excited) and gaining insight. Below is an image from one of the TAPT forms filled in by participants.

Figure 7.6
TAPT Questionnaire



Teasing apart results

Teasing apart Time / Feedback / Facilitator			
Experience (1)	**Surface elements (2)**	**Experienced effects (3, 4, 5)**	**Distilled experience (6)**
		~~Literal (3)~~ / **Abstract (4)**	
PARTICIPATED IN TWO SESSIONS USING IMPROV TECHNIQUES ① THE CREATIVE DESIGN PROCESS IN 4 STAGES & WITH INTERACTIONS BETWEEN THE 'PLAYERS' ② AS 'COMPONENTS' OF A SYSTEM CONCEPT DIRECTED BY ITS DESIGNER	~~ACTIONS & FUNCTIONS~~ FLOOR, WALLS, ACTORS, ~~PROPS~~, FUNCTIONS AUDIENCE, STAGE. FACILITATOR	External PHYSICALITY ~~Act~~ ACTION MOVEMENT TIME SOUND REACTION	REFLECTIVE BEHAVIOUR REACTION ACTION EMBARRASSMENT LAUGHTER
		Remember to underline key effects! (5)	

IT TOOK A LONG TIME TO GET ME WARMED UP BECAUSE I AM NATURALLY CONSERVATIVE.
I UNDERSTOOD (I THINK) HOW IT COULD BE USEFUL AS A FAST & FLUID EVALUATIVE MECHANISM BUT I THINK IT WOULD TAKE MORE TIME & MORE PEOPLE & MORE PRACTICE & MORE DIRECTION BY OBSERVER TO EXTRACT MAXIMUM FROM IT.

*Note.*Photograph by the author.

7.1.7 Creativity in Action

As mentioned already, I am interested in gaining a better understanding of a type of creativity that involves bodily movement as part of the creative thinking process. I have named this phenomenon "*Creativity in Action*". This concept of a type of creative perception is informed by epistemic action and is rooted in ideas from embodiment theory which I came across during my literature review. Epistemic Action is rooted in the connection of physical involvement in one's environment to gain knowledge. Embodiment researcher Alva Noe's (2004), states that without action there is isn't a possibility for perception. Interestingly in Impro this idea of collective perception is often referred to group mind.

Through applying Improvisational techniques to collaborative design process, I hoped to gain a better understanding of what is happening in this creative context to promote it as part of general creative process during a RePlay. Due to my interest in '*Creativity in Action*' I developed RePlay to exploit and learn more about this type of experiential learning via the body. What intrigues me about RePlay is how through collectively engaging in a type of physical externalization, a type of group mind, seems to emerge in the same way collective chanting or a choir seems to merge a group into a singular energy or voice, creating a powerful experience for those involved.

Summary of Results and Conclusion

I introduced the RePlay framework and its value for prompting what I call, '*Creativity in Action*'. Utilizing TAPT to evaluate RePlay provided early evidence of a correlation between RePlay sessions and flow, both useful for understanding RePlay and understanding group flow. As such, the players found their fellows and the stage important; they reported a high energy state, as well as anxiety and excitement; time flowed more quickly for them, and some participants reported reflection and increased understanding of their design process after the activity. Given that RePlay involves bodily externalizations: this can have positive effects on the design process, helping designers encourage presence as part of their process. Use of improvisational creativity helps designers remain in a creative (not evaluative) state of mind, alongside RePlay supporting participatory, embodied co-design. RePlay also offers; increased awareness, improvisational creativity, divergent and associative thinking, reflection, awareness, flow and group mind. After completing this case study RePlay was used in workshops and during presentations at TEI (Tangible Embodied Interaction) conference as well as the Tudor Innovation Labs in Luxembourg. The next case study discussed in this chapter, utilized RePlay as part of applied design contexts in which the use of RePlay was less about developing or evaluating the framework but more concerned with utilizing as a part of a participatory design process.

7.1.8 Results and Future work

One of the valuable off shoots of this case study was a proposal to develop RePlay as part of a creativity tool kit at Tudor Innovation Labs in Luxembourg. Another was the development of a workshop which could be conducted at conferences. In terms of my development of RePlay, I also incorporated again the technique of '*trigger objects* 'which developed upon my early research with utilizing "make tools" or props as part of RePlay. This case study was valuable and fruitful as it not only focused on developing the RePlay framework but also evaluating it and looking for connections from what I was observing by conducting RePlay to what I knew about creative process, collaborative design, and experiential learning. A number of these ideas were used in the next two case studies which I will relate in this chapter.

7.1.9 Tudor Innovation Labs

One outcome of presenting RePlay at conference was an approach from Tudor Innovation Labs in Luxembourg, who expressed interest in developing RePlay as part of a creativity toolkit for service design. The Centre de Recherche Public Henri Tudor is a Luxembourg-based research institution that provides research, development, and innovation services across several domains including advanced materials, service science, environmental technologies, and healthcare. Its activities span applied and doctoral research, development of tools and methods, technological assistance, training, and knowledge transfer. Tudor had identified that existing creative design tools were limited in their engagement with the emotional, contextual, and temporal dimensions of experience, and wanted these phenomenological aspects incorporated into their design process. A collaboration with RePlay, they felt, would open new perspectives by adding characteristics of

improvisational creativity — reflection, flow, perceptual shifts, enactive perception, and bodily externalization — to their existing toolkit, which at the time covered only classical pen-and-paper sketching techniques and convergent-divergent brainstorming. The proposed collaboration would have been structured around McFadzean's (1998) classification of creativity tools as paradigm preserving, paradigm stretching, or paradigm breaking, and would have involved workshops, training sessions, theoretical writing, and case studies in the domain of Architecture, Engineering, and Construction. Although the collaboration did not ultimately proceed due to scheduling constraints, the proposal reflected the growing potential of RePlay as a transferable.[9] framework capable of being implemented beyond my direct involvement as facilitator. A full outline of the proposed work packages and timeline is included in Appendix A.

7.1.10 Workshop Structure

Another interesting offshoot was the development of a workshop structure for conducting RePlay as part of a conference or similarly during a retreat. Appendix B provides an overview of the workshop I proposed as a collaboration with another PhD candidate who was teaching an experimental course at Iowa State University entitled Emerging Practices of Human-Computer Interaction. The course was being taught at the graduate level and geared primarily toward online master's students interested in tools for professional practice of HCI (Human Computer Interaction).[10]

7.2 Case Study #2: Global Studio

7.2.1 Introduction

This case study was unique in that it was the first time I utilized RePlay in an applied design context, working with the Global Studio in Bhopal, India over a period of several months. Global Studio is an action research program where international interdisciplinary students, academics, and professionals come together to collaborate on community-based projects.

Another aspect which made this case study distinctive is that it involved collaboration with individuals outside the disciplines of human-computer interaction and the design of tangibles or services. The design team that assisted with collecting RePlay data included professionals and students in urban planning, policymaking, and architecture, as well as children and stakeholders from the Kabadkhana community. The picture below shows our team, which organically came to

[9] Tudor proposal can be found in appendix of this thesis.

[10] Please see appendix for sample of workshop structure.

include some of the children from the Kabadkhana community. Not pictured are our mentors who consisted of international professionals, policymakers, and urban planners from Bhopal. Parents and teachers from the local school who at various points offered support with data collection and feedback are also not pictured.

Figure 7.7
Global Studio Team with Children from the Kabadkhana Community



Note. Photograph by the author.

It was a privilege to have had the opportunity to explore and develop RePlay as part of a longer project, and I am grateful for the support of the other members of the design team. Given that RePlay was only one component of a larger project, I will try to contextualize how RePlay was utilized to inform the Global Studio's final proposal, and discuss the observations, data, and interpretation of results. As in previous studies, the objective was not to evaluate or develop RePlay as a framework but to use it in an applied context as part of a design process. It was an opportunity to utilize RePlay in the wild and observe both its challenges and benefits.

7.2.2 Research Context/Motivation: Inclusive Urbanization: Global Studio

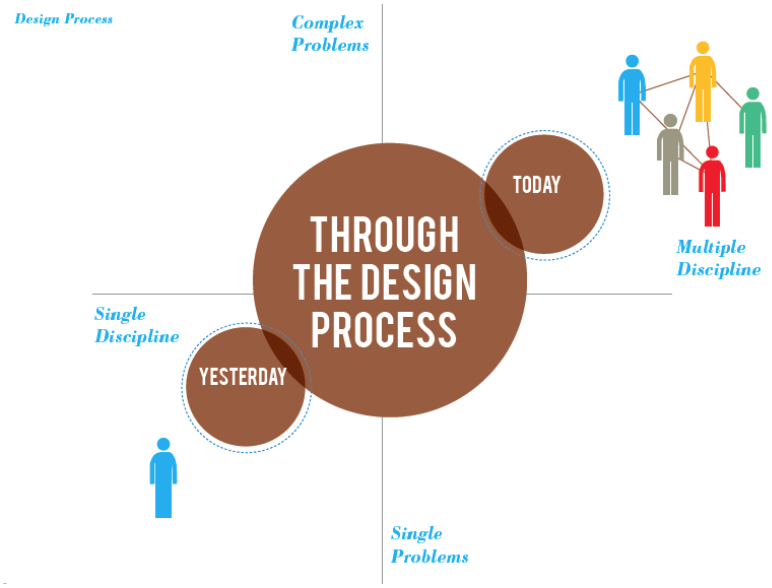
In 2012, Global Studio visited Bhopal, India, where I participated in a design and planning project within the Kabadkhana neighborhood, looking at access to water, solid waste collection, education, infrastructure, and housing. The proposals developed during this time were presented to local and international professionals and academics at the conference "Re-imagining Inclusive Urbanization," which promoted critical engagement with international development issues such as climate change, environmental justice, participatory urban practices, and the role of design and planning professionals, researchers, and communities in promoting sustainable and inclusive urbanization. Below is a quote from our presentation summarizing the vision of the Global Studio project (About Global Studio).

Figure 7.8
Global Studio Project Vision



The conference sought to promote inclusive urbanization in the context of environmental change and sustainable development, exploring themes of poverty, social injustice, and social unrest in the context of urban development. It aimed to move beyond disciplinary boundaries and advance innovative thinking by highlighting projects that capture intricate lessons and encourage this agenda. By bringing together theoretical thinking and emerging reflections from a multidisciplinary world of practice, the goal was to advance the inclusive urbanization agenda internationally. The image below reflects the motivation of the studio organizers to bring together professionals from various disciplines rather than focusing on a single area of specialization. One other design researcher and I attended the studio, contributing design research skills to the project. I would like to acknowledge Andrea Augsten's role in creating graphics for the project and supporting my documentation and execution of RePlay sessions.

Figure 7.9
Design Process



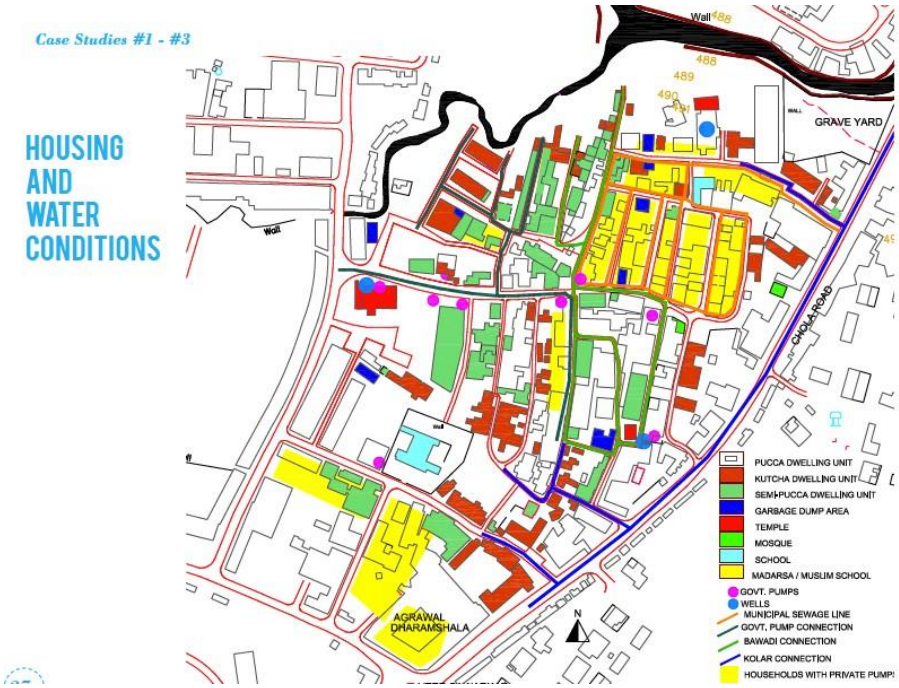
Note. Diagram by Andrea Augsten.

The conference contributed to the Millennium Development Goals, particularly Goal 7 on environmental sustainability, which set a target of achieving a significant improvement in the lives of at least 100 million slum dwellers by 2020. Approximately fifty multidisciplinary students and professionals from India, Australia, the UK, the USA, Finland, Germany, and Nepal worked intensively on projects identified as locally important to achieving inclusive urbanization. Prior to the conference, the Global Studio cohort engaged with government officials, NGOs, and community groups, working with people as partners and building capacity across all those involved. The Global Studio educational program built on previous work in Istanbul (2005), Vancouver (2006), and Johannesburg (2007) (Global Studio).

7.2.3 Kabadkhana Housing Project

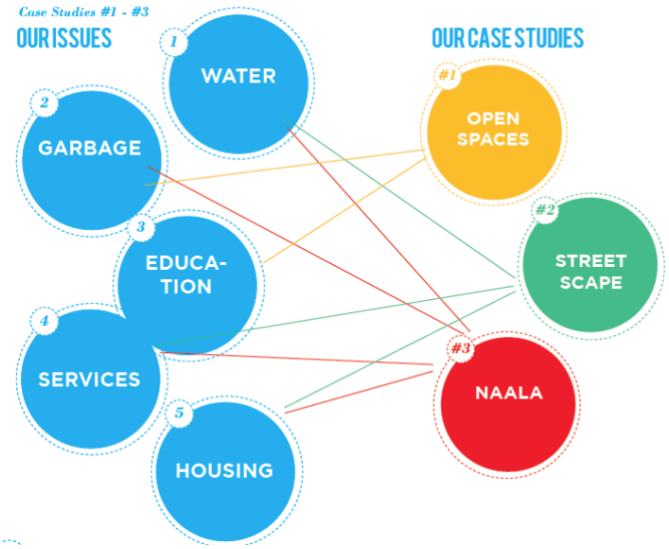
The Housing Studio stemmed from the policy initiative under Rajiv Awas Yojana (RAY, 2011), a flagship program for providing housing and basic services to the urban poor. The studio investigated current poverty alleviation practice as realized in a recent housing project for the Madrasi Colony slum, which provided new G+3 residential dwellings on the site of the former slum but had for various reasons failed, leaving the community in difficult conditions. In contrast to this approach, Global Studio investigated alternative, scaled, and participatory design methods to improve the Kabadkhana area in the northern part of Bhopal. The intent was to understand the existing neighborhood as an intricate material, spatial, and social fabric, and to develop case study approaches that built upon its existing qualities to improve the living conditions of the urban poor. Below is a map of the entire project and some of its key landmarks.

Figure 7.10
Map of Housing and Water Conditions



Three major case study areas were identified: the open and public spaces in and around the public middle school, with a focus on rethinking the potential of open spaces to strengthen community and public life; the Naala river, to rethink water management and its relationship to material flows within the neighborhood; and an exemplary street section connecting the Naala river and open public spaces, to investigate the domestic reality of the neighborhood. Our team, pictured in the project overview diagram below, formed part of the Open Spaces case study, with a key focus on garbage and education. RePlay was used to gather needs and requirements from the community regarding the local school and the open spaces around it and proved central to establishing the children of the community as our primary stakeholders and as the main vehicle for collecting data and conducting participatory design.

Figure 7.11
Project Overview



Note. Image by Andrea Augsten.

The investigations and design proposals were developed under the assumption that it is preferable to work with and build upon the existing materiality and built fabric of a neighborhood rather than to erase and build anew. The range of proposals served to illustrate possible material solutions and processes that built upon the found qualities of the site. Based on our design research, propositions for new housing schemes were developed alongside suggestions for material standards in larger scale housing developments. Our group focused on the middle school because initial walk-throughs of the site and conversations with children from the Kabadkhana community made clear that it was the children who were most familiar with the open spaces, as they played outdoors regularly. I suggested this would be an ideal location for conducting a low-barrier method such as RePlay to learn more about the needs of the community. Through an initial RePlay session conducted informally in a nearby park with some of the local children, we decided to focus our proposals on two key landmarks: the community hall and the adjacent Shankar Dayal Sharma

School. Below are images from the first workshop we conducted at the park and sites that the children showed us.

Figure 7.12
Site: Shankar Dayal Sharma School and Community Hall



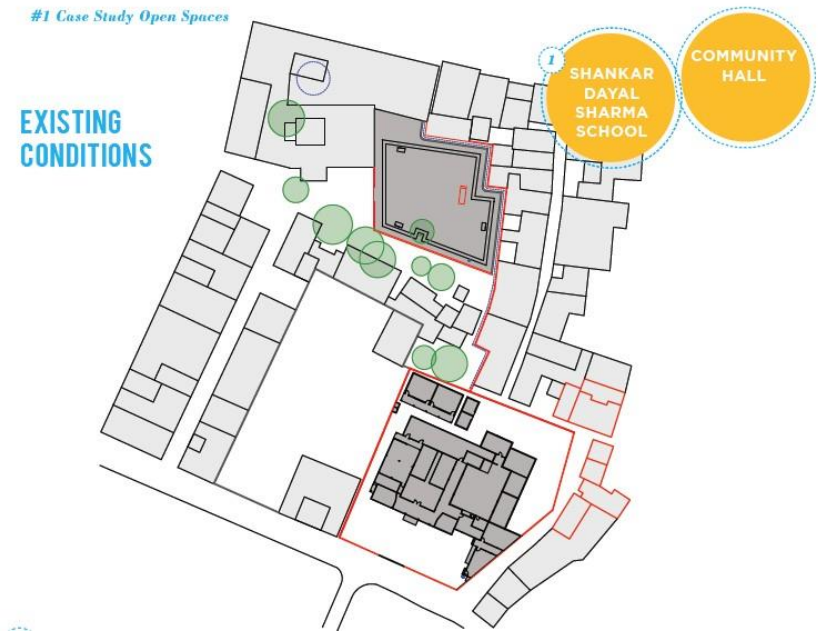
Note. [AUTHOR: source of image, e.g. "Photograph by the author."]

Figure 7.13
Open Space and Temple in the Kabadkhana Neighbourhood



Note. [AUTHOR: source of image, e.g. "Photograph by the author."]

Figure 7.14
Existing Conditions of the School Site



7.2.4 My Role

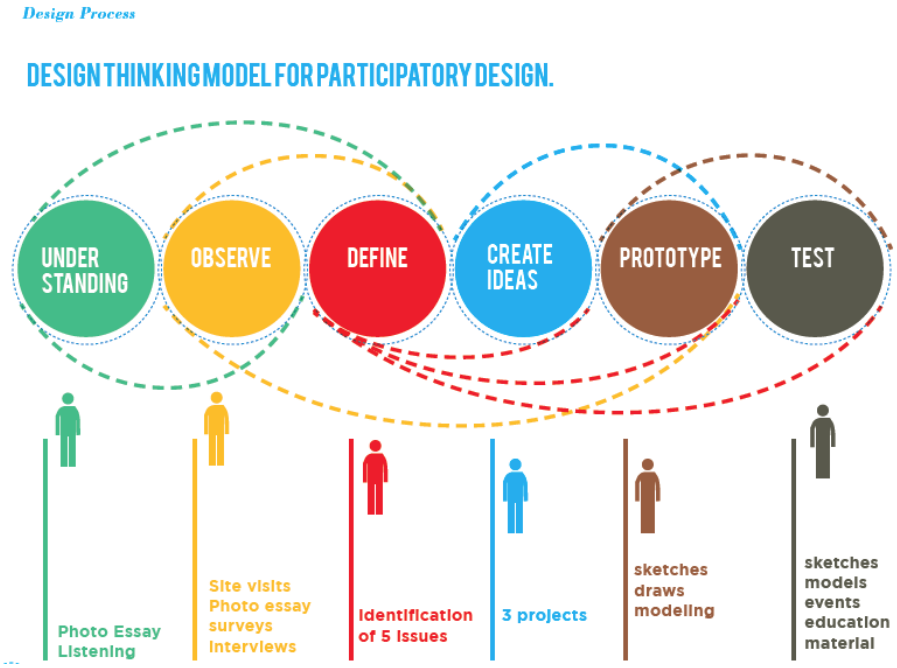
As the facilitator of RePlay, with a background in design research methods and creative process, my role was to identify a suitable context for the RePlay framework within the innovation process of the housing team. Once we decided to work with the children, RePlay became our primary method for gathering community input. My peers in the design team were students, architects, urban planners, and policymakers. Some had direct experience of the context, others had an international perspective or relevant education. My rationale for joining this studio was to find an applied context for RePlay and to support the inclusive urbanization approach by drawing on my knowledge of participatory design. RePlay seemed an ideal framework for bridging the different communities. For the design team particularly since a shared language was an obstacle, body language offered a way to communicate beyond its boundaries along with the assistance of volunteer translators. After a number of walk-throughs, it became apparent that the children were the most engaged, knowledgeable, and open members of the community when it came to discussing their neighbourhood's needs. This led us to the local school as an ideal location for both conducting RePlay and applying ideas generated from the community.

7.2.5 Research Design: Open Spaces: Approach and process

Traditional understandings of design process tend toward a linear model in which distinct stages lead to a final product, with different actors and disciplines contributing their expertise at key points. However, this linear approach is not well suited to complex problem-solving; instead, the process needs to be cyclic and reflective, with all design disciplines involved at every stage. Collaboration between all members of the team is what generates innovative outcomes — a

dynamic that parallels how the creative process is often described in the literature. During the preparation of the Kabadkhana project, our team of architects, urban designers, planners, and design researchers worked closely together to develop a variety of design ideas and proposals addressing the complex issues of housing for the urban poor. Below is an image of the overall process our team followed.

Figure 7.15
Design Process Diagram 2



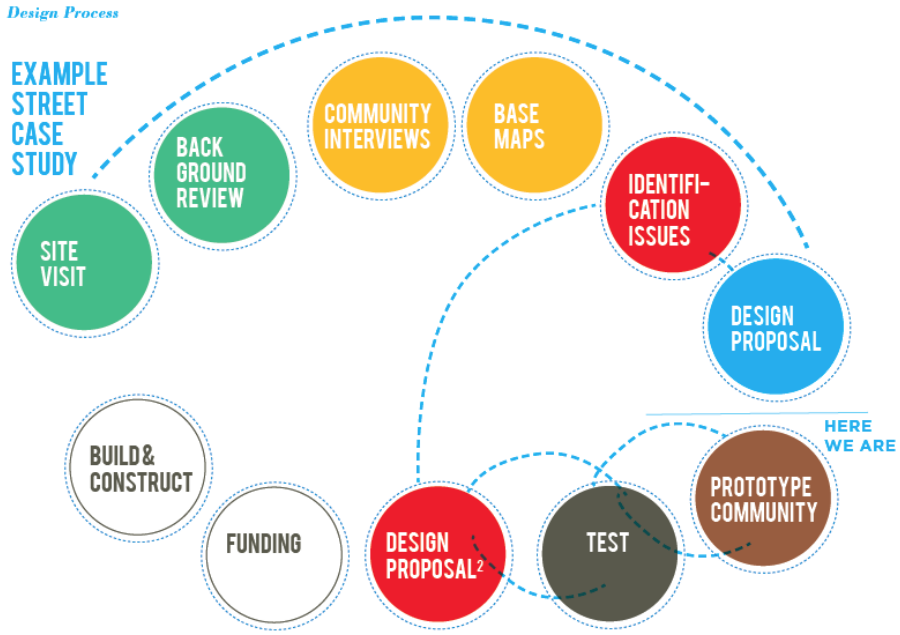
Note. Diagram by Andrea Augsten.

The team involved with Madrasi Colony surveyed material evidence regarding quality, use, and hierarchies of spaces, construction quality, and qualitative narrative assessments by the inhabitants. RePlay played a role in creating a bridge between the community and the students, architects, and urban planners.

As a team we approached the design task at Kabadkhana with two strategies in mind:

i. Identifying the perceptions of the spatial and social realities of the community through conversations with community members and research into the social and political context.
ii. Using our own observations and interpretations of community data as the basis for design recommendations.

Figure 7.16
Design Process Diagram 3



Note. Diagram by Andrea Augsten.

The results of this exchange was a proposal which was put forward and presented at the conference attended by important policy makers in Bhopal.

7.2.6 Developing a Dialogue

Based on community input and our own observations, a set of educational, spatial, and material interventions were developed to strengthen and improve conditions at the school on a short, mid-, and long-term basis. Below is an image from the photo surveys conducted during our site visits.

Figure 7.17
Kabadkhana Impressions



Note. Photographs by Shawna Ng.

One of these interventions was RePlay. The team solicited input through three strategies:

i. Identifying community stakeholders, including educational, religious, and other community decision makers and facilitators. Through this process we also contacted the school principal, who was heavily involved in developing a community hall in the building adjacent to the school.

ii. Engaging with children both formally and informally, treating them as gatekeepers to the community in both a spatial and social sense. Games in the classroom and in informal environments were used for community mapping and as an entry point to other community members such as parents and teachers. RePlay was conducted both in the open and in the classroom and was combined with community mapping activities with the children.

iii. Spatial observation through fieldwork, identifying both qualitative and material problems through informal observation, conversation, and mapping. The design process underwent various iterative loops involving stakeholders throughout the development of our proposal.

7.2.7 Data Collection Methods

We conducted interviews with the principal, and the local community as well as conducted RePlay mapping exercises with the children. We also conducted walks with children onsite with the children taking photographs of their daily routines which is a well-known practice in design research called cultural probes. We also took measurements with the local community and educated the locals regarding design options through prototypes. Below is an image of one of the key requirements we developed with the community

Figure 7.18
Design Needs

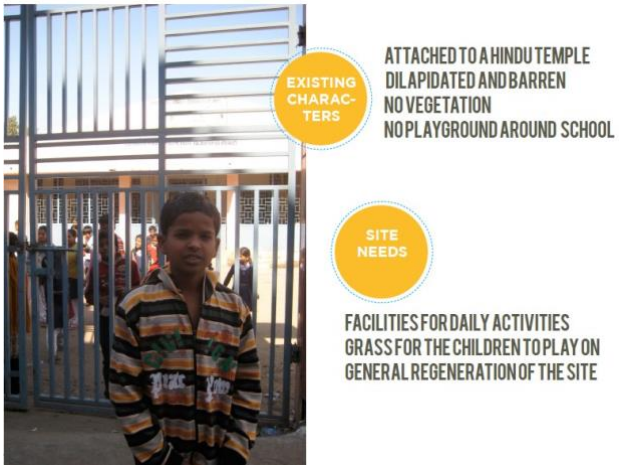
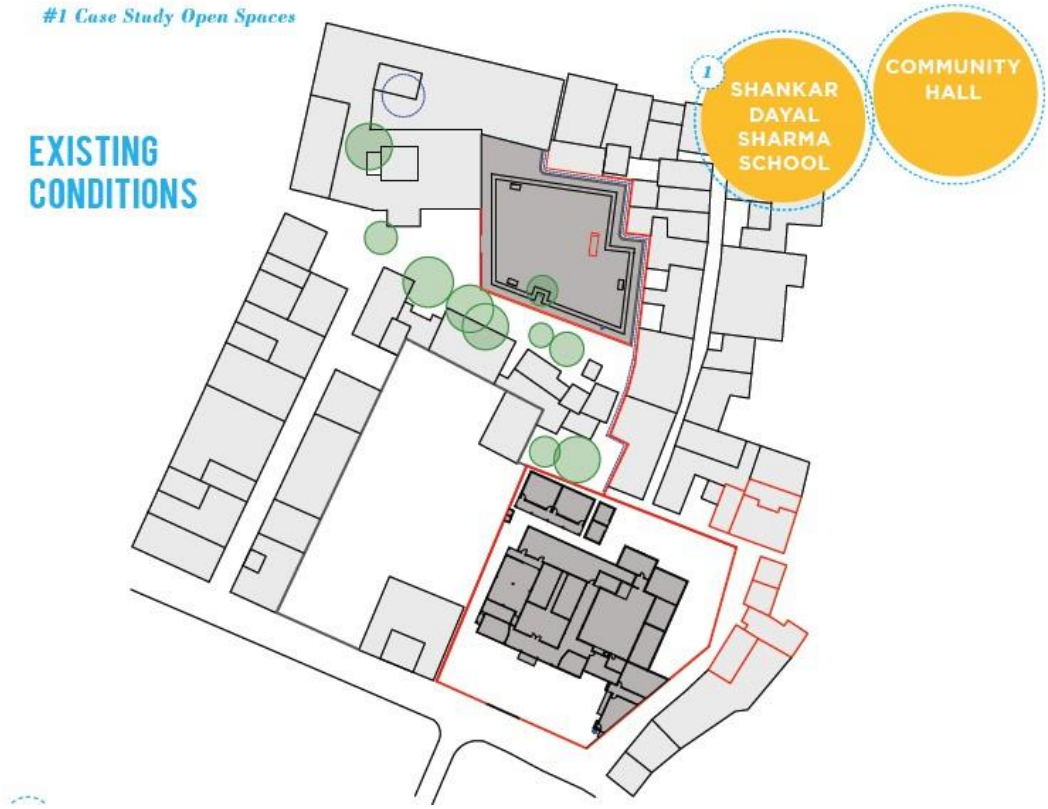


Figure 7.19
Open Spaces Map



7.2.8 Overall Project Design Questions

The outcomes of our research and design studio were manifold and correspond to the various agendas which framed our proposals.

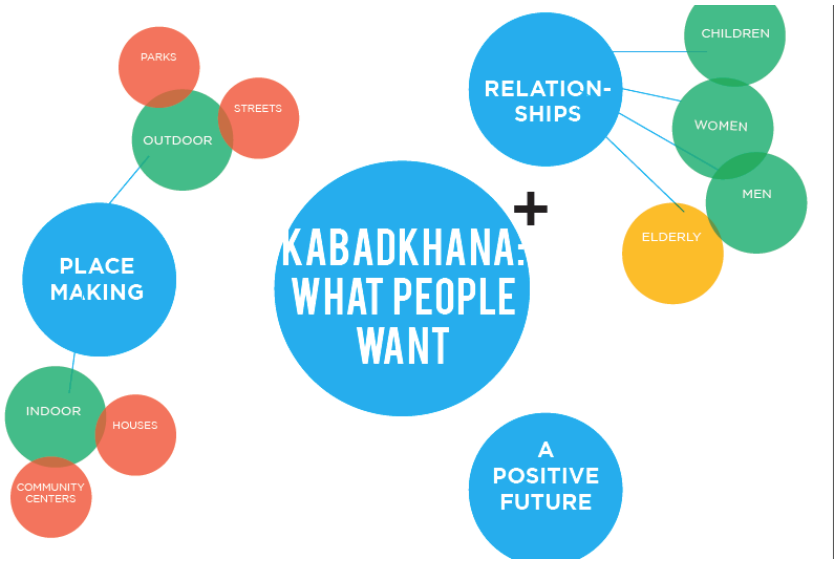
The guiding questions for the entire project were:

i. What are the deficiencies of the Madrasi Colony that can serve as lessons learned for future policy, development, and building approaches?

ii. What are the qualities of the Kabadkhana neighbourhood that can be strengthened and built upon to improve and upgrade the neighbourhood?

iii. What are the problems within the neighbourhood on a material and urban level that require improvement, as perceived by the community?

Figure 7.20
Overall Project Goals



Regarding the Madrasi Colony, inhabitants voiced discontent about various aspects of the new housing, including lack of livelihood spaces, affordability, open drainage, and building quality. Basic and avoidable design flaws were also observed, such as lack of diversity in dwelling units, missing cross-ventilation, and underutilised spaces for ventilation and daylighting. In terms of the overall layout, there was a distinct lack of consideration for public and open spaces.

Despite being classified as a slum, Kabadkhana proved to be a multifaceted community. Several open and public spaces were used by different members of the community at different times and for different occasions, and we perceived a quality and attachment that marks a genuinely living community. The problems identified by the community and confirmed through on-site observation concerned water and wastewater, garbage removal, education, and basic services.

7.2.9 RePlay Global Studio Research Questions

i. What types of RePlay games would be most helpful in this context in terms of beginning dialogue between the design team and the Kabadkhana community.

ii. How could RePlay be utilized as a framework for the participants to voice their desires and needs for this community.

After conducting a RePlay session, the children used a combination of mapping and the design machines game to develop feedback about their desires for the park. The image below shows two of the researchers, a student architect and a translator, discussing the children's drawings.

Figure 7.21
Mapping with the Children



7.2.10 Description of RePlay Workshops

Two RePlay sessions were conducted: first at a local primary school, upon agreement with the principal, and later informally in a nearby park. Children who were students of the primary school and above the age of seven were involved, as well as other local children. Establishing a consistent group of participants proved challenging due to language barriers and the varied socioeconomic backgrounds of the children — some did not have a fixed address and only periodically attended classes. For this reason, we decided to conduct the second workshop in the park so that children from across the community could participate, not only those enrolled at the school.

Figure 7.22
RePlay Session Documentation

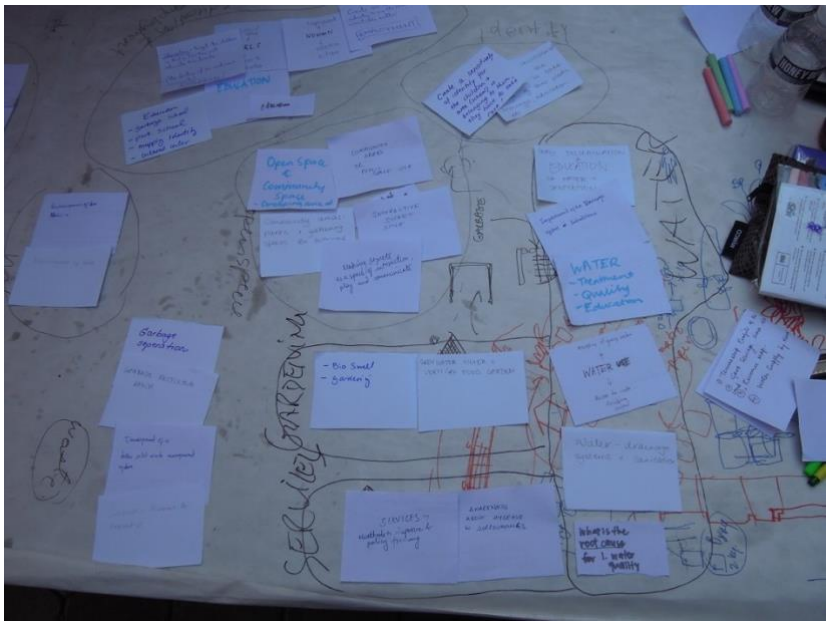


Note. Photograph by Andrea Augsten.

In between the first and second session, part of the design team generated mind maps that highlighted services that had been expressed by the community as being important as well as design proposals.

Below are some images of the mind maps created by the design team

Figure 7.23
Team Design Mapping Documentation 1



Note. Photograph by the author.

Figure 7.24
Team Design Mapping Documentation 2



Figure 7.25
Design Map



Figure 7.26
RePlay Session 1



Note. Photograph by Andrea Augsten.

Figure 7.27
RePlay Session 2



Note. Photograph by the author.

After conducting a series of warm up exercises the children engaged in a design mapping game via RePlay in which they created and utilized their bodies to create a tableau of their desires for this site.

Figure 7.28
RePlay Session 3



Note. Photograph by Andrea Augsten.

As a secondary activity, after conducting a RePlay session we asked the children to create maps on paper of their ideal version of their community. The children highlighted areas they felt were important, such as gardens, play spaces, and clean water. Informed by this process, our team focused on locations collectively identified as opportunities for design proposals: the courtyard, backyard, and community hall, all of which were on the same site as the school. Below are some images of the maps created by the children.

Figure 7.29
Design Mapping with Children



Note. Photograph by the author.

7.2.11 Discussion

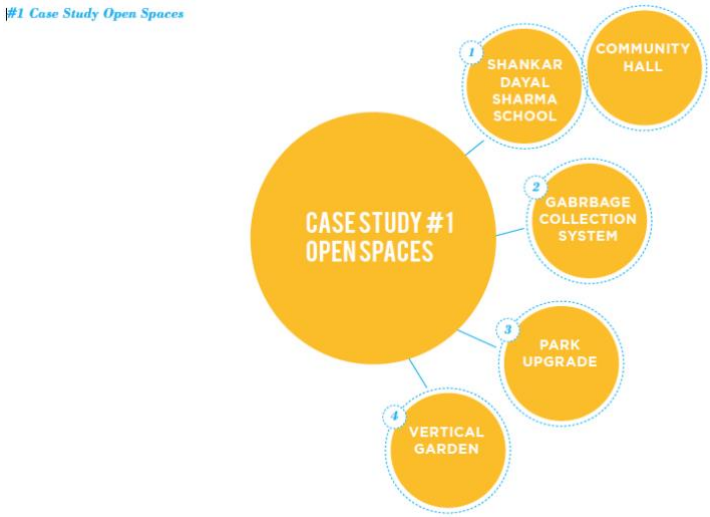
Overall, the design teams identified a cluster of open, public, and semi-public spaces around the existing public school in the southern part of the neighbourhood. This area functioned as a social focus for community activities and had clear potential to strengthen communal life and spatial neighbourhood identity.

Three key issues were identified as requiring attention:

i. Access to drinking water and washroom facilities.
ii. Garbage separation and removal.
iii. Improvements to public spaces.

Below is an image of some of the key concerns and areas our team focused on. Although the RePlay sessions identified garbage collection as a key focus as well as a vertical garden, I will highlight only the major areas we developed as proposals.

Figure 7.30
Case Study Proposal Overview

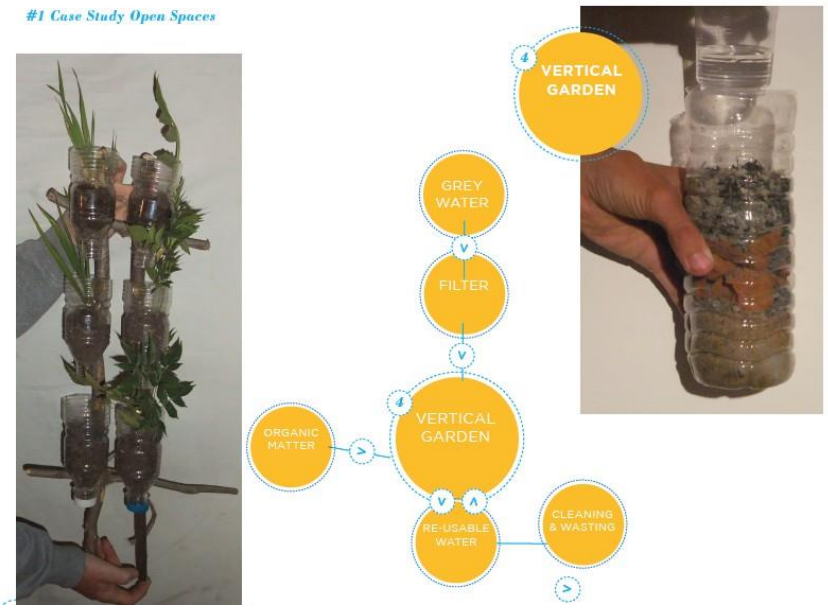


Note. Diagram by Andrea Augsten.

The design process was inclusive and fluid, drawing organically on the various skills and disciplines of our team. We focused on the children as gatekeepers and as unique observers of the spatial environment, recognizing that they interact with and use local spaces differently from adults. We approached the design task with two parallel strategies: using graphic design to create educational tools to support the spatial recommendations being made for the site, and using interviews with the principal, RePlay sessions, mapping exercises, and site visits to gather and interpret community input. Other members of the team focused on developing a graphics program and a rich iconic language for both educational purposes and on-site use. We began by developing an iconic symbol for the neighbourhood that might unify its various smaller communities and create a sense of integration among diverse members.

Based on community input and our own observations, a set of educational, spatial, and material interventions were developed across three timeframes. In the short term, we focused on garbage removal and addressing the tube well as an unhygienic water source, proposing filtration, readily available garbage containers, and the clearing of green spaces. The latter turned into a friendly contest with the children. In the medium term, we proposed creating chalkboard games for children such as hopscotch, a staff area for teachers, a dedicated garbage separation area, gardens, and designated play areas, along with a new tube well filtration system to address ongoing water supply concerns.

Figure 7.31
Vertical Garden



In the long term, we recognized that the community hall needed to be completed, as it still lacked a roof. We also recommended security improvements to the site and proposed the creation of a second-level watchtower. During our walk-throughs we came across a derelict stage used by the community during festivals and celebrations and recommended that it be relocated inside the community hall for use as a presentation platform.

Figure 7.32
Results of the Design Mapping Exercise with Children



Note. Photograph by the author.

7.2.12 Conclusion: The Impact of RePlay on design process

RePlay encouraged exploration of physical parameters such as spatial requirements, experiential knowledge, and contextual information. By using the body as a resource for a bi-directional design process. Due to its low entry threshold and informal nature, it offered children the opportunity to participate and provide feedback as part of a complex architectural design process. From the results collected, a model was generated and presented at the conference as a proposal for how the site might be developed. As shown in Figure 7.31, a key aspect of the proposal was the connection between the school and the community hall, along with additions requested by the community such as washrooms, a garbage separation area, new classrooms, gardens, a staff area, and an outdoor stage for performances by and for the community. A space near the school was also identified as a location for the park upgrade.

In addressing the three guiding questions outlined in the "Overall Project Questions" of this section Global Studio identified both the failures of the Madrasi Colony approach and the existing strengths of the Kabadkhana community as a basis for design recommendations. The problems identified such as water and wastewater, garbage removal, education, and basic services directly informed the short, mid-, and long-term interventions developed by our team. RePlay played a key role in this process by giving the children of the community a voice in shaping those recommendations, surfacing needs and desires that might not have emerged through conventional design research methods alone.

Figure 7.33
Site Map 3



Figure 7.34
Proposal: Connecting Open Space and School



Figure 7.35
Proposal: School Yard Before and After



Figure 7.36
Proposal for Park Upgrade



Figure 7.37
Proposal Overview

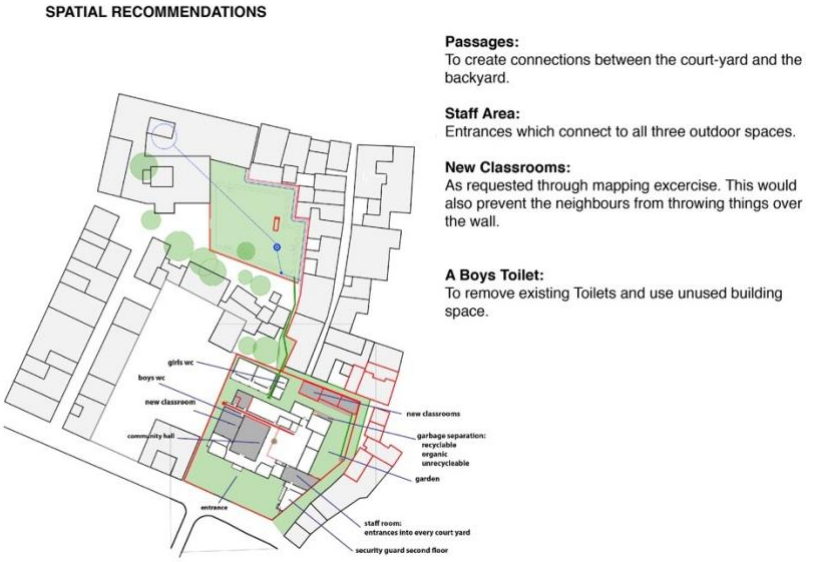


Figure 7.38
Tube Well Proposal

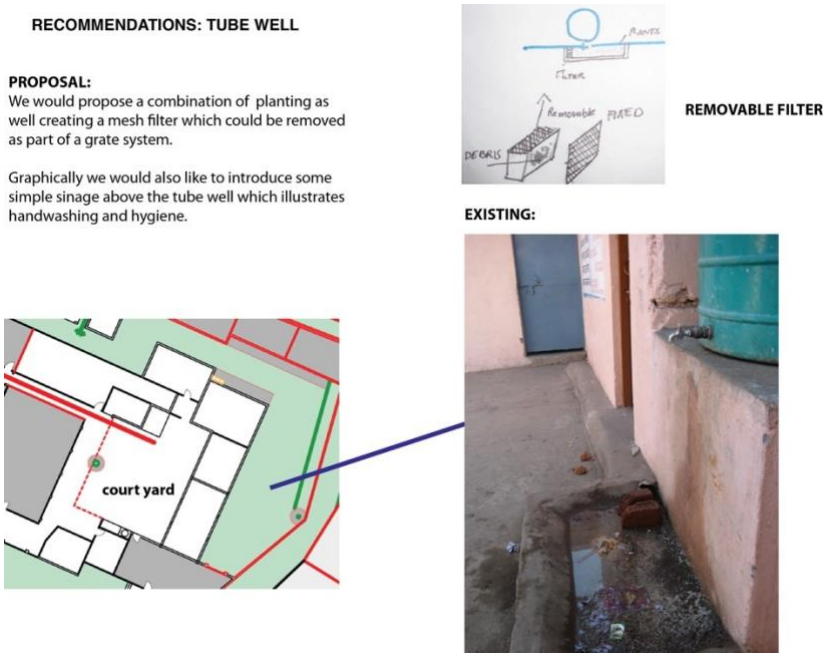


Figure 7.39
Site Proposal 1

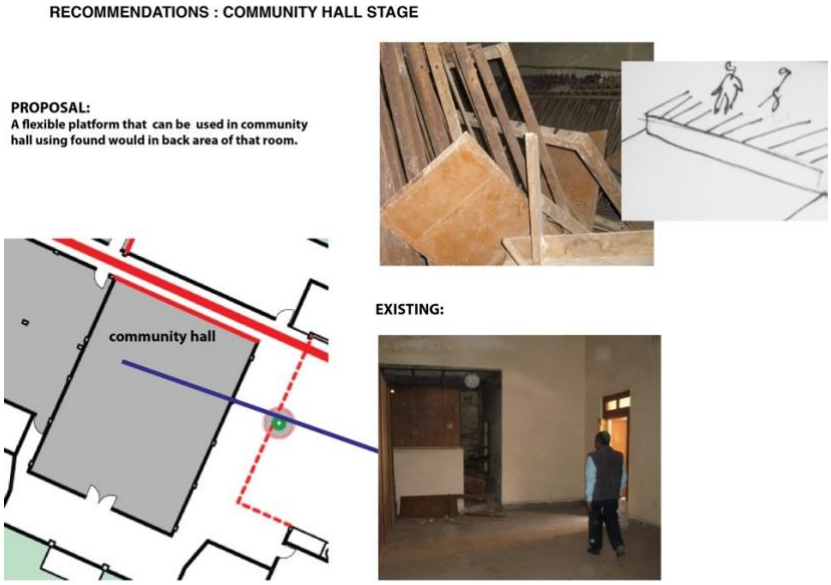


Figure 7.40
Site Proposal 2

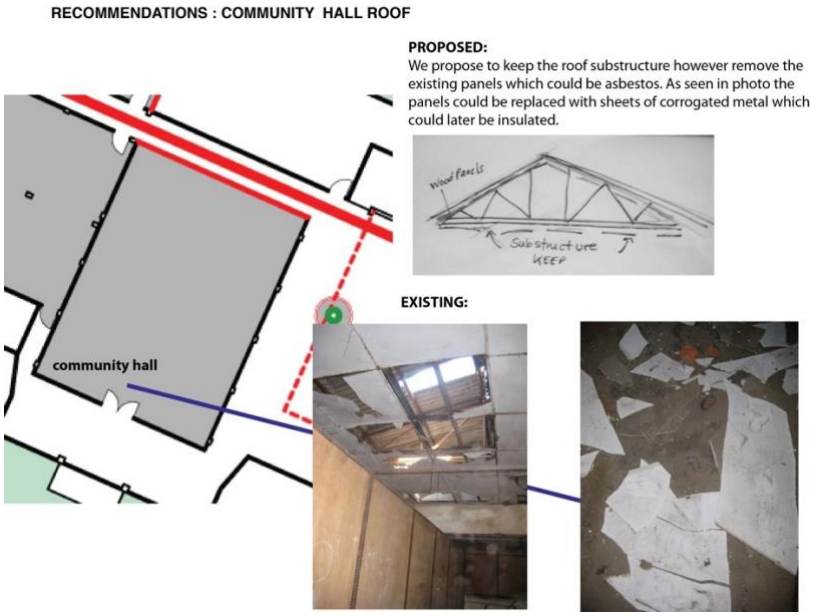
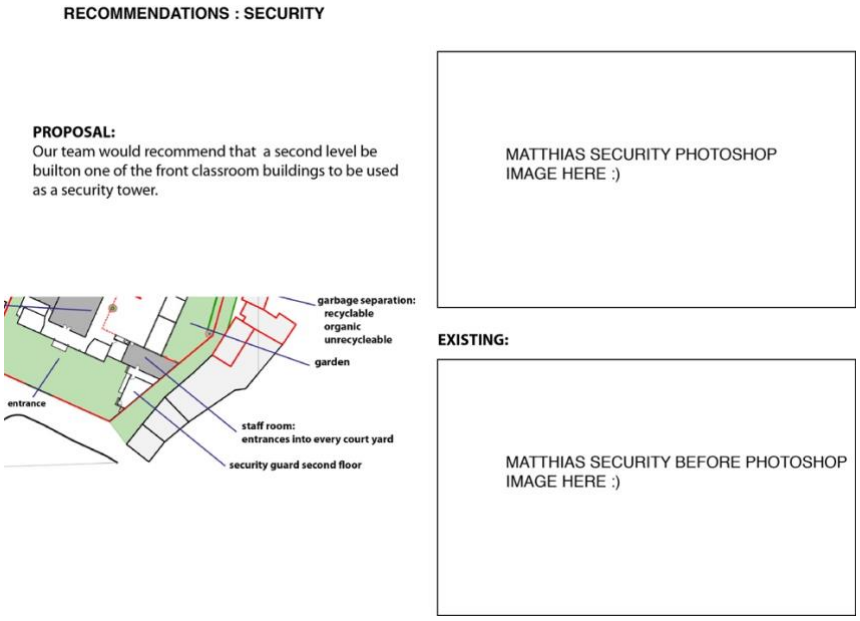


Figure 7.41
Site Proposal 3



Figure 7.42
Site Proposal 4



7.2.13 Future work

If I were to conduct this study again, I would give more attention to the reflection component of RePlay, which I believe would benefit not only the architects and planners but also the community participants. Given more time, I would have liked to conduct RePlay with the design team itself and incorporate that process into the qualitative data informing our proposal. In the case studies

that follow, I explored this reflective dimension further, along with additional techniques and tools developed as part of the RePlay framework.

7.3 Case Study #3: Bendables

The Power of Play: "Bendable Explorations utilizing STEAM, Co-design Process, and Theatrical Improvisation (RePlay) with Young Makers"

7.3.1 Introduction and Motivation

This case study, like the others in this chapter, was motivated by the development of RePlay a framework I designed to facilitate improvisational creativity and to observe and study creative process. As with the Global Studio case study, the objective here was to use RePlay in an applied context, deploying it as a tool for observing collaborative creativity and supporting an innovation process rather than evaluating the framework itself. RePlay fosters creative thinking and reflection through physical externalization and theatrical games informed by design research methods.

7.3.2 Bendables Case Study Research Goals

i. To further develop the RePlay framework and utilize it to observe collaborative creativity.
ii. To utilize RePlay as part of an innovation process.
iii. To develop a prototype for a tangible educational toy utilizing RePlay that would encourage experiential learning about electronics with young makers, using bend interaction as a key design feature.

7.3.3 Bendables Study Research Questions

i. What are some of the design and technical requirements when exploring the development of electronic educational toys that employ circuit building?

ii. How does designing a product with a bend interaction affordance in mind affect the outcome?
iii. How does RePlay encourage reflection as part of maker-inspired learning with children?
iv. How did including an embodied and experiential process affect the learning of the children engaged in making?
v. How does conducting RePlay impact children's design processes, and how is bend deformation incorporated into their final outcomes?

7.3.4 Overview of Case Study

As I worked through this PhD research project I developed an interest in collaborating with the Creative Interactions Lab at Carleton University, where I saw a unique opportunity to develop RePlay further and explore its use as part of a hands-on learning process in the classroom with electronics. After completing my time as a guest researcher at the Creativity Lab at Sussex University, UK, and completing the Global Studio case study, I was successfully funded by an

NSERC Engage Grant (National Sciences and Engineering Research Council of Canada) to collaborate with Carleton University and an industrial partner, Maker Junior, in Ottawa, Canada. In my role as principal researcher, I conducted two workshops using the RePlay framework as part of making workshops with children aged seven to nine, exploring bend interaction as a design affordance. The aim was to develop a learning toy that could be used alongside RePlay, independently, or in informal settings to support experiential learning about electronics with young children.

Following the initial workshops with the children, the research team experimented with 3D printing to create models of our prototype. We also developed a business proposal for taking the prototype further, at this stage naming it "Bendables," and explored the possibility of a Kickstarter campaign and seed funding from BC Ventures. We presented our findings at the Maker Faire in Vancouver, which led to a short exploration of 3D printing materials and prototype sketches with another research assistant at Emily Carr University in Vancouver, just before the end of our funding period. This work also sparked an application to New Ventures BC a start-up pitching competition. I have included excerpts from our BC New Ventures application in the appendix of this thesis which occurred at the end of our funding period in Canada. [11] As this research has spanned over a decade and there has been many technological developments, I will also include some images at the end of this chapter which used AI as a prototyping collaborator.

7.3.5 Carleton University Creative Electronics Lab Partnership

For my academic research partner, Prof. Audrey Girouard of Carleton University, this project was a departure from her technical research into bendable interfaces, as it explored design thinking processes such as RePlay. I however, saw an opportunity to develop a prototype using bend deformation (Fellion et al., 2016; Girouard et al., 2011; 2011; Lo & Girouard, 2014; Warren et al., 2013) while also continuing to develop RePlay. Girouard's work explores the deformation of surfaces using projections and flexible displays, and how bend gestures affect interaction. My earlier work with Global Studio had focused on participatory design rather than technology; this research was rooted in human–computer interaction (HCI), specifically Organic User Interfaces (OUIs). OUIs use non-planar displays, such as flexible displays, as both input and output, so that the deformation of the display itself conveys the state of the information on the device (Alexander et al., 2013). Girouard had identified a need for a user-centred approach to developing OUIs: to explore contexts for bend interaction and to evaluate these interfaces empirically to establish requirements for future products. Building on her research, we co-

[11] Please see appendix for BC Ventures application.

designed a series of low-fidelity prototypes with young makers in two RePlay workshops. These were developed further by our design team in Ottawa and later at Emily Carr University of Art + Design, with input from Nick Fellion, a researcher in Girouard's lab, on bend deformation technology. The research team included four research assistants and the two research partners, and my industry partner, Maker Junior, was closely involved throughout.

7.3.6 Maker Junior Collaboration

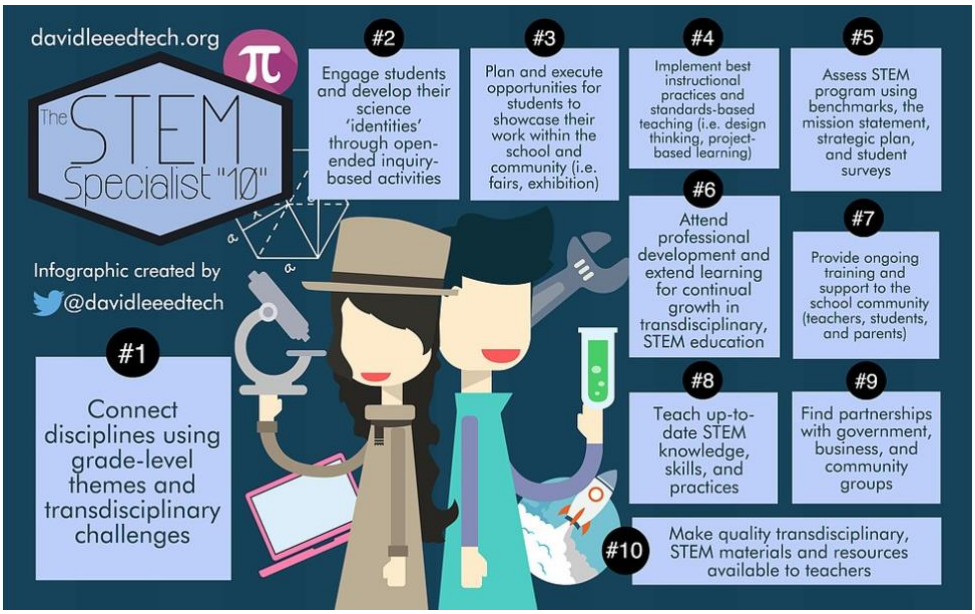
Maker Junior is a company that uses "Maker" inspired projects to help kids learn about technology by combining traditional arts and crafts materials with electronic components. "Maker" inspired projects help kids learn about technology by combining traditional materials with electronic components and alternative conductive materials such as conductive paint and conductive thread. Through workshops at schools, libraries and community centers across Ontario. Maker Junior encourages young people to engage in "tinkering". Tinkering is a mindset, and a playful approach to solving problems through direct experience, experimentation and discovery and is a powerful way to learn. I wanted to develop a prototype for a learning toy which used bend deformation and circuit building as part of its key features. I also wanted to study using RePlay as part of a user centered approach during the innovation process. My results using RePlay in this context unlike the other case studies presented a unique entry point for researchers to gain insights about 'maker inspired learning' as well as tool that could be used in the classroom or at home. Alongside this more formal design research I also conducted market research into state of the art of electronic educational toys which included developing a business model for a kickstarter campaign to further develop our prototype. I also co-authored a paper regarding this research with one of my research assistants Euan Fraser Tait who at the time of this research was working towards a degree in psychology at Carleton University.

7.3.7 State of the Art: The Importance of Maker-Centered Learning

When this research was conducted, maker culture had strong appeal in education, particularly for teaching technology. Initiatives such as Stanford's FabLab@School brought digital fabrication into K–12 schools (Blikstein, 2013), while schools, community centres, and libraries built making facilities as part of a broader democratization of technology. Blikstein (2013) argues that the Maker Movement in education rests on three long-standing pedagogical pillars: experiential education, constructivism, and critical pedagogy. Peppler (2016) similarly describes teachers as the driving force behind its growth. Yet educators also reported gaps. In a survey of 500 educators involved in makerspaces, 90% said they needed materials, project ideas, and activities, and 64% wanted better access to research on how making contributes to learning (Remold, 2016). Exploring maker-based learning with younger children therefore called for a

different kind of tool: one that could support making while also making children's creative processes visible.

Figure 7.43
The STEM Specialist



Note. Lee, D. (n.d.). STEM school. Retrieved October 17, 2026, from https://www.davidleeedtech.org/stem

Peppler and colleagues describe this interdisciplinary field as "makeology", the study of making (Peppler et al., 2016). In one study, Wohlwend, Peppler, and Keune (2016) observed 40 preschoolers making with "squishy circuits", conductive modelling clay used to build simple circuits (Schmidtbauer et al., 2012). From their observations of engagement, orientation to making, and elaborated outcomes, they developed the Design Playshop Model, organized around play, design, collaboration, and technology. They concluded, however, that the field still lacked theory on play-based technology and on contexts in which children can collaborate with new technologies.

7.3.8 Montessori and Experiential Learning

Montessori's work offers an earlier precedent for this embodied approach. Montessori treated movement as central to learning from infancy through elementary school. Her materials involve manipulating objects, moving the body as part of a task, and engaging the senses, making symbolic concepts concrete, as in the Pink Tower of graduated cubes (Montessori, 1912; Lillard, 1988; Standing, 1998). What I have approached elsewhere through embodiment philosophy as enactive perception thus also has deep roots in educational theory.

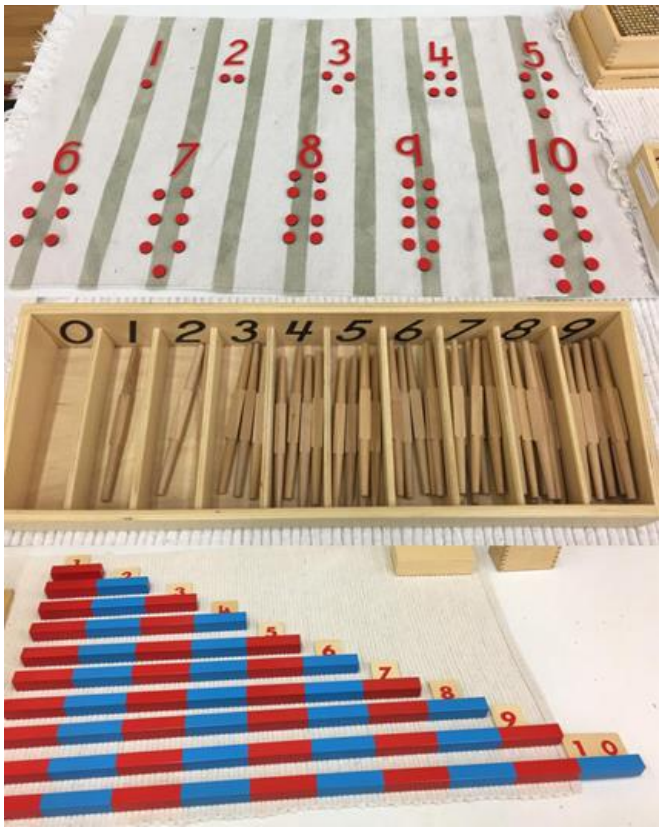
Figure 7.44
Pink Tower



Note. From "Building the Pink Tower," by L. Bertsch, 2015, *Children's Garden Montessori of Canton* (http://childrens-garden-montessori.com/2015/building-the-pink-tower/).

Bendables, the prototype that emerged from this case study, shares similarities with the Pink Tower in that both provide opportunities for learning about principles such as geometry, shape recognition, and numeracy. However, Bendables also incorporates knowledge about design thinking and circuit building. The consistent pale pink colour of the Pink Tower is a deliberate choice to keep the learning activity focused on volume and spatial reasoning (Montessori, 1912). This example illustrates Montessori's deep concern with movement as part of the learning process: "The skill of the hand is bound up with the development of the mind" (Montessori, 1912, p. 79).

Figure 7.45
Montessori Materials



Note. From "Building the Pink Tower," by L. Bertsch, 2015, *Children's Garden Montessori of Canton* (http://childrens-garden-montessori.com/2015/building-the-pink-tower/).

An important misconception about Montessori is that she was opposed to technology use in the classroom, when in fact she advocated for a "technology of the times" corner (Stoll and Lillard, 2008, p. 335). In HCI terms, this presents a significant opportunity for developing scenarios that support a more experiential learning environment, particularly around screen-based interaction.

7.3.9 The Maker Movement and STEAM Toys

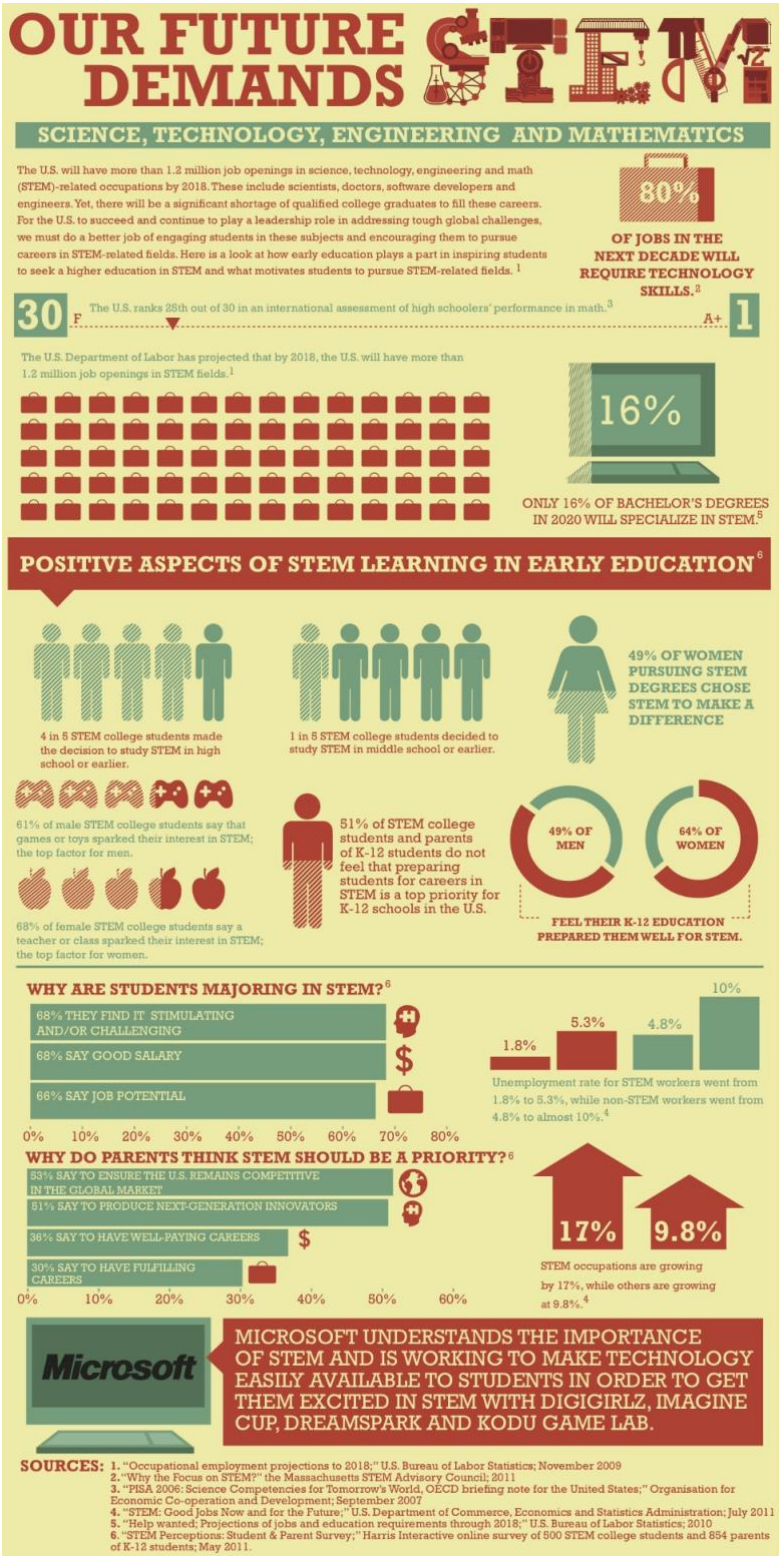
The Maker Movement has led to the creation of several technology products and solutions by individuals working outside traditional institutional infrastructure, facilitated by the increasing availability of information and the decreasing cost of electronic components. Alongside this has come a growing recognition that society faces a shortage of engineering and science graduates a concern, that has strengthened the case for STEAM learning in the classroom. This kind of hands-on engagement with technology presents a unique opportunity for children to explore technology through tinkering, and educators, parents, and children have increasingly expressed interest in incorporating the principles of the Maker Movement into educational curricula. As Peppler, Halverson et al. (2016) observe, "We see the Maker Movement as an opportunity to infuse

technology into early childhood curricula through teachers' expertise in familiar staples of early childhood education: dramatic play and exploratory design with art materials."

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infuse technology into early childhood curricula through teachers' expertise in familiar staples of early childhood education: dramatic play and exploratory design with art materials

Figure 7.46
Future of STEM

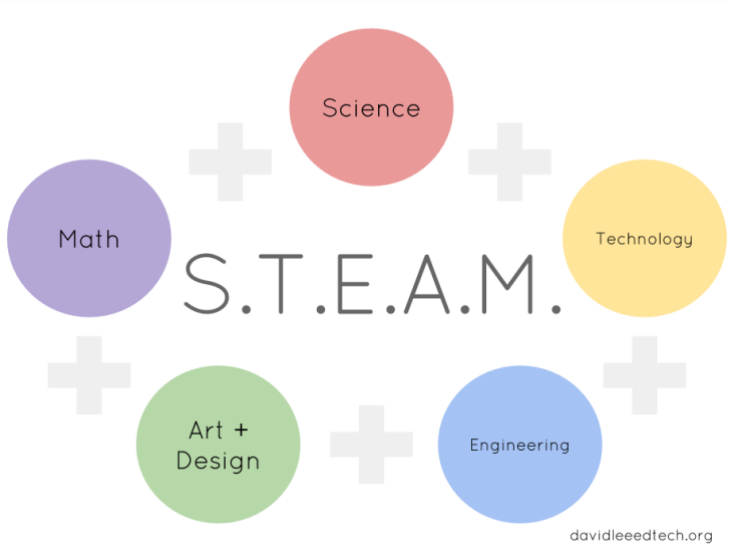


Note. Keeler, A. *Teacher Tech with Alice Keeler*. From alicekeeler.com.

Technology and education researchers Peppler et al. (2016) are invested in developing models for understanding making and ensuring developmental inclusivity.

This presented a meaningful opportunity for RePlay, which similarly supports active learning and creativity through engagement with the external environment, while also functioning as a tool for reflection. This alignment is captured well in the following observation: "You must learn to make. You must always seek to learn more about your making. You may become a journeyman or a master artisan…" (Schmidtbauer, Johnson, Jalkio et al., 2012). This underscores the importance of reflection as an integral part of making and learning with children. Below is a diagram of how Science, Math, Technology, Art and Design, and Engineering all intersect in the domain of STEAM.

Figure 7.47
Components of STEAM



Note. Lee, D. (n.d.). STEM school. Retrieved October 17, 2026, from https://www.davidleeedtech.org/stem

At the time of this research, a niche but growing market of educational electronic toys with a STEM or STEAM focus was beginning to emerge (Gutnick, Robb, Takeuchi, and Kotler, 2011; Hudak, 2015; Johnson, 2016; Luckerson, 2015; Paulo, Blikstein, and Worsley, 2016; Shuler, 2012). Market research conducted as part of this study found that two-thirds of companies in this space raised funds through the crowdsourcing platform Kickstarter. One of the most successful raises being Cubetto, which closed at $1.6M against an original goal of $100,000. The Bendables

prototype is distinctive within this market in that it targets children aged two to five, an age group that few toy designers were considering at the time.

Several products informed the development of Bendables. Cubetto stood out not only for its innovative design but for its explicit connections to Montessori learning principles, computer programming concepts, and the maker movement whose values closely aligned with our own research goals. Like Bendables, Cubetto embraced a co-design process by distributing free versions of the product to educators for classroom testing, treating the educator community as active partners in development.

Figure 7.48
Cubetto



Note. [AUTHOR: source of image and permission]

LittleBits similarly has built a large online community of children and educators who construct and share projects together, demonstrating the power of community-driven co-design as part of an innovation process.

Figure 7.49
littleBits



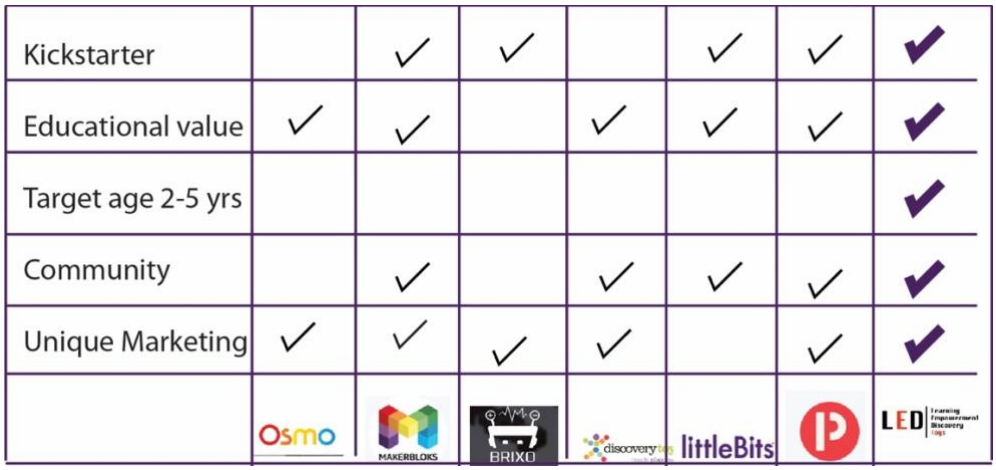
Note. [AUTHOR: source of image and permission]

In many ways the innovation processes of both Cubetto and LittleBits mirror the co-design approach we planned to explore with the Maker Junior community of children, educators, and parents.

Other products we examined included Osmo, an iPad gaming accessory combining physical materials with screen-based interaction; Makerbloks, Canadian-made electronic building blocks with academic partnerships at Concordia University; and Brixo, which embedded circuits into standard building blocks. While each of these addressed circuit building and imaginative play, none targeted the two to five age group or incorporated bend interaction as a design affordance — the two key differentiators of Bendables.

What distinguished Bendables from all these products was its combination of bend deformation technology, early childhood focus, Montessori-informed design principles, and co-design process with young makers

Figure 7.50
Competitive Matrix



Note. Bendables is part of LED Toys.

7.3.10 Research Methodology

This project involved a co-design process in which an adult design team collaborated with young makers in an informal making context. The unique quality of this design process was that the children were not simply passive participants but held key roles as active members of the design team. For this project we drew on both the Bluebells method and the RePlay framework, applying these strategies within an informal making workshop (Kelly, Mazzone, Horton, and Read, 2006; Gongora, 2010a, 2010b; Gongora and Dix, 2010, 2012a, 2012b .

Bluebells is a method developed by researcher Janet Read at the Child Computer Interaction Group at the University of Central Lancashire, used in HCI to co-design technological artifacts with children. In the Bluebells method, children are not treated merely as users but as equal members of the design team what Read terms "informants/designers." This means they are not only providing information about the context but actively contributing to defining design requirements and executing early prototypes. The method is structured around three stages that specify the role of the children at each point in the design process: "before play," in which the adult design team engages in fact-finding; "during play," in which the children become involved in design activities; and "after play," in which the adults construct prototypes and implement products (Kelly, Mazzone, Horton, and Read, 2006).

In a similar way, RePlay required us as facilitators and design researchers to present the materials and the design challenge in a way that was both accessible and imaginative, with the goal of inspiring the children and collectively generating ideas, contexts, suggestions, and design requirements. The prototypes produced during this first phase were intended to be developed further by the adult design team, who drew on existing research, previous prototypes, and their

expertise in interaction design, deformable displays, materials, and circuit building. The results of the adult design team's work are discussed in Part II of this case study.

In this context RePlay was employed primarily as a body storming technique, rather than as a tool for facilitating reflection on individual creative process or for evaluating the framework itself. As a final step, however, the children did reflect on the experience of conducting RePlay and on how it informed their final prototypes.

The applied design research goal was to explore bend deformation as a unique interaction affordance, incorporated into an activity involving circuit building. In contrast to conventional app-based or touchscreen interfaces, a deformable interface offers a tactile, experiential, and physical form of interaction with technology — presenting significant opportunities for HCI research, for designing with children in mind, and for developing new contexts for engagement, learning, and play with technology.

7.3.11 Research Hypothesis

We expected to gain insights into designing a deformable prototype with children, including technical requirements, knowledge of our target audience's needs and expectations, and a range of data: video recordings of physical externalizations, photographs, low-fidelity prototypes, interviews, and drawings. The low-fidelity prototypes created by the children were intended to serve as the basis for further development by the adult design team. As part of this exploratory research project, we also expected to identify new research challenges and areas of potential opportunity. Based on the prototypes and user studies, we anticipated developing a set of requirements for designing toys that utilize display deformation as a core design feature.

7.3.12 Workshop Structure

The research involved low-fidelity prototyping and co-design sessions with a mixed team of interaction designers, facilitators, educators, and children. The core design requirement was that bending needed to be a key facet of the prototype. Using RePlay, collecting traces, and think-aloud methods, we investigated the extent to which bend interaction was informing the activity, and whether RePlay facilitated the children's creative process and subsequent reflection on making. The first part of each workshop utilized the RePlay framework.

Figure 7.51
Poster for the Maker Junior Workshop



Above is an image from one of our workshop sessions which we emailed to families who had already attended a Maker Junior workshop. What was unique about using the RePlay framework in this context was its ability to mesh design research with improvisational games to encourage design thinking and collaboration. The session began with traditional Impro warm-up exercises, including passing an invisible object around the group. As the object was passed, participants would transform it by giving it properties such as "heavy" or "fuzzy." In the second workshop, following feedback from the research team, a constraint was introduced requiring children to incorporate at least two bends and two trigger objects into their project.

7.3.13 Trigger Objects

Trigger objects are open-ended props that serve as metaphors for tangible interfaces. This technique was first developed as part of the Lancaster pilot study and later refined at the Tiree Tech Wave, where academics from various interdisciplinary backgrounds — computer science, arts, and social sciences — used low-fidelity prototypes of their own projects as trigger objects within a RePlay workshop. In each case the trigger objects included an electronic component.

In the context of this case study, trigger objects were incorporated as a next step within a design machines activity, created by the adult design team for use in the RePlay sessions. As shown in the image below, each trigger object incorporated bend interaction and a circuit component — one had a vibration motor, one had an LED, and one had a buzzer. When bent and connected end to end, the objects would trigger the circuit to buzz, vibrate, or produce a sound.

Figure 7.52
Trigger Objects at the Bendables Workshop



Below is an image of one of the participants interacting with a trigger object as part of a RePlay workshop.

Figure 7.53
Participant Using a Trigger Object



Once the bend constraint was explained, the children were led through an exercise whereby we organically introduced the Trigger objects and gave children opportunities to interact with them during the Design machines exercise.

Figure 7.54
Design Machines Exercise with Children and Researchers

7.3.14 Design Machines



In this game, players use their bodies to illustrate an object or system. Each player must maintain physical contact with at least one other player while remaining attentive to what others are offering. Minimal discussion among players works best, and sounds can be incorporated as well. The exercise is abstract in nature and can be applied to conceptual or experimental exploration. Examples we have used include representing social networks such as Facebook, or more technical concepts such as data flow diagrams.

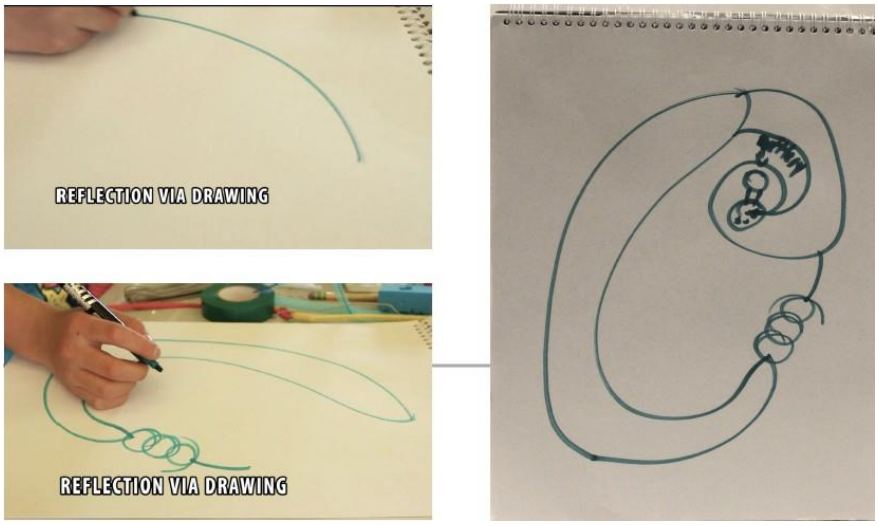
Figure 7.55
Design Machines Exercise with a Bendable Prop



7.3.14 Traces

At the end of each making session, the children worked in pairs with a researcher and were asked to explain their inventions to one another. Researchers asked exploratory questions about each child's design process to encourage reflection. Children were prompted to document their ideas through drawings as well as verbal explanations. We referred to these reflective outputs as traces — a term introduced earlier in this research project.

Figure 7.56
Traces Documentation



A trace[12], is a visual method of collecting research data about creative process, as an alternative to relying solely on interview data. The technique was first developed as an exploratory research strategy at Philips Design in Eindhoven and later used as part of an artistic residency at SÍM in Iceland. In a trace, the creative individual shares reflections usually drawings or early prototypes about their process while working alongside the researcher, who shadows them and creates visual snapshots of what they interpret as recurring themes or significant observations.

In the first workshop, traces took the form of drawings created by the children as well as physical manifestations of their inventions. In the second workshop, traces evolved into physical externalizations. In both cases, children were prompted to accompany their traces with verbal explanations, and these feedback sessions were videotaped to facilitate reflection on making. Following each workshop, the adult design team debriefed together to discuss the results and identify areas for improvement; these debriefing sessions were also videotaped for future reference.

Between workshops, the adult design team explored different materials and form factors and expanded upon the prototypes developed with the young makers. This work was informed by existing research, previous prototypes, and the team's combined expertise in interaction design, engineering, psychology, computing, deformable interfaces, and technical validation.

7.3.15 Participants

We worked with two groups of six to ten children between the ages of seven and nine, all of whom had previous experience attending a Maker Junior workshop or event. The workshop team consisted of two facilitators and three research assistants responsible for taking notes and photographing and drawing the children's projects. A fourth research assistant was exclusively responsible for videotaping the design process. Once the making portion of the workshop was complete, researchers conducted interviews with the children about their inventions and creative process. Following each workshop, the research assistants and facilitators debriefed together to discuss what had worked well and what could be improved.

7.3.16 Expert Design Team

The initial design team consisted of Audrey, Allison, and me. This team later expanded to include four research assistants from the fields of psychology and human-computer interaction, as well as individuals with expertise in 3D printing, material exploration, and bend deformation.

[12] See Methods Chapter

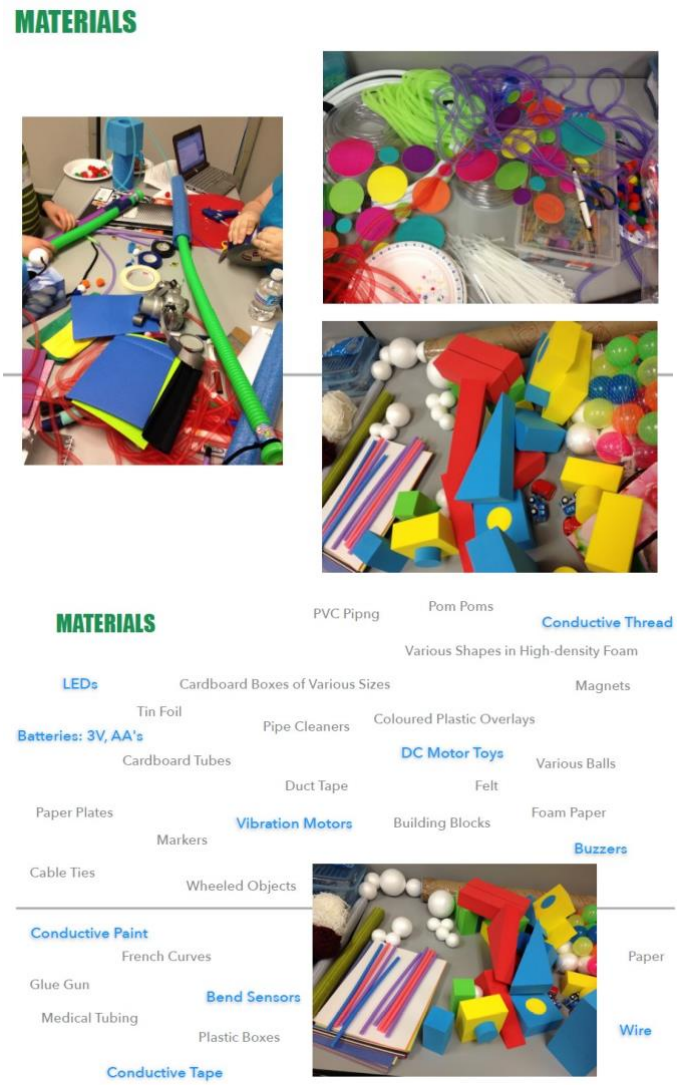
7.3.17 My Role

My role in this case study was multifaceted, spanning researcher, facilitator, designer, and ultimately co-developer of a proposal to bring the Bendables prototype to market.

7.3.18 Materials

Arts and crafts materials including pipe cleaners, pom-poms, foam, and mesh were used alongside circuit building materials that enabled vibrating, spinning, lighting up, and movement in straight lines and circles. Circuit building materials included conductive paint, wire, DC motors, vibration motors, buzzers, LEDs, and bend sensors. We anticipated that the children's projects would combine both the electronic and arts and crafts materials. Below are some images of the materials used in the workshops.

Figure 7.57
Workshop Materials



the inspiration behind our choice of materials was very much driven by sparking the children's interest in combining craft materials with electronic components to add interaction to their inventions.

7.3.19 The Moment

"The team of bright minds assembles each a designer in their own right. A dense mix of wide eyes and sheepish gazes as the children gaze at the craft tables overflowing with some familiar and some new materials such as mesh, wires, lights and buzzers. Parents curiously peer back as they file out of the room. After an energetic session of focused improvisational play utilizing the RePlay framework, the young designers are set loose, grabbing armfuls of materials. The smell of hot glue and faint metallic tang wafts around the room. The quick snips of wire cutters snipping pipe cleaners

and insulated wire can be heard at every table. The room is filled with the chatter of collaboration. Many sentences beginning with 'I know, I'll…' 'Maybe if I…' and 'Am I allowed to…?' can be heard bouncing around the room, with each child working through their process in their own unique way. This is a study exploring how some of our youngest minds are invaluable to the design process when there is both guidance and creative freedom in equal measures." (Gongora and Tait, unpublished, 2017)

Building on technical research into display deformation via Organic User Interfaces (OUIs), we worked with children to co-design low-fidelity prototypes as a way to explore design requirements, form factors, contexts, and activities for an electronic toy utilizing bend interaction as a design affordance (Alexander et al., 2013; Holman and Vertegaal, 2008; Lee et al., 2010; Lo and Girouard, 2014; Warren et al., 2013). Our research goal was to explore deformation as a unique design affordance paired with circuit building. In contrast to the commonly used interaction styles of taps and swipes on touchscreen interfaces such as iPads, a deformable interface offers a tactile, experiential, and physical form of interaction. This presents a novel approach for tangible human-computer interaction research and a particular opportunity for designing with children in mind, as it complements their natural inclination to explore their environment through tactile manipulation.

7.3.20 Observations

Given the exploratory nature of this research, we were prepared for a wide variety of results and an organic workshop structure. We have framed the results of the co-design process using a structure parallel to the Bluebells method, organized around three phases: before play, during play, and after play. The most significant results occurred during the "during play" phase at the workshops conducted with the young makers.

Figure 7.58

Child ID worksop 1	Invention outcome	Child ID worksop 2	Invention Outcome
1, Male	-Aesthetic Bending Ranndom craft materials taped together	7, Male	-Functional Bending Light up game required the bending of wires to function
2, Male	-Absence of Bending Alien craft model	8, Female	-Functional Bending Copied trigger object from RePlay
3, Female	-Aesthetic Bending Model of a cat, bent pipe cleaners to create whiskers	9, Male	-Functional Bending Conceptual ink sprayer used bending to direct ink hose
4, Male	-Absence of Bending Decorated Pen Holder	10, Male	-Functional Bending Wires were positioned so they could be bent to complete the circuit to power his lamp
5, Male	-Absence of Bending Robot model, using toy cars as wheels	11, Female	-Functional Bending Complex use of lights and circuitry to modify a toy car Included a rudimentary impact sensor that relied on deforming a bumper made of wire
6, Female	Functional Bending Complex light up alien model with posable head	12, Female	-Functional Bending Electronic belt, bending was necessary to wear and activate the belts sound and light functions

Workshop Documentation



We had hypothesized how the children might respond to RePlay but were genuinely uncertain what to expect. Following Workshop 1, we refined the workshop structure to allow for greater reflection and clearer constraints around the use of bend deformation, based on observations made by the researchers and facilitators during the debriefing session. Table 7.3 summarizes the inventions created by the children across both workshops.

Table 7.3
Summary of Makers' Inventions from Workshops 1 and 2

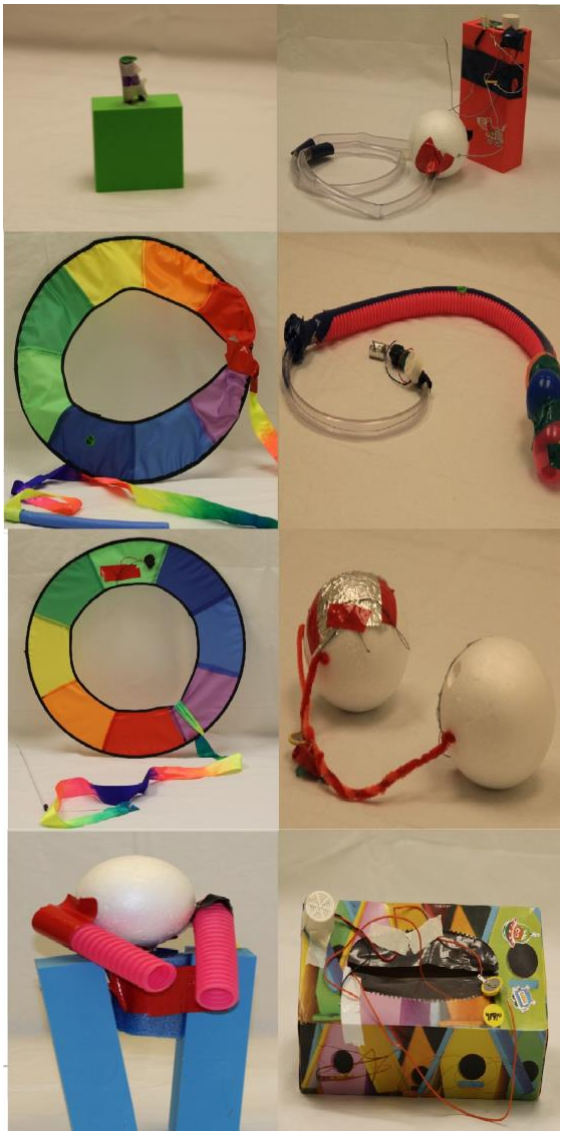
7.3.21 Before Play

We conducted a great deal of material research and best practices research of existing electronic toys (18,19,20). Given the connections between various components was an important design requirement for this age group, as discussed in the previous section we researched traditional toys with this quality and how the material design was executed. In terms of our research design, we also used RePlay games that we thought would be relevant to facilitating the design process as well as fostering reflection about making.

7.3.22 During Play

In Workshop 1, as seen in Table 7.3. the children struggled to incorporate bend interaction as a functional component of their inventions. In some cases, it was dropped as an interaction altogether and became instead a purely aesthetic characteristic of the design.

Figure 7.59
Workshop 2 Objects



In Table 7.3, each invention has been given a designation depending on its

relationship with bending. Aesthetic bending is defined as bending that functions merely as an accessory to the design, with no functional qualities. After the creation phase of each workshop, children were questioned about their design process and use of bending.

In Workshop 1, young makers would identify a malleable part of their invention and declare it a bendable component. The challenge we observed was that bending was never fully conceptualized as an interaction style. We suspected that children were creating their projects without bending in mind and later attempting to justify that aspects of it were bendable to satisfy the researchers.

In Workshop 2, as previously noted, we introduced constraints requiring children to incorporate at least two trigger objects and two bends into their inventions. This change in workshop structure produced dramatically different results. Rather than generating numerous superficial examples of bend interaction, the children's projects became considerably more elaborate. Each invention became more focused and tangible, and the children displayed a much stronger grasp of bend as an interaction style, incorporating bending as a functional rather than decorative aspect. This is evidenced in Table 7.3 and Figure 7.59

Workshop 1 was characterized by inventions that mostly consisted of one or two pre-made objects glued or taped together. In Workshop 2, following the introduction of trigger objects and the addition of constraints, the children's projects became far more complex. One example the second from the top on the right-hand side of Figure 7.59, may at first appear to be a collection of craft materials loosely assembled, but its construction is deceptively complex: a belt that buzzes and lights up when wrapped around the wearer's waist, activated by the deformation of the material. Reviewing the two workshops side by side made it clear that the children were capable of sophisticated design processes when given both inspiration and a framework within which to develop their ideas.

In Summary the trigger objects were successful in providing children with a concrete starting point and a demonstration of how circuit building materials could be applied. This contrasted with Workshop 1, where children were presented with a large quantity of materials and minimal guidance, resulting in numerous but under-elaborated prototypes that did not fully engage with bend deformation as a design requirement.

7.3.23 Summary of Results

One of the research goals was to understand the types of activities children engage in during the making process. Robots emerged as a dominant theme, explored by several children independently. Other popular themes included wearables, small animals, wheeled objects, and flying objects such as Frisbees. Several children also created decorative boxes, while others produced highly interactive objects that explored fundamental concepts of interaction design, the principle that when X occurs, Y is triggered. Some projects were more process-oriented or conceptual in nature, with the young maker driven by curiosity about the materials rather than a predetermined outcome.

Design processes varied considerably across participants. Some children arrived with concrete plans; others developed their ideas as they worked with materials. Some were motivated by abstract concepts such as "gravity"; others by personal use or a desire to improve something in their daily lives. This variation echoes observations of expert designers and the uniqueness of individual creative process (Gongora and Dix, 2010).

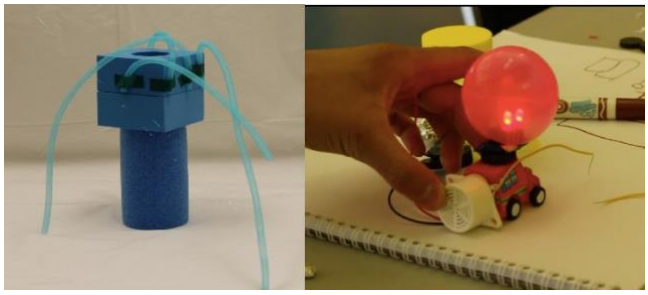
One particularly illustrative example is Maker 1, who participated in the RePlay session but did not display overt enthusiasm. His design process was individualistic as he chose to sit on the floor away from his tablemate and created what he described as aesthetic toys "just for me," focused on exploring the properties of materials such as mesh tubing. This contrasts with Maker 11, who from the outset had a clear planning process.

Even among twins, clear differences in design process were evident, illustrating how individual and unique the creative process can be. Makers 9 and 10 both displayed enormous enthusiasm

throughout the workshop, eagerly engaging with materials and maintaining a constant stream of work. Maker 9 reported that he had been inspired to create his ink sprayer after watching one of the researchers wave their arms during the design machines exercise. The movement he observed, reminded him of an octopus, which provided him with inspiration. His twin, Maker 10, reported that he had not been inspired by the design machines activity but had become fascinated with the light-up trigger object, prompting him to create a secret reading lamp to be used after his mother had put him to bed. It was activated by the deformation of wires to turn the light on and off.

Other children reported that the RePlay exercise had been "fun" and had "helped wake me up" but had not directly informed their design process. Despite this, fostering awareness within the creative process, even when participants do not consciously register it, is one of the well documented benefits of conducting RePlay as part of Creativity in Action (Gongora and Dix, 2012a). Child 12, for example, stated that she relied entirely on a stream of ideas that began as soon as she started assembling materials and speaking aloud.

Figure 7.60
Aesthetic Objects and Impact-Sensing Car

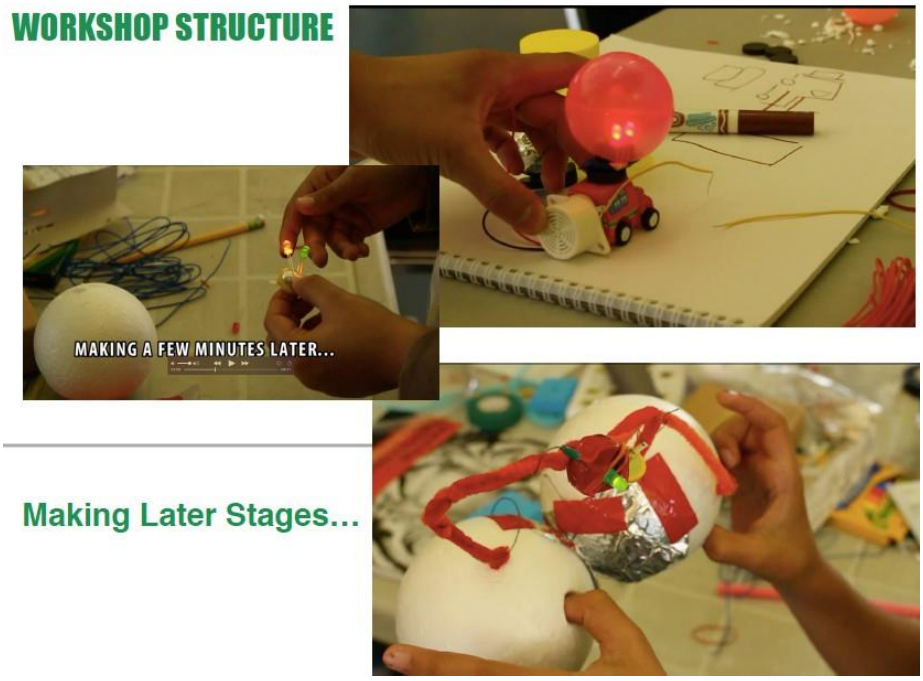


Note. Left: aesthetic objects taped together. Right: impact-sensing car.

The variety of designs and ideas displayed by the young makers across both workshops was remarkable. One concern raised by a facilitator was the observation of a "viral" effect on several occasions, whereby one project drew the attention of other children and resulted in copycat designs. The study controlled for this by seating children in separate groups at different tables; however, a small copycat effect did occur in some cases, as can be seen in the two middle images on the left side of Figure 7.59. There are two projects constructed by different children at opposite ends of the room that are almost identical in appearance.

Beyond these few exceptions, most designs were based on unique concepts drawn from each child's personal experience. Maker 3, for example, designed a model cat because her parents would not allow her to have one in real life. During the RePlay exercises she was extremely shy. Figure 7.54 shows her clinging to a researcher's leg during a Design Machines game but she opened up considerably once she began applying her idea and bringing it to life.

Figure 7.61
The Making Process



7.3.24 After Play

Based on the themes and activities the children gravitated toward, we decided to develop a kit concept that would facilitate building activities such as constructing animals, masks, jewelry, and cars. One aspect we explored in more detail was how circuits might be embedded inside building blocks, which led to material exploration through 3D printing of the connections. Given that the adult design team came from diverse backgrounds such as engineering, computer science, and design we opted to use squishy circuits as a communication tool and as a tactile way to collectively explore aspects of the prototype (Schmidtbauer et al., 2012; Wohlwend et al., 2016).

From a technical standpoint, we explored using fiber optic cable as a bend sensor that, via light attenuation, could sense the degree of bending. This change in light level caused by bending the fiber optic cable could then be used as input to trigger an interaction. We encountered this application of fiber optic cable through previous research implementing it in the design of a flexible stylus pen (Fellion et al., 2016).

7.3.25 Discussion

Blikstein and Worsley (2016) argue that maker-centered learning and teaching the fundamentals of human-computer interaction are becoming increasingly necessary as society moves toward a culture of technological literacy. Materials and tools designed for children such as robotics kits and electronic kits should be developed specifically with this age group in mind. Platforms such as Arduino are not appropriate for young learners, as they introduce a level of technical complexity

that is foreign to the original learning goal and tends to frustrate children before they can accomplish even the simplest projects (Blikstein and Worsley, 2016). Designing learning tools with this specific demographic in mind fosters youth-oriented accessibility. Traditional childhood development theorists such as Piaget, Montessori, and Vygotsky have argued that hands-on experiential learning is extremely valuable in shaping the educational process (Montessori, 1912; Mooney, 2013; Stoll, 2008). Making is one way of bringing engineering to young learners, providing concrete experiences that give meaningful context to abstract science and math concepts. Constructivism a term associated with Seymour Papert (1993), a founding figure of the maker movement encourages children to independently develop projects with technology while working within a supportive framework.

One unique and unexpected outcome of this case study was how the RePlay framework came to serve as a tool for teaching fundamentals of human-computer interaction. Through the design machines exercise, the children began to understand the basic principle of cause and effect and how to translate this into design requirements for their inventions. This is evidenced both in the children's final projects and in how the design machines activity and trigger objects together provided a physical analogy for guiding and supporting the young makers' design thinking.

7.3.26 RePlay and Body Storming

Following the introduction of trigger objects and constraints in Workshop 2, a clear shift in outcomes was observed. In Workshop 1, many children appeared confused by the instruction to incorporate bending into their projects and instead opted to create superficial models based on familiar objects or to copy other children (see Figure 7.59, left side). Makers in Workshop 1 were also frequently uncertain about how to use the electronic components, despite researcher explanations. In Workshop 2, by contrast, the trigger objects were much more integrated into the makers' projects from the outset. RePlay proved effective not only as a tool for facilitating initial brainstorming but also as a means of communicating the constraints of bend interaction as a design requirement particularly through the combination of design machines and trigger objects. The use of RePlay to introduce bend interaction in Workshop 2 resulted in more elaborated projects in which bending was incorporated as a functional interaction rather than a merely aesthetic characteristic. This is evidenced in the reflection phase, when researchers asked children about their design process and received considerably more concrete and articulate responses. The children clearly described their train of thought, as documented in the video record of the workshops. Table 7.3 illustrates how bend interaction is more deeply integrated into the final designs from Workshop 2, functioning as an essential component rather than a superficial addition.

Figure 7.62
Maker #7's Light-Up Guessing Game

Note. Left: interior. Right: light-up exterior.

A clear example of integrated functional bending that emerged in Workshop 2 is Maker 7's light-up guessing game, featured in Figure 7.62. The premise of the game was that the player had to guess which of three lights would illuminate after bending a wire to complete the circuit a simple but purposeful use of bend interaction. This contrasts with Workshop 1, where Maker 1's object incorporated bending only as a material property rather than as a deliberate interaction. Based on these results, RePlay shows clear potential as an effective tool when co-designing with children.

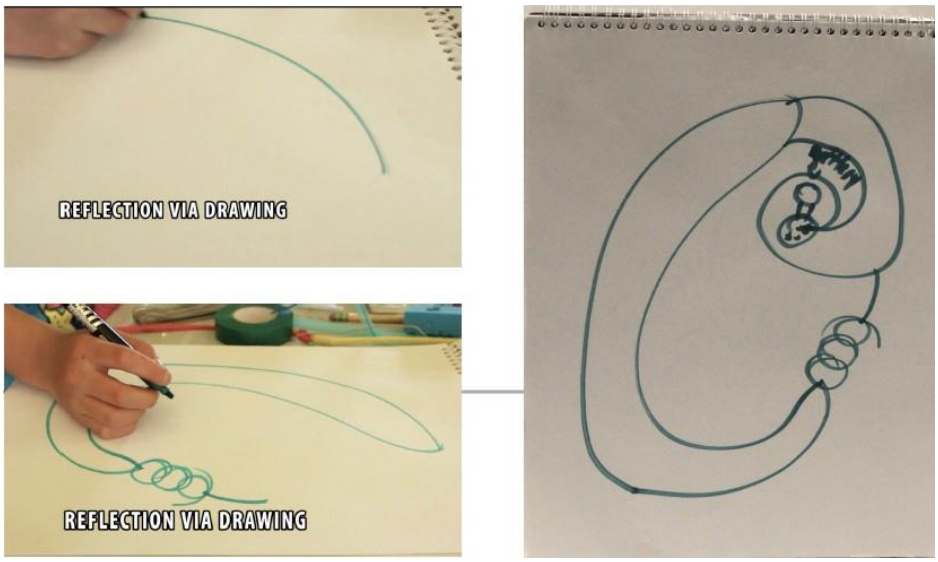
7.3.27 Physical Externalization and Reflection on Making

An important aspect of the makers' design process was how the children responded to physical externalization activities and how this translated into their design process in differing ways. For example, while Makers 9 and 10 based their design process on conversations with each other and reported gaining no creative input from the RePlay exercises, Maker 9 also reported that during the invisible ball exercise he had been inspired to think about ink and octopuses which jumpstarted his idea for an ink sprayer featuring a hose, or tentacle, that would spray ink. Maker 11 similarly responded well to the design machines exercise, reporting that seeing one of the researchers bend their arms reminded her of a car, which prompted her idea of using a toy car as the basis for her circuitry project.



Another key observation was that only a few children utilized drawing as part of their creative process an interesting finding given that design research suggests drawing functions both as a tool for reflection and as a tool for planning during the creative process (Gongora and Dix, 2010). This can be seen in Figure 7.63, where Maker 12 is shown drawing her electric belt invention.

Figure 7.63
Maker #12 Drawing Her Electric Belt



Note. Maker #12 drawing the electric belt she had created earlier in the workshop.

In the first workshop, children were asked to work in pairs, with one child describing their invention to the other through drawing. This task proved daunting for most participants. One of the workshop facilitators, who has extensive experience working with this age group in making contexts, noted that drawing can be particularly challenging for children of this age, who may still be developing manual dexterity and confidence with drawing materials.

Figure 7.64
Maker #12 Bodystorming Her Design



Note. Maker #12 using bodystorming to reflect on her design

Children at this age are also eager to please and may not yet feel they have the skills to communicate their ideas effectively through drawing. We therefore sought to incorporate physical externalization into the reflection component of the workshop not only in the early body storming phase via RePlay, but also later as an alternative to drawing.

In the second workshop, children were asked to physically act out their inventions to their partner while being asked exploratory questions by the research assistants. This approach proved considerably more effective than drawing both as a tool for reflection and as a means of collecting information about the children's making process. Figure 7.64 shows this in action: after a researcher prompted Maker 12 to act out her invention, she was able to incorporate physical expression naturally into her reflection process.

7.3.29 Technology Product Development

The primary focus of this research was the design process rather than the development of technological breakthroughs. However, given that part of the research involved exploring the bend interaction aspect of the prototype, it is relevant to briefly document the technical approach taken. Based on recommendations from the research team, we decided to explore the use of solid-core fiber optic material as a bend sensor, achieved through the effect of light attenuation (Fellion et al., 2016).

7.3.30 Conclusion: Phase 1

Data collected through this case study shed light on the styles of learning, themes, and activities that children repeatedly explore when engaged in making, the importance of hands-on interaction with materials, and the role that physical externalization played in their creative process. I also

continued to develop strategies for supporting and facilitating making via RePlay (Gongora and Tait, unpublished, 2017).

As a result of the research conducted at Carleton University, in collaboration with the industry partner and through the co-design process with the children, we were able to conceptualize a prototype for a tangible manipulative called Bendables essentially a set of blocks with embedded circuitry that incorporate bend sensors to create connections and trigger interactions. Using Bendables, children experiment with circuit building as part of creating masks, jewelry, wheeled objects, robots, wearables, and other STEAM-inspired projects. Like other researchers in the field of STEAM education, this project is grounded in the value of experiential learning.

7.3.31 Phase 2: Results and Future Work

Building on the co-design workshops conducted in Phase 1, the second phase of this research focused on developing the Bendables prototype further and presenting findings to a wider audience. The co-design process with the children had established key design requirements particularly around the connections between components and circuit building which informed the adult design team's continued material and technical exploration. Strategies developed through RePlay in Phase 1 were refined and carried forward into this phase. The findings were also presented at the Vancouver Maker Faire, where the prototype attracted interest from educators and makers in the community.

Figure 7.65
Maker Faire Website



7.3.32 Material Exploration

The adult design team used a range of materials to develop and communicate ideas, including squishy circuits, paper prototyping, LittleBits, 3D printing, and crafting materials like those used in the workshops. Squishy circuits proved particularly useful as a way for the team to work through design ideas collectively, given that team members came from diverse backgrounds in engineering, computer science, and design.

Figure 7.66
Playing with Bendables Prototypes and Material Explorations



Note. The author's daughter playing with prototypes of Bendables and material explorations.

As part of this phase, we conducted material exploration through 3D printing of connection points and digital fabrication and developed 3D models to visualize the prototype. This proved to be one of the more challenging aspects of the process, as it was difficult to find a model that captured what Allison (Maker Junior) and I had envisioned, and my own limited experience with 3D modelling meant this was primarily led by other members of the team. We also devoted considerable time to exploring circuit connections and drawing on Nick Fellion's expertise regarding the use of fiber optic cable as a bend sensor. To familiarize myself with 3D printing technology I visited digital fabrication labs in Ottawa, Montreal, and Vancouver. Upon returning to Vancouver, we explored flexible filament and the possibility of using silicone molds for printing materials.

Figure 7.67
Optic Fibre Demonstration and 3D Printing Documentation



Note. Nick Fellion demonstrating optic fibre, with documentation of 3D printing and prototyping.

7.3.33 Bendables: Prototype Description

Bendables is a set of Montessori-inspired creative tools designed for open-ended STEAM play and experiential learning for children aged two to five. Each Bendable is a tactile, malleable object with embedded circuitry that can light up, buzz, vibrate, or produce sound. Some incorporate bend sensor technology that allows children to modulate colour, sound, or vibration through bending and deformation. By connecting a series of Bendables, a young maker is able to complete a basic circuit, learning foundational concepts such as positive and negative charge, power sources, and cause and effect embedded within play contexts that also support shape recognition, counting, colour, and the development of manual dexterity.

The technology is intentionally secondary to the learning experience. Each Bendable incorporates specific qualities such as an LED, sound, or vibration among other possibilities including more advanced learning concepts such as parallel circuits are also possible. Bendables are designed to be open-ended, allowing children to create a wide range of projects like wearables such as jewelry and tails, geometric constructions, rainbows, small animals without a predetermined outcome. In this sense Bendables functions less like a programmed educational toy and more like

a construction material in the tradition of Lego or Montessori manipulatives: a set of simple, flexible components whose complexity emerges through the child's own creative engagement. The prototype was developed with the intention of being used both at home and in early learning environments such as Montessori kindergartens, preschools, and maker spaces. I believe that empowering even very young children to be creative with technology in a way that is tangible and experiential rather than passively consuming content on tablets is crucial to learning. The beauty of Bendables is its simplicity, which in turn leads to endless play and learning possibilities grounded in the value of open-ended experiential learning.

7.3.34 3D Modelling and Prototype Development

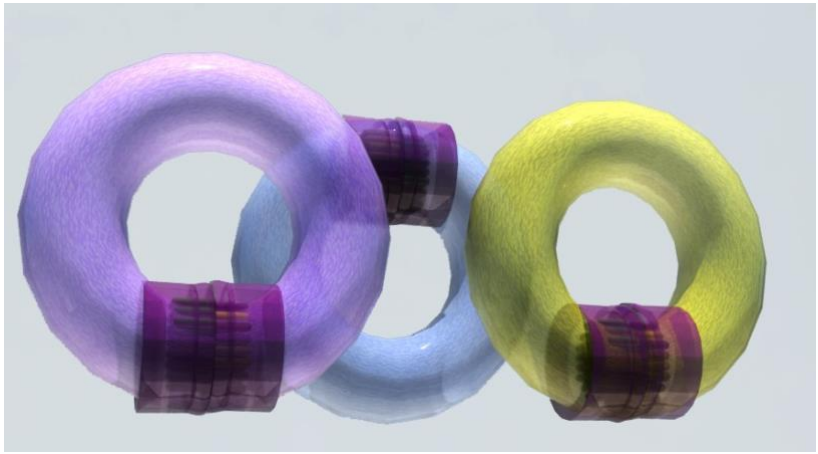
The following figures show early 3D models of the Bendables prototype developed by research assistants Rufino Ansara at Carleton University and Dennis Valouski at Emily Carr University as part of the adult design team's work in Phase 2. These models represent the team's attempts to visualize the physical form of the prototype, exploring how the connection points between Bendables might be shaped and how the embedded circuitry could be housed within a tactile, child-friendly form factor.

Figure 7.68
Early 3D Model of Product Development 1



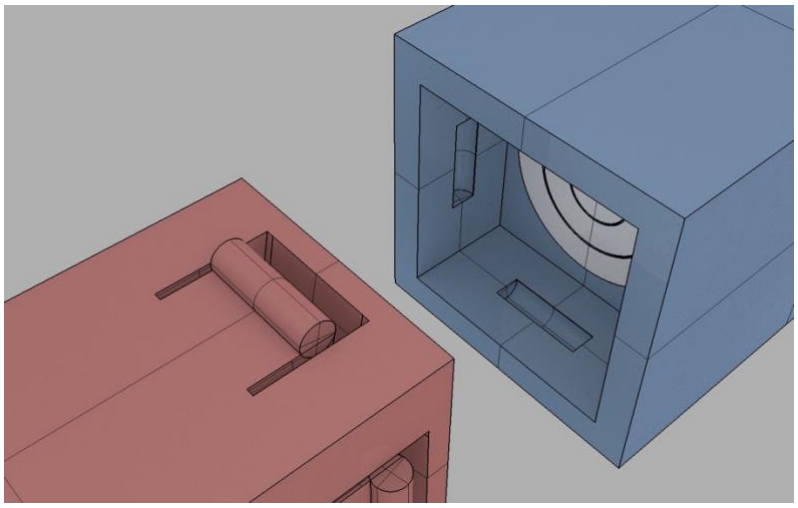
Note. Model by Rufino Ansara.

Figure 7.69
Early 3D Model of Product Development 2



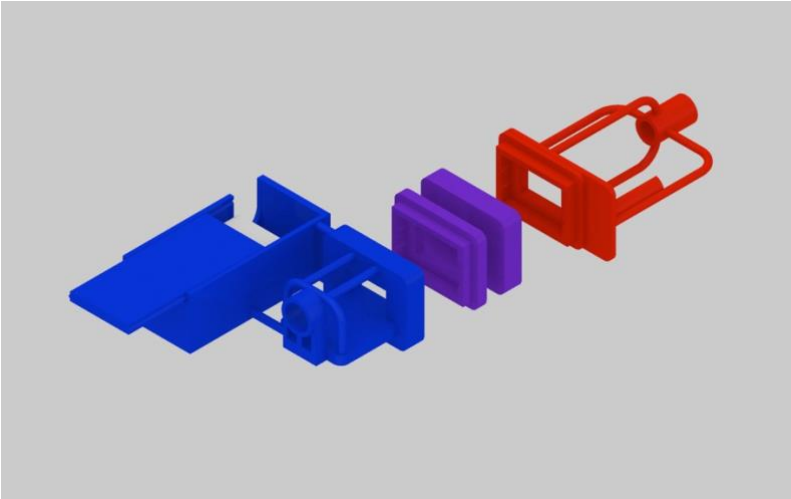
Note. Model by Rufino Ansara.

Figure 7.70
Early 3D Model of Product Development 3



Note. Model by Dennis Valouski.

Figure 7.71
Early 3D Model of Product Development 4



Note. Model by Dennis Valouski.

7.3.35 LED Toys: From Research to Market

To further develop the research outcomes in the original case study period, we prepared a business proposal and applied for a BC Ventures grant to support the path to market, naming the product "Bendables" under a social venture called Learning Empowerment Discovery (LED) Toys created with the goal of helping children create with technology. Like Primo Toys (the creators of Cubetto), we decided to create an umbrella company for our proposed first product.

Figure 7.72
LED Toys Logo

LED Learning Empowerment Discovery Toys

As part of the BC Ventures grant application, we developed the following product description:

"Bendables is a creative toolkit designed for open-ended STEAM play for children aged two to five. Inspired by Montessori principles and experiential learning, Bendables lights up, buzzes, and creates sound, promoting early learning about circuits, numeracy, shape recognition, and cause and effect through tactile play. Bendables empowers children to create with technology and can be used at home and in preschools and early learning centers. Don't buy toys build them!"

The application also articulated the broader social motivation behind the project:

"Given the explosion of the maker movement and the increasing accessibility of technology including tools such as 3D printing there is a significant opportunity to explore new learning experiences for children. Unlike the current workforce, our children will be creating their own job descriptions and applying their skills in cross-disciplinary ways that may be difficult to imagine today. A contemporary example of this is biohacking, a social movement in which individuals and organizations pursue biology and life science using tools equivalent to those found in professional laboratories. As technology becomes more embedded in society and everyday objects, the notion of technology as a discipline-specific domain is dissipating. Innovation is situated at the confluence of culture and technology. It is important, therefore, that children from a young age and from various social and economic backgrounds are provided with opportunities to explore at a conceptual and abstract level how to relate to a society in which technology is becoming a seamless part of everyday life."

7.3.36 Target Audience and Contexts

The application identified two primary customer groups and their respective needs.

Customer A

Parents of children aged two to five expressed a desire for toys proven to support self-motivated learning and creativity; toys that teach children to be creative and give them an advantage; and toys that empower children to build and create with technology rather than passively consuming it through devices such as tablets. A recurring concern was that current toys do not yet reflect the role that technology plays and will increasingly play in society, including emerging phenomena such as the Internet of Things (IOT's).

Customer B

Educators identified a need for cost-effective learning materials that promote STEAM principles and can be integrated into existing lesson plans. They expressed a desire to be part of a community connected to other educators who share the same values and noted that current materials are outdated and do not reflect the role of technology in contemporary society. Educators also wanted support in developing curriculum and contexts for introducing technology in accessible and teachable ways and expressed a clear desire to bring STEM and STEAM principles into early learning environments.

The application also identified the following as ideal contexts for Bendables:

Montessori kindergartens; early learning centers; elementary schools; homeschooling environments; special needs classrooms and inclusion programs; after-school programs; technology clubs; STEM

curriculum settings; gifted programs; public libraries and community centers; maker spaces; tutoring contexts; technology camps; and the existing Maker Junior community.

Figure 7.73
Design Requirements



Note. Photograph by the author.

Figure 7.74
Bendables



Note. Photograph by the author.

A full outline of the business proposal developed as part of the BC Ventures application, including the business model, revenue streams, business plan, project timeline, technical timeline, and value chain, is included in Appendix C.

7.3.37 RePlay: Future Work

It would be interesting to conduct a further study in which the reflection component was more deeply embedded as part of the design machines game. In this scenario, RePlay would serve as a

framework for both body storming and reflection with design machines used first to introduce the making activity and its constraints via trigger objects and then played again at the end of the making session as a reflective tool. In this second instance, the children would collectively recreate each other's inventions with their bodies, narrating the functions of their creations and describing how they achieved their outcomes. Researchers would ask questions about the children's process and use of materials to facilitate reflection on making. This structure would more fully realize RePlay's potential as a tool for Creativity in Action, embedding reflection at both the beginning and end of the making process.

7.3.38 Conclusion

As society moves toward an increasingly ubiquitous integration of technology into everyday life, the nature of play is also transforming. Traditionally, imaginative role play has offered children an opportunity to rehearse adult activities. With technology as a creative tool, however, children can make functional inventions that reflect their own unique needs and requirements changing the nature of play and the agency children must shape their surroundings. This kind of hands-on engagement with technology presents a significant opportunity for maker-inspired learning, and gives educators, parents, and education researchers a shared stake in developing curricula that incorporates the principles of the maker movement into the classroom and beyond.

7.4 Chapter Summary: RePlay Across Contexts

The three case studies presented in this chapter represent a progression in the application of RePlay as a creativity research framework spanning from evaluation and refinement in a peer academic setting, through to deployment in a complex community-based participatory design context, and lastly to application as part of an innovation process with young makers in a maker education setting. Taken together, these case studies address the three overarching research questions that frame this thesis.

The first research question asks whether it is possible to create a framework for facilitating the qualities of improvisational creativity that is useful for design process, implementable, and transferable. The three case studies provide compelling evidence that RePlay meets this criterion. At the Tiree Tech Wave, RePlay was implemented with academic peers from diverse disciplines and evaluated using TAPT, suggesting an early connection between RePlay sessions and participants' reports of flow-like experience. At the Global Studio in Bhopal, RePlay was transferred into a radically different context. A multilingual, cross-cultural participatory design process that proved effective as a low-barrier tool for community engagement. In the Bendables case study, RePlay was adapted for use with young children in a maker education setting, demonstrating its flexibility across age groups and disciplines. In each case, RePlay was not only

implementable but produced concrete outcomes: design proposals, community input, and a tangible prototype.

The second research question asks how RePlay enriches what we already know about creativity and contributes to our understanding of collaborative creativity. The TAPT analysis conducted at the Tiree Tech Wave provided early empirical evidence of a connection between RePlay and group flow a phenomenon that has been theorized in the literature (Sawyer, 2000, 2017) but rarely documented in the context of collaborative design. Participants reported loss of self-consciousness, time distortion, high energy states, and moments of insight all characteristic features of flow experience. The Global Studio case study added to this by suggesting how embodied play can create a shared perceptual experience that transcends language and cultural barriers, opening new possibilities for participatory design in complex community contexts. The Bendables case study further enriched this understanding by showing how RePlay can foster not only creative thinking but also reflection on making a dimension of collaborative creativity that is often overlooked in maker education research.

The third research question asks what it is about the physical externalization of ideas through improvisation that distinguishes it from more internal methods such as drawing or writing. This question was addressed most directly in the Bendables case study, where physical externalization through design machines and body storming produced markedly richer and more elaborated design outcomes than drawing-based reflection, particularly for young children still developing manual dexterity and confidence with drawing materials. The Global Studio case study similarly suggested that bodily communication can carry design intent more effectively than verbal or written methods when language is a barrier. And the Tiree Tech Wave case study showed how the collective physical experience of a RePlay session generates a form of group awareness of what might be called Creativity in Action that is qualitatively different from the individual, internalized forms of creative thinking that dominate conventional design methods.

Across all three case studies, several consistent themes emerge. The role of the facilitator is central meaning, RePlay does not function as a self-running method but requires a skilled facilitator who can balance structure and openness, prompting without directing. The use of constraints whether through trigger objects, design machines, or specific brief-driven instructions sometimes produced richer and more focused creative outcomes than open-ended approaches. Also, Reflection, whether through TAPT, traces, physical externalization, or verbal debriefing, proved essential to translating the embodied experience of a RePlay session into usable design knowledge. RePlay repeatedly appeared to create a shared perceptual experience that parallels what Sawyer (2000, 2017) describes as group flow, and that appears to be one of RePlay's most distinctive contributions to collaborative design practice.

These findings are explored in greater depth in the Discussion chapter that follows, where the theoretical implications of RePlay as a creativity research framework are examined in relation to the broader literature on embodiment, improvisation, and collaborative creative process.

Chapter 8: Discussion: Toward a Creative Mindset

"A new type of thinking is essential if mankind is to survive and move toward higher levels."
— Albert Einstein, telegram dated 25 May 1946, reported in The New York Times.

8.1 Introduction

This chapter draws together the key findings and theoretical contributions of this research project, connecting the literature reviewed in earlier chapters with the observations made across the exploratory studies and case studies in this thesis. It is organized around four core themes that emerged through the development of RePlay:

i. The importance of a creative mindset.

ii. Reflection as a multi-layered component of creative process.

iii. Creativity in Action as an original theoretical contribution.

iv. The value of spaces for play, what I have named the sandbox, as a condition that supports creative emergence.

Taken together, these four themes constitute what this thesis proposes to call the potential for:

Hybrid creative ecologies, a term I used to describe creative processes that develop through interactions among people, their bodies, materials, and environments, and to consider how AI might participate in these relationships as a direction for future research of creative emergence.

The empirical basis for this discussion comes from the repeated appearance of similar processes and patterns across different research settings with the application of RePlay. Tiree Tech Wave foregrounded reflection on participants' experiences, including accounts interpreted in relation to flow, using TAPT to make those experiences available for discussion. Global Studio showed how RePlay could work as a participatory and embodied method in social innovation and urban planning contexts, particularly where language, age, and power differences complicated conventional interview-based methods. The Bendables Case Study demonstrated how RePlay could operate in a maker-based learning environment where children used drawings, circuits, trigger objects, materials, and prototypes to move between imagination, embodiment, and technological making. These cases differ substantially, yet each offers an account of how RePlay created a sandbox in which aspects of creative process became more visible, shareable, and open to reflection. I would therefore like to return the conversation to the original three research questions stated in the methodology chapter of this thesis:

i. Is there a way to create a framework for facilitating the qualities of improvisational creativity that make it useful for design process as well as implementable and transferable?

ii. How does this enrich what we already know about creativity and add to our understanding of collaborative creativity?

iii. Given that a large component of improvisation involves physical externalization of ideas as a form of Creativity in Action, what is it about this embodied approach that distinguishes it from more internal or representational methods such as drawing or writing?

iv. This discussion chapter therefore moves between three levels of analysis:

v. What is it that RePlay made visible in the empirical and qualitative studies?

vi. How do these observations support the concept of Creativity in Action discovered through this body of work?

vii. Given that a large component of improvisation involves bodily enactment of ideas as a form of Creativity in Action, what does this approach contribute to creative process compared with graphic and written forms of representation such as drawing and writing and future research into flow, embodied collaboration, and hybrid creative ecologies.

Table 8.1
Research Questions and Overview of Discussion Responses

Research Question	Discussion Response
RQ1: RePlay as transferable framework	The case studies show that RePlay could be adapted across design, community, and maker-learning contexts while preserving a common structure of improvisation, reflection, externalization, and facilitation.
RQ2: Contribution to collaborative creativity	The findings suggest that collaborative creativity is not only cognitive or verbal, but relational, embodied, affective, and materially supported.
RQ3: Embodied externalization	Bodily enactment through Design Machines and bodystorming, alongside TAPT, trigger objects, drawing, maps, traces, and prototypes, made aspects of creative process observable and discussable. The discussion examines what enactment contributed alongside graphic and written representation.

8.2 The Relationship Between Neuroscientific Research and RePlay

A note on how I engage neuroscience in this chapter. I write as a design researcher and an informed non-specialist, not as a neuroscientist. I began this research when network neuroscience was still new and when brain imaging had only recently made it possible to observe large-scale networks working together. Part of my process was to survey that emerging field and hold it alongside what I was observing qualitatively in RePlay sessions. Throughout this chapter I therefore use neuroscience as an interpretive lens: I note where participants' experiences and the patterns I observed resonate with, or are consistent with, accounts in the neuroscientific literature. I do not claim to measure neural activity, to establish mechanisms, or to explain what I observed by reference to the brain. Where the discussion draws these parallels, it points to resonances between my qualitative findings and an emerging body of research, not to causal or mechanistic claims.

The groundwork for this section is the creative activity documented in the studies as part of developing RePlay. In the exploratory interviews presented in Chapter 5, Beth and Luis described drawing over one another's sketches to develop and communicate ideas. In the Bendables Case Study in Chapter 7, Maker 11 reported that seeing a researcher bend their arms during the design machines exercise reminded her of a car, prompting her idea for a circuitry project based on a toy car. These examples differ: the first is an account of collaborative design practice, while the second describes a child's response to an embodied activity within RePlay. Yet together, they inform my understanding of Creativity in Action by showing how ideas can develop through responses to other people's contributions, gestures, and materials. The theoretical discussion that follows builds on these situated accounts. Neuroscience and AI offer additional perspectives and directions for inquiry, but the studies themselves do not establish the neural mechanisms of these creative processes as this is beyond my expertise nonetheless, I felt it important to introduce some of the findings from these fields.

As mentioned already, the field of creativity research has undergone significant shifts since its early twentieth-century origins, beginning with internalist models focused on the individual creative mind, epitomized by Wallas's (1926) stage model, moving to psychological approaches concerned with personality and divergent thinking in the 1950s and 60s, and later incorporating sociological and systems-based approaches that foreground the role of environment, collaboration, and external forces (Sawyer, 2012).

More recently, neuroscientific approaches have examined the neural processes associated with creative thinking and flow. These are related areas of inquiry, but findings about creative idea generation should not automatically be treated as findings about flow (Beaty et al., 2016).

Research on creative cognition has examined interactions among the Default Mode Network (DMN), associated with spontaneous thought, imagination, and internally directed cognition; the Executive Control Network (ECN), associated with focused attention and goal-directed thinking; and the Salience Network, implicated in coordinating attention to relevant information. Beaty et al. (2015) found increased functional connectivity between default and executive network regions during creative idea generation. Their subsequent review describes how cooperation between these networks can support creative thinking (Beaty et al., 2016). This resonates with my own view of creativity as an interaction between generative and evaluative processes. In this sense, creativity can involve a conversation between these processes, with functional coupling describing coordination between patterns of neural activity.

However, the roles that these networks play during collaborative flow remains a valuable question for future research. As such RePlay could offer a context in which to examine how generative and evaluative processes interact during embodied improvisation, alongside participants' accounts of their experiences. Yet this would require research designed to investigate flow and neural activity together which is beyond my expertise in neuroscience. I would however like to survey some of the research being done in the field as its relevant to some of my findings conducting RePlay.

Bartoli et al. (2024) used intracranial recordings and electrical stimulation to investigate the DMN's contribution to divergent thinking and mind-wandering. Their study provides evidence for a causal contribution to performance on the divergent-thinking task they examined, rather than establishing that the DMN alone drives creativity. Barnett and Vasiu (2026), in a review of nine studies, propose that interactions between default and executive networks may help explain aspects of flow and creative engagement. Their account also raises possible implications for emotional regulation, which would also require further investigation. These neurological findings offer perspectives for interpreting participants' experiences at Tiree Tech Wave, but the resemblance between those accounts and descriptions of flow does not necessarily establish a shared neural mechanism and would need to be confirmed with targeted studies during RePlay sessions. EEG research also offers task-specific observations. Lopata et al. (2017) examined alpha-band activity during musical improvisation, identifying differences associated with task demands and improvisation training. In a separate study using word-association problems, Bieth et al. (2024) found increased frontal theta power shortly before responses that participants reported as insight. These findings concern different tasks and do not establish a common brainwave pattern for theatrical improvisation or RePlay so although promising would also require further investigation.

Incubation research offers another perspective. Yang and Wu (2022) found that an incubation task allowing mind-wandering, compared with one discouraging it, was followed by more flexible but less persistent idea generation and a greater likelihood of solving problems through intuitive insight. Their results suggest that mind-wandering can support some spontaneous aspects of creative thinking while limiting more deliberate ones. This is consistent with my interest in the

relationship between openness and structure in creative process. However, the study used laboratory creativity tasks, and whether similar processes occur in theatrical improvisation and RePlay was observed but would need to be researched more deliberately from a neuroscientific interdisciplinary approach. Dietrich's (2004b) theory of transient hypofrontality, introduced in Chapter 1, offers a further theoretical perspective on reduced self-consciousness during flow through temporary reductions in aspects of prefrontal processing. This also provides a possible interpretation of experiences described in this thesis, however, was not a confirmed mechanism established by the RePlay studies.

Despite this it's valuable to draw on all this literature as a possible interpretive perspective on the embodied and relational processes examined through RePlay.

While I was a guest researcher at Sussex, I seriously considered using an Emotiv EEG headset in a possible collaboration with Zolatan Dienes to investigate these processes. Dienes is a Reader in Experimental Psychology at Sussex. I did not pursue this work because I lacked the expertise in neuroscience required to undertake it. As such no neural activity was measured in the RePlay studies. The possibility and my enthusiasm for investigating these questions through future collaboration is taken up briefly in the Future Work section later in this thesis.

8.2.1 Neuroscience: The Role of Suggestibility in RePlay

Also Closely related to my discussion of creative responsiveness is the concept of suggestibility, understood here as openness, absorption, and receptivity to experience. In RePlay, my interest is in how participants respond to one another's offers and to emerging possibilities while retaining the ability to question, adapt, or decline them.

Dienes (2012) offers a metacognitive account of hypnotic responding in which people can intentionally act without experiencing the intention, so that an action feels automatic. This raises a question for my work about how improvisers experience spontaneous action. The principle of "yes, and" encourages participants to receive and build on one another's offers, cultivating the responsiveness and lability that interest me in RePlay. Accepting an offer may nevertheless be fully conscious. I therefore propose a conceptual connection between suggestibility and creative responsiveness, rather than claiming that the exercises demonstrate hypnotic responding or a shared neural mechanism. Because Dienes (2012) locates hypnotic responding in altered monitoring of one's own intentions, his account invites comparison with Dietrich's (2004b) transient hypofrontality and raises the possibility that highly suggestible individuals may be more readily disposed toward the spontaneous, non-judgmental engagement associated with improvisational creativity and flow. I treat this as a resonance to be investigated rather than an established shared mechanism. These neuroscientific developments are explored in their applied dimensions in the closing sections of this chapter; they are introduced here because they offer a frame of reference

from the neuroscience literature that resonates with what I observed in this research, rather than a biological explanation of it.

8.3 Posthumanism

As discussed in Section 4.4.6 Posthuman and relational theories challenge individualistic accounts of human agency and offer perspectives for considering creativity through relationships, interaction, and entanglement (Braidotti, 2013; Barad, 2007). These perspectives inform my understanding of creativity as emerging through relations between participants, materials, and environments.

Research on human/AI co-creativity examines how computational systems can contribute to a shared creative process, including how interaction between people and AI is structured (Rezwana & Maher, 2023). Research on large language models has also investigated how AI generated suggestions influence human creative writing (Doshi & Hauser, 2024). What these researchers claim is that access to generative AI ideas causes stories to be evaluated as more creative, better written, and more enjoyable, especially among less creative writers. However, generative AI enabled stories were more like each other than stories by humans alone. They suggest that their results point to an increase in individual creativity at the risk of losing collective novelty. This dynamic resembles a social dilemma: With generative AI, writers are individually better off, but collectively a narrower scope of novel content is produced. These results have implications for researchers, policymakers, and practitioners interested in bolstering creativity. Alongside questions about whether machines can simulate or replicate human creativity (Boden, 2004), these developments raise questions about when AI might be understood as a creative collaborator and what distinguishes collaboration from the use of a tool.

RePlay, as a framework grounded in improvisation, embodiment, and relational creativity, offers a useful perspective on these questions because it directs attention to how creativity develops through interaction. Although the studies presented in this thesis examined human collaboration, they provide a basis for asking how responsiveness, reflection, and shared exploration might be supported within human–AI creative processes. I therefore propose this connection as a direction for future research into hybrid creative ecologies.

8.4 Improvisation and Flow

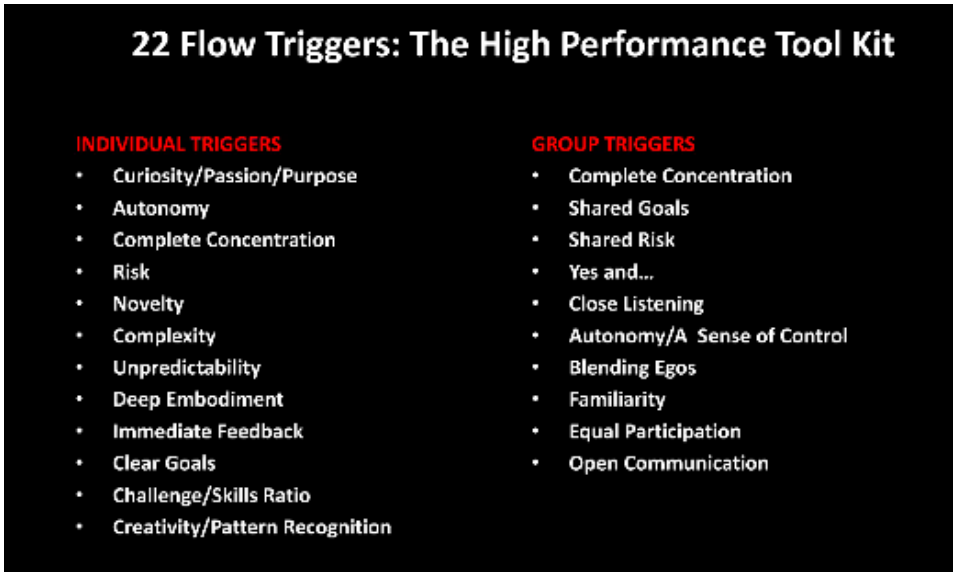
Since the 1960s, a great deal of focus has been on tools and techniques that improve productivity and accelerate idea generation, from De Bono's (2016) Six Thinking Hats to more recent interest in brain stimulation and biofeedback as performance enhancers. Yet in the field of performance studies during this same period, Viola Spolin (1999) influenced by the sociologist and early childhood educator Neva Boyd was developing something quite different: a system of

improvisational games designed not to optimize output but to cultivate presence, spontaneity, and openness to others. It is my view that Spolin was an early creativity researcher, anticipating many of the insights that neuroscience and design thinking would later formalize.

The structure of her Impro games built around withholding judgment, deep listening, and responsive co-creation maps closely onto what Kotler and Wheal (2017) describe as the group-level triggers for flow in applied innovation contexts. As shown in Figure 8.1, these triggers shared risk, complete concentration, a sense of control, and rich environmental feedback echo Spolin's language around facilitating improvisational creativity and connect directly to what I observed during the Tiree Tech Wave case study. RePlay does not guarantee flow but seems to create the conditions for it, and understanding how it does so requires attending to both the social technology of the framework and the mechanisms through which embodied awareness is trained within it.

Flow is notoriously challenging to study: some creativity researchers treat it as highly ephemeral, while others understand it as a process grounded in repetition and self-determination over extended periods (Csikszentmihalyi, 2008). Design practice compounds this difficulty further, since it is often a solitary activity mediated by screens and software, making it particularly challenging to observe flow emerging within a mixed team of designers from diverse backgrounds. What my research suggests is that RePlay makes this observation possible by creating the social and embodied conditions under which group flow can emerge and be documented.

Figure 8.1
Flow Triggers



Note. From Kotler presentation (2020).

Through Spolin's Impro games, actors learned to keep their attention on what was happening in an embodied, present-tense fashion, rather than falling into self-consciousness or reaching for ideas from an intellectual source. Spolin's concept of a point of focus functions similarly to a mantra in meditation practice, keeping the player present and engaged with what is unfolding rather than rationalizing or pre-planning. In this playful, active state, intuitive and spontaneous choices arise naturally.

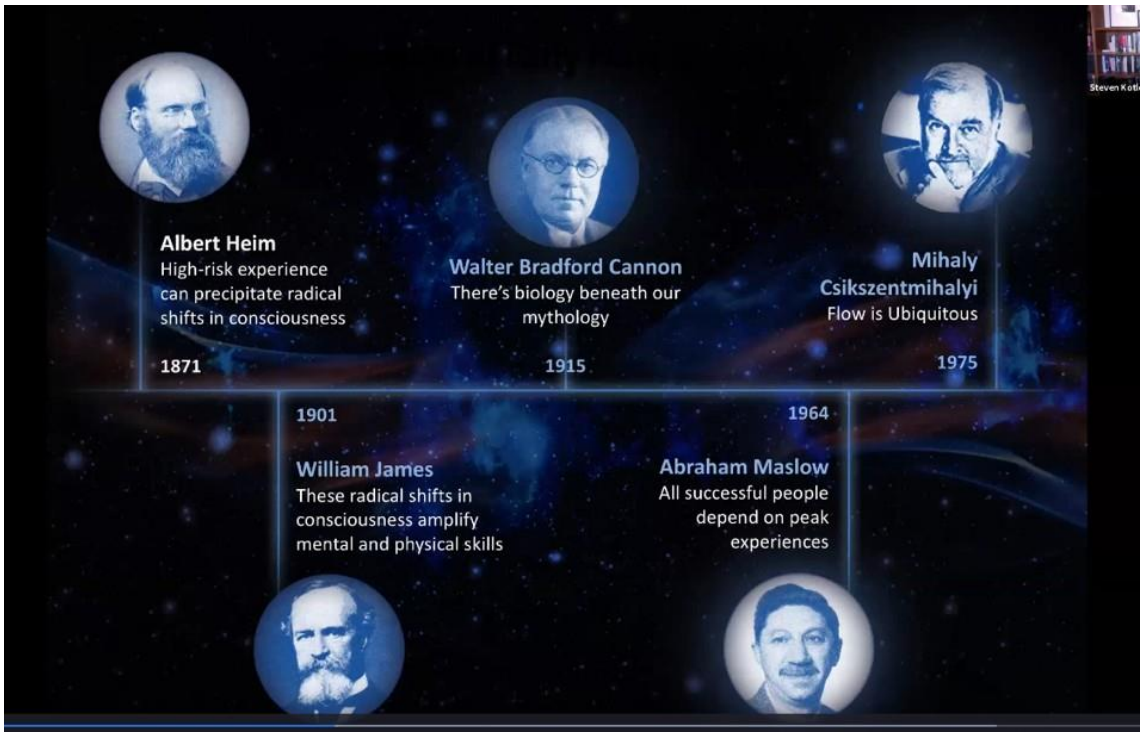
Spolin's games effectively counteract the inner critic and invite spontaneous creativity a strategy that, through my development of RePlay, I have observed to be equally useful in collaborative design and innovation contexts (Spolin, 1999). It was around this time in 1999, that Spolin's work first reached me through the competitive Impro Olympics I participated in. As I noted in the methods chapter, that early training in improvisational theatre in Ottawa informed my intuition that Spolin's approach had something important to offer design research an intuition that ultimately has shaped the development of RePlay.

8.5 Neurocognition and Creativity

Kotler and Wheal (2017), as discussed earlier, offer a framework for understanding peak performance and flow that translates neuroscience research into proposals for practice. Their work informs my interest in how creative engagement might be cultivated through improvisational theater, while RePlay approaches this question through embodied activity, facilitation, and reflection.

The timeline presented in Figure 8.2 illustrates their account of changing approaches to understanding these experiences, including attention to both internal processes and environmental conditions.

Figure 8.2
Flow Throughout History



Note. From Kotler (2020).

Their concept of STER (selflessness, timelessness, effortlessness, and richness) provides a descriptive vocabulary for considering aspects of the experiences reported by participants at Tiree Tech Wave. I use this vocabulary to interpret their accounts, rather than to establish that participants experienced a particular neural state. What I find useful in this framing is the proposition that conditions supporting creative engagement can be deliberately cultivated, an idea that resonates with my development of RePlay.

Table 8.2
Cross-Case Synthesis: What RePlay Made Visible

Case study	**What happened during RePlay Session**	**What RePlay made visible**	**Significance**
Tiree Tech Wave	Used RePlay and TAPT with design/HCI practitioners.	Flow, loss of self-consciousness, embodied reflection, and the value of physical externalization.	Shows RePlay as a method for facilitating and qualitatively studying group flow and reflective creative process.
Global Studio	Used participatory, child-led, embodied and mapping activities in an urban planning context.	Children's spatial knowledge, community concerns, daily routines, and embodied/local knowledge.	Shows RePlay as a social innovation and participatory design method that can translate local knowledge into design proposals.

Case study	What happened during RePlay Session	What RePlay made visible	Significance
Bendables	Combined RePlay with drawing, circuits, simple electronics, trigger objects, and prototyping.	Children's material reasoning, interaction ideas, making processes, and embodied understanding of tangible technology.	Shows RePlay as a maker-based co-design framework and a method for studying creativity through material artefacts.

Related evidence comes from Onarheim and Friis-Olivarius (2013), who developed an eight-week Applied NeuroCreativity course combining neuroscience concepts with practical creative work. They reported an average individual relative improvement of 28.5% in divergent-thinking fluency, measured by the number of alternative uses participants generated for everyday objects. This improvement was greater than that observed in comparison courses without the neuroscience component. The findings suggest that neuroscience-informed teaching can contribute to developing an aspect of creative thinking. They do not establish equivalent improvements in creativity overall, flow, or collaborative improvisation, but offer a relevant perspective on the possibility of cultivating creative capacities through developing cognitive awareness as part of creativity awareness training.

8.6 Creativity through an Autopoietic Lens

RePlay as already mentioned in this thesis, can be interpreted productively through an autopoietic lens: as a self-organizing, context-responsive process that develops through its relationships. Developed by Humberto Maturana and Francisco Varela, the concept of autopoiesis combines the Greek roots for self (*auto*) and making or production (*poiesis*, which shares its root with poetry). It describes how living systems continually produce the components and relationships that sustain their organization while interacting with their environment (Capra, 1997, p. 97). I use this concept as an analogy for the recursive, relational, and self-renewing qualities of creative process, rather than claiming that creativity is literally a biological autopoietic system.

This perspective directs attention to both the elements of a creative activity and the relationships through which it develops. I utilized RePlay as a structured yet open-ended framework for researching collaborative creative process because it made interactions among participants, bodily actions, materials, and environments more visible and available for reflection. Participants responded to emerging ideas and to one another, shaping the conditions for subsequent contributions. Through this lens, creativity can be understood as a process whose possibilities are continually renewed through situated interaction. The autopoietic analogy therefore helps articulate how creative activity develops through the relationships that sustain it. Previously I

returned to this perspective at the close of the sandbox discussion, where I consider how supportive conditions can enable these dynamics to emerge.

8.7 RePlay's Contribution to Confluence Models of Creativity

RePlay contributes to the broader trajectory of creativity research by drawing on confluence approaches, which bring together multiple influences to understand creative process (Gruber and Davis, 1988; Feldman, 2010, p. 169). These approaches expanded creativity inquiry beyond isolated cognitive processes or personality traits, recognizing the interaction of factors such as domain knowledge, intrinsic motivation, and environment. They provide an important foundation for considering how different conditions and capacities work together to support creativity.

The RePlay framework developed through this research builds on this foundation by foregrounding the embodied, performative, and relational dimensions of collaborative creative process. Improvisation, interaction, and co-presence provide ways to examine how these influences operate during an unfolding activity: how participants respond to offers, negotiate roles, externalize ideas, and develop shared meaning through engagement with one another and with materials. This emphasis also offers a perspective for future inquiry into creative collaboration involving agentic AI systems.

The concept of Creativity in Action, developed through this research, describes the dynamic process through which creative possibilities emerge and develop through situated, embodied, and responsive activity. Within this process, participants may cultivate the capacity to recognize their own creative choices, attend to others' contributions, and redirect an activity when an impasse occurs. Creative awareness is therefore an important dimension of the concept.

Flow describes an experiential state that may arise within creative activity. However, Creativity in Action encompasses a broader process, including moments of absorption alongside hesitation, reflection, breakdown, and changes in direction. The sections that follow examine how RePlay can facilitate this process and support awareness of its unfolding dynamics.

8.8 Teaching a Creative Mindset Through RePlay

In this research, cultivating a creative mindset involves encouraging openness to possibilities, association, analogical thinking, experimentation, and resourcefulness. Practices associated with the maker movement, mindfulness, improvisational theater, Montessori education, arts-based learning, and experiential learning offer different perspectives on how such qualities might be developed. My interest lies particularly in how bodily activity, attention, and engagement with materials can support creative exploration.

Froebel and Maria Montessori emphasized children's active exploration and engagement with their surroundings as important dimensions of learning (Mooney, 2013, p. 43). Froebel's play gifts provided tactile materials through which children could explore relationships and externalize ideas (Froebel, 2012), while Montessori emphasized movement and sensorial engagement in education (Montessori, 1912). I see these approaches as relevant precedents for the embodied orientation of RePlay: learning and understanding can develop through acting on, arranging, and responding to materials. The Bendables Case Study provided an opportunity to explore these educational principles through arts and crafts, basic circuit building, and design activities with young children. Bringing improvisation and theatrical play into this setting allowed us to explore science, technology, engineering, arts, and mathematics (STEAM) learning through embodied making. Children worked with gestures, drawings, materials, and circuits to develop low-fidelity prototypes. These activities informed my understanding of how RePlay could support movement between imaginative exploration and technological making.

Ward (2016) describes LEGO-supported storytelling research reporting benefits for children's narrative skills, interaction, and cooperation. This provides a related educational context for considering the relationship between play, material exploration, and expression. In the Bendables Case Study, I observed children developing ideas through making and responding to others' contributions. These observations suggest possibilities for facilitating creative engagement through RePlay, while leaving its comparative educational effectiveness as a question for further research.

8.9 Relationality, Embodiment, and Co-Presence in Collaborative Creative Process

What distinguishes RePlay is its emphasis on the relational and embodied dimensions of collaborative creative process. Through facilitation, improvisation, and shared activity, it creates conditions in which participants can respond to one another and develop ideas together. The qualitative evidence presented in this thesis draws attention to how the quality of these interactions shapes creative possibilities.

Sawyer's (2000, 2017) discussion of group flow offers one perspective on moments of shared engagement. My concept of Creativity in Action encompasses these moments alongside the hesitation, negotiation, reflection, and changes in direction through which collaborative creativity develops. Flow may therefore be one dimension of this process.

As discussed in Section 8.2, Barnett and Vasiu (2026) propose that interactions between default mode and executive control networks may help explain aspects of flow and creative engagement. This offers a possible neurocognitive perspective on the experiences described here. Whether and

how such network interactions relate to embodied collaboration in RePlay remains a question for future research, since the studies did not measure neural activity.

RePlay does not optimize the individual performer; it creates the conditions for collective creative emergence. This distinction matters because, as the research in this thesis suggests, the most generative creative moments tend to arise not from individual peak performance but from the quality of interaction between participants. What Sawyer (2000, 2017) describes as group flow, and what I describe as Creativity in Action operating at the social level. This is also consistent with the proposal that flow may involve coordinated DMN-ECN network interaction rather than the activation of any single brain region (Barnett and Vasiu, 2026), a network state that resonates with what RePlay appears to cultivate through collective embodied improvisation, approached through social and relational means rather than individual neurological intervention.

"We certainly believe the brick is a very, very valuable tool in learning through play but is it the only way or only tool? No, certainly not." (Ward, 2016)

8.10 The Importance of Reflection in Creative Process

Schön (Schön (1992), as discussed earlier, distinguishes knowing-in-action, reflection-in-action, and reflection-on-action. RePlay provides a framework for exploring these forms of knowing within creative practice, drawing attention to bodily activity as a resource for engaging with a design problem space. My use of reflection also has connections with mindfulness and contemplative practice, particularly the capacity to notice one's thoughts and responses without becoming wholly absorbed in them. I draw on this connection to consider how participants might attend to their creative process while remaining responsive to the activity unfolding around them.

Early in this PhD project, I explored whether introducing reflection during creative activity could influence its direction or reveal new requirements. During the early exploratory research in Lancaster, while I was developing RePlay through the BadIdeas scenarios, I observed that introducing explicit reflection during an unfolding improvisation could interrupt its momentum (see Section 5.6). This informed my subsequent attention to the timing and form of reflection within RePlay.

During the exploratory work at Philips Design, I sometimes interpreted participants' accounts as shaped by what they believed I expected to hear. Introducing a breaching strategy through design mapping helped challenge familiar descriptions of their practice and opened further discussion (see Sections 5.7.4 and 5.7.12). I understood this as a way of making taken-for-granted aspects of their process more available for reflection.

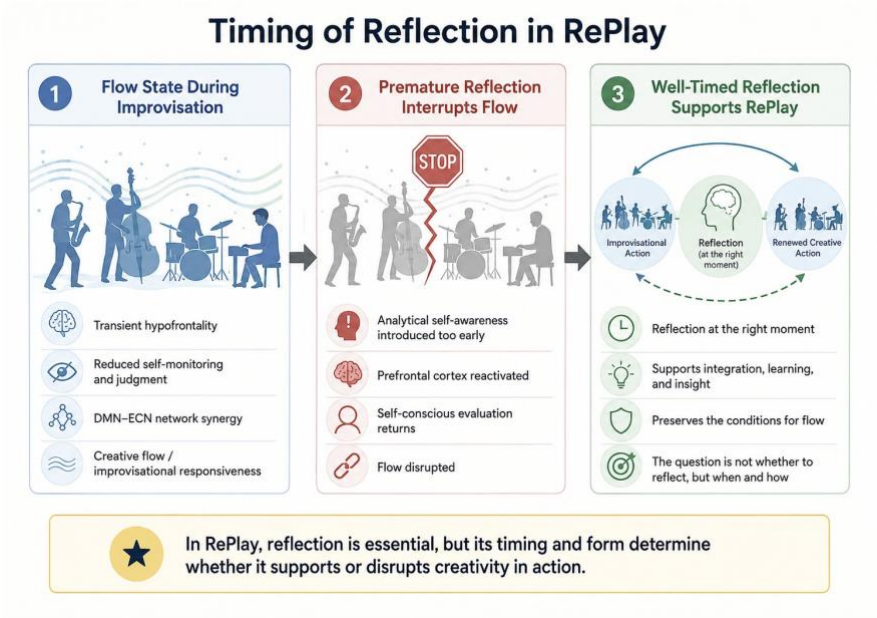
Across the research, reflection provided opportunities to articulate and reconsider creative experiences. The Philips Design interviews revealed how practitioners incorporated reflection into their working processes (see Section 5.7.11), while the TAPT responses at Tiree Tech Wave helped participants describe and reflect on their experiences of RePlay (see Section 7.1.4). Taken together, these observations suggest that reflection's value depends partly on its timing, form, and relationship to the activity. They informed my approach to facilitating reflection within RePlay, both during creative activity and afterward.

8.11 Reflection, Neuroscience, and Flow

The observations discussed above suggest that the timing and form of reflection can influence participation in RePlay. In some instances, introducing explicit verbal reflection during an activity appeared to interrupt its momentum, while reflection at other moments helped participants articulate and reconsider their experience.

Dietrich's (2004b) theory of transient hypofrontality offers one possible perspective on the reduced self-consciousness associated with flow. However, the RePlay studies did not measure neural activity, and their qualitative evidence cannot establish that changes in prefrontal activity explain these observations. As discussed in Section 8.2, research on creative cognition also emphasizes cooperation between generative and evaluative processes. The issue is therefore how reflection is introduced and how it interacts with the unfolding activity. For RePlay, this makes the timing and form of reflection an important consideration in facilitation.

Figure 8.3
The Importance of Timing of Reflection During a RePlay Session

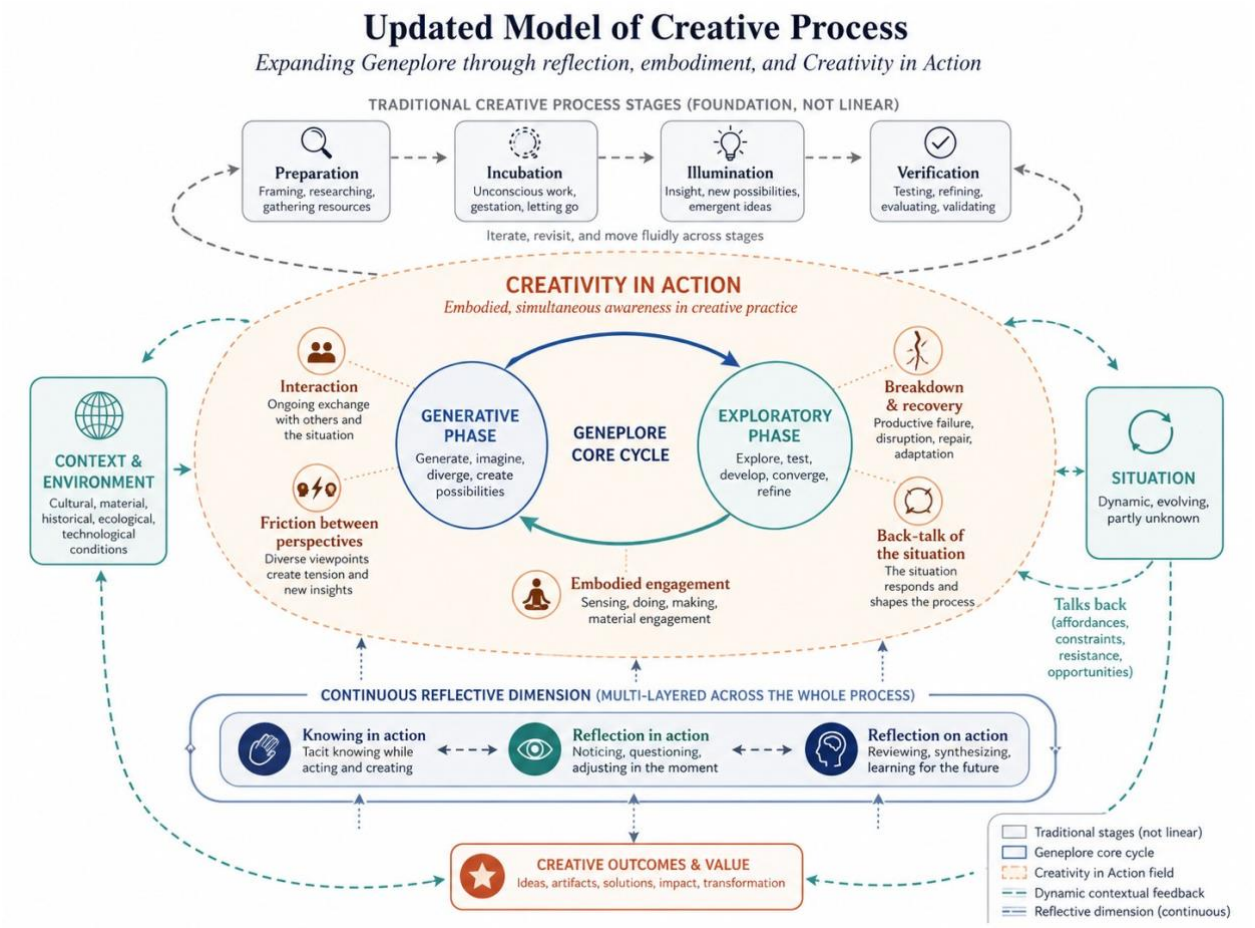


Note. Made by the author using ChatGPT.

During my exploratory phase developing RePlay with Impro actors in Lancaster, I embedded one of the actors in the role of reflector meaning, to verbally externalize what was happening in the improvisation as a kind of running verbal protocol (a kind of narrator). This negatively affected the process, as the participants themselves confirmed. Similarly, introducing a prop as a constraint to guide the improvisation toward exploring the properties of a BadIdea had limiting effects on the ideas players explored. Both interventions, well-intentioned as they were, reintroduced the inner critic into a space that functions best without it. In Impro this is well understood: failure is interpreted as a gift, and the principle of yes and, exists precisely to circumvent judgment and keep the creative moment alive. As Impro instructor and coach Liz Peters (2020) observes, there is no room in Impro for what she calls monkey mind, the self-evaluating, self-doubting internal commentary that keeps us from full presence and action. Peter's infinity box game, in which improvisers imagine reaching into a box for an idea and immediately throwing it away, trains exactly this capacity for non-attachment to one's own creative output.

What I observed early on was that reflection in Impro is not absent but deferred and transformed. It can emerge afterward as a perceptual shift, a reflection on one's umwelt, or one's perceived reality, which creates a productive friction of ideas that infuses the subsequent creative process. It can also occur during a creative activity, but only at the right moment and in the right form. I would assert that reflection needs to be incorporated as an equally significant dimension of creative process, which is what my updated model of creative process presented below proposes.

Figure 8.4
Updated Model of Creative Process



Note. Made by the author using ChatGPT.

As such, reflection can mean:

i. Reflecting on one's own creative process.

ii. Reflecting on the outcomes of a creative activity.

iii. Reflecting as part of and during a creative activity, at the right moment and in the right form.

Developing the ability to reflect during a creative moment develops the skill which is part of what I have named Creativity in Action. Since Impro is unscripted and ephemeral, once a performance is completed it leaves no natural trace, and actors deeply immersed in a scene may not even remember clearly what occurred. To address this, RePlay sessions were videotaped to create a trace: a record available for post hoc reflection by the design team. During my exploratory work in Lancaster, I documented externalization in the design process by recording video, collecting traces, administering questionnaires, and conducting reflective and contextual interviews about the

experience. Concepts such as production blocking, flow, yes and, group mind, shared mental models, and game of the scene proved valuable as a framework for discussing the process and troubleshooting group dynamics.

> **In summary, it is my assertion that reflection, and more importantly creative awareness, can be trained, and that its importance in the creative process deserves considerably more attention than it has received in the existing creativity literature.**

8.11.1 Embodied Design Mapping

My experience at Global Studio informed the development of RePlay as a participatory and embodied approach to design. Working in the Kabadkhana community drew my attention to how bodily activity and interaction could open opportunities for participation where differences in language, age, and power complicated conventional interview-based methods. These experiences also informed my understanding of reflection: when introduced at an appropriate moment and in a form responsive to the activity, reflection could help participants articulate and develop ideas.

Across the three case studies, reflection took different forms according to the participants, activities, and setting. Taken together, the cases suggest that opportunities for embodied reflection depend partly on facilitation and on an environment that provides both structure and openness. Within RePlay, improvisation offered a way to explore the relationship between acting and noticing, creating and observing, and moving and reflecting. I understand this responsiveness as one dimension of Creativity in Action: the situated, embodied, and relational process through which participants respond to one another and develop ideas together. The following section explores this concept in greater depth.

8.12 Creativity in Action

The concept I have named Creativity in Action describes the situated, embodied, and relational process through which participants respond to one another and develop ideas together. One dimension of this process is the capacity, developed through practice, to maintain an embodied awareness of one's own creative activity, other participants, and the spatial, social, and contextual factors that influence how ideas emerge.

In this discussion, I distinguish creativity as a broad concept from creative emergence as a particular emphasis within it. I use creative emergence to describe how new ideas, meanings, or directions take shape through an unfolding activity, without being fully specified in advance. In collaborative contexts, this draws attention to how contributions are taken up, altered, and developed through interaction between participants, materials, and the situation. The distinction concerns how creative possibilities develop, rather than simply whether an outcome is judged creative. Creativity in Action

directs attention to the embodied and relational dynamics of this development, while RePlay provides a framework for facilitating and studying it.

Creativity in Action is distinct from flow. Whereas flow describes an experiential state of absorption, Creativity in Action concerns how participants remain responsive within an unfolding creative process. This responsiveness can include noticing an emerging possibility, reconsidering a choice, or changing direction when an impasse occurs.

In this sense, reflection can operate within the creative act rather than requiring participants to step outside it. I propose that this kind of embodied awareness may sometimes support experiences of flow, but flow is neither a requirement nor an inevitable outcome of Creativity in Action.

8.12.1 Situating the Concept

Joas (1996) argues that human action is always creative in the sense that it is situated, purposive, and responsive to context a sociological account of how creativity operates within and against the cultural patterns of a social group. Pierre Bourdieu (1977) named the underlying structure of these shared patterns habitus, describing the cultural, social, and symbolic forms of capital that constitute a shared creative ecosystem. Conceptual artist Joseph Beuys developed a related idea through his theory of social sculpture: the proposition that everything is art, that every aspect of life can be approached creatively, and that everyone has the potential to be an artist (Bonami, 2005). RePlay, by applying a systems thinking approach, similarly creates a shared platform what I have called the **sandbox**, as a space for players from diverse backgrounds to come together and collaborate creatively across their differences.

Creativity in Action, operates at a different level from all three of these frameworks. Where Joas and Bourdieu describe creativity at the macro level of social and cultural structure, and Beuys proposes it as a philosophical and political stance, Creativity in Action as developed through RePlay describes what happens at the micro level of individual and collective embodied perception in the moment of creating.

It is grounded in understanding one's individual creative process, one's relationship to other players, and the context for which a product or service is being developed all perceived and navigated through the body.

Like the self-organizing process described through the autopoietic analogy in the Introduction, Creativity in Action is context responsive. It cannot be prescribed in advance, but it can be cultivated through supportive relational conditions.

8.12.2 The Neuroscience of Attention and Awareness

A significant challenge in studying Creativity in Action is that it is difficult to observe and train without interrupting the very activity one is trying to understand. A revealing experiment conducted

at the Max Planck Institute for Biological Cybernetics illuminates why. Watanabe et al. (2011) demonstrated that attention and awareness are in fact two distinct neurological processes that have typically been conflated. Using cleverly designed composite images shown at high frequency intervals, participants could direct attention toward a visual target without being consciously aware of it. The BOLD signal in the visual cortex was modulated by attention rather than by awareness alone. In other words, one can be paying close attention to a task without being genuinely aware of oneself performing it. A tennis player may be entirely focused on the ball without being aware of the moment they lift the racquet. This finding has direct implications for Creativity in Action. It suggests that attentiveness during a creative activity does not automatically produce the kind of self-aware, reflective engagement I observed with Creativity in Action. The simultaneous spontaneous association and focused awareness that Creativity in Action involves echoes descriptions in this literature of states in which these processes operate together rather than in alternation.

8.12.3 How RePlay Facilitates and Trains Creativity in Action

Viola Spolin (1999), in a later edition of her foundational work, replaced the term point of concentration with focus a distinction worth noting.

Point of Concentration implies an object to attend to; and focus implies an energy to sustain. For Spolin, the goal of focus in Impro is to keep the player simultaneously awake and aware, present to everything while keeping an eye on the ball.

Creativity in Action expands on this concept to include not only internal processes but also the perceptions of collaborators and the surrounding environment, experienced through embodied perceptual awareness. This forces one to question one's umwelt, one's perceived reality and through that questioning fosters the perceptual shifts that drive innovation.

8.12.4 TAPT and Flow as Part of Improvisational Creativity

During the Tiree Tech Wave, I collaborated with Clare Hooper (2011) and used her TAPT method to document what participants were experiencing during RePlay sessions. A significant number of the characteristic's participants used to describe their experience closely resembled descriptions of flow states: time distortion, loss of self-consciousness, heightened energy, and spontaneous insight. This observation is consistent with the cognitive processes Kenny and Gellrich (2002) identify as central to improvisation: short-term anticipation, medium-term recall, long-term recall, flow status, and feedback processes. It also aligns with Sawyer's (2000, 2012) research on the relationship between improvisational theatre and group flow, and with Spolin's (1999) original observation that Impro games are designed to maximize precisely this kind of embodied, present-tense creative awareness.

As one becomes a more experienced improviser, one becomes better at Creativity in Action. This is not simply a matter of technical skill. It requires developing the capacity to hold multiple simultaneous awarenesses: of one's own process, of the other players, of the space real and imagined, and of the emerging creative logic of the scene.

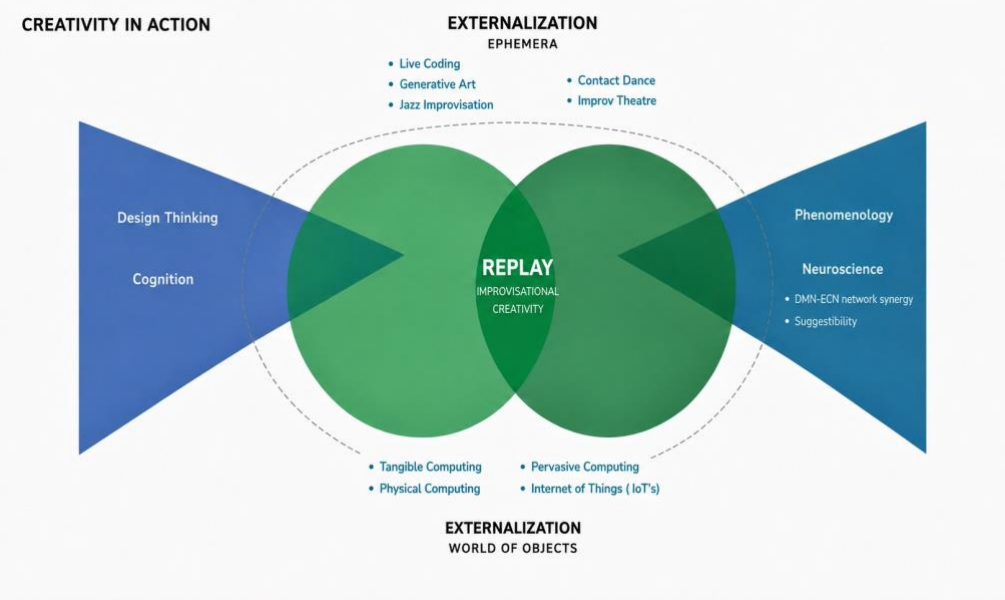
In Impro this capacity is illustrated by the concept of **game of the scene,** in which an experienced actor recognizes a recurring pattern or tension in a scene and chooses to play with it deliberately. This recognition goes beyond heuristic pattern-matching the expert retrieval of learned responses to familiar situations toward something genuinely generative: the capacity to make an offer that recontextualizes everything that has come before it and opens a direction that nobody in the room was moving toward.

> **An inexperienced improviser may rely more heavily on a learned response; an experienced one may become increasingly capable of producing something that was not present before the interaction. This distinction between heuristic competence and genuine creative arrival is what Creativity in Action is designed to cultivate. Current algorithmic systems can produce highly novel and surprising outputs, but they do not yet clearly demonstrate the full embodied, relational, and self-reflective capacity described here as Creativity in Action.**

Related to this is Heidegger's (1927/1962) concept of breakdown: the moment in which a previously smooth and unreflective activity is interrupted, requiring conscious restructuring of one's perception of the situation. In Impro, breakdown is not failure but invitation. Keith Johnstone (1989) describes this as "interrupting routines" the deliberate act of breaking with the action of a scene which can give unexpected value to what follows (p. 141). In RePlay, this process occurs regularly as the object being discussed or the context of the scene shifts suddenly among players. Each interruption offers an opportunity for shared understanding and creative exchange. Garfinkel's (1966) breaching experiments served a similar function during my exploratory research at Philips, deliberately disrupting participants' assumptions to surface more authentic reflection.

Other activities that demonstrate Creativity in Action include contact dance, parkour, technologically mediated performance, live coding, and some forms of installation and performance art. What these practices share with Impro theatre is the requirement to be simultaneously active and aware, creating and observing, moving and reflecting, in real time, without a script.

Figure 8.5
A Theory of Creativity in Action



8.12.5 Creativity in Action, Creative Cognition, and the Computational Frontier

Two theoretical frameworks illuminate what RePlay produces and why it matters beyond the boundaries of design research. The first is Ronald Finke, Thomas Ward, and Steven Smith's Genplore model of creative cognition (1992). The second is Margaret Boden's taxonomy of creative outputs (2004). They are addressing different questions, and they operate at different levels of analysis but together, and in conjunction with Sawyer's account of collaborative emergence, they provide the most precise theoretical grounding available for what Creativity in Action describes and what the case studies in this thesis demonstrate.

The Genplore model a contraction of generate and explore proposes that creative thinking operates through iterative cycles between two phases. In the generative phase, the mind produces what Finke et al. call pre-inventive structures: mental representations visual images, structural schemas, analogical mappings that have properties exceeding the thinker's original intentions. These structures are not yet ideas in the conventional sense; they are generative seeds whose implications have not yet been explored. In the exploratory phase, the thinker interprets, evaluates, and develops these structures in relation to constraints and goals, discovering meanings and possibilities that were not visible now of generation. The cycle then repeats exploration generates new pre-inventive structures, which open new exploratory phases.

Finke et al. identify three types of pre-inventive structure that the generative phase produces:

I. Combinatorial structures, which form novel combinations of mental elements;

II. Analogical structures, which map the relational organization of one domain onto another; and

III. Categorical structures, which reduce, restructure, or reconstitute the categories through which a problem is understood.

Each type corresponds to a different depth of creative engagement, and each appears, with different frequency and intensity, across the three case studies of this research. Boden's taxonomy as introduced in the literature review, operates at a different level. Where Finke describes the cognitive architecture of the creative process, what the mind does, Boden characterizes the relationship between creative outputs and the conceptual spaces they inhabit being what kind of thing a creative product is. Her central concern is whether creativity in any of these senses can be computationally modelled, which is why her taxonomy is directly relevant to the question of what current AI systems can and cannot do, and why it matters for the argument this thesis makes about Creativity in Action.

I would like to suggest that the two frameworks are complementary rather than competing. Finke describes the generative-exploratory process through which creative structures are produced and developed inside a single mind. Boden describes what kind of novelty the outputs of that process represent. Used together, they allow a precise characterization of what RePlay produces and of the level at which it makes its most significant contribution.

However, what neither framework accounts for, is what happens when creativity is genuinely collective: when the creative output emerges from the interaction between participants rather than from any individual cognitive process.

8.12.6 Collaborative Emergence and the Limits of Individual Models

Sawyer's account of collaborative emergence at this stage becomes essential. Sawyer argues that group creativity produces outcomes irreducible to individual cognitive contributions, that the interaction between participants generates possibilities that did not exist in any single mind (Sawyer, 2000, 2012). This social level of creative emergence is not adequately theorized by either Finke or Boden. It is, however, what RePlay is specifically designed to facilitate, and what the case studies consistently document.

Across the three case studies, RePlay produces all three types of pre-inventive structure identified by Finke, and outputs that can be characterized at all three levels of Boden's taxonomy. At the combinatorial level, trigger object exchanges at the Tiree Tech Wave generated novel associations between design concepts that no individual participant would have produced in isolation. The 'yes and' structure of improvisation is combinatorial in its basic operation: each offer is accepted and extended, creating chains of association that accumulate novelty through recombination. At the exploratory level, participants in the Lancaster pilot working with the BadIdea exercise moved

progressively deeper into the conceptual space opened by the constraint, discovering what the framework permitted through sustained embodied play. The children in the Bendables case study explored the design space of bend-sensitive materials through physical prototyping, finding what the technology afforded by inhabiting the interactions rather than reasoning about them analytically.

Transformational creativity (Boden's definition), the restructuring of the conceptual space itself, being the rarest and most significant mode, is a type of creative outcome that RePlay appears uniquely positioned to facilitate. Here two mechanisms are at work, the first is embodied analogical reasoning, which operates through what Gentner (1983) calls structure-mapping: not surface similarity but deep relational correspondence between domains. When participants at the Tiree Tech Wave used their bodies to represent data flow diagrams, physically enacting the movement of information through a system, the mapping between bodily action and abstract computational structure produced insights that the analytical mind had not found. The body talked back: its resistance, weight, and relational dynamics revealed properties of the design problem that had been invisible when approached through conventional representation. What became thinkable through the embodied analogy was not thinkable before it.

The second transformational mechanism I would like to present as structured disruption. The breaching experiments conducted during the exploratory work at Philips Design did not generate new ideas within an existing design framework; they disrupted participants' habitual assumptions so thoroughly that the problem space itself was transformed. Before the breaching intervention, participants reported their creative process in ways that confirmed rather than revealed their actual experience. After it, their accounts became considerably more complex and authentic, not because they had access to new information but because their categorical understanding of their own creative process had shifted. The Global Studio work in Bhopal adds a third instance: when community members enacted their spatial knowledge of the Kabadkhana neighborhood through embodied play, the conceptual blend that resulted, neither the designers' perspective nor the users', but a third emergent structure with properties belonging to neither input space alone, transformed the design team's understanding of the problem in ways that conventional user research had not achieved. In Fauconnier and Turner's (2002) terms, this is conceptual blending at the transformational level.

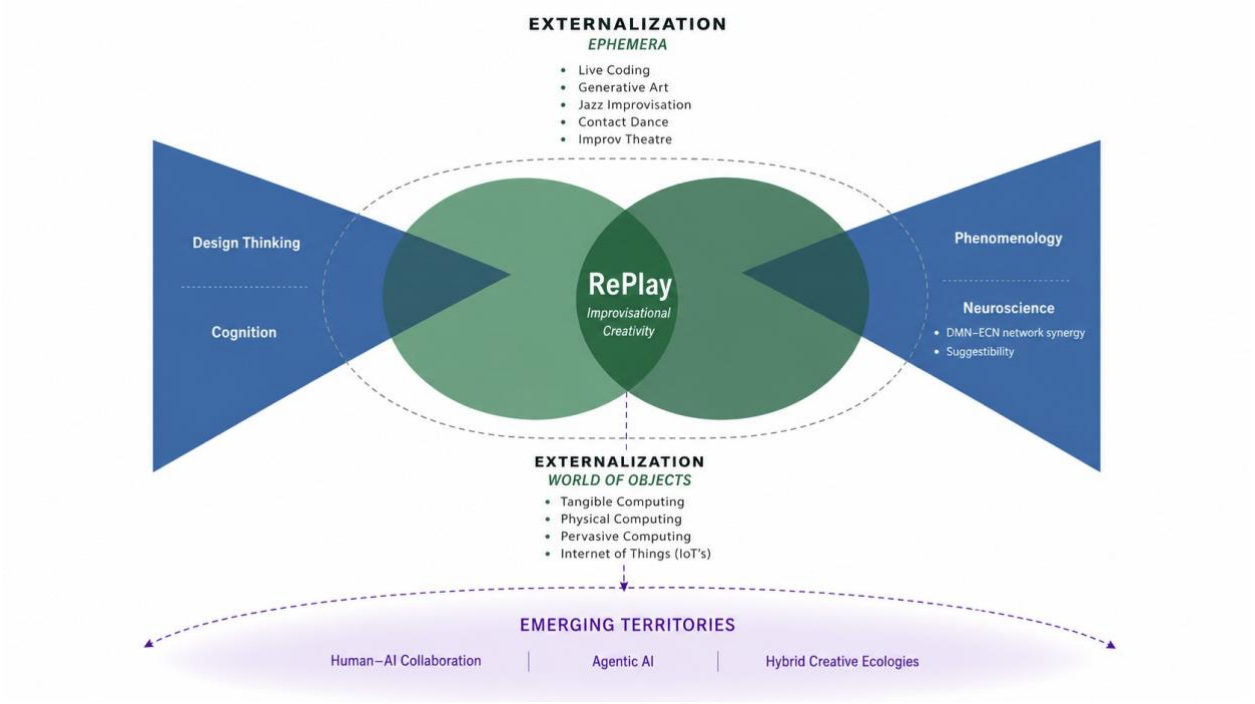
What Creativity in Action names, in relation to both frameworks, is the practitioner's real-time capacity to navigate across these creative levels, to recognize which mode the session is operating in, to introduce the condition that will shift it toward the next level of possibility, and to do so through embodied facilitatory intelligence rather than analytical decision-making.

Heuristic competence accounts for much of what experienced designers and improvisers do well, the expert retrieval of learned responses to familiar patterns however this navigational capacity goes beyond heuristic competence.

> **What Creativity in Action describes is the capacity that operates beyond heuristic competence: the recognition that the current moment calls for something that no learned pattern can supply, and the ability to respond to that recognition with genuine creative arrival rather than expert recombination.**

An experienced RePlay facilitator who shifts a session from exploratory to transformational mode is not applying a learned rule. They are exercising Creativity in Action at the meta-level, being creative about creativity itself.

Figure 8.6
A Theory of Creativity in Action and Emerging Territories



Note. Made by the author using ChatGPT.

This distinction between heuristic competence and Creativity in Action has direct implications for the computational landscape of creative AI and situates RePlay within a broader conversation that is currently unresolved at the frontier of the field. The systems that currently exist for computational creative collaboration can be understood in terms of how far they have progressed along the spectrum from combinatorial to transformational creativity, and where they fall short of the reflective and embodied intelligence that Creativity in Action requires. The implications of this distinction between heuristic competence and genuine creative arrival for current and future computational systems are developed in Chapter 9, Future Directions: RePlay and Agentic AI.

8.13 Cross-Case Synthesis: How RePlay Made Creativity Visible

In the three applied case studies, RePlay functioned less as a single fixed method than as a transferable creative ecology. In each context, the framework created structured conditions for participants to move from abstract discussion into embodied, relational, and material engagement. This is important because the central contribution of the thesis is not simply that improvisation can be useful in design; rather, it is that improvisationally structured design activity can make the usually tacit dynamics of collaborative creativity visible enough to be reflected upon, discussed, and studied.

The case studies also show that RePlay's transferability depends on its sandbox structure. The specific activities changed across contexts, but the underlying conditions remained consistent: playful constraint, facilitation, externalization, responsiveness, shared attention, and reflective return. These conditions allowed RePlay to work with adult practitioners, children, design researchers, community members, and maker-learning participants without reducing creativity to a rigid procedure. This supports the thesis claim that RePlay is best understood as a framework and methodology rather than as a single exercise or workshop technique.

Across the cases, embodied activity and material externalization provided different ways of making creative experiences and emerging ideas available for reflection. At Tiree Tech Wave, participants used TAPT to describe their experience of RePlay. One described "letting go of self-consciousness whilst having fun and understanding other people's views on the issues." Another reported that the activity "unveiled part of my thoughts in an unexpected way" (see Section 7.1.4). These accounts helped make participants' experiences of the group activity available for discussion and interpretation.

In Global Studio, children in the Kabadkhana community used their bodies to create tableaus expressing their desires for a local site. They also produced paper maps of their ideal community, identifying gardens, play spaces, and clean water as important. These activities helped the design team identify priorities and locations for possible interventions. Here, embodied and graphic externalization worked together to communicate children's perspectives on their environment. In the Bendables Case Study, Maker 11 reported that seeing a researcher bend their arms during the Design Machines exercise reminded her of a car, prompting her idea of using a toy car as the basis for a circuitry project. Her account connected a gesture encountered during RePlay with a subsequent design decision. Responses varied, however, and some children attributed greater importance to conversations or materials than to the RePlay exercises.

These examples contribute different forms of evidence: accounts of shared experience at Tiree, expressions of community priorities in Global Studio, and a participant's account of an emerging design idea in the Bendables Case Study. Together, they suggest that RePlay can support both

creative exploration and the generation of traces and accounts through which aspects of creative process become available for research and reflection.

8.14 The Role of Suggestibility in Creative Process

Building on the discussion of suggestibility in Section 8.2.1, I would like to posit that whether flow emerges during a RePlay session may depend significantly on what Persinger et al. (2009) call lability: the suggestibility and openness of the group to shared altered states of consciousness. This concept can be read alongside Dienes's (2012) research on hypnotic suggestibility as a relatively stable individual trait, which suggests that highly labile or suggestible individuals may be more readily disposed toward the kind of reduced self-monitoring and absorbed attention that characterizes flow.

In a RePlay session, the structured improvisation, the warm-up games, the yes, and philosophy, and the shared physical engagement appeared to support the collective lability of the group, functioning in effect as a social technology for facilitating the conditions under which group flow might emerge.

This is consistent with recent neuroimaging research proposing that flow may involve coordinated DMN-ECN network interaction rather than activation of any single brain region (Barnett and Vasiu, 2026). The collective, embodied experiences participants described during RePlay seem to resonate with accounts of this network coordination. Where some neurostimulation technologies approach such states through direct neural intervention, RePlay is of interest here because it approaches comparable experiences from a relational and social direction however these states were not measured just observed. Group flow during a RePlay creates a kind of collective perceptual experience, a highly embodied way of working that parallels what occurs during professional improvisation (Sawyer, 2000; Hitt, 1999).

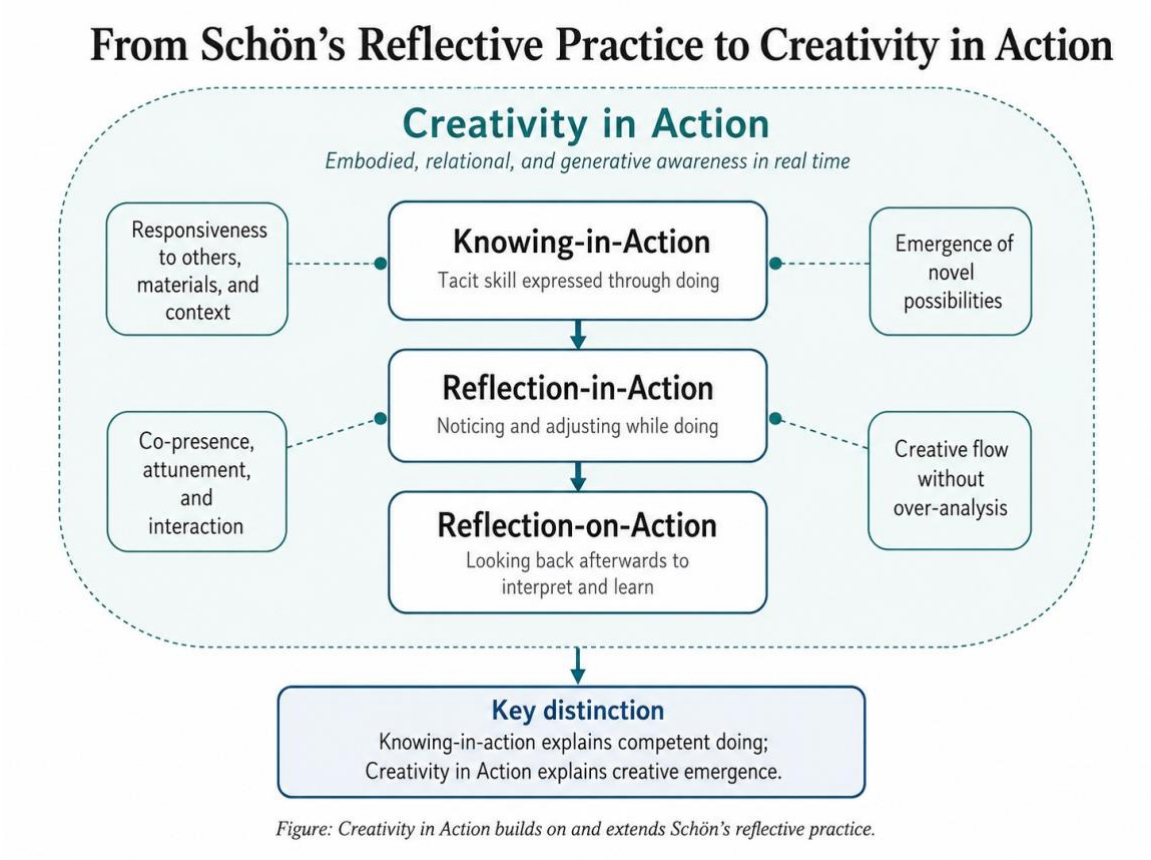
8.15 The Role of RePlay as Social Technology

Throughout this project I have discussed Varela's concept of enactive perception, yet terminology often fails when it comes to describing how one might use enactive perception within creative process. This is precisely where the term Creativity in Action became useful: as a way of naming and training this capacity as part of design process, building on what Schön (1992) describes as knowing in action, reflection in action, and reflection on action.

While Creativity in Action builds on Schön's (1992) framework, it departs from it in several significant ways. Schön describes tacit professional knowledge embedded in skilled practice as expertise that operates below conscious awareness in the individual practitioner. Creativity in Action, by contrast, describes a quality of embodied creative awareness that is trainable rather

than exclusively the province of expert practitioners, collective rather than individual, and grounded in enactive perception as in, the phenomenological sense articulated by Varela et al. (1991) and Noë (2004).

Figure 8.7
From Schön's Reflective Practice to Creativity in Action



Note. Made by the author using ChatGPT.

Where Schön's reflection in action operates at the level of conscious professional judgment, Creativity in Action reaches into the pre-noetic dimension that improvisation surfaces before the evaluative mind can intervene. And where Schön's framework is primarily corrective, Creativity in Action is generative: its goal is not to fix what has gone wrong but to open new perceptual possibilities through embodied creative exchange.

Creativity in Action builds on Schön's concepts of knowing-in-action and reflection-in-action but is not reducible to either. Knowing-in-action describes the tacit knowledge expressed through skilled practice, while reflection-in-action describes the practitioner's capacity to notice and adjust while an activity is unfolding. Creativity in Action extends this account by naming the embodied, relational, and generative awareness through which new possibilities emerge in real time. It includes tacit skill and situated reflection, but also responsiveness to other participants, materials, environments, constraints, and the unanticipated "back-talk" of the situation. Whereas Schön's

account is primarily concerned with professional knowing and adaptive judgment, Creativity in Action is specifically concerned with creative emergence: the capacity to remain immersed in action while sensing, shaping, and responding to possibilities that are not fully known in advance. In collaborative contexts, this awareness is not located solely within an individual practitioner but is distributed across the group and the wider creative ecology.

One of the reasons RePlay works so effective is that it utilizes improvisational strategies that tap into pre-noetic aspects of consciousness, making ideas physical before there is an opportunity for evaluation. Dix et al. (2005) explain what embodiment theory suggests much of what we think consciously is not actually under conscious control: it is pre-noetic. Drawing on Libet's (1999) experiments, Dix et al. note that the conscious mind gets a chance to veto unconscious action hence the argument that we may not have free will so much as free won't.

8.16 The Role of Backtalk in Tangible Computing

Enactive perception, a term developed by philosopher Alva Noë (2004), proposes that perception is not something that occurs solely in the mind but is intrinsically connected to action. This echoes the perceptual psychologist Gibson (1979), whose concept of ecological perception emphasizes how our perceptions are tuned for acting in the world. When one uses the body as a tool for understanding, the body itself offers up what Schön calls a kind of back talk an unanticipated response from the materials and a situation that opens new directions for inquiry.

In tangible computing contexts, where gesture, context, and environment play central roles, this embodied approach has relevance. Understanding a design problem through the body can range from the very literal physically enacting the gestures of a mundane activity such as making breakfast to the quite abstract, such as using bodies to represent data flow diagrams as occurred during the Tiree Tech Wave, or physically prototyping use cases and interactions as in the design machines exercise during the Bendables case study.

A universally accessible example of how action supports design understanding is IKEA: customers are guided through room-scale installations of living rooms and bedrooms precisely so they can physically experience what it means to inhabit these spaces. During a RePlay session, participants engage in something structurally similar: using their bodies as source material for body storming through the innovation process, creating movement metaphors for their ideas a kind of physical sketch that makes thinking visible before it hardens into judgment

8.17 The Role of Play and Facilitation

One of the most significant observations across all three case studies was the quality of social connection that emerged during RePlay sessions. Anthropologist Victor Turner (1969) describes this

phenomenon as communitas: a state of togetherness that arises when individuals enter a liminal space, temporarily freed from the social roles, hierarchies, and conventions that normally govern their interactions. RePlay creates precisely this kind of liminal environment: participants from diverse disciplinary backgrounds for example architects and children in Bhopal, academics and makers on Tiree, children and software engineers in Ottawa all find themselves on equal footing, united by the shared constraints and playful openness of improvisation. This levelling quality is not incidental to RePlay's effectiveness; it is central to it.

Across the case studies, the facilitator's role emerged consistently as one of the most important and most delicate dimensions of a RePlay session. The facilitator is not a director; they do not determine outcomes or prescribe what participants should discover. They are, as Luis described during the Philips Design study, more like a guide: someone with a bird's-eye view of the process who can steer it in particular directions without constraining it. Over-facilitation as I observed during the Lancaster pilot when I embedded a reflector in the group disrupts the flow of the session by reactivating the evaluative, self-conscious mind precisely when the group is beginning to find its creative rhythm. Sawyer (2012) notes that the most generative group creative processes are those in which leadership is distributed and emergent rather than centralized and directive, which is exactly the model of facilitation that RePlay requires.

Connecting the facilitator's role to the classical model of creative process, Wallas (1926) identifies four stages; preparation, incubation, illumination, and verification and it is the incubation phase that is most vulnerable to disruption. Incubation requires a kind of protected suspension of judgment, a willingness to sit with uncertainty and allow associations to form without forcing them toward premature resolution. The facilitator's most important function in a RePlay session is often precisely this: protecting the incubation phase from the evaluative pressure that design contexts tend to impose too early. By knowing when to hold open a question rather than close it, when to introduce a new constraint rather than consolidate an existing one, and when to shift the energy of the group rather than let it stagnate, the facilitator creates the conditions in which illumination becomes possible. This requires not only skill and sensitivity but, ideally, a personal grounding in improvisational practice.

The facilitator's art is ultimately knowing when to introduce a constraint, when to shift a game, when to deepen the reflection, and when to simply step back and let the group find its own creative logic. The question of what kind of space makes this quality of facilitation possible leads directly to the fourth and final theme of this chapter: the sandbox. Another interesting proposition might be to have the role of facilitator be taken up by an Agentic player which is always available and able to embody some of reflection process while not interrupting the process.

8.18 Spaces for Play: The Sandbox

RePlay, at its most fundamental level, provides as mentioned a sandbox. A protected space in which ideas can be explored, tested, and reconsidered before participants commit to decisions in practice. I have used the term to describe a set of conditions that supports creative exploration through embodied activity, reflection, and interaction in Chapter 3. Although the idea of a sandbox is not new, this research draws attention to its methodological significance and how such conditions can be cultivated, and how in turns this makes creative process available for inquiry.

The case studies helped me understand that these conditions take different forms according to the setting and participants. At Tiree Tech Wave, improvisational activities followed by TAPT provided opportunities to articulate experiences of shared creative activity. In Global Studio, bodily enactment and mapping helped children express their perspectives on their community and its possible development. In the Bendables Case Study, children moved between improvisational exercises, drawings, materials, circuits, and prototypes. These settings differed, but each informed my understanding of how a structured, yet open environment could support exploration and reflection.

Kotler and Wheal (2017, pp. 160–161) and already mentioned in Section 3.8 discuss Burning Man as a large-scale example of a space for experimentation and shared discovery. I see a connection with RePlay in the opportunity to explore possibilities before translating them into everyday practice. The comparison concerns the provision of space for experimentation; it does not imply that the experiences or effects of Burning Man and RePlay are equivalent.

The sandbox also need not be a dedicated physical location. It can be sustained through a practice, a temporary arrangement, or a computational environment. Kenneth Newby's work in music composition and Stephon Alexander's exploration of connections between jazz and physics as well as AlphaZero and other computational frameworks, offer examples of practices in which a framework enables experimentation. Their relevance here lies in the relationship between structure and openness: a framework can provide enough coherence to sustain inquiry while allowing its direction to develop through exploration.

Play-based education offers another point of connection. Froebel's play gifts provided tactile materials through which children could explore and externalize ideas (Froebel, 2012). Pat Kane's (2011) account of the play ethic extends the discussion to the relationship between work and play, arguing for spaces that allow playful discovery. These perspectives help situate my interest in the sandbox as a condition for creative engagement among both children and adults.

Maker spaces, creative retreats, co-working spaces, fix-it cafés, and DIY communities offer further settings in which people can share, experiment, and learn through making. Their openness cannot

be assumed simply from the type of space: it depends on how participation is organized, how contributions are received, and what opportunities exist to reconsider an idea. In RePlay, facilitation, negotiated constraints, and opportunities for reflection help establish this openness. The sandbox is not a building; it is a set of conditions. Creating and sustaining those conditions is itself a creative and methodological act.

This understanding connects with the autopoietic analogy developed earlier in this chapter. I use that analogy to consider how a creative process develops and renews itself through relationships between participants and their environment, rather than to claim that creativity is literally an autopoietic system. The sandbox provides a way of attending to the conditions supporting those relationships. It therefore connects the some of the themes of this discussion: offering opportunities for a creative mindset to develop, for reflection to deepen, and for Creativity in Action to unfold. It supports creative emergence without prescribing what must emerge.

8.18.1 The Sandbox: Possible Neurobiological Benefits of a Social Technology Like RePlay

The social dimension of RePlay might have a neurobiological basis. The shared physical engagement, eye contact, synchronized movement, and mutual responsiveness of an improvisation session are the kinds of social and embodied engagement that flow literature associates with the release of oxytocin (trust and social bonding), serotonin (wellbeing and openness), dopamine (reward and motivated exploration), and endorphins and norepinephrine (energized arousal and sustained attention) (Kotler and Wheal, 2017). Tiree participants described feelings of energy, trust, and openness that resonate with these accounts. Popular accounts of flow associate these neurochemical conditions with flow states and creative risk-taking (Kotler and Wheal, 2017). At the level of neural networks, this neurochemical vocabulary resonates with the DMN-ECN coordination that recent neuroimaging research associates with creative flow (Barnett and Vasiu, 2026). I therefore read RePlay as a social practice whose conditions resonate with those this literature associates with lowered defences, trust, and the open, absorptive states linked to creative collaboration. I am drawing a parallel here, not claiming that RePlay produces these neurochemical or network states.

8.19 Creative Emergence and Group Flow

Sawyer (2000, 2012) argues that group flow is not simply the sum of individual flow experiences but a qualitatively distinct phenomenon with emergent properties that individual flow does not exhibit. In group flow, the creative output exceeds what any individual participant could have produced alone not because of simple addition but because the interaction between participants generates possibilities that did not exist in any single mind. During RePlay sessions: the most generative creative moments I observed tended to be those that emerged from the exchange between players rather than from any individual contribution. By cultivating the social and

relational conditions that participants associated with group flow, RePlay appeared to make this kind of collective creative emergence more consistently available rather than leaving it to chance.

This is why improvisational skills are increasingly valued in professional contexts well beyond theatre. Organizations such as Google have reportedly hired Impro practitioners [AUTHOR: add a source for this claim or remove it] to facilitate team development, recognizing that the capacities cultivated through improvisation such as, listening, building on others' ideas, embracing uncertainty, and staying present under pressure are precisely the capacities that high-performing creative teams need. RePlay makes this connection explicit by embedding improvisational practice directly within design process, treating it not as a warm-up activity or team-building exercise but as a core creative methodology.

Leonard and Yorton (2015) identify seven elements of good improvisation that are equally elements of good creative collaboration: yes and, ensemble thinking, co-creation, authenticity, and a generative relationship with failure, among others. My research with RePlay suggests that these are not merely theatrical conventions but transferable creative capacities. Yes and appeared in the Tiree Tech Wave as participants built on each other's trigger object ideas without premature evaluation. Ensemble thinking was visible in Global Studio when the children of Kabadkhana collectively mapped their neighborhood through embodied play. Co-creation was at the heart of the Bendables workshops where children and adult designers developed prototypes together. And the relationship with failure was perhaps most striking in the Lancaster pilot, where the most productive moments came precisely when participants stopped trying to get things right and started treating unexpected outcomes as gifts.

One quality that connects all these elements is what experienced improvisers describe as following the follower: the capacity to read the needs of the group in real time and shift one's own role, accordingly, moving fluidly between leading and supporting depending on what the creative moment requires. This is a form of distributed leadership that is quite different from conventional hierarchical models of group coordination, and it is one of the most transferable skills that RePlay cultivates.

In summary, good Impro and in turn good creative collaboration involves a willingness to listen, the ability to forge trusting relationships, a capacity to take and support responsible risks, and a readiness to adapt and stay open amid uncertainty (Spolin, 1999; Leonard and Yorton, 2015).

8.20 RePlay as Methodology and Framework

This thesis set out to investigate three interrelated questions. The first asked whether it is possible to create a framework for facilitating, as well as conducting creativity research about the qualities of improvisational creativity that make it useful for design process, and whether such a framework

could be made implementable and transferable across contexts. The second asked how such a framework might enrich what we already know about creativity, and specifically what it might add to our understanding of collaborative creativity. The third asked what it is about the embodied, physical externalization of ideas that distinguishes it from more internal creative methods such as drawing or writing.

The research conducted through RePlay offers direct answers to all three:

I. In answer to the first research question: yes, such a framework is possible, as the three case studies indicate. RePlay is a structured yet open-ended system of Impro-informed games, facilitation strategies, and reflective tools that draws on the creative qualities of improvisational theatre presence, spontaneity, the suspension of judgment, the acceptance of failure as a gift, and the principle of building on what is offered and applies them deliberately within design process. The framework proved implementable across three substantially different contexts: an academic HCI gathering on Tiree, a community participatory design project in Bhopal, and a maker education activity with young children in Ottawa. In each case RePlay was adapted to context without losing its essential character. What made this possible was the framework's underlying logic: a shared sandbox governed by improvisation's core principles rather than by fixed protocols, which gave it the flexibility to hold diverse participants, purposes, and constraints without becoming arbitrary.

II. The progression across the three case studies is itself evidence of transferability. At Tiree, RePlay was tested and evaluated as a design research tool among practitioners. In Bhopal, it was extended into community participatory design with non-specialist participants including children, requiring a more radically embodied and informal approach. In the Bendables case study, it was applied within maker education to support children in understanding and prototyping tangible, bend-sensitive interactions. Each iteration enriched the framework: new games, new facilitation strategies, and new data collection methods were developed in response to what each context demanded. RePlay did not remain static across these applications; it evolved autopoietically, in Maturana's sense, through its interaction with each environment. The requirements that emerged through this process to observe in situ collaborative design process, to encourage reflective practices within creativity, to create a low-barrier entry framework for collaborative creativity, to encourage enactive perception via bodily movement, and to collect first-person data regarding design process — are not constraints imposed from outside but properties that RePlay developed through use.

RePlay enriches existing literature on creativity in several ways, most importantly it contributes an original theoretical concept “Creativity in Action”, that names and

describes a quality of embodied, simultaneous awareness that experienced creative practitioners develop but that existing models of creative process have not adequately accounted for. Traditional stage models of creativity, from Wallas (1926) onward, treat the creative process as essentially sequential and largely internal: preparation, incubation, illumination, verification. RePlay's practice reveals this account to be insufficient.

What the case studies repeatedly suggested is that the most generative creative moments are not purely sequential and are not purely internal. They emerge through interaction, through breakdown and recovery, through the friction between perspectives, and through what Schön (1992) calls the back talk of the situation, the unanticipated responses that a design problem offers back when approached through the body rather than only through the mind. Reflection, in this research, appeared to be not one stage among others but a continuous and multi-layered process that must be deliberately timed and facilitated. My updated model of creative process below incorporates reflection as an equally significant dimension alongside the more commonly recognized stages. This is a contribution grounded in empirical observations across the exploratory and case study phases of this research.

With respect to collaborative creativity specifically, RePlay contributes the concept of the sandbox as a theorized condition for creative emergence rather than simply a metaphor. What the three case studies suggest is that group flow the qualitatively distinct phenomenon Sawyer (2000, 2017) distinguishes from the sum of individual flow experiences, does not arise spontaneously from talented people working together. It requires a structured yet open environment, a quality of facilitation that protects rather than directs, and a set of social and embodied conditions that lower the threshold for creative risk. RePlay was designed to provide all three.

Figure 8.8
RePlay and Creative Emergence



Note. Made by the author using ChatGPT.

Recent neuroimaging research associating flow with coordinated DMN-ECN network synergy (Barnett and Vasiu, 2026) offers a vocabulary that resonates with what this research observed behaviorally: that the participants who most fully inhabited the RePlay process reported losing track of time, heightened energy, building fluidly on each other's contributions, and what I recorded resonates with the integrated neural functioning this literature associates with creative flow. The TAPT data from the Tiree Tech Wave, which documented time distortion, loss of self-consciousness, and spontaneous insight among participants, also resonates with Dietrich's (2004b) account of transient hypofrontality, which offers one way of interpreting the reduced self-consciousness participants described during RePlay, though the studies did not measure neural activity and cannot establish that such changes occurred.

III. In answer to the third research question: what distinguishes the embodied approach of RePlay from more internal creative methods such as drawing or writing is not merely a matter of modality but of the perceptual access it provides. Drawing and writing are powerful tools for externalizing ideas that have already taken some form in the mind. They work primarily from the inside out. Embodied improvisation, by contrast, works simultaneously in both directions. The body does not merely express what is already known; it discovers what is not yet known by doing. This is what Noë (2004) means by enactive perception: perception is not a passive reception of information but an active,

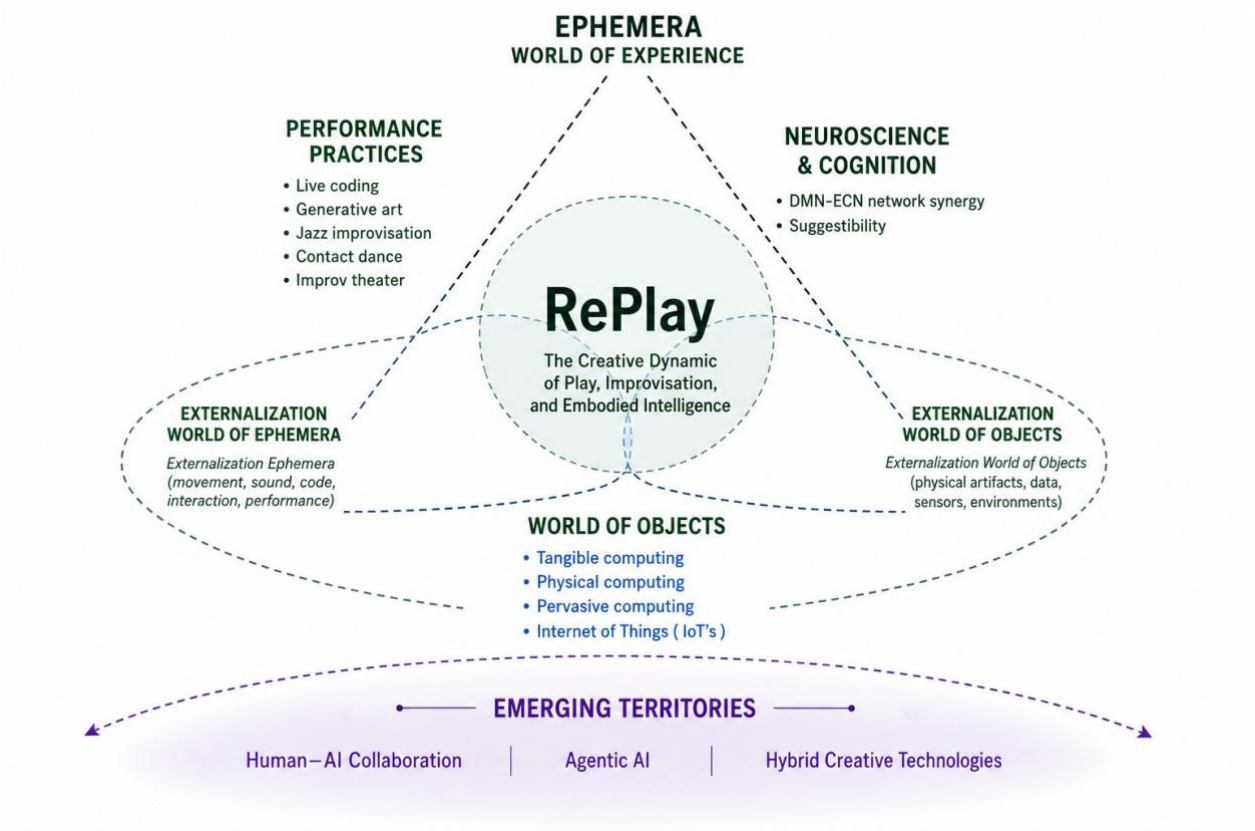
bodily engagement with the world, and what we come to know through action is genuinely different from what we come to know through reflection. When a designer uses their body to enact a design scenario as in to physically inhabit the perspective of a user, to move through a space, to improvise a sequence of interactions, they access a form of knowing that precedes and often surpasses what they could produce through deliberate cognitive effort alone. This is what Dix et al. (2005) describe as the pre-noetic: the layer of embodied, tacit understanding that operates below conscious awareness and that can be surfaced through physical action in ways that more internal methods may not reach. The Lancaster pilot illustrated this when verbal reflection appeared detrimental to the creative process, while embodied improvisation opened it. The Philips study demonstrated it when breaching experiments disrupted participants' habitual accounts of their own process and revealed more authentic and complex understandings. Global Studio demonstrated it when children in Bhopal were able to contribute meaningfully to a complex architectural design process not because they could articulate their spatial knowledge but because they could enact it.

8.21 RePlay's Contribution to HCI

This is also what makes RePlay significant within HCI specifically. Tangible computing, embodied interaction, and participatory design are all fields that have theorized the importance of the body in interaction and design. RePlay offers a practical methodology for doing what these fields call for: bringing the body into the design process not as a subject of study but as a resource for inquiry. Design mapping, breaching experiments, trigger objects, traces, TAPT and the video documentation of RePlay sessions are all tools developed within this research for making embodied creative process observable, recordable, and available for reflection. Together they constitute a methodological contribution to design research that sits alongside RePlay's theoretical contributions and that points toward a richer, more embodied practice of participatory and creativity-centered HCI.

8.22 Introduction: RePlay Ten Years Later

Figure 8.9
RePlay Emerging Territories



Note. Made by the author using ChatGPT.

8.23 From Earlier Intuition to Current Relevance

One of the important interpretive claims of this thesis is historical as well as theoretical. RePlay emerged from a period in which creativity research, design research, HCI, and improvisational practice were already beginning to move away from individualist and purely cognitive accounts of creative process. However, many of the ideas that initially motivated RePlay such as embodiment, co-presence, group flow, material participation, affect, improvisation, and distributed agency have become more central to the field over the last decade. This means that RePlay should not be understood only as a method developed within an earlier design research moment, but as a framework whose significance has increased as the field has moved toward embodied, relational, and hybrid accounts of creativity.

This matters because RePlay was never only a tool for generating ideas. It was developed to ask how creative collaboration becomes possible, how it can be facilitated, and how the tacit dynamics of group creativity can be made visible enough to be reflected upon. The more recent state of the

field strengthens this claim. Work on embodied design, social innovation, neuroaesthetics, group creativity, posthumanism, and human-AI creative systems all point toward the same problem: creativity is not adequately explained as an internal mental event or a finished product. It unfolds through situated relations among bodies, materials, environments, tools, histories, technologies, and forms of attention.

8.24 Embodied Co-Creation and Improvisational Methodologies

This chapter has described how RePlay aligns with a broader movement from discrete creativity tools toward holistic, embodied approaches to co-creation. In the years following the initial development of this research, participatory design and social innovation have increasingly turned toward methods that use movement, storytelling, sensory engagement, role-play, spatial enactment, and embodied narrative to help participants externalize experience. These methods are especially important where verbal explanation is limited, where tacit knowledge matters, or where participants' experiences are shaped by trauma, marginalization, childhood, neurodivergence, disability, or other forms of situated embodiment.

RePlay fits strongly within this shift because it gives structure to embodied co-creation without reducing it to a rigid protocol. Its games and techniques allow participants to perform, externalize, map, and reconfigure experience through action. In this respect, RePlay can be understood as a framework of embodied narrative practices: a way of making internal, social, affective, and spatial experience available through shared action. This is why the framework is relevant not only to design ideation but also to participatory research, social innovation, learning, community engagement, and the study of collaborative creativity itself.

8.25 Post-Pandemic Co-Presence, Hybrid Contexts, and the Return of the Body

The more recent context also changes how RePlay can be interpreted. After COVID-19 lockdowns and the expansion of remote work, design, education, and creative practice placed renewed emphasis on the problem of presence. Hybrid and remote contexts have made visible something that was often taken for granted in face-to-face collaboration: co-presence is not simply being in the same room; it is an embodied and relational condition involving attention, timing, trust, responsiveness, and shared orientation. RePlay becomes especially relevant in this context because it provides a practical way to cultivate and study co-presence rather than assuming it already exists.

This also reframes the sandbox concept. The sandbox is not merely a playful metaphor. It is a constructed condition for re-entering relational presence. It gives participants permission to experiment, fail safely, become physically involved, respond to one another, and suspend the usual

evaluative pressures of design work. In hybrid and digitally mediated creative cultures, this kind of structured return to embodied, playful co-presence becomes increasingly significant.

8.26 Advances in Creativity, Cognition, Flow, and Neuroaesthetics

Recent research in creativity, cognition, flow, neuroaesthetics, and neural synchrony offer additional support to the central premise of RePlay. The thesis does not claim that the case studies provide neuroscientific proof of flow or group flow. Rather, it argues that the qualitative patterns observed through RePlay absorption, loss of self-consciousness, responsiveness, shared attention, rhythmic attunement, embodied engagement, and reflective return are consistent with a wider body of research that increasingly understands creativity as distributed across brain, body, environment, and social interaction.

This is important because it clarifies the status of the claim in this work. RePlay should be understood as a qualitative and practice-based methodology that makes the behavioral, relational, and experiential dimensions of collaborative creativity visible. Neuroscience does not replace this qualitative evidence; it provides a complementary horizon that helps explain why embodied improvisational methods may be especially effective for cultivating flow-like states, group responsiveness, and creative openness. In this sense, the later scientific literature supports the plausibility and relevance of RePlay, while the case studies in this thesis illustrate how these dynamics appear in situated design and participatory contexts.

8.27 From Tools to Frameworks: RePlay's Retrospective Significance

Early design methods often treated improvisation, role-play, bodystorming, and prototyping as techniques to be used at moments in a design process. RePlay contributes something different. It does not simply add improvisation to design. It reframes improvisation as a methodological lens for understanding creative process. This is why the distinction between tool, method, framework, and methodology is so important across the thesis.

As a tool, RePlay offers specific games and exercises. As a method, it structures workshops and design activities. As a framework, it provides a creative sandbox for externalization, reflection, embodied action, and relational emergence. Finally, as a methodology, it generates data about collaborative creativity as it unfolds. The current state of the field makes this distinction more important because contemporary creativity research increasingly requires approaches that can work across human, material, computational, and ecological systems without reducing creativity to either individual cognition or technical output.

8.28 Posthuman, More-Than-Human, and Hybrid Creative Ecologies

If creativity is understood as embodied, relational, and emergent, then creative agency cannot be located only inside individual human minds. It is distributed across bodies, tools, materials, spaces, technologies, and social relations. This is consistent with feminist and posthumanist critiques of cognitivism, which challenge the separation of mind and body, subject and object, human and non-human, researcher and researched.

From this perspective, RePlay can be understood as a framework for studying creative ecologies. Its value lies not only in what participants say or produce, but in how bodies, objects, spaces, props, technologies, maps, drawings, prototypes, and gestures become part of the creative event. This becomes especially relevant in relation to artificial intelligence and hybrid creative systems. AI may generate impressive outputs but RePlay foregrounds forms of creativity that depend on embodied presence, affective feedback, social attunement, situated judgment, and mutual responsiveness. These are precisely the dimensions that become harder to account for when creativity is understood only through computational generation

8.29 The State-of-the-Field Claim

The central state-of-the-field claim is therefore this: RePlay was developed before the current widespread interest in agentic AI, hybrid creativity, embodied co-creation, and neurocognitive accounts of group creativity, but the field has since moved toward many of the concerns that RePlay was designed to address. This does not mean that RePlay predicted all later developments. Rather, it means that the framework was already working on a problem that has become more visible: how to understand, facilitate, and study creativity as an embodied, relational, situated, and increasingly hybrid process.

This strengthens the thesis contribution. RePlay is not simply a historical design method that was useful in three case studies. It is a framework that remains relevant because it offers a way to study what current creative technologies and design cultures often struggle to explain: how creative emergence happens through bodies, materials, social timing, environmental context, reflection, and shared action. Creativity in Action names this capacity. RePlay provides a way to cultivate and investigate it.

Table 8.3
State-of-the-Art Summary

Material	Discussion Function
Embodied co-creation and embodied narrative tools	RePlay belongs to a growing movement toward performative, sensory, and participatory methods.
Post-pandemic interest in presence and hybrid creativity	Strengthens the argument that co-presence, embodiment, and the sandbox are central conditions for collaborative creativity.
Neuroaesthetics, flow, altered states, and neural synchrony	Provides scientific support for the plausibility of RePlay as a qualitative method for studying flow-like collaborative states.
From tools to frameworks	RePlay is a framework and methodology rather than only a creativity framework.
Posthuman and AI creative ecologies	RePlay is relevant to current debates about human-machine creativity, material agency, and embodied grounding.

8.30 RePlay and Emerging Paradigms

The themes developed in this discussion chapter creative mindset, reflection, Creativity in Action, and the sandbox are not independent contributions. They are four dimensions of a single underlying insight: that creativity is not a property of individuals but an emergent phenomenon that arises through embodied, relational, improvisational interaction. Taken together, they constitute what this thesis proposes to call hybrid creative ecologies: entangled systems of human embodiment, social interaction, environmental context, and increasingly computational agency, within which creative emergence becomes possible. This concept is not proposed as a standalone theoretical contribution but as a synthesis of threads running through the thesis from its earliest chapters; Bateson's (2002) ecology of mind, Barad's (2007) theory of intra-action, Braidotti's (2013) posthuman relational ontology, and Maturana and Varela's (1991) autopoiesis. What RePlay contributes is not just a name for this phenomenon but a methodology for making it observable, possible to facilitate and transferable across radically different contexts.

8.31 Chapter Conclusion

This chapter has drawn together the empirical and theoretical contributions of the research across four themes: the cultivation of a creative mindset, reflection as a multi-layered dimension of creative process, Creativity in Action as the thesis's central theoretical contribution, and the sandbox as a condition for creative emergence. Read together, they answer the three research questions: a transferable framework for facilitating improvisational creativity is possible (RQ1); collaborative creativity is relational, embodied, affective, and materially supported rather than only cognitive (RQ2); and embodied externalization provides a form of perceptual access that more internal,

representational methods do not (RQ3). These findings also open a forward-looking question about how creative emergence of this kind might be supported within hybrid human and AI creative ecologies, which the following chapter takes up as a direction for future research.

Chapter 9: Future Directions

"It matters what matters we use to think other matters with." — Donna Haraway, Staying with the Trouble

9.1 Introduction

Chapter 8 developed Creativity in Action as a human capacity, culminating in a distinction between heuristic competence (the expert retrieval of learned responses) and genuine creative arrival, the capacity to respond to a moment that no learned pattern can supply. This chapter follows that distinction into the computational landscape. It asks what current AI systems can and cannot do in relation to Creativity in Action, how RePlay might inform the design and study of hybrid human AI creative ecologies, and what more speculative horizons from neural entrainment to a conjecture about collective creative flow might open for future research. The material here (some of which highly theoretical and ambitious nonetheless creative) is offered as future directions and interpretive horizon rather than as findings established by the studies in this thesis.

Throughout this research, I engage with neuroscience literature as a design researcher reading across disciplinary boundaries. This engagement provides an interpretive lens: language and concepts through which to consider patterns observed qualitatively in embodied, collaborative creative activity. When this research began, accounts of the relationships between large scale brain networks and creative cognition were emerging, and following their development became part of my inquiry. I bring this literature into dialogue with participants' accounts and my observations, identifying resonances and questions that inform my understanding of creative process. These connections are interpretive; they do not establish neural mechanisms underlying the experiences documented in the studies.

9.2 Improvisational Technological Frameworks

The OMax family of systems, developed at IRCAM by Gérard Assayag and colleagues over approximately three decades, represents the most sustained and sophisticated attempt to build genuine musical co-improvisation. OMax uses a factor oracle data structure to learn the stylistic patterns of a live musician's performance and reinject that material in transformed and recombined form in real time (Assayag et al., 2006). Its creators describe the underlying process as *stylistic reinjection*, a term that is precise and honest about what the system does. It reinjects the musician's own material back at them, working with what it has been given. In Finke's terms it is operating at the combinatorial level with exploratory recombination. Its descendants, SoMax, ImproteK, and DYCI2, each represent an incremental advance toward the goal of genuine process awareness.

The European Research Council's REACH project (Raising Co-creativity in Cyber-Human Musicianship), currently underway at IRCAM under Assayag's direction, is the most ambitious current attempt to close the remaining gap, combining computer science, cognitive science, social science, and the anthropology of improvised practices (reach.ircam.fr). That this problem requires thirty years of development and a major European Research Council grant to approach, and has not yet been solved, is not a statement about the immaturity of the technology. It is a statement about the nature of the problem.

In the domain of theatrical improvisation specifically, Improbotics, developed by Kory Mathewson and Piotr Mirowski represents an attempt to build an AI participant in live Impro performance (Mathewson and Mirowski, 2018). Human actors perform alongside AI agents in unscripted shows, accepting and building on language model outputs as offers in the improvisational exchange. The researchers are explicit about what their system achieves and what it does not: the AI does not understand the interaction, but its imperfections its incoherence, its unexpected juxtapositions, its failure to follow the narrative logic of the scene, can fuel the creativity of the human performers. The AI is functioning as a very sophisticated random constraint generator, not unlike a trigger object in a RePlay session. The 'yes and' however is being performed by the humans alone.

In the domain of embodied movement improvisation, Brian Magerko's LuminAI project at Georgia Tech's Expressive Machinery Lab has developed a co-creative AI dance partner that analyzes participant movement and improvises responses informed by an episodic memory of past interactions (Trajkova et al., 2024). The use of Rudolf Laban's movement analysis framework as a vocabulary for creative response represents a significant attempt to ground computational creativity in embodied phenomenological structure. Nevertheless, LuminAI's episodic memory is accumulative rather than process-aware: it learns from what it has experienced but does not hold the developing aesthetic logic of an ongoing session. Magerko himself has noted that co-creative AI using AI as a genuine creative collaborator rather than a generative tool remains rare (Magerko, 2016). His lab's work suggests from the computational creativity side what this thesis argues from the design research side: that genuine embodied co-creativity is not yet a solved problem, and that understanding might be improved by studying human improvisation first at a neurocognitive level.

Transformer-based generative systems such as; MusicGen, Suno, and their equivalents are semantically richer than OMax but temporally flat: they generate sequences without participating in an ongoing exchange, have no memory of the session as it develops, and no capacity to recognize the returning motif or the moment when the creative space needs to shift rather than continue.

9.2.1 AlphaZero and Computational Creativity

AlphaZero provides a compelling example of computational discovery and perhaps even transformational creativity within bounded formal systems. Starting from random play and learning through self-play, it achieved exceptional performance in chess, Go, and shogi without human examples or domain knowledge beyond the rules of each game (Silver et al., 2017). Its achievements illustrate how unexpected strategies can emerge within an established structure.

Hermann Hesse offers a useful literary analogy in The Glass Bead Game, describing how "within this fixed structure … a whole universe of possibilities and combinations is available to the individual player" (Hesse, 1969, p. 15). The fictional Game brings together ideas from music, mathematics, and other scholarly disciplines through a shared symbolic language. Its players create relationships between these ideas within an elaborate system of rules (Hesse, 1969, pp. 14–15).

The Glass Bead game just like AlphaZero is an illustration of how structure can enable creative exploration: the rules provide a language through which unexpected connections become possible. At the same time, the richness of those connections does not necessarily entail questioning the system within which they are made. This offers a useful comparison with AlphaZero's discovery of strategies within established game rules.

AlphaZero's task is to improve its performance within the specified game. Its training does not ask it to reconsider whether that game, its rules, or its objectives are appropriate to a different situation. This distinction matters for design, where creative activity may involve questioning the initial problem, negotiating goals, or reconsidering constraints. My interest in RePlay concerns both exploring possibilities within a shared framework and enabling participants to reflect on and reshape the framework itself. This is expressed through the onto-epistemological orientation of RePlay discussed in Section 4.6. AlphaZero therefore offers a valuable comparison, while its design does not establish the capabilities or limitations of all AI systems.

9.3 Why Creativity in Action Matters for Agentic Collaboration with AI

What all these systems share OMax, Improbotics, LuminAI, MusicGen, AlphaZero, is the absence of process awareness in the full sense that Creativity in Action requires.

Current systems do not yet appear able to hold the developing creative logic of a session in the full sense proposed here, recognize which level of creativity the moment calls for, and make a situated navigational move that shifts the session toward a new field of possibility. Within the terms developed in this thesis, creativity within these systems as player(s) of varying sophistication, but they do not yet demonstrate the embodied and relational judgment associated with facilitation. The sandbox, or an equivalent framing structure, is maintained by the human participants. Their capacity to generate, respond, or perform raises a further question: how might a computational

system contribute to the developing direction of a shared creative process? Creativity in Action provides a perspective for investigating this question through attention to responsiveness, embodied interaction, reflection, and the negotiation of emerging possibilities.

World-model research extends this discussion toward the relationship between representations, environments, and action. Ha and Schmidhuber (2018), for example, trained an agent within an environment generated by its learned world model before transferring its policy to the actual environment. Fei-Fei Li's (2025) account of spatial intelligence similarly emphasizes the connection between perception, imagination, and action, proposing world models that support interaction with real and virtual environments. These approaches make the relationship between a system and its surroundings central to the discussion.

I see a point of connection here with RePlay's emphasis on learning through situated activity. However, computational modeling of an environment should not be equated with participants lived bodily experience or their awareness of one another. The relevance to this thesis lies in the questions these developments make available: how could a system respond to a changing creative situation, help participants explore possibilities, and contribute to reconsidering goals or constraints?

The RePlay studies do not establish how AI would perform these roles. They provide a *framework for investigating them, including the relationship between contributing to an activity and facilitating its development*. Within the studies presented here, human facilitation helped establish and sustain the sandbox. How that responsibility might be shared within a hybrid creative ecology remains a question for future research.

For example, future research could distinguish between an AI system offering ideas that human participants develop and an AI system helping facilitate their creative process, for example by prompting reflection, drawing attention to emerging connections, or suggesting a change in direction. *A potentially fruitful area of study indeed…*

9.3.1 Hybrid Creative Ecologies

Alongside the systems discussed above, including OMax (Assayag et al., 2006), Somax/Somax2, ImproteK, and DYCI2 (Szpirglas, 2026), and Suno (Suno, n.d.), Kenneth Newby's computational practice offers another perspective on hybrid creative ecologies. What interests me particularly is the orientation he brings to this practice, discussed in Chapter 3. I understand this orientation through four related qualities: poetic infrastructure, exploratory space, improvisational partner, and epistemological medium. Together, these emphasize knowing through making rather than simply producing predetermined outputs efficiently.

In this orientation, the Geneplore cycle can be understood as extending across the human–machine boundary: the computational system generates musical material that can serve as preinventive structures, which Newby then explores, responds to, and cycles back into the next generative phase (Finke et al., 1992). I use Geneplore here as an interpretive framework for the practice, rather than as evidence that the computational system or even Newby possesses a conscious awareness of the creative process itself. Recurring motifs and evolving structures can become a developing shared vocabulary within the practice through sustained interaction.

The aesthetic responsiveness of this exchange involves Newby's judgment, his musical knowledge, and his responses to computationally generated material. These help shape the emerging direction of the work. The comparison with OMax and related systems therefore draws attention to how computation is incorporated into an ongoing creative practice, rather than establishing that Newby's system is a more genuine partner or that other systems merely mirror their users. What interests me is the relationship through which computational contributions become resources for further exploration and creative development while also developing one's own awareness of the creative process in general, their own unique process and how to trouble shoot when they encounter setbacks or blockages in the creative process. Thus, allowing for creative emergence.

Characteristics that make Newby's work relevant to RePlay are these qualities of poetic infrastructure, exploratory space, the machine as improvisational partner, and epistemological medium. Poetic infrastructure and exploratory space resonate with the *sandbox: the structures and conditions through which creative possibilities can be explored*. The idea of an improvisational partner connects with Creativity in Action by drawing attention to how ideas develop through responses to emerging contributions. Understanding the computational system as an epistemological medium, a medium through which knowledge develops, also raises questions about how making and reflecting can generate knowledge.

These connections suggest a shared concern with creating conditions for exploration, responsiveness, and reflection. However, Newby's computational practice and the embodied collaboration studied through RePlay involve different forms of participation. I therefore use this comparison to identify questions for future research into hybrid creative ecologies:

How might computational systems support a creative mindset, participate in exploratory activity, and contribute to reflection within a shared sandbox?

RePlay provides a perspective from which to investigate these possibilities. Its methods of observation, externalization, and reflection provide a starting point for examining how human participants respond to computational contributions and how these influence the direction of a shared activity.

RePlay contributes a theoretical framework and a research methodology, supported by qualitative empirical studies of creative emergence in human groups. These studies identify conditions through which collaborative creativity can be facilitated and investigated. They also inform questions about the forms of participation that computational systems might contribute to such collaboration. Investigating those possibilities would require further research involving human/AI interaction.

In summary, this research contributes to the study of performance creativity discussed by Sawyer (2012, pp. 348–352). By grounding creativity in embodied process, social interaction, and contextual awareness, the thesis develops Creativity in Action as a theoretical contribution. RePlay provides a methodological and practical framework through which these dimensions of collaborative creativity can be deliberately cultivated, observed, and reflected upon. Together, these contributions explain how creative possibilities can emerge through situated interaction and provide a way to study that emergence while it is happening.

9.4 RePlay and Agentic AI: Potential Future Directions

The emergence of agentic AI systems and large language models raises questions about computational participation in creative processes. Research into human and AI creative collaboration increasingly examines the interaction between human and computational contributions, including communication, turn-taking, and the development of a shared creative product (Rezwana & Maher, 2023). For this thesis, the possibility of AI as collaborator invites consideration of how RePlay might inform research into the hybrid creative ecologies described above.

In *The Society of Mind*, Minsky (1986) explains intelligence through the interaction of many simpler processes, which he calls agents. There is a useful structural analogy with RePlay: participants bring individual creative capacities, while possibilities also develop through their interactions within the constraints of improvisation. However, Minsky's agents are components of a model of mind, whereas RePlay's participants are people engaged in an embodied and social activity. I use this comparison to consider how interaction contributes to creative process, rather than to suggest that the two forms of agency are equivalent.

This distinction raises questions about what computational participation in Creativity in Action might involve. Generating a contribution, responding to sensory information, and maintaining records of an interaction are relevant capabilities, but their presence does not by itself establish the lived awareness of self, others, and context examined in this thesis. Equally, the RePlay studies do not establish that such participation is impossible for computational systems. They provide a framework for investigating the forms of responsiveness, reflection, and interaction involved for designing future collaborative hybrid creative ecologies.

Neuroscientist specializing in consciousness, Anil Seth, Faggin (Physicist and microprocessor pioneer), and Hameroff (Anesthesiologist and Consciousness researcher) and Penrose (Mathematician and Physicist) offer different challenges to the view that consciousness can be explained entirely through conventional computation. Their positions should not be treated as a single explanation. Seth (2024) emphasizes the grounding of consciousness in living, embodied systems, without requiring the quantum mechanism proposed by Orch OR which I will discuss in the next paragraph. Federico Faggin (2024), in *Irreducible*, proposes that consciousness is a fundamental aspect of reality connected to quantum information, rather than something produced solely by brain activity. His position challenges the sufficiency of classical computation as an explanation of consciousness but is not presented here as an established mathematical proof and claim that computational creative awareness is impossible.

Roger Penrose, a mathematician and physicist, and Stuart Hameroff, an anesthesiologist and consciousness researcher, propose a more specific mechanism. Their orchestrated objective reduction theory, known as Orch OR, connects conscious moments with quantum processes and objective reduction within neuronal microtubules (Hameroff & Penrose, 1996, 2014). Research showing that a microtubule-stabilizing drug delayed anesthetic-induced loss of righting reflex in rats is relevant to investigating the role of microtubules in anesthesia (Khan et al., 2024). However, this finding does not by itself demonstrate the quantum mechanism proposed by Orch OR, which remains contested.

These perspectives raise different questions about consciousness, embodiment, and computation. They do not establish that consciousness and creativity are equivalent, or that creative emergence requires a quantum explanation. I bring them into this discussion as resonances and ways to consider what computational accounts might explain about creative participation and what remains unresolved. The embodied and relational processes examined through RePlay provide a context for developing these questions, but the studies do not test or adjudicate between these theories of consciousness.

This comparison is sharpened by AlphaGo's 2016 match against Lee Sedol. In the second game, Move 37 was so unexpected that one expert commentator initially described it as a mistake; its strategic value became apparent as the game developed (Metz, 2016). It was an extraordinary computational achievement. Using Boden's (1998) distinction, I interpret it primarily as exploratory creativity within the possibilities of Go, with potentially transformational implications for human understanding of strategy. A conceptual space includes assumptions about what constitutes a promising move, not simply the game's formal rules. Move 37 challenged those assumptions, although this does not establish that AlphaGo transformed its own generative constraints.

The kind of creativity that emerges in a RePlay session may involve another dimension: an offer that recontextualizes the shared situation, changes the social and material field of action, and

develops through responses that may not be fully attributable to any one participant's prior intention. I use the phrase *the thing that arrives* to emphasize this experience of creative emergence: a possibility taking form through unfolding interaction, rather than being fully specified in advance. This description does not establish that the process lies beyond computation.

The distinction therefore concerns how creative contributions develop and are taken up within a shared activity. Move 37 demonstrates that computational systems can generate unexpected and valuable contributions (Metz, 2016). RePlay directs attention to how participants notice, interpret, and develop emerging possibilities through embodied, relational, and reflective activity. What I call the *unrepeatable offer* names a contribution whose meaning develops through a particular unfolding situation. Whether and how computational systems might participate in these dimensions of Creativity in Action remains an open research question.

This situated understanding also connects with the earlier discussion of Joas and Bourdieu. Joas (1996) foregrounds the creativity of action as it develops in response to situations. Bourdieu's (1977) concept of *habitus* draws attention to the dispositions formed through social experience that shape perception and practice. These ideas help me distinguish access to contextual information from participation in a socially and historically situated practice. An AI system's access to conversational context or stored information should not automatically be equated with the embodied histories and practical dispositions that human participants bring to RePlay. For future research into hybrid creative ecologies, the question is how different forms of memory, contextual responsiveness, and participation might interact within a shared creative process.

9.4.1 Neural Entrainment and the Limits of Human–AI Creative Collaboration

Asking what human creative collaboration might contribute that current agentic AI does not requires moving beyond architectural description toward an account of what may happen physically when a group of humans enters collective creative flow. Two bodies of research are relevant here one well established, one more speculative and both provide hints towards possible future exploration. I have turned to neuroscientific creativity literature on the physical and relational dimensions of creative activity. I read this work alongside the experiences documented through RePlay, looking for conceptual resonances rather than a neural explanation of the studies. Research on interpersonal neural coordination offers one perspective; some of the more speculative literature considered subsequently opens a more experimental set of questions.

The first is neural entrainment. Research across the last two decades has shown that when humans engage in sustained collaborative activity conversation, music-making, narrative, collective problem-solving their neural oscillations synchronize across individuals in ways that are measurable through multi-participant EEG (Hasson et al., 2012). This synchronization is a measurable physical phenomenon, not only a metaphor for felt connection. Some studies report coordination in frequency bands that have also been associated with creative insight and improvisation, although

findings vary by task and method (see Section 8.2). What participants in a RePlay session at its most generative described phenomenologically was a loss of self-consciousness, the heightened energy, the sense of thinking together rather than alongside each other. In essence, these are what Sawyer, Kotler and others have described as flow states. TAPT data from the Tiree Tech Wave documented participants' experience of these moments; whether they correspond to measurable interpersonal neural coordination is a question that multi-participant neuroimaging could, in principle, address in future studies.

Current agentic AI systems do not possess biological neural oscillations or theta rhythms and therefore cannot participate in interpersonal neural entrainment in the same biological form documented between human collaborators. A human may become rhythmically and attentively attuned to an interaction with an AI system, but the cross-brain synchrony measured in human groups does not currently extend across the human to AI boundary as biological neural synchronization. This does not imply that the human is socially or cognitively unaffected by the exchange, nor that computational systems lack temporal dynamics of their own. It means more narrowly that one neurobiological mechanism associated with human co-presence is absent from present human AI collaboration. The consequences of that difference for creative interaction remain an open opportunity for empirical questioning.

9.4.2 An Original Conjecture: Superradiance and Collective Creative Flow

The second body of research is substantially more speculative and leads to what I propose here as an original conjecture for possible future investigation. Physicist Mari Jibu and neuroscientist Kunio Yasue, working in a tradition related to that developed by Penrose and Hameroff, proposed that quantum coherence within water molecules surrounding neuronal microtubules might produce super radiant emission: a collective quantum optical event in which multiple processes emit coherently rather than independently (Jibu and Yasue, 1995). Superradiance, first described by physicist Robert Dicke (1954), refers to circumstances in which a sufficiently dense population of quantum systems sharing a common state emits collectively, producing an output more intense than the sum of independent emissions. The application of this concept to neural processes remains contested and has not been established by the present research. I introduce it only as a conceptual analogy and a possible hypothesis-generating framework for thinking about collective coordination and how that might come across in the architecture and design of such a system. This could perhaps form part of future neurophenomenological research study utilizing RePlay.

I therefore propose, explicitly as a speculative conjecture rather than an established finding, that future research might examine whether the neural entrainment documented between human collaborators during collective creative activity has any relationship to quantum-coherent processes analogous to the super radiant effects discussed by Jibu and Yasue (1995). At present, there is no empirical basis in this thesis for claiming that group flow is quantum physically irreducible to

individual states. The value of the conjecture lies in formulating a possible question for future multi-participant neurophenomenological research, not in offering a causal explanation of the findings reported here. Any investigation would require methods capable of distinguishing ordinary neural synchrony, interpersonal coordination, and genuinely quantum effects.

The implications however would be significant, if such a relationship were ever demonstrated. An agentic AI system can already observe and respond to outputs associated with collective creative activity, contribute generatively, and operate within complex pattern spaces. The question raised here is whether participation in the embodied event itself requires forms of biological or physical coupling not present in current systems. This remains speculative.

If the conjectured relationship between biological substrate and collective creative experience were supported, it could raise a further question about the sense in which an AI system participates in such an event. A system might contribute to the interaction without sharing the biological processes of human participants. I raise this as a philosophical possibility within the conjecture, rather than as a demonstrated or permanent limit on computational participation.

Within this speculative account, I imagine a membrane between computational participation and the embodied experience of the human ensemble. The membrane is my metaphor for a possible difference in participation, prompted by my reading of Penrose; its existence and significance remain questions for inquiry.

9.4.3 Hallucination, Grounding, and the Limits of Unanchored Generativity

The tendency of large language models to hallucinate and to generate outputs that are fluent, confident, and factually false is conventionally explained in statistical terms. LLMs predict the most probable next token given the preceding context, based on patterns learned from training data. When the model operates in a region of high uncertainty or encounters a query outside its training distribution, it continues generating plausible-sounding tokens because that is all it can do. It has no mechanism for knowing when it does not know. Fluency and accuracy are entirely separate properties of the system, and the model cannot feel the difference between a correct output and a statistically probable but false one.

This explanation is well established and technically accurate. The framework developed in this thesis prompts a further, more speculative question: whether hallucination might be connected to the absence of the embodied and social grounding through which human cognition is continually corrected. On this reading, hallucination would be less a bug to be removed than a tendency to be managed. What if it is the natural behavior of a generative system that lacks the layered

anchoring mechanisms through which human cognition remains tethered to reality meaning our embodied knowing?

What might embodied and social approaches to cognition help us understand about the relationship between generativity and accountability to a situation? I am interested in whether the layered feedback available through bodies, materials, and other people offers a useful way of thinking about this problem. The possible relevance of quantum processes belongs to a separate conjectural layer of the discussion. These connections extend my interpretation of creative participation rather than establish a causal explanation of hallucination.

Human cognition is grounded at multiple levels simultaneously. At the perceptual level, the body provides continuous feedback from the environment. Enactive perception, in Noë's (2004) account, is not a passive reception of information but an active loop of prediction and correction: we reach for the cup, our hand meets resistance or does not, and physical consequence corrects perceptual error before it can propagate. At the social level, neural entrainment provides a second layer of grounding. When two people are in genuine conversation their neural oscillations synchronize (Hasson et al., 2012), and this synchrony may contribute to a continuous process of mutual correction. If one person says something that does not match the other's model of reality, the divergence is perceptible through micro-expressions, hesitation, tone, and posture. There are embodied signals that propagate back into the conversation and trigger correction before the error can calcify into confident false output. At the deepest level, and here the argument enters the contested territory of Penrose and Hameroff's Orch OR framework, if conscious moments involve quantum coherent processes anchored in the physical geometry of spacetime, then human cognition would have a further form of grounding that statistical computation lacks; this remains highly contested.

Current agentic AI systems are also grounded differently from humans. Currently, they do not possess a living body that receives continuous sensorimotor feedback, and tokens do not push back in the same way that physical materials and environments do. They do not, yet participate in biological neural entrainment, so the embodied social feedback that operates between human interlocutors cannot propagate across the human-AI boundary in the same form. If theories such as Penrose and Hameroff's were ultimately supported, a further difference in physical substrate might also become relevant; however, this remains highly contested. The established point is narrower: language models generate through statistical and computational processes and therefore require external mechanisms for factual and environmental grounding. In this sense, confabulation can be understood as a predictable risk of generative systems whose fluent outputs are not automatically constrained by embodied contact with the world.

I propose here a conceptual connection, while keeping its different evidentiary levels explicit. AI hallucination and the present limitations of computational improvisation may both be examined

through the broader problem of grounding. Human improvisers are grounded in bodies, materials, the social field of the ensemble, and the physical reality of the room. These sources of feedback continually constrain and redirect what becomes possible without Communitas (Turner, 1969). Current language models do not possess an equivalent first-person embodied anchor, although they can be connected to tools, sensors, retrieval systems, and human feedback. They can produce something that resembles an unrepeatable offer, but they do not independently know whether an output is factually grounded or confabulated. The possible relevance of quantum physical processes is a separate and speculative layer of this argument and should not be treated as an established explanation of hallucination.

The more defensible concept is that embodied, social, and environmental grounding provide forms of correction and accountability that current generative systems do not possess autonomously.

Perhaps this relates back to Turner' s (1969) description of communitas: a state of togetherness that arises when individuals enter a liminal space, temporarily freed from the social roles, hierarchies, and conventions that normally govern their interactions. AI has no social context. It's not part of society as whole.

This connection has implications that might extend beyond the technical question of how to reduce hallucination in AI systems. It suggests that the forms of grounding through which human cognition remains tethered to reality, embodiment and social coordination, may be central rather than peripheral features of human intelligence. They may also help explain why human creative contributions can be trusted in ways that current AI outputs cannot yet be: not merely because they are surprising or novel, but because they are anchored in embodied and social contact with a situation.

RePlay, as a methodology, is designed to cultivate these forms of grounding: to bring participants into fuller embodied presence, closer social attunement, and perhaps greater collective lability. Neuroscience literature offers an interpretive lens through which I consider these qualities, while the studies document them through qualitative observation and participants' accounts. RePlay therefore provides both a framework for facilitating creativity and a way to attend to the embodied and relational conditions that matter as generative systems are becoming more part of creative practice.

It is not only a framework for facilitating creativity. It may also help sustain, as generative systems become more capable, the embodied and relational conditions on which trustworthy human creative judgment depends.

The framework developed in this thesis is grounded in embodied, performative, and relational creativity, and foregrounds improvisation, interaction, and co-presence as central to the creative

act. It draws attention to qualities that current agentic systems may lack. RePlay also provides a framework for studying, and perhaps developing, a hybrid ecology in partnership with an agentic counterpart.

9.4.4 Design Implications for Human–AI Creative Systems

Read together, the literature on neural entrainment, the philosophical questions raised by Orch OR, and my interpretation of RePlay suggest three design considerations for human–AI creative collaboration. These sources contribute at different levels: the considerations below are proposals informed by interdisciplinary surveying, rather than deductions from a single established account of creativity.

I. The first concerns preparation. Based on what I observed and what is reflected by Yes And in improvisational theatre, the human side of a human–AI creative collaboration may need to be in a state of sufficient lability for the collaboration to be most generative. Whether this corresponds to measurable reductions in prefrontal inhibition or to collective neural entrainment would need to be established empirically.

   Preparing participants relationally for that state may be as important as designing the AI system itself. RePlay, or something structurally similar, would then be not an alternative to human–AI creative collaboration but a preparation for it: a methodology for creating the relational conditions that support creative emergence on the human side of the exchange before the AI enters the process.

II. The second concerns interface design. Current human AI creative interfaces are almost entirely linguistic and sequential they generate, respond, evaluate, generate again. This rhythm may sit uneasily with what has been described about flow states, because it foregrounds the evaluative, self-monitoring mode that accounts of transient hypofrontality associate with reduced flow. A genuinely creativity-oriented human/AI interface would need to be embodied, rhythmic, and fast enough that evaluation cannot keep pace with generation. It would need to feel more like improvisation and less like editing. Whether such an interface is achievable within current AI architectures is an open question. Whether it is desirable is an ethical question, and what it would mean to design it responsibly is a question that the humanities, and frameworks like RePlay, would be well positioned to research.

III. The third implication is perhaps the most fundamental. As agentic AI systems become more sophisticated and more deeply embedded in creative processes, the risk is not that AI will replace human creativity. Whether creative emergence at its deepest level involves processes that classical systems cannot replicate remains an open question. The more immediate risk is subtler: that as AI becomes more capable at the heuristic layer of

creativity, the pressure to reduce creative collaboration to that layer increases, and the conditions that make deeper creative emergence possible such as embodiment, presence, lability, collective synchrony, the protected openness of the sandbox are gradually engineered away in the name of efficiency. RePlay offers, among other things, a way of resisting that reduction by keeping these human conditions of creativity in view.

9.4.5 RePlay and Neurotechnology

Alongside these philosophical questions, a parallel set of developments in neurotechnology is bringing the neuroscience of creativity out of the laboratory and into applied contexts. The work of Balder Onarheim and his colleagues at PlatoScience represents one such development. Their Applied NeuroCreativity (ANC) program reported that incorporating neuroscience principles into creativity training could increase divergent thinking skills by an average of 28.5% over eight weeks (Onarheim and Friis-Olivarius, 2013) offering empirical support for the idea that creative cognition can be deliberately cultivated. PlatoScience's subsequent development of the PlatoWork and PlatoCare tDCS devices has extended this work into clinical contexts, with regulatory approval for depression treatment in the EU and UK. Transcranial direct current stimulation modulates cortical excitability, and some protocols aim to reduce prefrontal inhibitory control in ways that invite comparison with the transient hypofrontality Dietrich (2004b) associates with flow. In this sense, tDCS and RePlay can be seen as approaching related states from opposite directions: tDCS through direct neural modulation, RePlay through embodied social improvisation.

However, recent neuroimaging research suggests that the neural target may be more complex than single site tDCS protocols currently address. Barnett and Vasiu (2026), synthesizing nine neuroimaging studies, propose that flow-related creativity may depend less on activation of any single brain region than on coordinated DMN-ECN network interaction a distributed pattern of connectivity that single-site stimulation may not reliably produce. This finding points toward both a limitation of current neurotechnology and a potential strength of RePlay: if flow requires network-level coordination rather than regional activation, then a social technology that facilitates collective embodied interaction may offer a complementary route to such states, a possibility that would need to be tested directly.

The work of Rodrigo Montenegro and Gamma Wave Technologies offers another point of comparison through its interest in sleep and neurotechnology. The proposed use of C-Rebro to engage with sleep-related processes brings incubation and threshold experiences into this discussion. I read this alongside Lopata et al.'s (2017) research on musical improvisation, as a different context in which neural activity and creative practice are considered. These strands prompt questions about associative thinking, evaluation, and the changing conditions of creative experience. They need not indicate a single neural signature shared by sleep, improvisation, and

RePlay, and their relationship with accounts of hypofrontality may be more nuanced than a direct equivalence would suggest.

The possibility of combining pre-session sleep enhancement via C-Rebro with in-session EEG monitoring using devices such as the Emotiv EPOC X represents a genuinely novel research direction: measuring the collective neural dynamics of a RePlay session in real time and correlating them with TAPT phenomenological data and Dienes's (2012) SWASH suggestibility baseline measurements. This multi-level measurement framework neurological, phenomenological, and psychophysiological simultaneously would allow testing empirically the central hunches of this thesis: *that RePlay may produce the conditions for collective creative emergence through social and embodied means*.

9.4.6 Critical Perspectives: The Humanities at the Centre of Creativity and AI

These developments in neurotechnology and AI are not unambiguously positive, and the humanities have an essential role in interrogating them. Caroline Bassett's *Anti-Computing* (2022) offers a crucial counterpoint to the enthusiasm that tends to surround new computational paradigms. Bassett argues that the history of computing is also a history of what gets excluded, suppressed, or rendered invisible by computational logics and that the humanities offer not merely a supplement to technical research but an alternative epistemological standpoint from which to ask different questions altogether. RePlay, as a framework grounded in embodied practice, phenomenological inquiry, and collective human experience, embodies precisely this alternative standpoint. It asks not what computational systems can do but what human creative capacities consist of and in doing so, it provides a necessary foundation for any serious attempt to understand what it would mean for an AI to participate in those capacities.

Artists and performers have already working at the frontier of human and computer creative collaboration such as composer Newby, by developing a sandbox for exploring computer assisted music composition and live coders such as Thor Magnusson, whose work embeds computational systems within improvised musical performance; and choreographers such as Kate Sicchio, whose practice explores the intersection of dance and algorithmic systems are generating knowledge about human and Computer creative interaction.

These practices are generating knowledge about human–AI creative interaction that neither neuroscience nor philosophy can currently produce on its own.

RePlay as a framework for facilitating and analyzing collective embodied creativity with computer and agentic systems, is unusually well positioned to engage with these practices as research contexts using the methodology developed in this thesis to study what emerges when human improvisational creativity and machine generativity and AI operate together in real time.

Below is a table which provides a survey to what is currently being considered in the field of human and AI creative collaboration using improvisation. Some of which crossing disciplinary lines with math, architecture, design and music. This table was created in collaboration with Chat GPT to survey the state of the art of the field at the time of writing this chapter.

Table 9.1
Selected Sources on Improvisation, Embodiment and Human–AI Co-Creation

Theme	Citation	Summary	Link
Embodied Design Thinking	Abrahamson, D. (2020). *The Future of Embodied Design for Mathematics Teaching and Learning. Frontiers in Education.*	Discusses frameworks for enhancing mathematics teaching through embodied design.	Link
	Abrahamson, D. (2025). *Designing for Embodied Sense-making of Mathematics. ACM.*	Explores the role of bodily actions in designing embodied learning activities.	Link
Improvisation in Design	LeWarne, M. (2020). *Repurposing Architecting Skills: Design as Improvisation. Medium.*	Discusses improvisational strategies in architectural design practice.	Link
	Mortensen, J. (2025). *Improvisation Lecture 2025. YouTube.*	Keynote lecture on improvisation techniques applicable across disciplines.	Link
Group Flow & Creativity	Robson, D. (2024). *The Flow State: The Science of the Elusive Creative Mindset. The Guardian.*	Explores the psychological aspects of achieving flow states in creative activities.	Link
	Diamandis, P. (2022). *10x Your Team's Creativity & Productivity. Medium.*	Discusses triggers and benefits of achieving group flow in team settings.	Link
AI & Co-Creation	Vartiainen, H., Liukkonen, P., & Tedre, M. (2025). *Exploring the Collaborative Co-Creation Process with AI. arXiv.*	Investigates human-technology relationships in co-design processes with generative AI.	Link
	Cramerotti, A., & Scalera, A. (2025). *Artificial Intelligence as Co-Creator: Rethinking Art and Authorship. Observer.*	Discusses AI's role in contemporary art and challenges to traditional notions of authorship.	Link
Neuroscience of Creativity	Frontiers in Computational Neuroscience. (2025). *Exploring the Neural Basis of Creativity: EEG Analysis.*	Analyzes brain activity during creative tasks using EEG in children.	Link

Frontiers in Behavioral Neuroscience. (2024). *EEG-Based Study of Design Creativity: A Review*.	Reviews concepts of creativity and explores brain dynamics associated with design tasks.	Link

9.5 The RePlay Creativity Companion: A Practical Extension

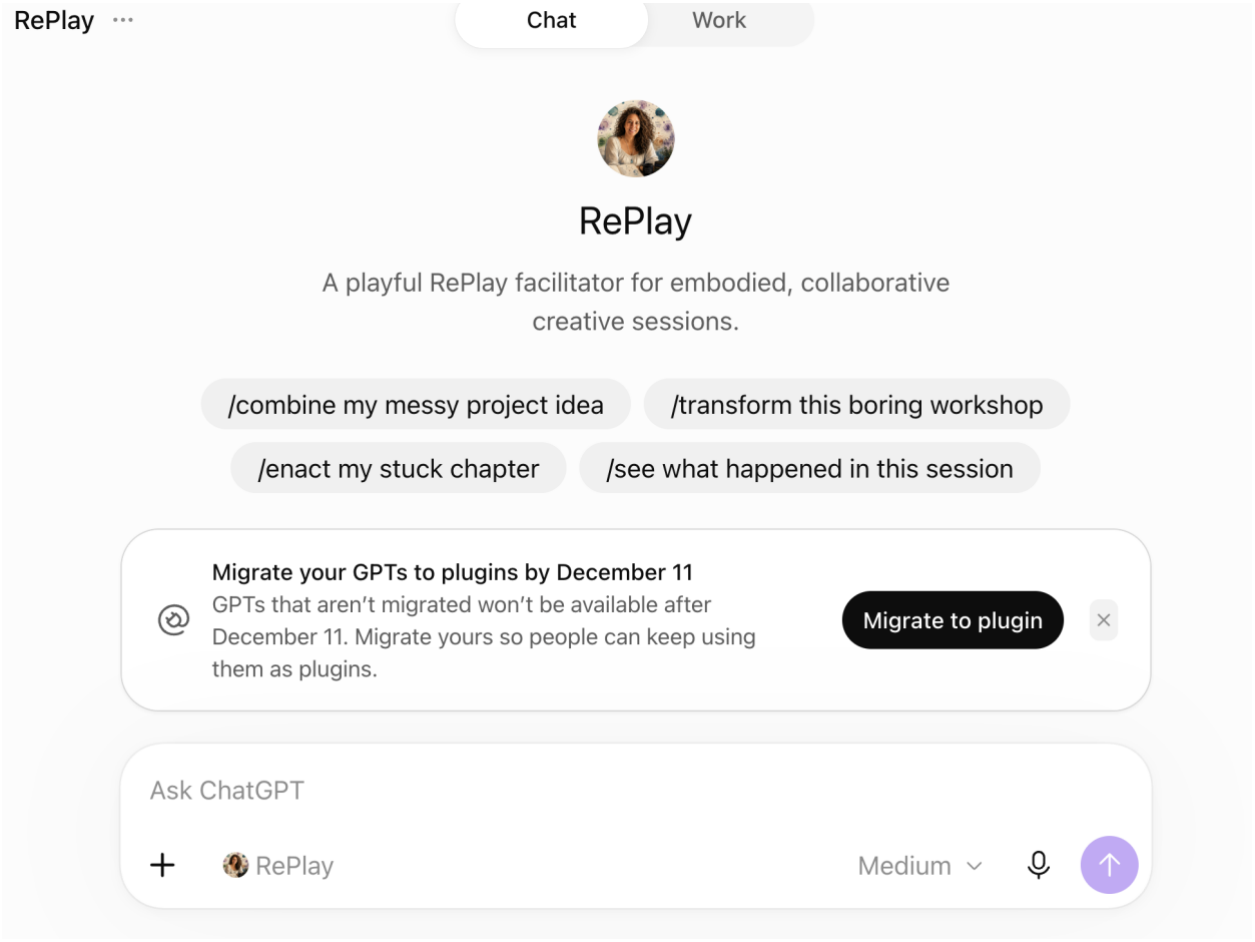
As a practical extension of this inquiry, near the end of my writing process, I developed a custom GPT called the *RePlay Creativity Companion*, configured through instructions that translate principles of RePlay into conversational activities. I designed it as a player-facilitator: it contributes creative offers while guiding the user through Yes And exchanges, trigger objects, Bad Ideas, reframing, role-play, and design mapping. Its purpose is to encourage awareness of how possibilities emerge through interaction, rather than focusing only on producing ideas. The instructions separate playful exploration from explicit moments of reflection and invite physical externalization through sketching, movement, objects, and spoken enactment. Although the GPT has no body, it can prompt users to bring their bodies, materials, and surroundings into the activity. The user remains the creator, while the system contributes prompts, responses, and opportunities to reconsider the developing process. I present the Companion as an exploratory application of the framework, rather than a finding established by the formal studies. It provides a practical starting point for investigating how AI might participate in facilitating creative activity and supporting human Creativity in Action. Below is a portrait that Chat GPT created of what this companion might look like. It surprisingly resembles the author.

Figure 9.1
Portrait of the RePlay Creativity Companion



Note. Made by the author using ChatGPT.

Figure 9.2
Screenshot of the Author's RePlay GPT in ChatGPT



Note. Screenshot by the author.

During the final revision of this thesis, developments in OpenAI's platform introduced further possibilities for extending the RePlay Creativity Companion. OpenAI's documentation describes moving custom GPT workflows into plugins: reusable packages that can combine skills, reference materials, and connections to external tools. Skills provide instructions for carrying out activities, while connected tools can provide access to information or supported actions. OpenAI identifies this migration explicitly in its guidance for ChatGPT Enterprise (OpenAI, n.d.).

For RePlay, this creates a possible route from a conversational Companion toward a reusable facilitation resource. Its instructions could be organized into skills for improvisational exploration, embodied externalization, design mapping, and reflection. Where appropriate, connected tools might support the recording of creative materials and the production of reflective session maps. These are possibilities for further development, rather than capabilities I have implemented or evaluated in the studies presented here. The significance lies in the opportunity to investigate how a computational participant might contribute to both creative activity and its facilitation, while

preserving the participant's agency and RePlay's emphasis on exploration rather than productivity alone.

9.6 Bendables Developing a Working Prototype with AI Support

Bendables offers a further practical direction for this research. The co-design workshops, material explorations, early 3D models, and LED Toys business proposal described in Chapter 7 formed part of the original thesis research. My more recent return to Bendables considers how AI might support the continued development of that concept toward a working physical prototype. This extends the original design work while creating an opportunity to examine human AI creative collaboration through a material project. The first step in this return to the project was visual exploration. The following account and images document that later development of the concept.

During the revision of this thesis, I experimented with AI-assisted visualization tools used to further develop the visual concept of Bendables, producing a more refined set of prototype sketches that build on the original 3D models. These images are presented not as research outputs of the original study but as a speculative development of the concept, illustrating the continued relevance and potential of Bendables more than a decade after the original research was conducted.

Figure 9.3
AI-Assisted Visualization of Bendables 1



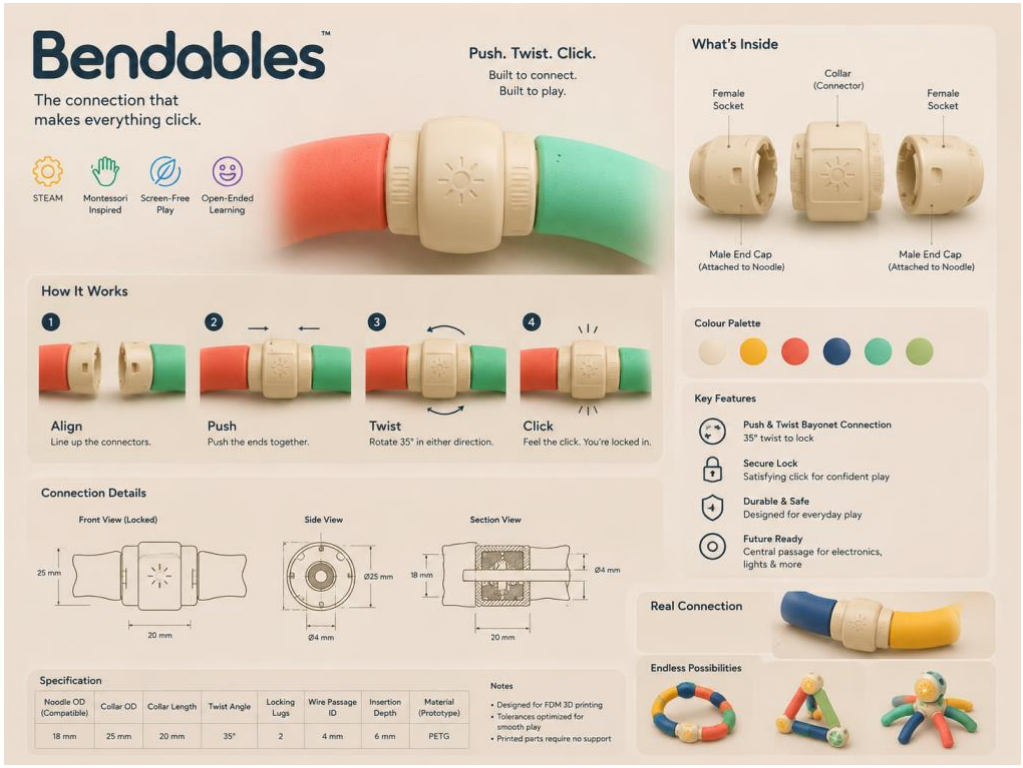
Note. Made by the author using ChatGPT.

Figure 9.4
AI-Assisted Visualization of Bendables 2



Note. Made by the author using ChatGPT.

Figure 9.5
AI-Assisted Visualization of Bendables Connections



Note. Made by the author using ChatGPT.

The next direction is to move from visual representations toward a prototype whose physical and electronic behavior can be explored and user tested. AI support could be investigated across this

process, including the development of 3D models, consideration of component connections and circuitry, and the interpretation of problems encountered during fabrication and testing. These are proposed uses to explore; the images above document visual development rather than a tested working prototype.

For RePlay, the interest lies in how the design develops through exchanges between the designer, computational contributions, and physical materials. A digital proposal may suggest a possibility, while making and testing can reveal constraints that require it to be reconsidered. Documenting these exchanges could provide a practical setting for examining how AI contributes to exploration, externalization, and reflection, and how the designer evaluates and transforms its contributions. The move toward a working Bendables prototype would therefore extend the project while providing a context for future design research into hybrid creative ecologies.

9.7 Limits of the Claims and Scope of Interpretation

The claims made in this discussion should be understood within the scope of a qualitative, practice-based, and exploratory arts/design-based research. The case studies demonstrated that RePlay could facilitate and reveal patterns of embodied collaborative creativity across different contexts, but they do not establish universal causal claims about creativity, flow, suggestibility, or neural synchrony. The thesis therefore treats RePlay as a methodological and theoretical contribution rather than as a standardized intervention whose effects have been quantitatively measured.

The neuroscience literature has contributed to the interpretive development of this research, providing concepts and language through which I have considered qualitative observations of embodied, reflective, and collaborative creative activity. This interdisciplinary engagement is part of the thesis's argument, alongside the development and application of RePlay and the articulation of Creativity in Action. The chapter also develops further propositions concerning neurotechnology, agentic AI, and hybrid creative ecologies. Interpretive resonances, philosophical conjectures, and proposals for subsequent studies have different roles within that argument; they should be read in those terms rather than as reports of neural mechanisms measured through RePlay.

9.8 Future Directions: Summary

The research agenda that emerges from this thesis points in several interconnected directions. Empirically, an important next question is whether RePlay is consistently associated with behavioural, experiential, and physiological patterns linked to collective openness and flow, and whether these could be examined through a multi-level framework combining multi-participant EEG, TAPT phenomenological data, and Dienes's (2012) SWASH suggestibility baseline measurements. This would test associations rather than presume that RePlay produces a specific neural state. The conjecture that collective creative flow might involve quantum-coherent processes

should be treated as a much longer-term and highly speculative horizon. It could not be investigated responsibly without validated theoretical foundations and measurement methods capable of distinguishing quantum effects from established forms of neural and interpersonal synchrony.

Theoretically, the concept of hybrid creative ecologies requires further development both in relation to existing posthuman and new materialist frameworks, and in relation to the emerging literature on agentic AI and collective intelligence. The question of whether creative insight and understanding involve processes that are not fully computable, raised here through the work of Seth, Faggin, Penrose and Hameroff, deserves sustained philosophical development beyond what this thesis has been able to offer.

Practically, the RePlay framework itself requires continued development as a facilitation methodology, a training program, and potentially a digital platform that scales its core principles beyond the contexts in which it has so far been tested. The present thesis provides theoretical foundations, a methodological approach, and qualitative evidence from which these directions can proceed. Its studies indicate that improvisational creativity can be facilitated, studied, and adapted across very different design, educational, and community contexts. It has introduced Creativity in Action as an original theoretical contribution that addresses a gap in the existing literature. It has positioned the sandbox as a condition for creative emergence rather than a luxury. It has connected these contributions to the most urgent contemporary conversations in neuroscience, AI research, and posthuman theory. And it has proposed, as an explicitly speculative conjecture, a long-term question about whether collective creative flow has any relationship to quantum-coherent processes.

9.9 Chapter Conclusion

This chapter has carried the argument of the thesis forward into the computational and speculative horizons now opening around creative practice. It has surveyed what current AI and improvisational systems can and cannot do, proposed how RePlay and Creativity in Action might frame the study and design of hybrid creative ecologies, and set out a research agenda spanning neural entrainment, suggestibility, neurotechnology, and a longer-term conjecture concerning collective creative flow, alongside the RePlay Creativity Companion as a first practical experiment. These are directions for future inquiry; the contributions established by the present studies, and the conclusions drawn from them, are summarized in the chapter that follows.

Chapter 10: Conclusion

"…combinatory play seems to be the essential feature in productive thought…"

— Albert Einstein, letter to Jacques Hadamard

10.1 Returning to the Research Problem

This thesis began from a problem that is both theoretical and methodological. As Chapter 1 argued, creativity research has moved from individual, cognitive, and product-oriented accounts toward systemic, embodied, relational, and situated understandings of creative process, yet it still has few ways of studying collaborative creativity while it is unfolding. Many models explain creativity retrospectively, through finished outputs, individual capacities, or abstract stages. They do not fully account for the moment-to-moment dynamics through which people create together: movement, gesture, affect, timing, improvisation, shared attention, and co-presence. Two guiding questions followed from this gap. How can collaborative creativity be studied while it is happening? And how can researchers attend to its tacit, embodied, improvisational, and affective dimensions without reducing them to individual cognition or final products?

My response was to develop RePlay, a framework that adapts the principles of improvisational theatre into a structured yet open sandbox for facilitating and studying collaborative creativity, and, through that work, the concept of Creativity in Action. RePlay was developed iteratively: first through exploratory research with improvisers in Lancaster, with design practitioners at Philips Design, and through the Sims trace study (Chapter 5), and then through three applied case studies (Chapter 7). These were conducted with design and technology researchers at Tiree Tech Wave, with children and community members in the Kabadkhana neighborhood of Bhopal through Global Studio, and with young makers in Ottawa through the Bendables project with Maker Junior. Across these settings RePlay served two purposes at once. It created conditions in which collaborative creativity could happen, and it made that creativity visible enough to be documented, reflected upon, and studied.

This chapter returns to the three research questions set out in Section 4.1, states the original contributions of the thesis, sets out the limits of its claims, and summarizes the directions for future work developed in Chapter 9.

10.2 Answering the Research Questions

10.2.1 RQ1: A Transferable Framework for Improvisational Creativity

The first question asked whether it is possible to create a framework for facilitating the qualities of improvisational creativity that make it useful for design process, and whether such a framework could be implementable and transferable. The case studies indicate that it is. RePlay was implemented in three substantially different contexts: an HCI and design research gathering on Tiree, a participatory urban design project in Bhopal, and a maker education setting in Ottawa. The specific games, materials, and forms of documentation changed in each setting, and each iteration added new games, facilitation strategies, and data collection techniques. The underlying structure remained consistent: improvisation, externalization, reflection, and facilitation, organized within a sandbox of playful constraint and shared attention.

What made this transfer possible is that RePlay operates as a set of conditions rather than a fixed protocol. Its transferability rests on the sandbox: a structured yet open environment that can hold diverse participants, purposes, and constraints without becoming arbitrary. This is also why the thesis distinguishes between RePlay as a tool (specific games and exercises), a method (a way of structuring workshops and design activities), a framework (a creative sandbox for externalization, reflection, embodied action, and relational emergence), and a methodology (a way of generating data about collaborative creativity as it unfolds). The answer to RQ1 is therefore not that a single workshop format worked in three places, but that a framework grounded in improvisational principles could be adapted to each context while preserving its essential character.

10.2.2 RQ2: What RePlay Adds to Our Understanding of Collaborative Creativity

The second question asked how this work enriches existing understandings of creativity, and of collaborative creativity in particular. The central finding is that collaborative creativity is not only cognitive or verbal. Across the studies it appeared as relational, embodied, affective, and materially supported. Ideas developed through participants' responses to one another's offers, gestures, drawings, objects, and materials, and through breakdown and recovery as much as through smooth absorption. A Tiree participant described "letting go of self-consciousness whilst having fun and understanding other people's views on the issues." Children in Kabadkhana enacted and mapped their priorities for a local site. In Bendables, Maker 11 traced her idea for a toy-car circuit to seeing a researcher bend their arms during the Design Machines exercise. Each of these accounts shows an idea taking shape through interaction rather than being carried, fully formed, by any one person.

Three further understandings follow. First, stage models of creative process from Wallas (1926) onward, in which creativity is largely sequential and internal, are insufficient to describe what happened in RePlay sessions. Reflection did not behave as a single stage. Its value depended on

its timing and form. In the Lancaster pilot, explicit verbal reflection introduced during an improvisation interrupted its momentum, while reflection afterward, or at the right moment and in the right form during an activity, helped participants articulate and develop their ideas. This is the basis of the updated model of creative process presented in Chapter 8.

Second, individual models of creative cognition, such as the Geneplore model of Finke, Ward and Smith (1992) and Boden's (2004) account of combinatorial, exploratory, and transformational creativity, describe valuable aspects of what RePlay produced, but they do not account for creativity that is genuinely collective. Sawyer's (2000, 2012) account of collaborative emergence, in which group interaction generates possibilities that were not present in any single mind, describes this social level more closely, and it is this level that RePlay is designed to facilitate. Within it, the thesis distinguishes between heuristic competence, the expert retrieval of learned responses to familiar patterns, and creative arrival: recognizing that a moment calls for something no learned pattern can supply and responding to it.

Third, group flow is an important dimension of collaborative creativity, but not the whole of it. Participants' TAPT accounts at Tiree described time distortion, loss of self-consciousness, heightened energy, and spontaneous insight, which closely resemble descriptions of flow and group flow (Csikszentmihalyi, 2008; Sawyer, 2000). RePlay did not guarantee these experiences, but it appeared to create conditions in which participants reported them. Creativity in Action, the concept developed to name what RePlay cultivates, includes such moments of absorption alongside hesitation, negotiation, reflection, and changes in direction.

10.2.3 RQ3: What Embodied Externalization Contributes

The third question asked what distinguishes the embodied, physical externalization of ideas in improvisation from more internal or representational methods such as drawing or writing. The answer developed in this thesis is that the difference lies less in modality than in the kind of perceptual access each provides. Drawing and writing are powerful ways of externalizing ideas that have already begun to take form; they tend to work from the inside out. Bodily enactment works in both directions at once. Drawing on Noë's (2004) account of enactive perception and Gibson's (1979) ecological approach to perception, the thesis argues that the body does not only express what is already known; it can discover what is not yet known by doing. When participants used their bodies to enact data flow diagrams at Tiree or became machines in the Design Machines exercise in Ottawa, the situation offered what Schön (1992) calls back-talk: unanticipated responses that opened new directions for inquiry. Because improvisation asks participants to act before they evaluate, it also gives ideas a physical form before the evaluative mind can veto them, a process Dix et al. (2005), drawing on Libet (1999), describe in terms of the pre-noetic.

The case studies also qualify this answer. Embodied enactment did not replace drawing, mapping, writing, or prototyping; it worked alongside them. In Global Studio, children's tableaus and their

paper maps of an ideal community together communicated priorities, such as gardens, play spaces, and clean water, that interview-based methods struggled to reach across differences of language, age, and power. In Bendables, children moved between gestures, drawings, circuits, and prototypes, and some attributed more importance to conversations or materials than to the RePlay exercises themselves. What embodied externalization contributes, then, is an additional and distinctive route into tacit, situated, and relational knowledge, one that is most valuable when combined with graphic, written, and material forms of representation.

10.3 Original Contributions

This thesis makes the following contributions to creativity research, design research, and human-computer interaction. The first three are primarily theoretical; the last two are primarily methodological and practical.

10.3.1 Creativity in Action

The central theoretical contribution is Creativity in Action: an embodied, relational, and improvisational form of creativity that unfolds in real time through responsiveness, co-presence, attunement, and situated action, together with the capacity, developed through practice, to remain aware of one's own creative activity, of other participants, and of the spatial, social, and contextual factors that shape how ideas emerge. Chapter 6 set out its component capacities: improvisational fluency, presence, co-presence, attunement, suggestibility, externalization, and reflection-in-action. RePlay provides the methodological frame; Creativity in Action provides the theoretical vocabulary for interpreting what unfolds within it.

Creativity in Action builds on Schön's (1992) knowing-in-action and reflection-in-action but is not reducible to either. It departs from Schön's account in five ways:

i. It is trainable rather than exclusively the province of expert practitioners.

ii. It is collective as well as individual, distributed across the group and the wider creative ecology.

iii. It is grounded in enactive perception in the phenomenological sense articulated by Varela et al. (1991) and Noë (2004).

iv. It reaches into the pre-noetic dimension that improvisation surfaces before the evaluative mind intervenes.

v. It is generative rather than primarily corrective: its aim is to open new possibilities rather than to repair what has gone wrong.

Creativity in Action is also distinct from flow. Flow describes an experiential state of absorption; Creativity in Action concerns how participants remain responsive within an unfolding creative process, including noticing an emerging possibility, reconsidering a choice, or changing direction at an impasse. Flow may sometimes accompany it, but it is neither a requirement nor an inevitable outcome. The concept was developed through observation and practice with RePlay, and it is offered as a foundation for further theoretical and empirical work.

10.3.2 Reflection as a Multi-layered Dimension of Creative Process

The thesis proposes a three-part taxonomy of reflection: reflecting on one's own creative process, reflecting on the outcomes of a creative activity, and reflecting as part of and during a creative activity, at the right moment and in the right form. Together with the updated model of creative process presented in Chapter 8, this taxonomy positions reflection as a dimension of creative process equal in significance to generation, rather than a single stage of verification or evaluation. It also makes the timing and form of reflection a practical concern for facilitation, and suggests that reflective awareness, like Creativity in Action, can be trained.

10.3.3 The Sandbox as a Condition for Creative Emergence

The thesis develops the sandbox from a loose metaphor into a theorized set of conditions that support creative emergence: playful constraint, facilitation, externalization, responsiveness, shared attention, and reflective return. The sandbox is not a building. It can be sustained through a practice, a temporary arrangement, or a computational environment. Drawing on autopoiesis as an analogy (Maturana and Varela, 1991), Kane's (2011) play ethic, and Turner's (1969) account of communitas, the thesis argues that creating and sustaining these conditions is itself a creative and methodological act, and that the sandbox is what allowed RePlay to transfer across contexts.

10.3.4 RePlay as a Framework and Methodology

RePlay is the principal methodological and practical contribution of the thesis. It is a structured yet open-ended system of improvisation-informed games, facilitation strategies, and reflective tools, including Tell Me More, Playback, Embodied Design Mapping, Design Tableaus, Design Machines, and Tangible Heroes. As a methodology, it combines these with TAPT, video documentation, traces, design mapping, trigger objects, contextual interviewing, and breaching strategies (Garfinkel, 1966) to make embodied collaborative creativity observable, recordable, and available for reflection in naturalistic settings. In this sense RePlay is a research framework that participates in producing the phenomena it studies: it creates the conditions in which collaborative creativity can be enacted, experienced, documented, and reflected upon. For HCI, where tangible computing, embodied interaction, and participatory design have long theorized the importance of the body, RePlay offers a practical way of bringing the body into the design process as a resource for inquiry rather than only as a subject of study.

10.3.5 RePlay as a Social Technology

Finally, the thesis proposes RePlay as a social technology: a structured social practice for cultivating the conditions that participants associated with group flow and collective creative emergence, including trust, co-presence, playful risk, and openness to one another's offers. Within this, the thesis proposes a conceptual connection between suggestibility, understood as openness, absorption, and receptivity to experience, and creative responsiveness. The "yes, and" principle cultivates a willingness to receive and build on offers while retaining the ability to question, adapt, or decline them. Neuroscientific research on flow and creative cognition, including accounts of transient hypofrontality (Dietrich, 2004b) and of interaction between default and executive networks (Beaty et al., 2016; Barnett and Vasiu, 2026), offers an interpretive lens with which participants' experiences resonate. Where neurotechnology's approach comparable states through direct neural intervention, RePlay approaches them from a social, relational, and embodied direction. Because the studies did not measure neural activity, this is a proposition for future research rather than a demonstrated mechanism.

Taken together, these contributions point toward what I have called hybrid creative ecologies: entangled systems of human embodiment, social interaction, materials, environments, and, increasingly, computational agency, within which creative emergence becomes possible. This is not proposed as a standalone contribution, but as a synthesis of threads running through the thesis, from Bateson's (2002) ecology of mind and Maturana and Varela's (1991) autopoiesis to Barad's (2007) intra-action and Braidotti's (2013) posthuman relational ontology. RePlay was developed before the current widespread interest in agentic AI, hybrid creativity, embodied co-creation, and neurocognitive accounts of group creativity. The field has since moved toward many of the concerns RePlay was designed to address, which is why the framework remains relevant: it offers a way of studying how creative emergence happens through bodies, materials, timing, context, reflection, and shared action, questions that become more pressing as computational systems enter creative practice.

10.4 Limitations and the Status of the Claims

The claims of this thesis should be read within the scope of qualitative, practice-based, and exploratory design research. The studies involved small groups in facilitated, in-person sessions across three case studies and a set of exploratory studies. They show that RePlay could be adapted to different contexts and could make patterns of embodied collaborative creativity visible, but they do not establish universal or causal claims about creativity, flow, suggestibility, or neural synchrony. RePlay has not been evaluated as a standardized intervention, and its effects have not been measured quantitatively or compared directly with other creativity methods.

I was the developer, facilitator, and analyst of RePlay, and this position shaped what I observed and how I interpreted it (Section 4.11). Participants' accounts may also have been shaped by what they believed a researcher wanted to hear, as I found at Philips Design. The claims about group flow and Creativity in Action rest on observation, video, traces, and participants' self-reports; TAPT depends on recall and may not fully capture the pre-noetic processes that improvisation surfaces.

Neuroscience appears throughout the thesis as an interpretive lens, not as evidence. No neural activity was measured in the RePlay studies, and the resonances I draw between participants' experiences and research on flow, network interaction, and suggestibility are interpretive connections that would need to be tested through dedicated interdisciplinary studies.

There is also a temporal dimension to the work. The fieldwork was conducted long before this thesis was completed, and Chapter 8 reads it partly in light of later developments in the field. This strengthens the argument for RePlay's continued relevance, but it also means that more recent literature has been used to interpret earlier data. The RePlay Creativity Companion and the AI-assisted Bendables visualizations presented in Chapter 9 were developed during the final revision of the thesis; they are exploratory extensions, not findings of the formal studies.

Finally, although the role of the facilitator is discussed throughout the thesis, it is not yet fully theorized. What training and background produce the most effective RePlay facilitation, and how much of a session's success depends on the facilitator rather than the framework, remain open questions. This opens opportunities to study agentic AIs as a creativity facilitator, and to treat the RePlay findings as design requirements for developing this type of hybrid system.

10.5 Future Work

Chapter 9 set out the future directions of this research in detail. Five directions follow most directly from the findings and limitations above. The first is empirical. Multi-level studies could combine multi-participant EEG, TAPT phenomenological data, and Dienes's (2012) Sussex-Waterloo Scale of Hypnotizability (SWASH) as a baseline measure of individual suggestibility, to examine whether RePlay is associated with behavioral, experiential, and physiological patterns linked to collective openness and flow. Such work would test associations rather than presume that RePlay produces a particular neural state, and it would require collaboration with neuroscientists, such as the collaboration with Dienes I considered while at Sussex.

The second concerns suggestibility. One observation that recurred throughout the development of RePlay was the importance of what Persinger et al. (2009) call lability, the openness of a group to shared experience, as a condition for group flow. Whether collective openness of this kind is related to group flow, and whether RePlay could be used over time to increase it in design teams,

is a largely unexplored question at the intersection of creativity research, consciousness studies, and HCI.

The third concerns facilitation. Further work is needed to theorize the facilitator's role, to develop training for RePlay facilitators, and to explore whether aspects of facilitation, such as prompting reflection without interrupting momentum, might be supported by an AI system acting as a player-facilitator, as the RePlay Creativity Companion begins to explore.

The fourth concerns hybrid creative ecologies. The most productive near-term approach is practice-based: using RePlay's methods of observation, externalization, and reflection to study how human participants take up, transform, or resist computational contributions, including in collaboration with artists already working at the human–AI frontier, such as composers, live coders, and choreographers, and through continued development of Bendables toward a working prototype. The more speculative questions raised in Chapter 9, including the conjecture concerning collective creative flow, are offered as long-term horizons rather than as findings.

The fifth is applied. RePlay's use in education, organizational development, innovation, and community co-design has barely been explored. The Tudor Innovation Labs partnership (Appendix A), which practical constraints prevented from developing during this project, and the growing maker education movement both offer opportunities to develop RePlay as a rigorously theorized facilitation program.

10.6 Closing Statement

RePlay began as a hunch: that something important about creative process was happening in improvisation that design research had not yet found a way to articulate. Over the course of this project, through exploratory workshops, residencies, case studies, and the sustained theoretical work of connecting improvisation to embodied cognition, systems thinking, neuroscience, and AI, that hunch has become a theorized framework, tested in practice across three very different contexts.

What I have learned is that collaborative creativity is less a mystery to be solved than a capacity to be cultivated. It is not the property of exceptional individuals but an emergent quality of attentive, embodied, playful interaction between people who have learned to listen, to follow, to fail generously, and to stay present in the moment of making. It arises in sandboxes, physical, conceptual, and social, where the normal consequences of action are suspended and participants are free to fail or to extend their understanding. It deepens through reflection: not the premature, flow-disrupting reflection that conventional design process tends to impose, but reflection that is well timed and transformative, which a good RePlay session makes possible. And it is trained rather

than taught, developed through repeated, embodied, improvisational practice within a framework of agreed constraints and genuine creative risk.

As generative AI becomes part of everyday creative practice, this understanding matters more, not less. What RePlay ultimately offers is a way of making visible what is most distinctively human about creative collaboration: not to protect it from AI, but to understand it more deeply, to cultivate it more deliberately, and to bring it into thoughtful dialogue with the computational systems that are increasingly part of how we create.

Appendices

Appendix A: Tudor Innovation Labs — Proposed Work Packages

The following describes the work packages proposed as part of a research collaboration between Lancaster University and the Centre de Recherche Public Henri Tudor, Luxembourg.

WP1 Characterisation of Creativity Methods

The objective of this work package was to complete Tudor's existing characterization grid of creativity methods and to characterize the RePlay methods within it. This grid would help recommend appropriate methods for a given creative context.

WP2 Workshop Definition

The objective of this work package was to build an experimentation protocol based on observations and analysis of workshops organized at Tudor, defining both the methods of observation and analysis and the structure of the workshops themselves.

WP3 Experimentation

The objective of this work package was to conduct two workshops using RePlay in the domain of Architecture, Engineering, and Construction, to test the adapted RePlay method and begin transferring it to workshop organizers.

WP4 Transfer

The objective of this work package was to disseminate the results of the research and development activities to relevant stakeholders, the scientific community and the Tudor ambassadors of creativity and to build on the experience gained during evaluation. Through training Tudor's ambassadors of creativity in RePlay methods, the aim was to enable the Tudor team to continue research and testing of the framework independently after the exchange had ended, comparing implementations across different design contexts. Support materials and training to transfer good practices of RePlay would form part of the outputs. The CRP Henri Tudor would benefit by adopting and integrating a novel creativity method into its service design toolkit, while Lancaster University would gain a formalized relationship of collaboration in creativity research.

Overall, the characterization of creativity methods developed by CRP Henri Tudor would then be applied to innovative creativity methods that would help formalize these techniques as part of design process. From a service design perspective, the experimentations of RePlay would help to define prospective prototypes for AEC (Architecture, Engineering and Construction) and thus open new perspectives of services within architectural design and human-computer interaction.

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