OFF THE LIP

Collaborative Approaches to Cognitive Innovation

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Collaborative Approaches to Cognitive Innovation

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Our GIFT to All of Us: GA(Y)AM

Preface

This special issue of AVANT is all about Cognitive Innovation. It is not about CogNovo, the interdisciplinary and international doctoral training programme that produced three different Off the Lip events. It is not about Off the Lip 2017, the novel symposium format we developed to collaboratively create a publication resulting in this special issue of AVANT. It is not about the seemingly heterogeneous collection of papers that follow this preface. *Collaborative Approaches to Cognitive Innovation* required something else, something we are starting to capture in the four GIFT principles. While this special issue is not solely about CogNovo, Off the Lip events, or the content of the following submissions, all these aforementioned elements were necessary to shape our current understanding of Cognitive Innovation, the very process which led to numerous publications, exhibitions, and events during the past three years. In a sense, all of our previous endeavours have culminated in this collection of 26 distinct pieces of work, yet we hope and believe that this special issue also marks a beginning. Let us explain.

Similarly to you reading this article right now, most of us joined the work on Cognitive Innovation *in medias res*. A unique transdisciplinary strategy was already being discussed when the doctoral training programme CogNovo formed around it. At that time, it seemed that CogNovo was born out of the desire to build a *multidisciplinary* team, to formulate *interdisciplinary* research questions, and aiming "to be truly *transdisciplinary*" (Denham, 2014, p. 202). Each of the 25 CogNovo research fellows, selected from a large cohort of applicants with a diverse range of backgrounds, were assigned to a team of academic supervisors and industrial partners (for more details, see Maranan, Loesche, & Denham, 2015). In addition to the doctoral training and through several workshops and symposia, spontaneous collaborations were triggered; project-related groups that formed and disbanded, with the roles of each individual changing over the course of CogNovo. We realise now that these dynamics and their implications reflect one of the necessities identified by Choi and Pak (2006) in their literature review on transdisciplinarity, to "transcend the disciplinary boundaries to look at the dynamics of whole systems" (p. 355), but this discussion would take us beyond the scope of this preface. Besides observations of the process,

our results can also be traced through the generated artefacts, for example the texts written from the angle of multiple disciplines about the shared topic of Cognitive Innovation transcending into new knowledge—some of which are collected in this special issue of AVANT.

Cognitive Innovation has been described as a self-referential and incremental process that changes itself. Denham and Punt (2017) have given it a functional form, mapping the accessible knowledge of the environment, the individual, as well as their mental processes through these same mental processes onto themselves. In the first Off the Lip in 2015, Blassnigg (2015) linked this to Bergson's merging of memory and image as a "dynamic process within the mind in its constant self-creation in osmosis with its enaction in the given environment" (p. 17) As a result, the engagement with CogNovo not only changed the knowledge about Cognitive Innovation, but it also must have changed the group, changed the individuals involved, and changed the research process itself—a process of Cognitive Innovation as well. In summary, one might argue that research is changed by research itself and as such, cannot be planned in full at its outset. This leaves the question of how such a dynamic process can be understood, not to mention researched?

The GIFT of Improvisation

Our inspiration for thinking about research in such a dynamic and open setting comes from improvisation practice. Improvisation has been described as a vivid practice in the arts, which highlights the collaborative settings, openness, ongoing exploration, and reinforcement of the creative process. The bases for improvisation are curiosity and the embracement of surprise. Improvisation focuses on the process rather than the outcome; it welcomes uncertainty and understands progress as a dynamic change. Outcomes appear through (and in) the process of doing, without clear initial expectations of results. We propose that transdisciplinarity can be understood and framed as improvisational research. We consider the following four main principles to contribute to this type of research:

> **Generosity**: Share ideas, constructive criticism, and reflections, to allow knowledge and methods to develop, and perspectives to adjust. Share as much as you can and be generous enough to acknowledge when the time is not right for an idea. Every contribution, from any individual or discipline should be considered of equal eligibility. Be curious about their knowledge and methods.
>
> **Interdependence**: Use and establish links between partners, research questions, and solutions from different disciplines. Improving the accessibility of your language and ideas reflects a capability to generalise, not to simplify concepts. It allows you to share the perspectives and principles of a discipline, find the connections to knowledge from other fields, and establish a common

ground with the others. Anticipatory planning cannot account for inputs from all participants, instead implement a "rolling ball" strategy and embrace associations that allow reshaping ideas. The weight of the influences that shape your project will change throughout the different phases of the project.

Free exploration: Allow time for exploration and experimentation with different approaches. Allow successes and failures to inspire the next step and allow input from others as well as coincidences to influence your contribution. It is important to embrace the risk that comes with this approach.

Trust: Participation and contribution requires trust. Trust is not built on promises, but it needs time and action to grow; trust that everyone is contributing as much as they can. Respect the improvisational space and all individuals who share it with you, and acknowledge the origin of ideas.

Improvisational practice does not replace planning and it certainly does not replace preparation or research rigour. On the contrary, improvisational time and space require explicit attention and rigorous planning. Having clear spatial and temporal constraints on a collaborative process allows individuals, and the group as a whole, to adjust their commitment between sessions according to previous experiences and constraints outside the improvisation. These boundaries act as a safety net that allows unconstrained application of the other four principles during improvisation.

GIFT: Current Version

During CogNovo, the organisation of events changed over time, culminating in this year's Off the Lip 2017. The novel format of a collaborative, feedback-based Off the Lip 2017 symposium leading to this special issue was successful beyond our expectations. We invited speakers to come with "almost ready" papers that they would consider publishing in this special issue. Once we received all submissions and to ensure high quality of feedback, we asked each of the authors to write a response to one or two other submissions. During the event, these responses were presented just after the papers, before opening the discussion and questions to the whole audience. We designed the event as a single track with extended "social time." These longer lunch breaks, shared breakfasts, and evening events served as an informal platform to exchange ideas. They emphasised the personal interactions and they also ensured that each submission received adequate feedback. The principles of GIFT were implemented inherently and implicitly yet some of them were identified in the discussion with all delegates towards the end of Off the Lip 2017.

If Cognitive Innovation is, as suggested, the driving force behind the research we have practiced within CogNovo, then this practice is not just the result of the knowledge of the individuals of the extended network of CogNovo and the environment we are situated in. It is, at the same time, an aggregated result emerging from

all previous events and collaborations, a fleeting temporal manifestation, and a foundation for future iterations. Even through writing and reading this text, we will change our and your future practices. Therefore "GIFT Ain't (Yet) A Manifesto," but we invite you, the reader, to join us in developing the idea further.

Earlier in this text we articulated the hope that Off the Lip 2017 and these texts will not just be the climax of the doctoral training programme CogNovo.eu, but rather abeginning. Concretely, we would also like to announce the beginning of the CogNovo Foundation. If you enjoy or want to criticise our approach, if you want to engage or want to grow these ideas into a "Manifesto," then please get in contact through our website at CogNovo.org. In the meantime, we hope you will find the writings in this special issue both an insightful and intriguing input to the next iteration of your process of Cognitive Innovation.

Frank Loesche & Klara Łucznik
with the OTLip17 Committee:
Susan L. Denham, Hannah Drayson, Kathryn B. Francis, Diego S. Maranan, & Michael Punt

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Cognitive Innovation, Irony and Collaboration

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Abstract

What seems clear from the experiences of researchers in CogNovo is that the concept of cognitive innovation offered a new vocabulary, and thus a clear space, within which creativity could be explored free from the baggage of prior conflicting definitions. The concept was, from its inception, intrinsically ironic in the sense that Richard Rorty developed the term. Although initially we did not fully appreciate the potential this offered, approaching creativity under the rubric of cognitive innovation led to novel ideas that would not have emerged if we had taken a more conventional discipline-led approach. One example was expressing creativity as a mathematical function and as a media form in a parallel text. The absurdity of describing a process of such complexity in this form did not pass us by. However, this self-conscious irony, not a common rhetorical strategy in the sciences, clarified our understanding of cognitive innovation as a recursive function that allowed us to express a continuity between the basic life processes of exploration, innovation and the construction of the self, and the social and cultural ramifications of these processes; creativity. It led us to conclude that cognitive innovation furnishes a view of the self as a dynamic entity, for whom reality and novelty are contingent on one's current state, both of which can change and be changed, and offers a means for enhancing the rigor of the current debate on what counts as creative. It also reveals the value of irony in not disavowing the inevitability of multiple perspectives and prospectives on reality, and consequently offers a way to avoid unnecessary reductivism. In this paper, we will argue, as we take the insights of CogNovo forward, that irony offers a hitherto unappreciated strategy for collaborative research.

Keywords: cognitive innovation; collaboration; creativity; irony; Richard Rorty.

DUMBY. I congratulate you, my dear fellow. In this world there are only two tragedies. One is not getting what one wants, and the other is getting it. The last is much the worst; the last is a real tragedy! But I am interested to hear she does not love you. How long could you love a woman who didn't love you, Cecil?

CECIL GRAHAM. A woman who didn't love me? Oh, all my life!

DUMBY. So could I. But it's so difficult to meet one.

LORD DARLINGTON. How can you be so conceited, Dumby?

DUMBY. I didn't say it as a matter of conceit. I said it as a matter of regret. I have been wildly, madly adored. I am sorry I have. It has been an immense nuisance. I should like to be allowed a little time to myself now and then.

LORD AUGUSTUS. [Looking round.] Time to educate yourself, I suppose.

DUMBY. No, time to forget all I have learned. That is much more important, dear Tuppy. [Lord Augustus moves uneasily in his chair.]

LORD DARLINGTON. What cynics you fellows are!

CECIL GRAHAM. What is a cynic? [Sitting on the back of the sofa.]

LORD DARLINGTON. A man who knows the price of everything and the value of nothing.

CECIL GRAHAM. And a sentimentalist, my dear Darlington, is a man who sees an absurd value in everything, and doesn't know the market price of any single thing.

LORD DARLINGTON. You always amuse me, Cecil. You talk as if you were a man of experience.

CECIL GRAHAM. I am. [Moves up to front off fireplace.]

LORD DARLINGTON. You are far too young!

CECIL GRAHAM. That is a great error. Experience is a question of instinct about life. I have got it. Tuppy hasn't. Experience is the name Tuppy gives to his mistakes. That is all. [Lord Augustus looks round indignantly.]

DUMBY. Experience is the name every one gives to their mistakes.

CECIL GRAHAM. [Standing with his back to the fireplace.] One shouldn't commit any. [Sees Lady Windermere's fan on sofa.]

DUMBY. Life would be very dull without them.

Oscar Wilde, *Lady Windemere's Fan*

We take our title from Richard Rorty's 1987 book, *Contingency, Irony and Solidarity*, which challenges the idea that epistemology will reveal reality in its fullness. The attraction of this approach to our project of developing a concept of cognitive innovation as the entrainment of two discrete systems—one cognitive and the other cultural—was that it allowed us to engage with the world and our perception of it without insisting on any ultimate reality. How, and to what extent, these two systems are entrained is, we argue, historically variable and largely a matter of the opportunities that exist in the dominant social and economic institutional structures to accommodate cultural beliefs, preferences and values. Today the research relations between reasonably codified instruments of knowledge (for example, the sciences and the arts and humanities) are determined by the institutional platforms that afford information exchange. In the case of those sciences that deal with human cognition, these have been compartmentalized in a very particular way since the beginning of the 1800s to the extent that the arts and humanities are no longer considered a reliable source of information about the human mind. The emigration of the mind from the arts may or may not have been appropriate as the science of Psychology developed, but is perhaps less helpful now as we consider a (mental) function such as creativity which is inextricably entwined with cultural and social structures. To begin we had to develop a methodological framework for collaboration on research projects between those disciplines that are primarily organized to undertake epistemological research and those that try to know the world through individual and collective sensation. And for this we revisited *Contingency, Irony and Solidarity*.

Rorty opens his book with a reflection on the redistribution of intellectual labor in the revolutionary fervor of the late 1700s:

> About two hundred years ago, the idea that truth was made rather than found began to take hold of the imagination of Europe. The French Revolution had shown that the whole vocabulary of social relations, and the whole spectrum of social institutions, could be replaced almost overnight. This precedent made utopian politics the rule rather than the exception among intellectuals. (Rorty, 1987, p. 3)

He is careful to note a parallel Romanticist movement in the arts with a similar revolutionary spirit, pointing out that the move to thinking about art as a process of creation rather than imitation brought the arts into conflict with Enlightenment science which also claimed the authority to challenge the hegemony of Religion as the "master text." In this way, he identifies a bifurcation in philosophy between the scientifically inclined philosophies that use reason to critique human belief and those which regard the arts as responses to engagement with a reality that is nonhuman. Rorty's move in this description of the secularization of human thought and action enabled him to distinguish between World and Truth. Truth, he asserted, is a product of the human mind and is what happens when we describe the world. By investing heavily in the role of language in the construction of truth (about the world), Rorty was able to consider the historical dominance of one mode of truth over another as a matter of vocabulary and habit, captured by his notion of different "final vocabularies."

The ironist's concern with the restraints of language, in particular, is core to our understanding of the arts as a developmental practice of civilization. A rejection of art as the exclusive handmaiden of religion stimulated new visual, musical and literary forms that were intended to compensate for the expressive boundaries of language in this project to reflect a secular concern with feeling. Michael Baxandall (1974), in *Painting and Experience in Fifteenth Century Italy*, argues that in its maturity, the project of the Italian Renaissance was successful because it was rooted in the experience of its patrons, who, in Rorty's terms, had a different final vocabulary. Across Europe, in the centuries that followed, that is until the Modernisms of the twentieth century, polyglot practices including the theatre, the novel, and the poem were primarily vehicles for some of the intangible aspects of being human such as perception, emotion and affect. At its most intense, the artistic concern with the human psyche found coherence across many media in Romanticism. Mario Praz (1933) in his discussion of this in *The Romantic Agony* claims that

> [t]he word 'romantic' thus comes to be associated with another group of ideas, such as 'magic', 'suggestive', 'nostalgic' and above all with words expressing states of mind such as the German 'Sehnsucht' and the English 'wistful'. . . . Such ideas have this in common, that they furnish only a vague indication, leaving it to the imagination to make the final evocation. . . . The essence of Romanticism consequently comes to consist in that which cannot be described. The word and the form, says Schlegel in Lucinde, are only accessories. (p. 33)

The concern with the restraints of language and the ironic strategies that it provokes is most familiar in the arts, and indeed can be said to be at the core of the dominant practices of the last century. However, it is no less prevalent, if perhaps less celebrated, in the many other ways that we attempt to describe the world, including the sciences.

Many nascent sciences start with empirical observations, collections of facts about the world; consider von Humboldt's explorations in the Canaries and South America (see von Humboldt, 1814–1825/1995) or Darwin's voyage on the Beagle. Observations inevitably lead to questions of causality, and the development of theories and new vocabularies which seek to explain the observations and capture new concepts; von Humboldt's identification of ecosystems, Darwin's theory of evolution. In a sense, science recognizes all theories as approximations to the truth while at the same time believing that there is some ultimate truth (the observations) to be understood.

Neuroscience has been no different. From Cajal's investigations and wonderfully intricate drawing of neurons and glial cells, came his idea of synaptic connections between discrete neurons and the glial "glue" framework that supported functioning of the neuronal network. Modern day neuroscience is replete with better and bigger ways to image the brain at work and increasingly more nuanced ways to manipulate brain processes. Arguably the greatest challenge today lies in theoretical neuroscience and the development of comprehensive systems-level theories of brain function. In this endeavor metaphors abound, e.g., neurons and neuronal networks as electrical

circuits, the eye as a camera, the brain as a computer, memory as a filing system; all different final vocabularies. What is not so easily recognized is the difficulty of jumping outside of whatever vocabulary is currently vogue in the field, which (often imperceptibly) conditions lines of enquiry. To follow just one strand, Hermann von Helmholtz in realizing the complexities faced by perceptual systems (clutter, ambiguity, incomplete information) suggested that perception should be understood as an inferential process (von Helmholtz, 1863/1885). Richard Gregory (1980), in the same vein, analogized perception with scientific hypothesis testing; the brain generating its best guess of external reality, evaluated and refined in the light of new evidence from the sensors. Today predictive coding—(e.g., Friston, 2005), the brain as a hierarchical generative system—is an influential theory in the neurosciences, with a new final vocabulary drawn from statistical inference; countless experiments are now interpreted in terms of predictions, prediction errors, priors, posterior probabilities and so on.

Yet investigations of perception graphically demonstrate a fundamentally ironic aspect to brain function, in Rorty's sense of the word. The perceptual systems, it would seem, explore multiple alternative interpretations of the world which are not generally available to conscious awareness, but which can be exposed under circumstances of unchanging stimulation in a phenomenon known as perceptual multistability (Leopold & Logothetis, 1999). Originally it was found by presenting different static images to the two eyes that perceptual awareness tended to switch (quite abruptly) between the two images (Porta, 1593), and consequently became known as binocular rivalry (Breese, 1909). Since then perceptual switching has been elicited in many other ways, e.g., ambiguous form from motion, Necker cube (Leopold & Logothetis, 1999), and modalities, e.g., auditory streaming (Pressnitzer & Hupe, 2006), verbal transformations (Kondo & Kashino, 2007). Although perceptual switching is highly stochastic, and individually idiosyncratic, there are common underlying characteristics that point towards the (evolutionary) importance of never fixing on any final decision regarding interpretations of reality.

Viewing the (embodied) brain as a generative system that makes predictions of future, as yet unobserved, events provides a link towards a neuroscience of anticipatory behavior, imagination and social interaction. The ability to think prospectively, to imagine other realities, to construct new truths, also underpins counterfactual thinking and creativity. In "A View from the Bridge" (Denham & Punt, 2017) we sought to differentiate cognitive innovation (the incremental exploratory process in which individuals construct the knowledge, skills and thinking processes of the self) from creativity and the social propagation of novel ideas and artifacts. Just as the notion of predictive depth provides a measure of how far into the future an individual organism plans its behaviors (possibly a useful distinction between species), so influential depth may provide a measure of the impact of a new artifact or idea, and the ability and readiness of others engage with it. Influential depth provides a snapshot of the propagation of new information within a community; each individual processing the

information at a rate determined by their intrinsic state. In such a dynamic system, new information (potentially) changes the system state and behavioral repertoire; neither the information nor the individuals, nor the social network remain static, and the changes wrought to the system affect the possibilities of future behavior. This is just as true of scientific discovery as of any other human activity; an experiment that exposes what is claimed to be a new truth to (scientific) knowledge affects what counts as truth in the past and the future. As such, as Rorty suggests, truth is an ironic construct in that the very idea of truth is simultaneously absolute and provisional. From this recognition, we would argue that the neuroscience of creativity, currently focusing largely on individual brain function, should adopt a broader perspective that encompasses influential depth and the recognition of the interactive constructive and filtering role played by society in the creative process; the creative ecosystem.

Conclusion

For collaboration between individuals to occur, there is a need for information to be exchanged. Inevitable differences between the multiple vocabularies of the individuals necessitate the negotiation of translations or mappings between the vocabularies before effective information exchange can take place. In a multidisciplinary project such as CogNovo, these negotiations embraced quite fundamental concerns, such as what counts as a valid research question or valid form of enquiry. Seeking an alternative to consensus, and insisting on collaboration that retained difference and disciplinary distinction, i.e., transdisciplinarity (Blassnigg & Punt, 2013), led us to irony as a methodological tool.

If we take the pragmatic view that the way we describe the world is a product of a final vocabulary and not a consequence of the reality of the world (whatever that might be argued to be), then, Rorty asks, what is our relationship to truth when we are talking about the world, and for this question he turns to the idea of irony. In contrast to the belief in a desire to know the real essences of the world and so reflect its truth, the ironist recognizes that we are always restrained by language in anything that we explore. The ironies of CogNovo and cognitive innovation may not have been well developed when this project started in 2013, but through its research new vocabularies have been developed that, while not claiming any privileged access to truth, can be played off creatively against other vocabularies with (in Rorty's words, so strikingly close to Wilde's), "metaphors of making rather than finding, of diversification and novelty rather than convergence to the antecedently present" (Rorty, 1987, p. 77).

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Analyzing Ambiguity in the Standard Definition of Creativity

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Abstract

The increasingly rich and diverse literature on creativity has its core in psychology, but spans the cognitive sciences from artificial intelligence to philosophy and borrows from the wider humanities. Perhaps because of this immense breadth, there remains considerable disagreement with respect to the identity of the object of research. How to define creativity?

According to the "standard definition," creativity consists of "effectiveness and originality." This definition is (relatively) consensual and therefore appears to capture something common to academic concepts of creativity. I conduct a conceptual analysis of the definition; thereby, I isolate and describe two ambiguities. Firstly, the definition leaves open the choice of the context and norms against which to measure originality and effectiveness. Secondly, it does not discuss the possible role of a subjective judge.

My goal is not to propose yet another model of creativity, but to clearly identify the possible meanings of the word *creativity* in academic research. The existence of different interpretations does not necessarily reflect a fundamental disagreement about reality, but rather a failure to achieve consensus on a shared technical language. Therefore, simply recognizing and acknowledging the competition between diverse interpretations can form the basis for successful communication and for a complementary division of labor; it could improve the viability of interdisciplinary collaborations and prevent unnecessary fragmentation of the field.

Keywords: creativity; definition.

An incomplete or vague definition is not necessarily damaging, even when it affects the most central concept of a field or discipline. For instance, Trifonov (2011) collected 124 definitions of life (the central concept in biology), and Legg and Hutter (2007) brought together 72 definitions of intelligence (the central concept in artificial intelligence and an important one in psychology). Despite this inability to settle on a definition of their object of study, these fields appear to be thriving. Why, then, should we worry about the definition of creativity? Perhaps because of the disparate roles of these concepts (life, intelligence, creativity) in the corresponding disciplines. Indeed, both "life" in biology and "intelligence" in artificial intelligence are usually relegated to a philosophical backstage; the leading roles are instead given to evolution or medicine (biology), or to planning or learning (artificial intelligence). In contrast, the concept of creativity is at the forefront of creativity research. Creativity researchers often make general claims about the nature of creativity: statements of the form "*creativity correlated with x*" or "*creativity requires y*." If we cannot confidently separate the creative from the non-creative, such statements themselves become vague and ambiguous. To prevent this, we must know what we are talking about when we talk about creativity.

The "standard definition of creativity" (Runco & Jaeger, 2012) is, in its present form, the fruit of decades of discussions and debates aimed at reaching a point of (approximative) agreement between creativity researchers. The result is a bi-partite definition: creativity requires (1) originality and (2) effectiveness. This definition is best understood by also considering the family of related definitions to which it belongs: "novelty and value" or "novelty and appropriateness."

I propose investigating this definition via conceptual analysis, a philosophical method consisting of clarifying a concept by exploring possible interpretations and testing their internal consistency, sometimes by using thought experiments. The analysis reveals two sources of ambiguity: the relativity of the criteria of originality and effectiveness to a context and norm, and the potential subjectivity of a judge of creativity. I believe these ambiguities, and the misunderstandings they cause, can help explain some of the disagreements and fragmentation in creativity research.

In the next section I discuss the history of the field, introducing some useful distinctions. I then study the standard definition in more detail: what is meant by *originality* and *effectiveness*? Finally, I consider some of the implications for creativity research.

Background

Before discussing the ambiguities of the definition, it is useful to give an overview of past conceptualizations of creativity.[1]

[1] For a more detailed account of the story of Creativity Research, interested readers can consult Batey and Furnham (2006) or Hennessey and Amabile (2010). Some of the key characters are cognitive processes, personality traits, social interactions, creative achievements, and practical applications.

The word itself is a surprisingly recent addition to the western vocabulary;[2] its appearance is almost concomitant with that of Creativity Research as a field, with Guilford's address to the American Psychological Association (Guilford, 1950). Indeed, prior to the 1940s it was virtually unheard of in English, German (*Kreativität*), or French (*créativité*). Its popularity rose sharply and steadily until the 2000s (Google Books Ngram Viewer, 2017); the European Union branded 2009 the "Year of Creativity and Innovation" (European Commission, 2009). As the popularity of the word grew, academics devised models of creativity. Important such models include:

- **Stage-based models** (Wallas, 1926): the creative process is divided into separate stages, such as preparation, incubation, illumination, and verification. Later models (see Lubart, 2001) have included stages for problem-finding or for the communication of results.
- **Convergent and Divergent thinking** (Guilford, 1956): creativity is considered within a theory of the intellect, in which creativity results from the interplay of convergent and divergent productive processes.
- **Blind Variation, Selective Retention** (**BVSR**; Campbell, 1960): this recently revitalized (Simonton, 2011) model focuses on a trial-and-error explanatory framework; it is amenable to cognitive/computational as well as social interpretations.
- **The Systems Model** (Csikszentmihalyi, 1996, p. 6): "creativity results from the interaction of a system composed of three elements: a culture that contains symbolic rules, a person who brings novelty into the symbolic domain, and a field of experts who recognize and validate the innovation."

In order to handle the concepts presented in different *explanatory models*, various *taxonomies* have been proposed. Such work includes the "four Cs" (Kaufman & Beghetto, 2009), which distinguish types of creativity ranging from "mini-c" (creativity in learning and development) to "big-C" (eminent creativity). Another example is the four Ps framework (Rhodes, 1961), which refers to the elements of creativity research as the Person, Product (object, idea, behavior...), Process, and Press (interactions with the social environment of the creator).

These variegated views and frameworks illustrate the fragmentation of the field (recognized with concern in, e.g., Hennessey & Amabile, 2010). This fragmentation is also evident in comprehensive introductions to the field, such as Sawyer (2012) or Runco (2014), in which different sections or chapters discuss cognitive, developmental, neurobiological, social, educational, and cultural perspectives . . . among others.

[2] However, related terms and concepts predate it; for instance, there was considerable discussion of genius in the 19th century.

Indeed, creativity research has produced an awe-inspiring variety of "perspectives" and "approaches," but it has failed to converge towards a big picture. I believe this is because the researchers share the same lexicon, but often do not speak the same language.

In light of this history, it should come as no surprise that the word *creativity* is fought over by academic communities who attach different meanings to it. But a word with multiple competing meanings is impractical for communication. How can misunderstandings be avoided? A radical solution would be to stop using the term altogether in favor of a set of more precise alternatives; this is unrealistic due to the cachet that *creativity* already has. Therefore, I suggest a more pragmatic approach: let us identify and list the different meanings attached to *creativity* and use this list to disambiguate the uses of the term in creativity research. In this article, the first step of this program takes the form of a conceptual analysis.

Conceptual Analysis of the Standard Definition

Margolis and Laurence (2014) define conceptual analysis as "a distinctively a priori activity that many take to be the essence of philosophy . . . Paradigmatic conceptual analyses offer definitions of concepts that are to be tested against potential counter-examples that are identified via thought experiments" (§ 2.1, para. 3). Conceptual analysis has been criticized (Margolis & Laurence, 2014) on the grounds that the intuitions with which we navigate thought experiments can be individual- or culture-dependent. In an attempt to contain this risk, I will not consider the concepts of creativity used by lay people or by creatives: I expect these to be sometimes incoherent, and usually inconsistent across individuals, communities, or cultures. Instead, I focus on the definitions and intuitions put forward by creativity researchers whose views are informed by experimental evidence, correspond to an extensive knowledge of the field, and aim to achieve consensus.

The Standard Definition

The "standard definition," summarized by Runco and Jaeger (2012) as "originality and effectiveness" (p. 92), is related to a cluster of bi-partite definitions which has accumulated since the origin of the field. Each component is better understood by considering the cluster of related terms:[3]

- **Originality**, Novelty/Novel/New, Non-obvious, Uncommon, Unique.
- **Effectiveness**, Adaptive, Appropriateness, Correct, Fit, Good, Realistic and acceptable, Relevant, Valuable, Usefulness, Worthwhile and compelling.

[3] Runco and Jaeger (2012) provide references for the corresponding definitions.

Unfortunately, these definitions make use of concepts that are themselves under-specified. This is no coincidence: they harness ambiguous terms to describe an ambiguous concept. Instead of decomposing creativity into more precise and fundamental concepts (as an explanatory definition would: "water is H_2O"), some vagueness is preserved. This could be by design: to be consensual, the definition must preserve the existing inconsistencies and disagreement between researchers. There is only one way to preserve these disagreements in a definition while avoiding incoherence and contradiction: the definition must be ambiguous, under-specified. Indeed, this is what makes this definition an interesting starting point for elucidating ambiguity in the word *creativity*.

What ambiguity is there? I find two different sorts.

First Ambiguity: Context and Norm

The first sort is the *relativity* of the two components. Absolute interpretations are not taken seriously in the field: that is, few believe that creativity requires either absolute novelty or originality, or objective good. Thus, originality and effectiveness must be relative to something. But relative to what?

1. **Originality is relative to a context:** originality can only be measured relative to a group, and novelty relative to a history. I will refer to this group or history as the *context*.
2. **Effectiveness is relative to a norm:** effectiveness, goodness, relevance, can only be measured with respect to goals, criteria, or values; in the most general sense these are called *norms*.

In practice, creativity research often lets context and norm vary together by specifying them based on a singular point of view. For instance, one may implicitly choose the point of view of *the creator*: the creative product must be new to the creator (context), and effective for the creator's purposes (norm). It is also possible to prefer *some group external to the creator:* the product must then be original within the group (context), and effective for the group (norm).

Thus, the concise definition, *"creativity requires both originality and effectiveness,"* can be rephrased as *"creativity with respect to a context and a norm requires both effectiveness relative to the given norm and originality relative to the given context."* This more cumbersome definition makes it explicit that the components (originality and norm) are ambiguous whenever norm and context are not specified.

To illustrate this point, consider the following two examples of creative individuals drawn from distant branches of the literature: the New Caledonian crow Betty, and the 20th century post-impressionist painter Vincent van Gogh. Betty was dubbed creative (Weir & Kacelnik, 2006) for building a tool to solve a problem. The crow had

never made such a tool before, and had not seen another crow make one, hence the tool-building process was original within Betty's context and was effective at reaching the food reward. Contrast with Van Gogh, whose widely recognized creativity is dependent not merely on the novelty of his paintings with respect to his personal history, nor to their fit with his own norm of artistic value. Instead, the creativity of the painter is measured against the history of art, the artists of his time, and the norms of today's art connoisseurs and art historians. Based on the definition, we are justified in saying that both Betty and Van Gogh are creative in some sense; but they are creative relative to different contexts and norms. The difference between them is not (just) quantitative, but qualitative because different norms and contexts and therefore different concepts of creativity are involved.

Second Ambiguity: The Interplay between Creator and Judge

The second source of ambiguity is the person or group *emitting the creativity judgement*, presumably based on the two criteria. This is surprising: while in the previous section I described creativity as *relative* (to norms and context), it remained nevertheless possible to directly measure it against these elements, if they were supplied. But a *subjective judge* is now introduced, typically a community or even a field. This negates the possibility of assessing the creativity of an individual in isolation; this undermines branches of creativity research that focus on cognitive characteristics at the individual level.

But this is what major figures of creativity research have done. For instance, Runco and Jaeger (2012) observe that "The standard definition only pinpoints which criteria must be used; it does not say anything about who is to judge each" (p. 92) Csikszentmihalyi (1996, pp. 23–25) explicitly asks his readers to pick a judge: either the creators themselves, or relevant members of society, the latter having his vote. Later, he presents the following thought experiment: "[Van Gogh's creativity] came into being when a sufficient number of art experts felt that his paintings had something important to contribute" (Csikszentmihalyi, 1996, p. 31). For Csikszentmihalyi, Van Gogh therefore became creative after his death, by virtue of the changing opinions of art experts.

Why would the terms of my first distinction not suffice? Distinguishing different contexts and norms, one could write that Van Gogh was both (1) not creative based on the criteria of a first group (his contemporaries), but (2) was creative relative to the criteria of another group (later critics). However, these authors rejected this path. I surmise that, for them, creativity involves a dynamic interaction between the creator and the judges, such that the creator is able to alter the norms by which the product is evaluated. This is most clear in the case of the arts, and perhaps best expressed by Proust (2006/1921) with respect to another painter:

> People of taste and refinement tell us nowadays that Renoir is one of the great painters of the last century. But in so saying they forget . . . that it took a great deal of time, well into the present century, before Renoir was hailed as a great artist. To

> succeed thus in gaining recognition, the original painter, the original writer proceeds like an oculist. The course of treatment they give us by their painting or by their prose is not always agreeable to us. When it is at an end the operator says to us: "Now look!" And, lo and behold, the world around us (which was not created once and for all, but is created afresh as often as an original artist is born) appears to us entirely different from the old world, but perfectly clear. Women pass in the street, different from what they used to be, because they are Renoirs, those Renoir types which we persistently refused to see as women. The carriages, too, are Renoirs, and the water, and the sky. (p. 1131)

The creator, via his creation, proceeds "like an oculist": transforming the vision of the judges, and thereby, their judgement. Is this specific to the arts? Kuhn (1970) sees a similar phenomenon in the sciences, in which an "incommensurable" innovation must lead to the "conversion" of a scientific community to new criteria of good science. In this view, creativity is an emergent social phenomenon rather than a mere cognitive ability.

However, this interpretation seems rather more applicable to the eminent, "big-C" creativity of historical importance, than to the "mini-C" or "little-C" creativity of children and daily life. Indeed, Csikszentmihalyi's Van Gogh thought experiment could "seem insane" to some readers, such as, perhaps, experimental psychologists attempting to measure creativity in the lab. It is more useful for those focused on the process of creative thought, for instance the insight phenomenon, to adopt a more prosaic interpretation of the definition, according to which Betty the crow is creative.

Discussion

I have presented two types of ambiguity in the definition of creativity. The first concerns the context and norm against which originality and effectiveness are to be measured. The second concerns the existence and identity of a judge of creativity.

The use of a definition with multiple interpretations might correspond to a belief that the different types of creativity are, if not identical, at least related. For instance, the first ambiguity can be set aside when the norms and context of the individual and those of society are close enough to produce similar evaluations of creativity. The second ambiguity, despite considering creativity as an emergent social phenomenon, nonetheless suggests the involvement of certain cognitive processes on the part of the creator. In particular, there is a striking parallel between the "paradigm shifts" (Kuhn, 1970) seen in the most eminent of scientific or artistic works and the representational change observed in insight problem-solving (Ohlsson, 1992). The consensus view is that, despite the differences, the areas of agreement justify the unity of the field (Tardif & Sternberg, 1988). Despite this relatedness, it is not difficult to provide examples which satisfy one interpretation of the definition, but fail to satisfy another; I have done so in the previous section. This justifies my recommendation to explicitly state the interpretation of the definition whenever the word *creativity* is used.

How might these ambiguities affect the field? Consider, for example, the much-debated relationship between mental illness and creativity (e.g., Kyaga et al., 2011). Mental illness causes ineffective behavior relative to oneself, but exploring the less-traveled path may increase the probability of discovering something valuable relative to the community. Therefore, differing interpretations of creativity with respect to the first ambiguity may help explain the heated disagreement on this issue.

Let us consider another example in the sub-field of computational creativity. The interpretation of creativity in Wiggins (2006) focuses on cognitive processes and therefore appears to fit best with an interpretation in terms of originality and effectiveness relative to the agent's point of view. In contrast, the interpretation in Colton, Charnley and Pease (2011) explicitly considers interactions with a spectator, thus allowing for the presence of a judge. The two interpretations are apparently conflicting, but they can be viewed as complementary in light of this analysis.

Ultimately, a definition is a matter of convention, not of fact. Being aware of possible ambiguities allows the intended interpretation to be clearly specified, and this can suffice to restore shared understanding.

Conclusion

I have analyzed the standard definition of creativity in terms of its interpretation in creativity research. Doing so, I found two sources of ambiguity. The first is the relativity of creativity to a particular context and set of norms, against which one can measure originality and effectiveness. The second is the introduction, or not, of a subjective judge, whose norms for judgement can be influenced.

Sawyer (2012) views creativity research as divided and claims that as long as the different communities proceed "on separate tracks, we will fail to explain creativity" (p. 14). By studying the definition of *creativity*, I hope to have shed light on hidden causes for these divisions; creativity researchers study different concepts (creativity relative to oneself, to a group; involving a subjective judge or not), but collectively refer to these concepts using the same label. The recognition of these semantic differences could be an important step towards successful collaboration.

The work conducted here is philosophical, but it could be (in part) empirically tested. My analysis makes testable predictions about what academics believe: if the analysis is correct, it must be possible to find semantic clusters in the creativity literature corresponding to the different interpretations of the word *creativity*. This could be done by adapting the method of Jordanous and Keller (2016).

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Academic Carelessness, Bootstrapping, and the Cybernetic Investigator

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Abstract

The following discussion is concerned with certain forms of poor practice in academic publishing that give rise to "academic urban legends." It suggests that rather than simply consider phenomena such as poor citation practices and circular reporting as mistakes, misunderstandings, and evidence of lack of rigor, we might also read them as evidence of a particular kind of creativity—for which misunderstandings, assumptions, and failures of diligence are mechanisms by which potentially influential ideas manifest. Reflecting particularly on a critique of the debate surrounding pharmaceutical cognitive enhancement and its use by university staff and students, the following will argue that investigators within the disciplines concerned with the effects or development of these technologies are themselves implicated as potential subjects. Alongside reflections from science fiction studies that offer insights into the experiential dimension of reading and misreading, this paper offers some insights regarding how we might think of mistakes and misunderstandings as a form of bootstrapping and a source of creativity in scientific and technological development.

Keywords: academic carelessness; bootstrapping; cognitive innovation; creativity; looping effects.

Academic Urban Legends

In his paper "Academic Urban Legends," Ole Bjørn Rekdal (2014a) reconstructed the birth of the widely held but misplaced belief that "spinach is an excellent source of iron" (p. 639). Ironically, through the poor citation practices of those who commented on it, the story about spinach, often used as an example of academic carelessness, became attached to another academic urban legend, which blamed the mistake

regarding spinach's dietary attributes on the misprinting of a measurement of iron content with a misplaced decimal point. Tracing back through the nested citations that gave rise to this second story, Rekdal (2014a) showed that it too, is ungrounded. Many of the authors who mistakenly used the example of spinach in this way never went back to consult the original source, with the result that a claim that was itself unsubstantiated was also consistently reported inaccurately. A damning pattern of citation errors in work that was intended to debunk myths in science and medicine but instead perpetuated them was the result.

Citation plagiarism—in which a secondary citation is presented as a primary one without consulting the original source—was the main culprit in Rekdal's analysis (2014, p. 639). As he pointed out, for academic writers who want to reuse an idea or phrasing, the temptation is to make use of references reported in other texts in this way. If the preceding author has reported the content of the source with honesty and accuracy, this kind of omission is undetectable. Unreliable sources, or citations that misrepresent or solidify tentative or faulty evidence, contribute however to the generation of academic urban legends.

Despite the moral and practical implications of having the wrong facts before us, in the case of academic writing, evidence is selected in order to build an argument and move forward the discussion. Whether careless, lazy, or outright dishonest, the examples that Rekdal examined in his work are troubling, both given the effects of a misapprehension with the scale and influence of the myth about spinach, and how apparently endemic this type of inaccuracy appears to be (Rekdal, 2014a; 2014b). However, as the following discussion will suggest, apart from as failure, the academic urban legend can also be read in another way—as evidence of a particular kind of creativity—for which misunderstandings, assumptions, and failures of diligence are mechanisms by which potentially influential ideas manifest.

The Self-Referential Debate about Neuro-Enhancement Technologies

Debates about neuro-enhancement technologies are another discourse that have garnered criticism. An example is Hazem Zohny's (2015) analysis of the discussion of "pharmaceutical cognitive enhancement" (PCE); PCE is the off-prescription use of drugs such as Adderall and Ritalin for performance enhancement that has been allegedly on the rise in workplaces, schools, and universities (the discussion centers around the United States). Zohny argued that while recently the subject of intense discussion, the nature, novelty, and prevalence of PCE has been consistently overstated. In addition to a number of conceptual problems, technologies indicated by the novel terms "cognitive- and neuro-enhancement" (p. 264) are neither conceptually

nor technologically new;[1] the concept of neuro-enhancement itself is a misnomer. Zohny argued that there is good evidence that drugs associated with cognitive enhancement only generate *experiences* of enhanced cognitive function—improving mood and feeling, but not actual performance. Cognition—when separated from mood and attention—is a problematic category (pp. 263–264).

In similarity with Rekdal's discussion of citation plagiarism, Zohny pointed out that the discourse around PCE shows evidence of "circular reporting, whereby the media references academic papers and academic papers reference the media" (p. 265). In this back and forth between the academic literature and the media—which regularly reports on PCE and other forms of cognitive enhancement such as "nootropics"—the two interrogate the quality of citations that has led to the perception that PCE is effective and widespread in use.

While PCE may be partly fiction, the debate around it remains productive in a number of ways. For commentators, particularly in disciplines such as neuroethics, the growth of the PCE legend has offered an argument for the important role of discussions about the politics of enhancement; attending to legality and decriminalization, workplace pressure, education, and neoliberalism. (Sampson, 2016; Wiegel, Sattler, Göritz, & Diewald, 2016). The dialogue, for better or worse, is one that moves between academic disciplines and the popular press where commentators attempt to open, and perhaps feed, the debate. Petrounin's (2014) article "European Students' Use of 'Smart Drugs' Is Said to Rise" in *The New York Times* cites an interview with an academic who despite having "no longitudinal data," has the "impression from discussions with students over the last years that consumption has likely increased" (Savulescu, 2015). Despite the thin evidence, the exciting and troubling prospect of widespread PNE becomes a hook, or perhaps a wedge, a way to access and evidence other, more occult and harder to articulate problems around self-determination, emerging technology, and the nature of knowledge-work. Another feature of this debate is the way in which the regularity with which PCE and similar technologies are mentioned popularizes and spreads the idea that they are necessary and acceptable. Inaccurate and overblown it may be, but the idea of neuro-enhancement is an idea with substantial weight, and as a technological imaginary (Punt, 2000) encapsulates a popular model for a technology that holds sufficient weight to pick up its own momentum.[2]

[1] Adderall, for example, is a mixture of amphetamines. Although at this juncture Tom Wolfe would probably point out that the widespread practices of prescribing amphetamines to children may be new, despite the fact that he first came across their use in the 1960s (Wolfe, 1997). For a history of the relationship of drug to network technologies, see Power (2013).

[2] Atkinson's *Delete: A Design History of Computer Vapourware* (2013) offers complimentary examples of how the computing industry has produced "vapourware" products that are in some cases never intended to reach production, but instead provide the public with misconceptions about technological capabilities or near-to-market products.

Cognitive Innovation, Looping Effects, and Bootstrapping

Central to the integrative definition of "cognitive innovation" proposed by CogNovo PIs has been the idea that it is a process by which an individual, or a society, engages in "constructing and adapting the self" (Gummerum & Denham, 2014, p. 586). Taking this as a model of cognitive "bootstrapping" they refer to a recursive "creativity function," the results of which are creative products that may be seen as the results of individual self-adjustment and self-reflexive perception (Denham & Punt, 2017, p. 184). With its focus on recursive processes, this definition of cognitive innovation can be seen to refer to the cybernetic potential of the mind at work on itself, both at a neural and—through representation—cultural level.

While individual cognitive innovation is self-reflexive, if not self-aware, on a cultural level it might be argued that the cognitive sciences and discourses that surround them are a source of novel ideas about the mind and self that might be incorporated into working models of exploration. The idea that the language, models, and discourses of the human sciences influence the way in which people understand themselves is a mainstay of academic work that seeks to approach them from historical and cultural perspectives. Projects of categorization, diagnostic and managerial in the human and social sciences influence how people think about themselves and one another, with the curious effect that they become "looping kinds" (Hacking, 1995, pp. 352–355).

Michael Pettit has pointed out that "few have greater confidence in psychology's ability to mold subjectivity than its critics" (2014, p. 146): the principle of looping kinds is so rarely questioned that it has become a truism. He argues that current work to historicize psychology tends all too easily to anticipate a one-directional flow of influence between the sciences and the subject and makes a number of suggestions about what is missing from accounts of "the loop." Building on an awareness that "subjectivity is neither something authentic and interior that psychology documents nor is it something imposed from outside" (p. 155), approaches might incorporate models of cognition and affect; or models of culture. These recognize the agency of audiences and their role in interpreting and making use of the way in which they are represented; "the social life of psychological science is simultaneously a set of stories about the subject's augmentation, exploitation, cooptation, appropriation, defiance, incredulity, and boredom" (p. 155).

Pettit's critique, and his suggestion that we might be more "attentive to . . . the materiality of the circuits through which psychology travels" (p. 155), indicates that something might be gained from further exchange between critical history of psychology and media historical or media archaeological work that considers people not as subjects, but as audiences. While some of this work takes its objects of study to be the development of specific media forms, for the most part accounts of cognition and

affect, and the audience as actively engaged in the interpretation, reception and development of media forms and content are fundamental concerns; media, such as the academic texts and media reports discussed above, are material and cultural expressions of creativity (Punt, 2000; Pepperell & Punt, 2000). In "A View from the Bridge," Denham and Punt (2017) elucidate this position with regards to the development of the cinema as a cognitive apparatus. They draw on Gustav Metz to argue that the cinema is a "is a technological experience in which the viewer engages with their perception in action" (p. 2).[3] We might imagine that in the case of media which represents ideas from the psychological or cognitive sciences, this self-reflexivity may become even more pronounced. Indeed, Marcia Holmes, in a paper exploring the representation of brain-washing technologies in cinema, argues that these narratives, delivered by a cinematic apparatus comparable to the represented technology in the film, produce a particular and very active subject position, that of the "cybernetic spectator"—"a subject who scrutinises how media and other demands on her sensory perception can affect consciousness, and seeks to consciously participate in the mental conditioning and guide its effects" (Holmes, 2017, p. 3).

Bearing in mind this self-referential attention to the meaning and content of experience, within a narrative that stresses the plasticity and potential manipulability of the subject, we might reflect on the fact that in certain cases, as researchers, academics and educators, the subjects of the PCE discussion are broadly same community who investigate it. As Holmes' invocation of cybernetics stresses, much as does Denham and Punt's use of "bootstrapping" (2017, p. 184); looping effects are in themselves generative, and hence and we might speculate that academic mistakes and misunderstandings are interpretable as some form of cultural-level cognitive innovation. In this, the media in question, academic writing, offer expression as much as "scaffolding" (Clark, 2015, p. 18) for cognitive innovation as cultural creativity.

Academic Writing, Novelty and Neology

Since the late 80s and 90s the invention of novel terms signifying new technological and conceptual developments have offered a currency of bi-directional exchange between techno-scientific research, culture and science fiction (sf). Istivan Csicsery-Ronay's (2008) in-depth analysis of the nature and affordances of "fictive neology" (pp. 13–46) in sf is instructive as to how we might begin thinking about the creative and aesthetic aspects of discourses such as the sciences and philosophy that have cultural intersections with the genre. Neologisms are generated in a variety of ways that include shifts in meaning, lengthening, shortening, and compounding terms. As he points out, it is only when certain aspects of scientific knowledge become accessible to the public through journalism and science communication initiatives that they

[3] Here we see Metz's idea doubly out of context and secondarily cited.

are ubiquitous enough to be incorporated into writing practices, as academic, journalistic, and fictional discourses intermingle. The practice of "neologogenesis," the creation of new terms, is one that communicates the "linguistic power" (p. 14) of the new word's users.

In sf, the very existence of new words in the fictional world prompts the reader to consider the events and conditions that have made them necessary. As Csiscery-Ronay suggests, drawing on Samuel Delaney's work, in a text where many if not all of the words are familiar, we assume that the world described in the text is identical to the one we already know (p. 22). When a neologism appears in the text, we must account for what is different about that world that has led to the word coming into existence, and indeed use. The *loglo* of Neal Stephenson's *Snow Crash* (1992, p. 7)—the unbroken lights of fast food franchises, motels and nation states that line the freeways of US West coast—indicates a specific feature of the landscape so ubiquitous it requires its own term, but within the account, he offers a discussion of the kind of experience that engagement with novel terminology evokes, which points this discussion towards a consideration of how the academic texts discussed above are dealt with, the way they function for the readers, writers and thinkers who make use of them, and how neologisms create a certain type of reading experience.

When do readers do this work of interpreting? While novel words prompt imaginative invention, but they might also be dealt with by being ignored, or at least overlooked. A feature of perceptual creativity *and* bootstrapping may be a development of the ability to overlook or ignore one's lack of understanding or familiarity with a term. Rekdal's (2014b) reminder that striving to use primary sources is a "basic academic principle" (p. 744) is correct, but still, secondary citation offers a space for "boostrapping." Likewise the "feverish linguistic atmosphere" (Csicsery-Ronay, 2008, p. 26) of genres such as cyberpunk fiction might offer cognitive training grounds for dealing with unresolvable levels of novelty and ambiguity, whether for the apparent dislocations of contemporary techno-culture, or perhaps working in transdisciplinary research environments where ambiguity is often criticized, but may have its own benefits.

Despite the conflicting variety of reasons that individuals are interested in the discussion of PCE, the ways in which the discussion has been generated, enabled and distorted can be seen as a productive cultural function of the mind's interest in itself, the potential misunderstandings about PCE that it entails don't mean that it is necessary to undermine the productivity of the discourse, if we consider how they reflect potentials rather than facts.[4] Circular reporting and academic urban legends fit

[4] This observation would also be supported by the similar discussions around direct current stimulation (DCS) technologies, which involve the application of electrical current to the head or brain, equally for therapeutic purposes/neuroscientific experimentation and (apparently) increasingly used for performance enhancement (Wexler, 2017).

alongside the creative shifting of neologism. As different features of writing practices, they offer ways for the bootstrapping processes of self-adjustment to take place within and at the fringes of research spaces. They suggest that people, including scientists—on individual and social levels—may be thought of as "cybernetic investigators," whose failings may sometimes have their own value.

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Response to "Academic Carelessness, Bootstrapping, and the Cybernetic Investigator" by Diego S. Maranan

In this paper, Drayson argues that certain features in academic practices—such the circulation of academic urban legends that are quoted as fact, or the gap between the discussion on and actual prevalence of pharmaceutical cognitive enhancement—can be explained through the bootstrapping aspect of Cognitive Innovation. The argument is compelling. What I would like to pick up on is a point made later in the paper about how neologisms contribute to the reimagination (or at the very least, the reinterpretation) of the perception of the self, society, and the environment. Drayson's invocation of cybernetics in relation to cognitive innovation is timely. In particular, neology plays an important role in describing, defining, and reinscribing new views on the human condition in general (and human cognition in particular) in relationship to an evolving media and technology landscape. Neology thus plays a role in Denham's (recursive) cognitive innovation function. Coining a new term can bring into focus or even into existence a new view of the human condition as it is inflected by the media technologies that humans create; this term in turn then generates new thoughts, values, and behaviors.

Drayson also lends weight to an argument that is hinted at in other paper in this issue, "Navigating Cognitive Innovation" (p. 45), which I co-authored. There, my co-authors and I suggested that the term "cognitive innovation" carries a semantic load that obscures the full depth and breadth of what the term might be intended to signify. In addition, we proposed that technology should be explicitly addressed in Denham's cognitive innovation function. Drayson's paper suggests that we need to go one step further: might it be useful to coin an altogether different and new word (much like Stephenson's 'loglos' or, say, Maturana and Varela's 'autopoiesis') for the process signified by cognitive innovation? Perhaps the semantic baggage of the constitutive terms of "cognition" and "innovation" prevents us from properly producing that "moment of dislocation [and] distancing" that makes neologisms so powerful?

This train of thought leads me to a final question: what are the relationships between cognitive innovation and theoretical frameworks such as *cybernetics*, *autopoiesis*, and *posthumanism*? For instance, "cognitively innovative" systems seem to be the larger class of systems that subsumes both self-observing and self-modifying systems. There are clearly links between these frameworks which could be further explored in future publications.

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Navigating Cognitive Innovation

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Abstract

This paper revisits the concept of Cognitive Innovation with the aim of helping newcomers appreciate its (intended) demarcating purpose and relevance to the wider literature on cognition and creativity in the humanities, arts, and sciences. Particular emphasis is paid to discussion of the pitfalls of sense-making and the concept's affordance. The main argument presented is that proponents of the concept face the dilemma of seeking to demonstrate its transdisciplinary nature and applicability vis-a-vis retaining its semantic distinctness. Proceeding from a classification of Cognitive Innovation as a dispositional construct, we discuss how it feeds into existing research approaches and opens up new sensibilities in related areas. The perspectives of temporality, interdisciplinary balancing, technology, and metatheories are proposed as promising areas for future elaboration of the function of Cognitive Innovation.

Keywords: concept analysis; creativity; interdisciplinarity; metatheory; temporality.

Introduction

In her seminal paper on concept analysis, Rodgers argues that intellectual progression is greatly impaired when definitions and attributes of fundamental concepts are not made clear: "[Q]uestions regarding vague or ambiguous concepts are met with confused responses that are dependent upon individual and often ad hoc interpretations" (Rodgers, 1989, p. 330). Conceptual unclarity characterizes several research areas that have become tantalizing in cognitive science within the last decades, including creativity, consciousness, cognition and play. Research that proposes

measures of creativity or attempts to determine neural correlates of creativity is often criticized not on the basis of its methodological rigor, but on the basis of its claim to represent the concept of creativity. At the same time this might also be the root of disagreement between different lines of research.

Lack of clarity regarding the concept of creativity has been a recurrent theme within CogNovo's[1] network of principal investigators, PhD students, affiliates, and partners, where presentations on creativity have often extended into dead-end discussions about fundamental ontological and epistemological questions. In order to overcome these discursive impasses, Denham and colleagues proposed the notion of Cognitive Innovation to help position (or perhaps displace) creativity. In this paper, we draw attention to the notion of Cognitive Innovation as we understand Denham (2014), Gummerum and Denham (2014) and Denham and Punt (2017), collectively referred to as "Denham and colleagues."

To help tighten the grip of the concept's unique affordance, we examine a series of issues regarding interpretation and comprehension of the depictions by which the concept comes into expression. Our aim is twofold: first, to help newcomers to the concept appreciate its (intended) demarcating purpose; second, to suggest new approaches to interdisciplinary research on cognition.

Cognitive Innovation as a Neologism

The notion of Cognitive Innovation was coined long before the recent rendering by Denham and colleagues, when Acker and McReynolds (1965) introduced the Obscure Figures Test as a measurement of Cognitive Innovation. Their paper references a talk at the annual convention of the American Psychology Association as the source of the term, but the available proceedings do not mention it at all (McReynolds, 1964). Presumably the term was discussed during the talk and summarized in Acker and McReynolds (1965):

> It is conceived that in the course of his commerce with his[2] environment, an individual builds up an over-all cognitive structure which for him represents the nature of reality and in terms of which input data should be processed. This over-all cognitive structure can be assumed to undergo certain changes over time. The processes whereby these changes are brought about are what is meant by "cognitive innovation," i.e., innovation or the introduction of newness into the cognitive structure. (p. 851)

[1] CogNovo started as a doctoral training program at Plymouth University, jointly funded by the EU through the Marie Curie Actions and Plymouth University. For an overview of the CogNovo program (https://CogNovo.eu) and its twenty-four research projects, see Maranan, Loesche, and Denham (2015).

[2] For clarification: even though only male performance is discussed, females and males participated in the study. Presumably the assumption and results apply to both genders, even though the wording suggests otherwise.

The cognitive structure mentioned here resembles to some extent imagery or mental representation and individual knowledge. The manipulation of internal structures towards something novel is what Acker and McReynolds (1965) address with their use of the term Cognitive Innovation. Denham and colleagues also mention such manipulation as a key property in their articulation of the concept. Interestingly this exhibits some overlap between the two uses of the term, without explicit reference.

In perhaps the most succinct linguistic definition available from their contributions, Denham articulates the concept of Cognitive Innovation as "a recursive process in which an individual probes its boundaries to seek out new knowledge, selects promising avenues for more extensive exploitation, and synthesizes what it learns within its growing body of knowledge" (Denham & Punt, 2017, supplement, p. 4). Denham refers to Cognitive Innovation as a generic and recursive function manipulating not just the imagery (and other explicit knowledge), but also the individual's set of internal mental processes and the Cognitive Innovation function itself. The sum of sensory inputs is the third distinct parameter feeding into the Cognitive Innovation function. In its functional form, Cognitive Innovation is presented as

$$F_{t+dt}, x_{t+dt} \Leftarrow F_t(F_t, x_t, s_t)$$

where

> F represents the mental processing of an individual, and the set of things it knows about, . . . F_t represents all internal (mental) processes, is the set of ideas, facts, words, and so on that are known by the individual and can be exchanged with others, s_t are things in the world perceptually accessible to the individual and t is an index of time. (Denham & Punt, 2017, supplement, p. 5)

Cognitive Innovation as a Dispositional Concept

Whereas Denham and colleagues seem to have a strong idea about the essence of Cognitive Innovation, we draw attention to the question of how to make sense across the vast range of disciplines that are engaged with cognition and innovation. Lack of familiarity with the concept poses at least two pitfalls in terms of sense-making.

First, the reallocation of meaning to a compound term which makes use of omnipresent words with rich historical semiotic loads requires the term to be freed from unintended meanings. Familiarity with its constituting terms of cognition and innovation may misleadingly activate interpretations that combine unintended attributes of both. Cognitive science forms its own research domain, including a set of disciplines at the intersection between neuroscience, anthropology, artificial intelligence, linguistics, philosophy, and psychology (see Thagard, 2005, p. X [sic]). Innovation appears to be used within social sciences and economic and engineering

literature, with an emphasis on multi- and interdisciplinary work (see Crossan & Apaydin, 2009; Fagerberg, Fosaas, & Sapprasert, 2012). As a result, innovation has a number of definitions across and within different disciplines, often related to the "implementation of creative ideas" (Amabile, 1988, p. 126) and echoing two dimensions also used for the definition of creativity on individual levels of novelty and usefulness (see Runco & Jaeger, 2012; Stein, 1953), but typically measured on an organizational level (Sawyer & Bunderson, 2013, p. 14). In short, we note that each of the constituting elements of Cognitive Innovation are very rich and semantically overloaded. As opposed to the blank slate approach of inventing an artificial word to describe the concept, cognition and innovation—to stay within the metaphor—have chalk scribbles dense enough to provide some colored but almost indistinguishable background. At the same time, this approach situates Cognitive Innovation in approximation to metatheories, involving humans and human behavior.

A second (general) pitfall of sense-making is that one thing is understood in terms of something else, be it an existing conceptual framework, terminology, or historical or cultural situatedness. Gadamer's (1960) notion of fusion of horizons (*Horizontverschmelzung*) eloquently captures the inevitable compromise that takes place during any text comprehension: two "horizons," i.e., scopes of insight restrained by "historically effected consciousness," are fused during the interpretative act—the horizon of the text and the one of the reader. Thus, the same description of Cognitive Innovation will most likely be understood quite differently by an expert on, say, Cognitive Flexibility Theory (e.g., Spiro, Coulson, Feitovich, & Anderson, 1988) than by an expert on epistemology (e.g., Archer, 1988). Both topics share similarities with Denham's description of Cognitive Innovation, but respectively emphasize the different aspects of learning and knowledge production. While aspects and insights from such related domains are commensurable with the description of Cognitive Innovation, it is impossible to determine in an absolute sense whether such aspects are intrinsic features of Cognitive Innovation. Denham may say they are, or are not, and someone else may say the opposite. Hereby a challenge regarding the conceptual clarity of Cognitive Innovation emerges: Denham's definition of the concept—a recursive process of exploration, exploitation, and synthesis—is expressed at a very high level of abstraction that is easily translatable or applicable to numerous domains and contexts. While this genericity may be embraced and leveraged, as exemplified by all the writings of Denham and colleagues, the question of the concept's boundary marking is left unresolved (except for the distinction between creativity and Cognitive Innovation).[3] Whether or not this semantic fluidity is a problem depends on the ontological underpinnings of the concept.

[3] Denham and Punt, however, seem to be aware of this contingent imposing of meaning onto the concept in acknowledging that what they are tackling "is, and also is not, necessarily the same thing" (Denham & Punt, 2017, p. 185).

Historically, concepts have been thought of as belonging to one of two categories (Rodgers, 1989): "Entity views" treat a concept as a clearly demarcated and stable "thing" with a rigid set of necessary and sufficient conditions. The essence and truth value of a concept can therefore be approached positively through a reductionist approach and should not be examined relative to some context. "Dispositional views," on the other hand, treat concepts as habits or behavioral potentials. In contrast to a fixed and reductionist approach, they acknowledge dynamic formation of concepts through individuals' interpretation and utilization as a sine qua non condition. We argue that the concept of Cognitive Innovation is a dispositional construct. This is perhaps most clearly expressed in the paper by Denham and Punt (2017), which articulates the concept on the basis of two distinct mindsets influenced by the domains of computational neuroscience and media archeology, respectively. Whereas this dual perspective arguably supports their intention to promote Cognitive Innovation as a focus for collaboration between the sciences, arts, and humanities, the format of the paper—two self-standing essays "in which the contributing specialisms retain their academic and methodological distinction and voice" (Denham & Punt, 2017, p. 184)—does not promote fusion of disciplinary horizons by example. Bearing this point in mind, the "bridge" from which Denham and Punt (2017) look at Cognitive Innovation (as indicated by the paper's title) is probably better understood as a nautical metaphor (i.e., the platform from which a ship is commanded) than as a construction that connects existing platforms across a gap. A pertinent question posed by this interpretation is: Where is the ship heading?

Charting New Territories in Cognitive Innovation

If we proceed from the assumption that Cognitive Innovation is a dispositional construct, we can begin to envisage how the concept feeds into existing research approaches and opens up new sensibilities. The following three strands of thought follow from our contemplation of the notational form of the functional definition of Cognitive Innovation.

Emphasizing the Temporality of Cognitive Innovation and Creativity

In cognitive sciences, creativity is assumed to be a stable trait that can be measured without changing it. Both the functional description of creativity by Denham and colleagues and their characterization of Cognitive Innovation instead emphasize their malleability to influences over time. Even in their notation, time might be overlooked as a small subscript to the parameters and results, but it is a subscript to every single parameter. Indeed time, it could be argued, should be more explicitly addressed in the study of creativity as it emerges from Cognitive Innovation.

The effect of task-specific training has been shown for divergent and convergent thinking (Scott, Leritz, & Mumford, 2004), as well as insightful tasks (Weisberg, 2014). This alteration of internal knowledge, as represented by *xt* in the Cognitive Innovation function, changes with repeated exposure and therefore time. Based on this empirical and anecdotal underpinning it is no surprise that time plays an important role in many theoretical models of creativity, such as the temporal stages mentioned by Wallas (1926) to Csikszentmihalyi (1988), and basically any idea that taps into the second "P" (Process) from Rhodes' (1961) "four Ps of creativity" model, which uses time as an independent variable.

Following up on this theoretical stance, it remains unclear how much the recursion of perceived time (for example, through Earth's rotations around the Sun and itself) or technologically and culturally constructed time (rotations of minute hands on clocks, "the same" bus every 7 minutes) itself is intrinsically reflected in the functional description by Denham and colleagues. Future discussions might want to address the effect chrono-biological or chrono-technological processes have on the recursion of Cognitive Innovation.

A temporal perspective can also be used to illustrate the difference between Cognitive Innovation and creativity. Denham and colleagues characterize creativity as an exaptation of Cognitive Innovation and appear to suggest that creativity is a contemporary and socially grounded expression of what is ultimately Cognitive Innovation.[4] The distinction can be perceived with a thought experiment: What was creativity (or what did people think about it) 10 years ago? Probably it was similar to what we think now. What about 100 years ago, when the word "creativity" first emerged in Western languages? What about 6,500 years ago, when the wheel was invented? What about 525 million years ago, when the first vertebrates emerged? 525 million years ago, creativity was probably "non-existent," whereas cognitive innovation probably did exist.

[4] Part of what distinguishes creativity from Cognitive Innovation is that the notion and valuation of creativity (and what constitutes a creative product, process, or person) is contingent on its environment in all its social, cultural, technological, and political dimensions. For instance, it has been suggested that social risk-taking is associated with creativity (Tyagi, Hanoch, Hall, Runco, & Denham, 2017); that is to say, what or who is creative is not necessarily considered socially acceptable. A second distinction of Cognitive Innovation from creativity—potentially also a consequence of the involvement of multiple agents—is the application or at least applicability of the resulting products. The formula Cognitive Innovation = creativity + communication + application is oversimplifying the idea of Cognitive Innovation as an "endless cycle of exploration, exploitation, and explanation" (see Gummerum & Denham, 2014, p. 586), but emphasizes the distinction to creativity nevertheless.

Decomposability, Balancing Interdisciplinarity, and Technology

The functional definition of Cognitive Innovation states that it is recursively constituted of an individual's mental processes (F), their existing knowledge (x), and properties of the perceptually accessible world (s). Denham and Punt (2017) further suggest creativity is constituted not only by the terms of the Cognitive Innovation function, but additionally by the knowledge (y) and cultural and societal processes (G) of the community (Denham & Punt, 2017, supplement, p. 10). We propose that the decomposability of Cognitive Innovation and creativity in such particular terms affords strategies for evaluating and advancing interdisciplinary research programs such as CogNovo.

First, it suggests that a research group studying Cognitive Innovation and creativity would best be served by a disciplinary mix that included not only cognitive neuroscience and psychology to cover terms F and x, but also cultural anthropology and political sociology (which were absent in CogNovo), perhaps with an emphasis on ethnography as a methodology. This complement of disciplines more fully corresponds to the components of the functions.

Second, it calls for reflection on the role that computational sciences and media studies play in the research agenda of an interdisciplinary research group studying human creativity. Why should computation, media, and technology matter in this field? In the creativity function, where do things like hammers, telescopes and mobile phones fit in? Strictly speaking, they are simply part of the perceptible world, s, yet they seem to be more significant than that. We suggest that technology (in the sense of apparatuses, equipment, and tools) might be considered to constitute a special aspect not only of the material, perceptible world (s), but also of societies' ways of thinking and doing (G). Describing the function of contemporary technology, Punt (Denham & Punt, 2017, p. 185) points out that technology serves to supplement the human body, either by "alleviat[ing] the hardships of nature through muscular amplification" (particularly in the past), whereas contemporary technology (also) extends the "limitations of the sensory range" of the human organism. Indeed, technology can, as McLuhan (1964) argues, be an "extension of ourselves" in that it extends the cognitive system as much as it can extend the body (Brey, 2000). Technology can play an active role both in perceiving the world differently and also in transforming it. We thus argue that technology deserves to be set aside as a special term in the creativity function. Hence, the creativity function

$$F_{t+dt}, x_{t+dt}, G_{t+dt}, y_{t+dt}, s_{t+dt} \Leftarrow F_t(F_t, x_t, G_t, y_t, s_t)$$

might be more completely described as

$$F_{t+dt}, x_{t+dt}, G_{t+dt}, y_{t+dt}, s_{t+dt}, T_{t+dt} \Leftarrow F_t(F_t, x_t, G_t, y_t, s_t, T_t)$$

where T stands for technology—the apparatuses, devices, and mechanisms that extend the body and brain, and thus arguably extends (or at the very least mediates)

human agency (Latour, 1994). That is to say, the recursive, functional form of Cognitive Innovation and creativity facilitates an extended description of cognition that is much in line with theories of The Extended Mind (e.g., Clark & Chalmers, 1998). This transcends the focus on intra-cranial processes, which historically have been the object of cognitive studies.

Cognitive Innovation and Metatheory

The existing articulations of Cognitive Innovation do not explicitly mention any particular philosophical anchorage, nor do they claim to pertain to any context, historical era or culture. In this regard, the concept shares fundamental features with metatheories. One example of a metatheoretical framework with particular strong affinities to Cognitive Innovation is Clare Graves' Emergent, Cyclical, Double-Helix Model of Adult BioPsychoSocial Systems Development (e.g., Graves, 1974). Graves' lifelong project was to study no less than the developmental path of human nature. In the 1950s he began to collect anthropological and psychological data without having any hypothesis, in an approach similar to what was later formalized as Grounded Theory by Glaser and Strauss (1967). The culmination of his work was the proposal of a pattern and direction in the path of human development in the form of a framework that integrates various theories of human development, e.g., Maslow's (1943) hierarchy of needs, and Dawkins' (1976) idea of memes. On the basis of data collected over a period of more than 30 years, Graves proposed seven developmental levels of being or existence in the world that occur in a predictable successive order.[5]

Graves' work, we propose, is relevant for Cognitive Innovation as it demonstrates traces of recursion at work and also demonstrates the link to societal processes and community knowledge. It is a rich qualitative account of what Cognitive Innovation—a shadowless structural description—leaves behind, so to speak. Graves' model shares with the model of Cognitive Innovation the aim to account for development from more primitive levels or states to more sophisticated levels or states. Graves' model does this by suggesting a particular direction in the spiral of development of human nature, whereas the model of Cognitive Innovation suggests bootstrapping mechanisms by which development takes place. Whether the latter qualifies for the label of a metatheory is debatable, but at least Cognitive Innovation lends itself as a useful supplement to enhancing self-reflexivity in metatheoretical frameworks like Graves' in a concise way.

[5] Graves' work (particularly his taxonomy of developmental levels) has been popularized by Beck and Cowan's (2005) work on Spiral Dynamics and Ken Wilber's (2000) work on Integral Theory.

Conclusion

The pragmatic value of the concept of Cognitive Innovation to the academic discourse on creativity (and other fields) will stand its test in years to come. It is tempting, both to proponents and reviewers of the concept, to elaborate on possible meanings suggested by the semantic load of its two constituting terms, not least because many concepts in the history of cognitive studies appear to be closely related, named similarly, or both. However, subsuming too many principles under the concept—a likely consequence of opening it up to fit existing discourses of various disciplines—comes with the risk of diluting its semantic span. For this reason, we have suggested that Cognitive Innovation ought to be thought of more in terms of a metatheoretical framework than as a concept. While increasing the accessibility of Cognitive Innovation to a wide audience is in line with Denham and Punt's aspiration to have it provide "a theoretical and practical platform from which to explore disciplinary differences in our understanding of creativity" (Denham & Punt, 2017, p. 184), it is potentially confusing to propose what seems to be a semantic chameleon as a conceptual demarcation from creativity. In addition to pointing out this dilemma (without attempting to solve it), we have highlighted a few aspects of sense-making and affordances of the concept that we think future investigations should examine in more detail.

While Denham and Punt (2017) do not directly propose a method to integrate their different disciplinary specialisms by which they approach and discuss Cognitive Innovation, their individual horizons clearly intersect and seem to be within the reach of integration or fusion. It seems therefore as if the challenge of promoting Cognitive Innovation as a research object lies not so much in the description of the concept, but rather in how to study and write about it in a transdisciplinary manner. We have outlined a few ideas on temporality, interdisciplinary balancing and metatheories that we believe are important to consider in more detail in future enquiries and developments of Cognitive Innovation to navigate analytical operations in the muddy waters of conceptual territory.

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Music as Water:
The Functions of Music from a Utilitarian Perspective

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Abstract

The rapid increase of technologically enhanced listening platforms gives listeners access to music with ever-increasing ease and ubiquity, giving rise to the suggestion that we should now conceptualize music as a resource similar to water; something that is utilized to achieve everyday goals. This paper proposes that music is a utilitarian resource employed by listeners to augment cognitive, emotional, behavioral, and physiological aspects of the self. To better explore these notions this paper examines the potential role of the "functions of music," first espoused by Alan P. Merriam in 1964. Merriam suggested music has a situational use and an underlying function (music's ability to alter the self through listening).

The research presented here asserts that listeners interact with specific musical materials to achieve or orientate themselves towards contextually-rooted goals. Reinforcing Tia DeNora's suggestion that music is a "technology of the self" this research presents the results of a 41 publication meta-analysis exploring the possible functions of music. The resultant Aggregate Thematic Functions Framework (ATF framework) identifies 45 possible utilitarian functions of music, spread across five domains of action. The framework also proposes a meta-domain and an emotional sub-domain.

Keywords: augmentation; functions; goal; listeningof music; regulation; resource; utilitarian.

Music as Water

"Music can now be seen as a resource rather than merely as a commodity" (North, Hargreaves, & Hargreaves, 2004, p. 42) from the perspective of the listener. North et al.'s stance is grounded in the psychological and sociological employment of music; they suggest that music is capable of performing useful functions for listeners. The utility of music has been highlighted in numerous studies, each illustrating music's potential to augment various aspects of the self: psychological (e.g., Chamorro-Premuzic & Furnham, 2007; Greasley & Lamont, 2011; Laukka, 2007), emotional (e.g., Gantz, Gartenberg, Pearson, & Schiller, 1978; Laiho, 2004; Sloboda, 2005), social (e.g., Bennett, 2015; Christenson & Roberts, 1998; Laiho, 2004), and physiological (e.g., Juslin, Liljeström, Västfjäll, Barradas, & Silva, 2008; Sloboda, 2005).

Alternatively, Kusek, and Leonhard (2005) echo the ideas of David Bowie (Pareles, 2002) by suggesting that, in the current climate, we should conceptualize music as a resource akin to water; a basic utility for all. They argue from an economic perspective that, for the music business to survive and thrive, music should be considered a household utility. These two views are not incompatible; rather they are complimentary and interrelated. The notion of water as something that has utility for us in everyday life (hygiene, survival, agriculture, etc.), and the notion of water as an economic model (subscription based) is entirely applicable when examining the current instantiation of music in everyday life. We should perceive listening from a utilitarian perspective.

DeNora (1999) referred to music as "a technology of the self" as it is a tool we use to augment facets of ourselves as listeners (social interaction, emotions, physiology, etc.). As a resource, music is also somewhat dependent on its transmission via technological mediums. The increasing reflexivity and portability of music listening devices "means that the choice to hear specific music can be exercised in more and more situations" (Sloboda, Lamont, & Greasley, 2012, p. 1). Krause, North, and Hewitt (2014) suggest that music can become imbued with new functions for us, and that these new uses spring from the increasing ubiquity of music in the world. Yet, this adaptive behavior does not exist in a vacuum. Scherer and Zentner (2001) point to the potent interplay of music, situation, and individual factors when individuals utilize music to achieve specific outcomes. Further compounding the issue of listening is the omnipresent sonic landscape in which we live, with sound as an increasingly pervasive force in retail establishments, restaurants and bars, television, associated media, recreation, etc. often occurring in direct opposition to our desired listening material or use of said materials. To fully understand the current state of utilitarian listening we must begin by facing two questions: firstly, how has our listening shifted over time with new technologies? Secondly, what functions can music perform for us?

The first of these questions is far too nuanced and wide-ranging to explore in this short paper. Some progress has been made (i.e., Sterne, 2003), but much of our engagement remains obfuscated or unmapped. Rather, this paper is concerned with

the second question. Whether we are aware or not of the potential ramifications music can have on the psychological, emotional, social, and physiological aspects of life (e.g., Knobloch & Zillmann, 2002; Saarikallio, 2011), it is a resource we employ on an everyday basis. Thus, this resource has innate functionality we can draw on. Arguably, music has always served functions for us but, with the growing technological refinement with which we listen, the potential for music to serve utilitarian functions has increased. Therefore, what functions does music serve and how can we begin to identify them?

Uses and Functions

> *Use* then, refers to the situation in which music is employed in human action; *function* concerns the reasons for its employment and particularly the broader purpose which it serves (Merriam, 1964, p. 210).

Alan P. Merriam was the first to suggest, define, and model the functions music could serve within a society. He explicitly created a divide between *use*, as being related to the situation, and *function* as the underlying rationale relating to the desired effect of the music. Andrew H. Gregory (1997) is one of the few researchers to strictly adhere to Merriam's original definitions and points to several examples of music use grounded in the situational or contextual aspects of music's employment: lullabies, battle, games, etc. Function, however, has generated far more interest in academic research, with many researchers proposing their own model of the functions of music. Merriam was the first to identify functions of music constructed from anthropological and ethnomusicological study, 10 in total: emotional expression, aesthetic enjoyment, entertainment, communication, symbolic representation, physical response, and four functions concerning social institutions and social stability).

Hargreaves and North (1999) attempted to re-evaluate Merriam's original model for the contemporary Western society, placing the emphasis on the social aspects of music (adding concepts related to self-identity, interpersonal relationships, and mood management). DeNora (2000) drew her own suggested framework that related to specific domains of action (the body, situations, communication, etc.), domains that are also reflected in the work Sloboda et al. (2012). Bull (2000) and Williams (2006) both performed work into the functions of portable music in contemporary Western society. Numerous other models also exist within the literature but there is currently no consensus as to the functions of music.

It should be noted that there exists no comparative analysis of functions from a historical perspective, and little is known about how functions may have changed over time as a result of technological or social change. Given the questions raised in the previous section, this further level of inquiry is not feasible owing to the interdependency of these concepts.

Aggregate Thematic Functions Framework

Given the variety and variation between the functions presented in the corpus of the literature, the following analysis attempts to identify an exhaustive list of the potential functions of music, and group them by domain of action (cognitive, emotional, physiological, social group, social individual). The analysis then provides a visual representation of the framework, suggesting possible interconnected functions, one meta-domain, and one sub-domain.

Literature Search

The search for salient literature was conducted using electronic academic databases. Using multiple keywords, the aim was to gather the broadest range of possible literature dealing with the functions of music. Keywords included: *function, music, use, regulation, strategy,* and *listening*. Pluralized terms were also used. The term *use* was specifically included to overcome the misidentification of function by many researchers. There were no date restrictions placed upon the search. Articles that replicated the work of prior researchers, without alteration, were excluded to remove redundancy.

Methodology

Publications were partially drawn from Schäfer, Sedlmeier, Städtler, and Huron's analysis (2013). Additional studies were identified from literature searches and references therein. 41 publications were identified in total. The publications draw from a broad range of disciplines (see Figure 1): music psychology and sociology represent over half of the body of papers (58%). Other areas include musicology, music and emotion, and music in everyday life. Sports sciences was the least frequent discipline (only one publication was identified). Few papers differentiate between recorded music listening and live music listening. This lack of differentiation shall be maintained here.

10 publications included multiple datasets. Where applicable, these are included and treated as discrete entities. Across the 41 publications 58 datasets were identified.

620 references to the functions of music were identified. 18 functions were labeled as "incorrect," as they did not adhere to Merriam's definition (the findings were in fact either *use* or descriptions of musical aesthetics). These were excluded from the analysis. The remaining 602 functions were then sorted into five domains of action (psychological, emotional, physiological, social individual, and social group) based on their description within the original source publication. Finally, the identified functions within each domain were combined based on their description in the original source publication and semantic coherence using NVivo software.

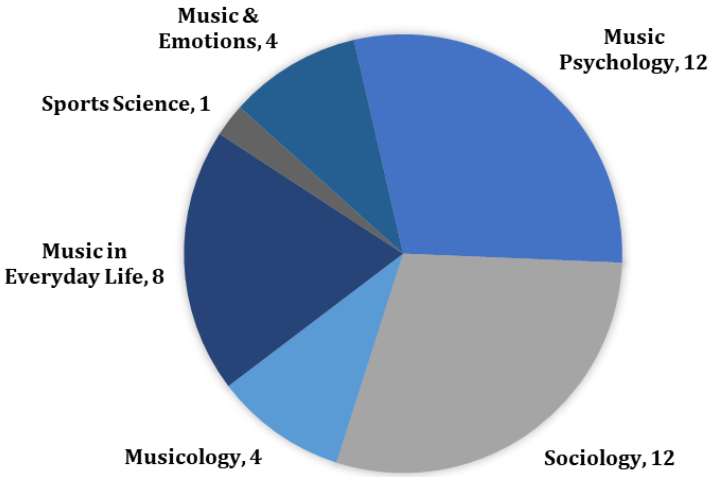

Figure 1. Paper distribution by discipline.

Results

The *emotional* domain of function was the most frequent within the aggregate body of functions: 158 instances of *emotional* functions (26% of total functions). The least frequent was the *social individual* domain of functions: 45 instances (7% of total functions). The *social group* domain accounts for more than three times that of *social individual* with 136 functions identified (23%). *Cognitive* functions and *physiological* functions also occurred with relatively high frequency (22% and 21% respectively). N.B. percentages are to the nearest integer.

Regarding the publications and individual datasets, *social group* was the most common domain of functionality: 45 of the 58 datasets within the aggregate body contained at least one function pertaining to the *social group* domain. Conversely, the *social individual* domain was the least frequent: occurring in only 24 of the 58 datasets. The threefold increase is not represented here, rather an approximate doubling between *social individual* and *social group* functions. This implies that whilst there are fewer functions overall pertaining to the *social individual* domain, this is not representative of how likely an article is to contain *social individual* function.

Analysis identified Christenson & Roberts (1998) as the most function-rich study, presenting 39 individual references to function. Two datasets did not yield any valid functions: Hargreaves & North (1999) *A*, and Packer & Ballantyne (2010) *B*. Functions were not weighted by citation count or impact factor of the source article.

The thematic semantic grouping of functions revealed 45 functions of music spread across the various domains. Five functions appeared within multiple domains, these were mapped to the *meta-domain*. Within *emotional* functions, there appeared a group of five interrelated functions. These were compiled into a sub-domain: *specific regulatory strategies*.

Findings & Discussion

45 discrete functions were uncovered in the Aggregate Thematic Functions Framework (hereafter referred to as ATF framework; see Figure 2) and were sorted into five domains of action. Two additional domains were also included for clarity (the *meta-domain* and the *specific regulatory strategies* sub-domain). The frequency of each function within the aggregate dataset is shown, and the total aggregate references within a domain is shown with the domain title. The *meta-domain* and emotional *specific regulatory strategies* sub-domain also include frequency.

The most function-rich domain in the ATF framework is the *physiological* domain, presenting 10 distinct functions, and the *social individual* domain is the least function-rich area, only offering 5 functions. Some functions were found in multiple domains, e.g., "Create & Maintain Atmosphere." These functions act on multiple domains simultaneously, and are hence grouped in the *meta-domain*, with the appropriate apportionment of references included. The emotional functions of music also showed a distinct subset of functions related to the directionality of emotional regulation: "Accentuation," "Change," "Convey," "Regulating," or "Triggering." These appear somewhat different from other emotional functions and refer directly to the specific emotional orientation an individual may desire from listening behaviors.

The most frequent domain-specific function was that of "Interaction & Bonding" (in the *social group* domain), occurring 47 times within the aggregate body. This function is concerned with "socialising" and "belonging" (Bennett, 1999), "social utility" (Laiho, 2004), and "social actualisation" (Packer & Ballantyne, 2010). The function concerns individuals using music within group scenarios as a means to establish and maintain interpersonal relationships. Other highly frequent functions include "Accompaniment" (employing music to do *something* to or to accompany mundane activities) in the *physiological* domain, "Distraction" (employing music to occupy unused attention during tasks or to avoid other thoughts/feelings) in the *cognitive* domain, and "Regulate or Maintain Emotion/Mood" in the *emotional specific regulatory strategies* sub-domain (using music to maintain a specific level or arousal or emotion/mood).

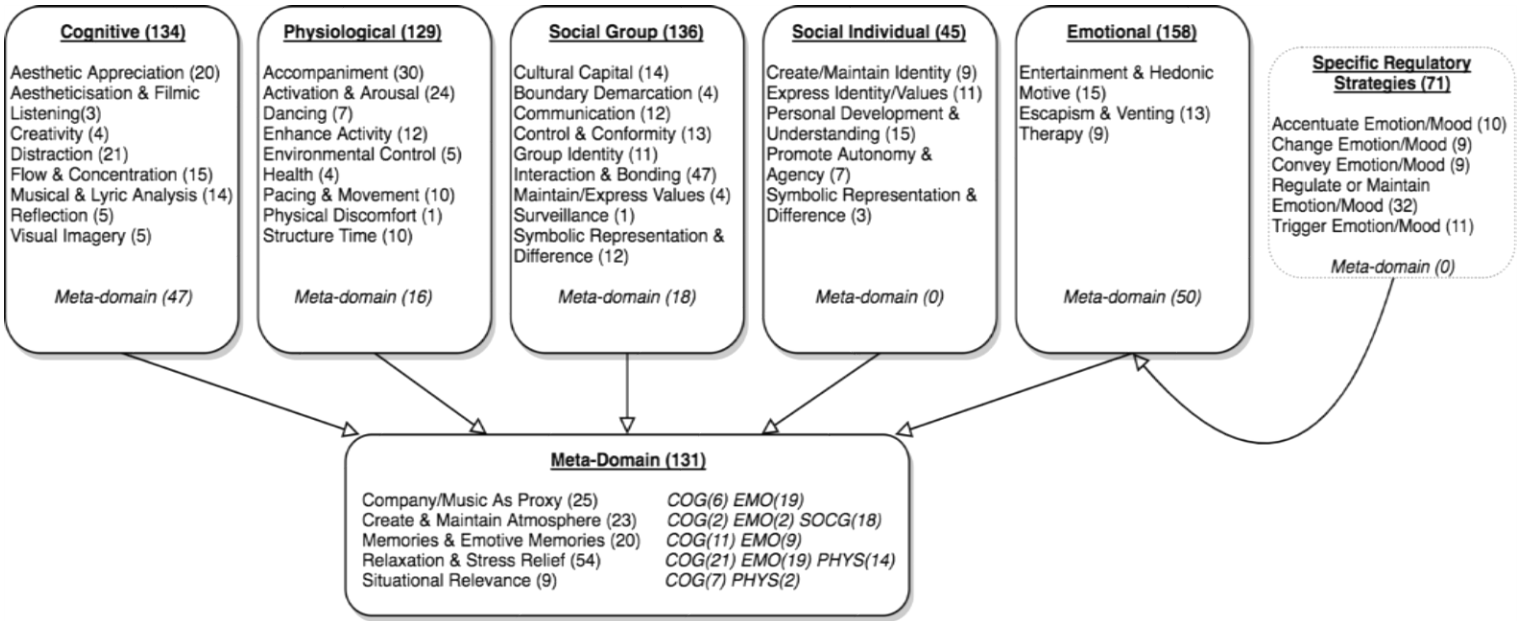

Figure 2. Aggregate Thematic Functions Framework

A caveat should be noted here. Whilst the ATF framework shows frequency of terms in the body of research, the data does not necessarily equate to the frequency of these functions in "real world" scenarios. Although a function occurs frequently in the literature, it is feasible this function occurs with relative infrequency in everyday listening episodes. The inverse could also be true: low frequency in research but high frequency of employment in real world situations.

The proposed *meta-domain* has certain inferences for the functions of music. It would appear to support the findings of Greasley and Lamont (2011): "People choose to listen to music to fulfil different functions simultaneously" (p. 63). Given that individuals use music to achieve multiple functions simultaneously (Greasley and Lamont stated an average of three functions per listening episode), the *meta-domain* may be an expression of this. "Relaxation" functions may occur in several domains simultaneously. It is also feasible that some functions resonate with one another. "Relaxation & Stress Relief" would certainly have implications for functions surrounding physiological arousal and emotional regulatory functions. In addition, it may be true that some functions, hypothetically at least, are mutually exclusive. It is unlikely that "Escapism & Venting" and "Flow & Concentration" functions could occur in tandem. However, from this analysis, it is not possible to identify which functions are used simultaneously, or which are in direct opposition to one another.

Conclusions

The ATF framework exhausts the possibilities presented in the available literature. It also proposes a domain-based conceptualization of function. However, it is possible that there are further functions of music that have yet to be uncovered, or possibly even other domains of action that have not yet been identified. Given our increasing technological augmentations of the self through listening, it is possible that new functions may appear over time.

Scherer and Zentner's (2001) assertion that the functions of music are grounded in contextual and personal factors remains a problematic concept. There is little research that attempts to identify which contexts give rise to which functions, and furthermore, which musical features are most conducive to actualizing which functions. The notion of mapping both musical features and situational factors atop the functions identified here is a daunting one. Some work has mapped musical features to emotional responses (cf. Gabrielsson & Lindström, 2001), although few have explored the other domains of action beyond the emotional.

Finally, this analysis aims to present a strong case for Merriam's (1964) original definitions. The confusion and variation in definition across the functions literature only hinders the search for functions. Often, we see *use* (the situational aspects), the underlying physiological *mechanisms*, and even the *effects* of music listening branded

incorrectly as *function*. Without adhering to the tenets of Merriam (or a newly constructed and widely accepted definition), it is unlikely this misattribution and resultant confusion of the concept of function will be resolved.

A utilitarian conceptualization of musical function may allow listeners to develop new methods of listening and active participation when augmenting aspects of the self. Just as water is a functional and ubiquitous resource, music, understood in this way, may present a readily accessible and ubiquitous resource for augmentation of the self.

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NB: References for publications used in the ATF analysis are available on request.

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From Computational Aesthetic Prediction for Images to Films and Online Videos

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Abstract

In the last decade, creating and sharing videos online has become a mainstream movement and has led to some creators generating one personal video per day, also called daily vlogging. Although robust solutions exist to suggest photographs based on aesthetic criteria, the rising number of online videos created and watched means that such recommendation systems are required more than ever for videos. The main purpose of this paper is to transfer the skill of computational aesthetic classification of photographs to videos while developing new ways of investigating video creation. Using a dataset of photographs rated on aesthetic criteria by an internet community and recently developed feature extraction algorithms, the computational aesthetic classifier is capable of state-of-the-art photograph classification depending on aesthetic preferences learnt from people's ratings. On a test set of YouTube videos, the same system then displays satisfying aesthetic classification results that consist of an attempt to match the provided human aesthetic quality ratings. Achieving a transfer of skill from photograph to video classification, the computational classifier is used to analyze the evolution of aesthetics in feature films; this highlighted the aesthetic classifier's visual preferences and caused some interesting patterns to emerge that were related to filmmakers' decisions. Aesthetic classification makes it possible to observe the evolution of aesthetics over the careers of daily content creators thanks to their abundant and regular online video content. It can aid the investigation into the impact of aesthetics on the popularity of online videos using the available metadata about the internet audience's appreciation. This can also provide a new tool for video content creators to assess their work and assist them in the production of content of higher aesthetic quality.

Keyword: computational aesthetics; skill transferability; video classification; visual preferences.

Introduction

The popularization of high-speed internet has led to an increase in visual content consumption. While photographs were introduced in the early years of the Internet, high definition videos are part of a trend still subject to fast growth. It has become increasingly complex to select a relevant video among the hundreds of hours of videos uploaded to YouTube every minute. Even though videos are already suggested through textual tags or speech analysis, little has been done to offer aesthetic-based filters for video suggestions due to the limitations of existing datasets. Despite recent efforts to build large datasets of videos, such as YouTube 8M, no video dataset for aesthetic video classification achieves a similar quantity of items as existing datasets for computational aesthetic classification of photographs (Abu-El-Haija et al., 2016). The largest aesthetic dataset of videos known to date is the recently published dataset by Tzelepis et al., which is composed of 700 short videos collected on YouTube and matched with aesthetic ratings (Tzelepis, Mavridaki, Mezaris, & Patras, 2016).

While previous works have focused on computational aesthetic classification of short videos (Niu & Liu, 2012; Tzelepis et al., 2016; Yang, Yeh, & Chen, 2011), "The Colors of Motions" by Charlie Clark illustrated the change in dominant colors over several feature films (Clark, 2014). Moreover, Jason Schulman's "Photographs of Films" offers novel ways of looking into the aesthetics of films as they overlap all frames from a film to obtain a single merged image (Shulman, 2017). The previous computational system was developed and trained to classify photographs depending on their aesthetics (Lemarchand, 2017), whereas this paper introduces the cross-media capabilities of this aesthetic classifier on the video dataset published by Tzelepis et al. To complete tests on Tzelepis et al.'s dataset, the classifier is used on films to observe special aesthetic patterns over time and points out the potential weaknesses and strengths of such classifier on both photographs and videos. At the end of the paper, the classifier is tested using YouTube videos as a resource, particularly videos by Casey Neistat, a filmmaker and daily vlogger. In the form of a case study, potential links between aesthetic prediction and video quality are investigated by looking at the evolution of aesthetics across years of work.

Training of the Aesthetic Classification System

In order to compare divergences in the behavior and performance of aesthetic classification systems in photographs and videos, an artificial intelligent system previously designed to classify images based on aesthetics that achieves state-of-the-art results on different datasets was selected (Lemarchand, 2017). The aesthetic classifier was first trained on a large scale photograph dataset called AVA (Murray, Marchesotti, & Perronnin, 2012). The AVA dataset is superior for learning aesthetic preferences as it provides one rating per image, compared to only one rating per video in Tzelepis et al.'s dataset, which is, on a visual level, a collection of many still

images. In this paper, visual information is defined as aesthetically pleasant if it has the potential to induce a positive response among the average observer, which is represented in existing datasets by the rating community's self-reports. The AVA dataset is also superior to Tzelepis et al.'s dataset in terms of representation of human visual preferences, as every image has received at least a hundred ratings according to aesthetic criteria. Training for aesthetic classification per image (and therefore per frame) allows a deeper understanding of videos as sequences and scenes can be isolated and analyzed. In fact, aesthetic classification systems are usually trained and tested with still images, mainly due to the complexity of collecting aesthetic ratings for video streams.

Previous works have proven to be effective aesthetic classification solutions with, for example, algorithms scoring images based on photography rules (rule of thirds, leading lines, etc.), or more computation-based approaches such as image descriptors and convolutional neural networks linking visual features to expected classifications (Datta, Joshi, Li, & Wang, 2006; Lu, Lin, Jin, Yang, & Wang, 2014; Marchesotti, Perronnin, Larlus, & Csurka, 2011; Romero, Machado, Carballal, & Santos, 2012). The aesthetic classifier used in this paper extracts measures of orientation distribution, curvature distribution, HSB color distribution (Hue, Saturation, Brightness), and reflectional symmetry on cardinal and diagonal axes. A deep neural network composed of 3 hidden layers is then used to learn visual preferences and obtain state-of-the-art results across several datasets such as Datta et al., CUHK and AVA (Datta et al., 2006; Murray et al., 2012; Tang, Luo, & Wang, 2013). This classifier was selected due to its cross-dataset performances and the fact that the low-level visual features extracted illustrate fundamental preferences in the human visual system. Therefore, it is suggested that low-level visual preferences can provide better cross-media performance as they tend to be less influenced than higher level preferences by cultural and personal experiences.

Applying Aesthetic Classification to Videos

In the AVA dataset, aesthetic classes are defined for each photograph by the average rating of all of the human aesthetic ratings provided with the dataset. All further predictions on new images or video frames are considered as a display of the aesthetic preferences of the rating community. In a video stream, the aesthetic classifier categorizes each frame independently as aesthetically low or aesthetically high. The high number of frames per second makes it possible to have several images embedding the same visual content from possibly different points of view. The aesthetic average over time is calculated using a large number of images. This average does not only estimate the aesthetic quality of the visual content over time, but the different points of view observed across frames make it possible to distinguish sequences containing frames with a normal aesthetic level, despite the fact that the binary classification

focuses on low or high levels. Indeed, sequences in which the distribution of the frames' classes is close to chance (50% low, 50% high) implicitly shows that the frames are close to average levels of visual aesthetics, based on the previously learnt visual preferences. This provides additional information regarding the classifier's confidence in its decision; in a binary classification task, this is a significant advantage compared to other existing classifiers. Nonetheless, biases in aesthetic classification may appear due to differences between the norms of photography and videography. Furthermore, in comparison to photographs, videos include additional semantic content due to auditory and motion information. This may mean that even self-reports may not correlate with the aesthetic classifier's predictions, as it focuses purely on visual information.

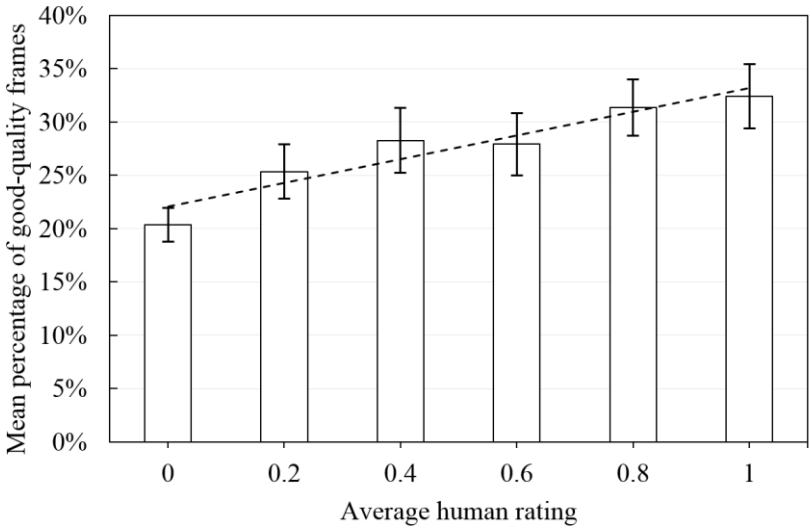


Figure 1. Mean percentage of good-quality frames detected in a video by the aesthetic classifier depending on the average human rating

The dataset of Tzelepis et al. is composed of 700 short videos downloaded from YouTube and rated in terms of aesthetics by 5 people. All frames from each video are then extracted before running the aesthetic classifier previously trained on the AVA dataset on each frame of each video, thus calculating the percentage of good-quality frames per video. The percentage of good-quality frames is then used as an input to a multilayer perceptron that is trained using the videos' aesthetic ratings. The percentage of good-quality frames detected in videos by the aesthetic classifier is shown to be strongly related to the human ratings of aesthetics, as displayed in Figure 1. The linear regression model presents a significant increasing slope of 0.12 ($t(698) = 5.11$, $p < .001$), meaning that a greater number of good-quality frames were detected in the best-rated videos. The method allowed comparison with the existing video aesthetic

classifier designed by Tzelepis et al. For each result presented in Table 1, the average precision out of 1,000 repetitions is calculated and for each repetition the training set (300 videos) and the testing set (400 videos) are randomized. Despite being far from the original results achieved by Tzelepis' solution, the proposed solution achieves results significantly above chance. This transfer of skill from photograph to video classification demonstrates the cross-media capabilities of the aesthetic classifier and that the percentage of good-quality frames in a video can be a relatively efficient predictor of aesthetic pleasantness. This recognition task also makes it possible to test the current binary classifier against another previously designed classifier. While the first version decides between the two aesthetic classes (low and high aesthetics), the second version estimates aesthetics on a scale from 1 to 10, as given in the AVA dataset. However, the percentage of good-quality frames estimated by the second version did not show any relationship with the human ratings, and the classification of videos depending on aesthetics is only slightly above chance, implying that the binary classification version is much more reliable, even though it has a limited scaling range.

Exploiting the Aesthetic Classifier on Films

Table 1: Precision for the top-*n* (5,10,15,20) percent most aesthetic videos with average accuracy and precision (in %).

	(Tzelepis et al., 2016)	Proposed classifier
Top 5%	82.00	64.54
Top 10%	82.00	64.74
Top 15%	83.33	64.89
Top 20%	81.50	64.80
ACC	68.14	54.60
AP	69.97	56.38

Considering that most recent films last between 90 and 180 minutes at a rate of 24 frames per second in average, extracting visual features of all frames involves a substantial amount of processing. The visual quality of the processed films is 720p (1280 × 720 px), which offers a good compromise between a reasonable image size for feature extraction and processing speed. Only one frame per second is extracted in order to limit the number of frames to process. Scoring feature films by different directors using the aesthetic classifier, Wes Anderson's focus on symmetry has resulted in films that achieve good-quality frame ratings, such as 56.16% for *The Grand Budapest Hotel*, 22.0% for *Moonrise Kingdom*, 20.60% for *Fantastic Mr Fox* and 58.83% for *The Royal Tenenbaums*. On another hand, Stanley Kubrick, who is known

for his shots with sophisticated depth of field effects, directed *Full Metal* Jacket, which presents 12.10% of good-quality frames, *A Clockwork Orange* with 17.75%, *The Shining* with 14.12% and *Space Odyssey* with 16.21%. Although percentages of good-quality frames possibly indicate some of the aesthetic classifier's visual preferences, reducing a whole feature film to a single score is highly limiting analyses. Due to having too few films to obtain significant statistics, further investigations on the aesthetic classifier's preferences between the two film directors is difficult, particularly when considering the potential influence of film type or year of release.

Initially, preliminary tests were performed for a pilot psychology experiment investigating potential relationships between physiological data and aesthetic pleasantness of video excerpts used as stimuli. The aesthetic change over time, which is observed by calculating the moving mean of frames' predicted aesthetic classes, shows significant fluctuations in the level of aesthetics depending on film sequences. Following the pilot tests, entire films were processed (for example, by Quentin Tarantino), and some interesting patterns are observed. One film, *The Hateful Eight* (2015), particularly stands out because the aesthetic prediction averages zero in the second part of the film, despite a reasonable number of good-quality frames in the first part. This drop seems to correlate with the switch from outdoor scenes to indoor scenes in the film; this was confirmed by the strong positive correlation (r = .82, p < .001) over the entire film between aesthetic prediction and the feature representing the distribution of pixels with normal brightness values (Figure 2). Considering the number of features involved in the aesthetic prediction processing, it can be seen that the aesthetic classifier trained on photos strongly dislikes darkness in the film. The classifier's results support the assumption that using photographs for training will create a bias in the learnt aesthetic preferences as, for example, high levels of darkness are more acceptable to a human eye watching films due to motion.

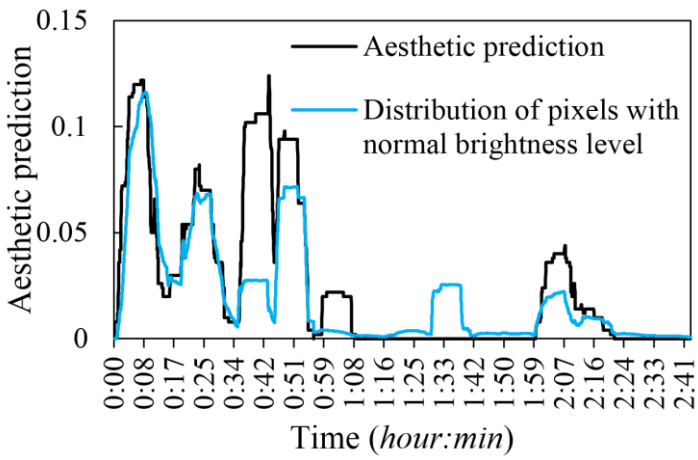
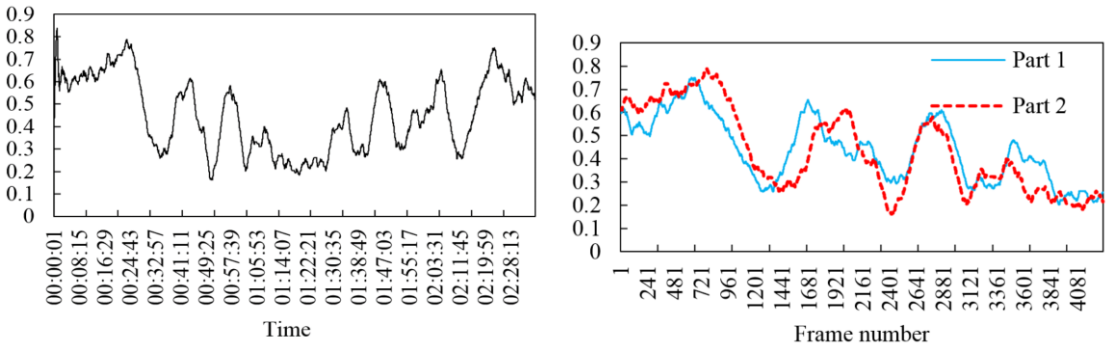


Figure 2. Plot displaying the correlation between brightness and aesthetic prediction in the film, The Hateful Eight (2015).

In another example (Figure 3a), the aesthetic prediction curve of *Django Unchained* (2012) shows a vertical symmetry centered on the middle of the film. The pattern is relevant when it is considered that Quentin Tarantino designed the film in two parts. It can be speculated that Tarantino knowingly wrote the scenario and set up camera shots to generate a symmetry between those two parts. After removing the credits, the axis of symmetry was found in order to compare the two parts using this axis as a splitting point. As shown in Fugure 3b, when mirroring the aesthetic prediction over time of the second part over the y-axis, a strong correlation ($r = .85$, $p < .001$) is found between the two parts, each of which contain a sequence of 4,000 frames. Such a strong correlation score seems to indicate the original intentions of the director. As the curve of aesthetic prediction did not appear to correlate with the different types of shot or the nature of scenes (dialogue, action, etc.), it implies that the apparent pattern must have been generated by an abnormal value in one of the features, similarly to the outdoor–indoor scene observation made for *The Hateful Eight* film. While no definite factor was identified as the origin, such a pattern may have been influenced by easily manipulable features such as symmetry and colors during filming, or altered in postproduction by Robert Richardson, the film's cinematographer.



(a) **(b)**

Figure 3. Aesthetic prediction over time, averaged using a sliding window of 500 frames: (a) aesthetic prediction of the film, *Django Unchained* (2012) directed by Quentin Tarantino; (b) comparison of the aesthetic prediction over time (implied by frame number) of the first half of Django Unchained and the mirrored aesthetic prediction of the second part on the y-axis.

Relying on IMDb.com's ratings, films of varying quality were processed such as *Birdemic*, *Batman* and *Robin* or *Kill Bill*. Not all analyzed films displayed interesting curves of aesthetic prediction, but all the curves representing films appeared to be influenced by the different sequences present in the films. Considering that the aesthetic classifier has been trained on photographs, the influence of film sequences on the aesthetic curve may be due to dialogue scenes complying more with photography rules than action scenes. The examples presented expose two advantages of such experiments. First, it makes it possible to test the visual preferences of the trained

classifier and evaluate the extent of the cross-media capabilities of a photograph-trained aesthetic classifier. Second, it allows the emerging patterns and filming styles generated by film directors to be analyzed and investigated.

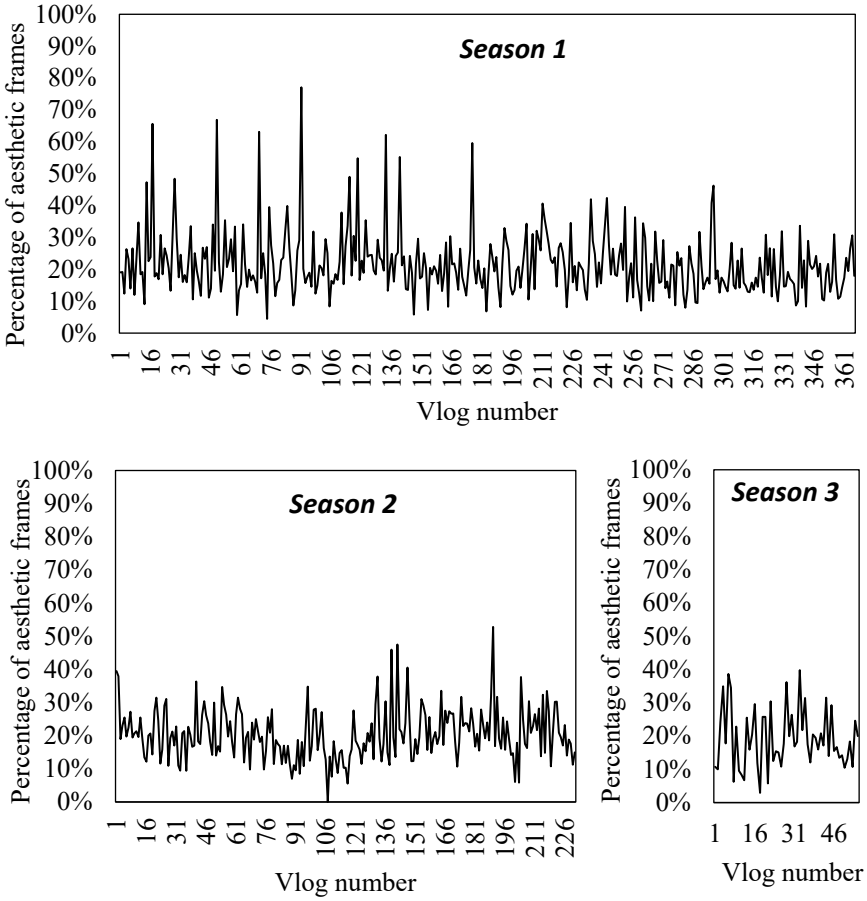


Figure 4. Percentages of good-quality frames in each video of the different seasons of vlogging by Casey Neistat.

Aesthetic Prediction on YouTube Content Creators

While the previous analyses of films are an indirect attempt at investigating patterns related to film directors' creative processes (e.g., Quentin Tarantino), the abundant video content provided by the internet, and especially YouTube, allows this to be studied further. With some video content creators producing up to one video per day, it is now possible to look at the aesthetic prediction of videos for one producer over time, and possibly over a career. For this task, the filmmaker and YouTube video creator Casey Neistat is selected due to the fact that he has a certain interest in videography

and is one of the first vloggers with 600 vlogging videos already online. As shown in Figure 4, percentages of high aesthetic quality frames for each video vary over the different seasons of Casey Neistat's vlogging, but the average aesthetic remains steady across all seasons. Videos achieving 60% to 77% of good-quality frames were all shot in a studio with professional lighting and framing, unlike most of his videos, for which filming was done spontaneously. Surprisingly, no correlation exists between the percentage of good-quality frames predicted by the computational aesthetic classifier and any of the parameters indicating a video's popularity, such as the number of views or the user rating. As previously shown, videos of higher aesthetic quality are classified with more confidence, as is illustrated by the previous statement. It can be suggested that video content creators could use computational aesthetic prediction to improve the quality of their content by selecting particular sequences or shooting their videos in different conditions to match the suggested standards emerging from the aesthetic classifier's training, which mimics people's preferences.

Conclusion

This paper demonstrates that a computational aesthetic classifier trained on photographs can also be used for classification of videos. Despite showing modest performances in this respect, the results demonstrate the cross-media capabilities of the original classifier, particularly when focusing exclusively on visual material. Moreover, processing frames individually and observing them as sequences across films makes it possible to learn more about the content creator's decisions and the aesthetic classifier's preferences, which is a novel approach in the domain of computational aesthetic prediction of videos. The first two tests in this paper respectively focused on the creative product as a whole and its content; the third experiment on vlogging videos establishes a new method to investigate video content creators over time. The approach offered by this paper is novel due to its focus on meaningful decisions of content creators, rather than traditional computational classification tasks. One application of this approach is to support video content creators in aesthetic decisions during the editing and postproduction process, giving them an immediate estimation of their audience's visual appreciation. Furthermore, it could be developed into assisting technology for visually impaired people who are willing to share their experiences and communicate through videos.

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Designing Life after the Storm:
Improvisations in Post-Disaster Housing Reconstruction as Socio-Moral Practice

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Abstract

If there is any endeavor so demanding of human creativity, it is the remaking of lives and property after disaster. However, post-disaster recovery is considered the greatest failure in disaster management, and within this field, post-disaster housing reconstruction is the most insufficiently investigated practice. Furthermore, studies of disaster management attribute failure to top-down and technocratic approaches that often overlook the agency, capacities, and moral priorities of those directly affected. In contrast, this paper attends to those displaced by disaster as creative and moral agents who manage to carry on with life despite their socio-economic and political vulnerabilities by drawing from theory in anthropology, disaster studies, and cognitive psychology. Through examining how inhabitants of a post-Typhoon Yolanda (Haiyan) resettlement site transform their housing to negotiate multiple and vague rules and regulations, I entangle myself with literature that assumes that the creativity of design lies in the capacity of individuals to improvise according to their values and in response to those of others, within a world that is continually unfolding. I also assume that improvisation is contingent upon processes of cognitive innovation in which social relations operate as indispensable intellectual resources for grasping and mobilizing knowledge that would give inhabitants of resettlement housing the best possible chance of attaining their hopes, dreams, and ambitions. Consequently, I propose that viewing creativity as an improvisational process highlights the agentic potential of design in even the bleakest and most quotidian of settings. My own hope is to extend the possibilities for correspondence between built environment practitioners and those who, because of their subaltern positionalities, tend to be overlooked by the field of post-disaster housing reconstruction and yet must live through the consequences of its practice.

Keywords: design; disaster recovery; housing; improvisation; morality.

Introduction: Context and Problems

Unity Village[1] stands at the end of a gravelly road and is nestled along a smattering of nameless hills in the Eastern Visayas Region. It is a transitional resettlement housing site built during the aftermath of Typhoon Yolanda, one of the deadliest typhoons in the planet's recorded history that destroyed 4.1 million homes (United States Agency for International Development [USAID], 2014). Almost 300 of these small white, steel-and-polypropylene plastic houses fitted with solar panels gleam pristinely in the midday sun, a stark contrast to the more modest social housing assemblages of plywood, nipa, and concrete that are situated closer to the town center. A scan of newspaper articles will reveal that an urban planner contracted to develop this type of resettlement housing extolled the project as an example of "adaptive architecture" with the potential to become a relocation "model for the world."[2]

However, the house and, by extension, housing, is an "illusory objectification" and is therefore central to competing social claims (Bourdieu, 1977; Buchli, 2013; Levi-Strauss, 1987). And so, whereas built environment professionals may view Unity Village as the quintessential materialization of modernist imperatives such as "sustainability," the inhabitants I encountered tended to expound on the harsh everyday difficulties of living in the housing site. This was because of the many bawal (prohibitions) imposed on them, including strict prohibitions against making even the smallest of changes to their housing structures. They have thus learned to improvise their way through these constraints, such as by turning their homes into covert stores.

I view these changes made by resettlement site inhabitants as everyday negotiations of a particular moral world that is animated by the built structures of post-disaster housing reconstruction, which (as with disaster management in general) typically involve the intervention of a state-sanctioned "club of experts"—policymakers, donors, architectural urbanists, etc.—who are often unaware of how their personal choices affect displaced groups (Chambers, 1997; Dyer, 2002, p. 162; Lyons, Schilderman, & Boano, 2010) and who tend to reproduce socio-economically informed patterns of vulnerability (Oliver-Smith & Hoffman, 2002).[3] I maintain that everyday changes in resettlement housing imply that inhabitants have gained an awareness that their

[1] All proper names used in this paper are pseudonyms.

[2] Due to ethical considerations, I chose not to cite the news sources to keep confidential the research site and the identities of those consulted. Those who would like to learn more about these sources can email me at pamela@curiosity.ph.

[3] While post-disaster resettlement housing programs typically adopt a top-down approach, there are many advocates of bottom-up and participatory social housing schemes, as documented in: *Architects and Post-Disaster Housing: A Comparative Study in South India* by Gertrud Tauber (2014); *Spatial Agency: Other Ways of Doing Architecture* by Jeremy Till, Nishat Awan and Tatiana Schneider (2011); and *Grounded Planning: People-Centred Urban Development Practices in the Philippines* by Laura Hirst, Mariangela Veronesi and Jessica Mamo (2016).

"moral environment" is wrong, and thus endeavor to run against the dominant moral grain in pursuit of their values, or, "what really matters" (Kleinman, 2006, pp. 1–7). On this point, I refer to Arthur Kleinman's distinction between two senses of the word "moral" (Kleinman, 2006, pp. 2–3): in the first sense, "moral" refers to "values," and life is inherently moral because it is about "what matters most" to us; in a more focused sense, "moral" refers to a sense of right and wrong. For the most part of this paper, I will hinge on the first sense pertaining to values, however, I will also allude to "moral" as a sense of right and wrong upon wrapping up my reflections with an exploration of a local terms that approximate "creativity."

We live in a manifestly shaky world in which "there is no script for social and cultural life" (Kleinman, 2006, p. 14). Because of this, "people have to work it out as they go along" (Ingold & Hallam, 2007, p. 1). I posit that the ways in which resettlement site inhabitants transform their dwelling show how the creativity of design lies in the capacity of people to improvise, to navigate a world of materials that is malleably moral and "forever on the verge of the actual," and in which people continually participate in each other's "coming-into-being" (Gatt & Ingold, 2013, pp. 144–145; Ingold & Hallam, 2007; Kleinman, 2006, p. 23). This understanding of improvisation aligns with literature that recognizes the processual character of creativity (Denham & Punt 2017; Richards, 2010; Russ & Fiorelli, 2010), as well as with literature that perceives design as a capacity available to all humans (Cross, 1995; Gunn, Otto, & Smith, 2013; Hill, 2003; Miller, 2011).

Lastly, this paper assumes that improvisation requires acquiring and mobilizing specific kinds of knowledge to respond with precision to a world in media res. Specifically, I employ the concept of cognitive innovation, defined here as:

> a recursive process in which an individual probes its boundaries to seek out new knowledge, selects promising avenues for more extensive exploitation, and synthesizes what it learns within its growing body of knowledge, which includes knowledge of how to act in the world and how to interact with other individuals. (Denham & Punt, 2017, supplement, p. 4)

I build on Denham (in Denham & Punt, 2017), Hallam and Ingold (2017) in underlining the significance of socio-cultural resources in cognitive innovation (and by extension creativity, particularly in an improvisational sense), which are not adjuncts to, but constituents of, mental activity (Geertz, 1973, pp. 73–74; Muthukrishna & Henrich, 2016).

In correspondence with these formulations of morality; conceptual links among improvisation, design, and creativity; and the sociality of cognitive innovation and mental activity, I ask: Why, and with what values do post-disaster resettlement site inhabitants improvise upon their housing? How do they go about acquiring knowledge that is critical to carrying on with life in resettlement? What kinds of improvisations emerge from this knowledge? I will next outline my methodology and findings regarding these questions.

Methodology

My research interlocutors live in Unity Village, a resettlement site funded by a religion-based NGO, in cooperation with the government. As I was interested in processes of adjustment and recovery, I used methods that "privilege narrative and observation" such as interviews and loosely structured group discussions (involving 20 individuals in total), and photo documentation (Oliver-Smith & Hoffman, 2002, p. 12). I needed to establish a high degree of trust with my interlocutors, because displeasing the neighborhood association officers and NGO representatives by relaying complaints to an outsider such as myself might lead to sanctions or eviction from the resettlement site. As such, I started by speaking with the more familiar beneficiaries of a women's NGO which commissioned me to conduct humanitarian shelter research in the aftermath of Typhoon Yolanda. I keep their identities confidential, and purposely did not converse with any of the site officers and managers. Instead, when necessary, I gleaned their views from the online media coverage of the housing turnover ceremonies.

I now turn, due to space limitations, to my discussion of two cases of improvisation.

Case 1: Nerissa

Nerissa moved to Unity Village with her two children and taught sewing classes at the site's livelihood program. During her pregnancy with her third child, her supervisor allowed her to continue working but she had to resign as soon as she gave birth. "I was told that it is bawal (prohibited) to have too many children here," said Nerissa. She thus needed to identify an alternative source of livelihood. Her partner, Joel, who is not the father of her children, contributes little to her family's expenses. These include entrance fees for her teenaged daughter to join beauty contests. "She is not that smart but she is pretty and she likes fashion. She might have a future there," Nerissa said.

Nerissa's other livelihood skills are cooking and selling pork barbecue. However, setting up a barbecue business in Unity Village was also out of the question because eating meat is bawal according to the religious values of the NGO. She also could not afford to travel daily to town to look for work. She noticed, however, that some of her neighbors would secretly sell everyday provisions from their homes—secretly because it is also bawal to turn one's house into a store. She thus decided to convert one of her two bedrooms into a home-based store, or sari-sari store in local terms. She chose the bedroom because she could at least lock the goods out of sight whenever the NGO representatives made surprise visits in the neighborhood, as part of their monitoring scheme. The next challenge involved keeping her goods fresh, as the plastic material of the house virtually turned it into an oven in the daytime ("we are being toasted in here"), and food items such as crisps became soggy and unpalatable.

To deflect the heat, Nerissa placed a fleece blanket donated by the NGO directly beneath the bedroom ceiling and over her goods by tying its corners around the beams (a common technique used in the neighborhood) with spare plastic straw rope which Joel asked from his employer. She had to tie the blanket in place because puncturing the walls no matter how slight was also bawal. Reportedly, the prohibition was based on the idea that should another disaster strike again and destroy the Unity Village housing units, the NGO could still recycle the undamaged housing materials for other purposes. "It's difficult here, but I will be strong. They promised that if we remain obedient and cooperative, they might give us a better house after five years," she said.

Case 2: Cora

Cora had a stroke two years before Typhoon Yolanda and has been in a wheelchair since then. Cora spends all her days in her plastic house in Unity Village. She was especially worried about heat stroke because the interior of her plastic house was hot and made her uncomfortable. Unity Village has no electricity; the solar panel in every housing unit could only charge one light bulb for night-time use, thus using an electric fan is not feasible.

Moreover, due to the absence of awnings, direct sunlight tends to permeate the interior of the house, a health risk for Cora. Notably, the lack of awnings is part of the housing design in Unity Village to protect the roofs from being blown away by strong winds, a convention in disaster-resilient housing. Rodel, Cora's husband, considered attaching a tarpaulin sheet to the front wall of their house for additional shade, but this, too, was bawal. Thus, Rodel cobbled together bamboo and discarded pieces of wood found within Unity Village to build a trellis in front of their house. He grew a vine which produced many long hanging roots forming a dense "curtain," thereby providing shade and comfort for Cora. The idea of the vine curtain came from Rodel's brother-in-law who lives in Manila. However, the village officers later ordered Rodel to remove the trellis to better monitor their household. Cora implored that they be allowed to keep it. "I cried and I begged. I told them I'm sick and I will die from the heat without the trellis. They took pity on me," she said, unable to say whether they could keep the trellis for the long-term.

Summary and Reflections

Everyday life restrictions that are imposed on resettlement site inhabitants and activated by the ubiquitous term bawal (Brenneis & Myers, 1984) make legible the moral proclivities of dominant actors in resettlement housing as a subfield of post-disaster housing reconstruction. Overtly, these include modernist interpretations of "adaptability," "sustainability," and "efficiency," (which I attach to prohibitions regarding family size, resilient shelter standards, as well as recycling imperatives),

religious tenets that, for example, view eating meat as an affront to the dignity of life, and the donor's belief in their absolute power which they wield over their beneficiaries. On the other hand, this dominant moral grain at times runs against the values of resettlement housing inhabitants, which include securing the education and future of their children, supporting their children's extra-curricular activities, protecting one's livelihood, and maintaining one's personal health and that of loved ones. Those who live in the site therefore attempt to find consonance between their moral environment and their individual values by improvising upon their built environment (Ingold & Hallam, 2007; Kleinman, 2006).

Finding one's way in the world also becomes more difficult due to the lack of transparency of what exactly these prohibitions mean. There is no written list of what is bawal given to the residents: its power lies precisely in its vagueness (Ingold & Hallam, 2007). This also allows those in power to interpret and implement the rules as they see fit, which according to my interlocutors, may depend on the social capital certain residents may have developed with the neighborhood officers and NGO donor representatives. As such, the relationship between the inhabitants and the NGO donor is not necessarily a dichotomous one, given volatile alliances and liminal social positions. Neighborhood officers, for example, are at once part of the resettled community as well as the NGO's official representatives within this community; their interpretation of "bawal" is therefore contingent upon their own shifting social identifications and sense of morality. Thus, while creativity has moral dimensions, moral decision-making is improvisatory and creative (Wall, 2005).

Meanwhile, the improvisatory practices of inhabitants include conversing with each other and with neighborhood and NGO officers to obtain information to clarify applications of "bawal," and observing the practices of neighbors to discover which prohibitions will have the greatest effect on their lives. Unity Village inhabitants not only depend on social relations to grasp the moral constraints of resettlement; they also acquire ideas, methods, materials, and skills from their spouses, kin, and neighbors to improvise according to their everyday dilemmas. For example, Nerissa decided to convert her bedroom into a provision store upon noting that her neighbors have been able to successfully run covert stores from other parts of their houses, and her use of a donated fleece blanket to preserve the freshness of her goods was also derived from her neighbors. Further still, it was Cora's husband, Rodel, who initiated finding an alternative to a tarpaulin sheet to provide the shade needed to address her health concern; Rodel obtained the inspiration to build a vine curtain from his kin: his brother-in-law in Manila. Social relations are therefore not only significant; they are fundamental to cognitive innovation and improvisation (Denham & Punt, 2017; Geertz, 1973; Muthukrishna & Henrich, 2016).

Furthermore, the natural environment itself can either pose constraints or become a material resource. Both Nerissa and Cora had to improvise against excess heat within contexts of livelihood and health, respectively. Meanwhile, inhabitants also draw materials from the natural environment when improvising. Cora's husband used vines for much needed shade; these were grown and formed with the help of bamboo slats from trees within the area. Nerissa and other female interlocutors improvised display shelves and other types of furniture partly out of wood sourced from a nearby bamboo grove, and often with the help of male members of the community.

And lastly, my research data point to improvisation as a process of finding the grain of one's becoming (Gatt & Ingold, 2013), which includes casting aside other grains permanently or temporarily for possible use in the future, as may be the case with Joel's tarpaulin idea. Constraints such as prohibitions, physiological conditions, and environmental forces such as heat bracket futures that are presently not possible (but might be explored later under different circumstances), and with them, specific assemblages of subjectivities, materials, and actions. Through iterative processes of not just selection (Denham & Punt, 2017), but also of casting aside for good or in the meantime, the friendliest stream to flow into becomes perceptible (as Ingold and Hallam [2007] might say): when one reserves using tarpaulin for a more opportune time, the viability of using vines as shade comes into view.

In some major Philippine languages, a term that approximates "improvisation" is diskarte, which can mean "strategies" or "resourceful" (as with the adjective madiskarte). Interestingly, diskarte is a Filipinization of the Spanish verb, descartar (to discard) and it originally referred to the piles of cards set aside or rejected during card games (Paz, 2008). Diskarte has a wide variety of meanings and applications, and one inflection refers to problem-solving in situations involving a high degree of uncertainty—from fishing (Veloro, 1994), to courtship (Tan, n.d.), and as I've learned from colleagues, to industrial design, and social housing as well. Notably, some of my interlocutors also said that diskarte has moral inflections in Kleinman's second sense of "moral" as pertaining to standards right and wrong (Kleinman 2006, pp. 2–3): diskarte that takes advantage of others is unacceptable, while life strategies that are adopted out of desperation, such as engaging in prostitution, can no longer be considered diskarte.

This paper borrowed from Kleinman (2006), Ingold & Hallam (2007), Gatt & Ingold (2013), Denham (in Denham & Punt, 2017), and Geertz (1973), and literature in disaster management studies (Barenstein & Pittet, 2007; Oliver-Smith & Hoffman, 2002; Tran, Tran, Tuan, & Hawley, 2012) that are critical of top-down approaches in post-disaster housing reconstruction. I have also traced how inhabitants of Unity Village improvised or used diskarte upon their dwellings according to their values, through seeking and applying intellectual and material resources from social ties. As such, I put forward an understanding of creativity and cognitive innovation as socio-moral practice. In relating improvisation to the notion of diskarte, I also offer an additional nuance

in understanding improvisation as a creative process, one that emphasizes the significance of casting aside to finding one's way within a world infused with difficulty and uncertainty. I hope that a study focused on everyday creativity, such as this one, will encourage resettlement housing practitioners to develop disaster recovery policies that attend to displaced groups not as mere objects of "needs assessment," but as potentially skilled designers who are capable of nudging life towards their own visions of sustainability, despite overwhelming constraint and with the barest of means.

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How Do Selected National Funding Agencies Communicate the Concept of Cognitive Innovation on Their Public Website?

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Abstract

In this paper, I discuss how three funding agencies have presented or discussed the concept of cognitive innovation in formulating their research programs, calls or funding opportunities on their website. Gummerum and Denham recognize the association between the innovator, innovation and the contextual challenge of the concept of cognitive innovation and its impact on society (Gummerum & Denham, 2014). Research funders make decisions to allocate resources to certain research questions and not others. Researchers attempt to understand how these decisions are made and consider them in applying for funding to them. One of the information sources that researchers can use to inform what areas of research they can get funding for or how to formulate their research grants is the public information on the website of the funding agencies. In this paper, I only focus on the information presented on their website and not their internal processes or policies. The approach of funding agencies to present what is categorized as innovation or creativity has the potential to influence how researchers focus or frame their research.

Keywords: innovation; research funder; research grant; research system.

Three funding agencies have been included in this paper: NIHR (National Institute for Health Research, UK), ZonMW (The Netherlands Organization for Health Research and Development, the Netherlands) and PCORI (Patient-Centered Outcomes Research Institute, USA). These agencies were identified as champions in dealing with issues of reducing research waste and adding value to research in a previous study (Nasser et al., 2017). This article shows that there is a lack of clarity on their

website in defining and outlining the concept of innovative or creative in formulating calls for research projects or programs and their underpinning evidence of what leads to innovation. Based on the information available on their website, it seems that some agencies assume that the background and achievements of individual researchers are the main catalysts, others consider collaboration with the industry as a key catalyst, and finally one organization considers developing new methods a key step that can lead to innovation. It was not clear how the organization evaluated and measured whether the strategies worked and were successful.

Gummerum and Denham recognize the association between the innovator, innovation and the contextual challenge of the concept cognitive innovation and its impact on society (Gummerum & Denham, 2014). Despite the wide use of the term "innovation" to describe certain research projects, only a tiny fraction of research projects are truly disruptively innovative and it has been suggested that the drive for innovation can inappropriately reduce the conduct of replication studies (Ioannidis, 2016; Ioannidis, Boyack, Small, Sorensen, & Klavans, 2014). Studies tend to deliberately be different in one or other minor aspect to justify getting resources or support to conduct the study.

Research funders make decisions on how to allocate resources to certain research questions and not others. Researchers attempt to understand how these decisions are made and consider them in applying for funding to the funding agencies. One of the information sources that researchers use to inform these decisions is the public information on the website of the research funding agencies. In this paper, I discuss how three funding agencies have presented or discussed the concept of cognitive innovation in formulating their research programs, calls or funding opportunities on their websites. This does not reflect the internal policies of the funding agencies, as I did not conduct in-depth interviews or ethnographies studies for each funding agency. The public information of the funding agency demonstrates the public image of the funding agency and how it might be perceived by researchers.

In a previous project, we conducted an evaluation of the websites of 12 research funders on how they address issues on reducing research waste; three research funders demonstrated the best strategies to manage the issue of reducing research waste and adding value to research: NIHR (UK), ZonMW (the Netherlands), and PCORI (USA), (Nasser et al., 2017). This reflects their commitments to add value to research, ensure that standards of research integrity are met and more evidence based. Therefore, I focused on these three organizations.

The National Institute for Health Research (NIHR)

NIHR is the key applied health research funder in UK. They expect that researchers work with patients and members of the public in designing and implementing the research projects, and that they demonstrate that the findings can potentially have

an effect on patient health in a reasonable timeframe. NIHR has a range of programs focusing on different research topics, including health services and delivery research, invention for innovation, health technology assessment (HTA) and public health research. There are two relevant programs on the NIHR website to this evaluation. One is active (invention for innovation; NIHR, 2017a), and one is currently on hold: Research for Innovation Speculation and Creativity (RISC; NIHR, 2017c).

The invention for innovation program is described as translational funding scheme focusing on advances in health care technologies, devices and interventions to increase patient benefit. It focuses on the innovation itself, the context and certain aspects of societal domain (but not the innovators themselves). It describes an invention as something that can increase patient benefit but also be adopted and commercialized. They are further described as two streams—the product development awards and challenge awards—both focusing on technology. Terms like "disruptive" are used to describe them without providing further clarification. The innovator is not discussed in detail beyond the organizations that they are affiliated with. The project requires collaboration between two or more of these organizations (higher education institutes, institutes associated with national health services (NHS), private industry). In the description of the guideline for applicants, they outline six criteria to inform prioritizing allocating resources to a project; one of them is level of innovation. The concept of innovation was described as "how the proposed device, technology or intervention presents a significant level of innovation, providing an advance over currently commercially available products. The application must contain an explanation of how adoption of the technology would change clinical practice and how the project will generate data to drive adoption" (NIHR, 2017b, p. 8). It doesn't describe in this section what they mean by "change clinical practice." They do describe in other sections the issue "increase patient benefit" (which is what they might be referring to).

The Netherlands Organization for Health Research and Development (ZonMW)

ZonMW's main commissioners are the ministry of health, welfare and sport and the Netherlands Organizations for Scientific Research, so its focus is on projects related to improving health and health care in the Netherlands. The organization not only focuses on conduct of health research but also on implementing research findings. ZonMW has a funding program called Innovative Research Incentives Scheme (Veni; ZonMW, 2016); they say that its focus is "the Veni target group consists of excellent researchers with a striking and original talent as well a considerable fascination for doing challenging and pioneering research. The focus in this respect is on innovative and curiosity-driven research." However, they do not describe the definition of "innovative."

There are not many details on how they adapted the processes to ensure that creative and innovative projects get prioritized. The calls were open and responsive, not commissioned and pre-defined. Studies intending to identify effective approaches to peer review research grants raised concerns that commissioning research (instead of having open calls) can hinder the creativity and innovation in research base (Staley & Hanley, 2008). That can explain the choice of this type of research grant call. This research program focuses on the innovator, innovation (although not described in detail how this is defined) and its societal impact.

The Patient-Centered Outcome Research Institute (PCORI)

PCORI has a legislative mandate "to assist patients, clinicians, purchasers and policy makers in making informed health decision by advancing the quality and relevance of evidence concerning the manner in which diseases, disorders, and other health conditions can effectively and appropriately be prevented, diagnosed, treated, monitored, and managed through research and evidence synthesis that considers variations in patient subpopulations, and the dissemination of research findings with respect to the relative health outcomes, clinical effectiveness, and appropriateness of the medical treatments, services, and [other] items" (PCORI, 2013b, p. 2). They have identified advancement in methodology as key step to be innovative in research. They acknowledge that our current research methods to evaluate health care intervention for patients and community are not optimal and we need innovative and new methods in health services research. They are looking for a new model of research and innovation that introduces a better balance between evidence generation using sound methods and the acceptance and utilization of them. The two key areas that they identified include: (a) developing consensus standards for research, (b) identifying gaps in patient's needs. As part of this concept, they introduced and awarded the PCORI challenge initiative 2013 called the PCORI matchmaking pap challenge. The winner proposed a platform that let users propose, endorse and pledge funds for research question and topics and researchers to apply for funding to conduct studies on the topics that have met their fundraising goals (PCORI, 2013a). These programs primarily focus on the innovation and its context and societal impact.

Conclusions

This is an overview on examples how these three national research funders communicated the concept of innovation and creativity in their research programs on their websites. The article demonstrates that there is a lack of clarity in defining the concept of innovation and creativity in shaping research grant programs and process and their underlying evidence around it on the websites. There seem to be underlying assumptions regarding what can lead to innovation, although the

underlying evidence is not always comprehensively reported—assumptions like supporting talented and high-achieving individuals (ZonMw), collaborating with industry (NIHR), or developing new methods can lead to innovation (PCORI). Moreover, it is unclear how the agencies evaluate whether their strategies were successful in achieving innovation or creativity.

This is not a full reflection of how the funding agencies conceptualize innovation and creativity or how researchers perceive it. A lot of internal discussion and policies are not communicated on the website. Researchers engage with staff members of funding agencies and experts in grant applications in universities and research institutes to decide how to formulate research grant applications. An in-depth evaluation including interviews with individuals in the funding agencies and researchers applying to the grant programs along with ethnographic studies on the processes in the funding agencies is required.

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Displacing Creativity:
Artists, Space Scientists and Audience-Led Television in 1970s India

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Abstract

From August 1975 to August 1976 the Indian space agency's world-leading Satellite Instructional Television Experiment, known as SITE, broadcast to 2,400 villages across the country. This early project of the Indian Space Research Organisation (ISRO) defined a societal remit still considered the formational imaginary behind the space agency's range of remote sensing and planetary activities. The paper focuses on a brief span of time following SITE when opportunities opened for village residents to take control of the media, and this came about in part through initiatives in which creative practitioners working with the space agency introduced methods of co-production. The shift in creative agency from producers to audiences carried radical possibilities for social mobility and locally determined, rather than state-led, development initiatives. The purpose of this short paper is to highlight how creativity coincided with audience-led innovation. Opportunities for audiences to use the technical equipment opened as creative methods of co-production became more commonplace, such that innovation reflected the cultural values, or cognitive matrix, of the audience. Although the shift in agency from producer to audience was unprecedented, it was swiftly suppressed when the national satellite broadcast system INSAT finally became operational in the 1980s, in spite of—or perhaps because of—this flourish of social innovation. Applying the concept "cognitive innovation" to this context foregrounds the limited opportunities available for rural television audiences to use the technology instrumentally for their own purposes. Displacing creativity, by dismantling the project and putting a halt to its emerging methods of co-production, was a way of delinking the audience from the

technology and thereby imposing a different order. By indicating how creative activity accesses cognitive innovation, the paper introduces the notion of "displacing creativity" as a transferable measure of agency. It argues that where creativity is displaced, crucial mechanisms by which subalterns gain agency to act and to innovate are lost.

Keywords: audience-led broadcasting; cognitive innovation; creativity; Satellite Instructional Television Experiment; television.

Introduction

From August 1975 to August 1976 the Indian space agency's world-leading Satellite Instructional Television Experiment, known as SITE, broadcast to 2,400 villages across the country via an ATS-6 satellite loaned by NASA. This early project of the Indian Space Research Organisation (ISRO) defined a societal remit still considered the formational imaginary behind the space agency's range of remote sensing and planetary activities. The experiment aimed at creating a model of rural community broadcasting and communication that could be rolled out nationally once India had its own INSAT satellite system in place for direct broadcast television. The entire project lasted over a decade with the planning stages beginning in the late 1960s and a smaller scale pilot in the district of Kheda, near Ahmedabad in the northwestern state of Gujarat, extending through to the early 1980s. It was anticipated that the satellite network would revolutionize the dissemination of information and become a key development tool because it linked settlements with minimal infrastructure to national and global transformations.

The concept "cognitive innovation" is allied to "creative activity" in the way both presuppose an agency to add, adapt or contribute.[1] The aim of this short paper is to indicate the involvement of creative practitioners whose methods and motivations carried with them the aspiration to open up the creative agency of audiences. Although some documentation exists of the involvement of staff and students from the National Institute of Design (NID) in Ahmedabad and the National Film and Television Institute (NFTI) in Pune (Seminar, 1978), the important role of creative interventions is absent from recent historiographies charting the significance of SITE in the Indian space program (Rajagopal, 1993; Harvey, 2000; Siddiqi, 2015). The research for this article (and a fuller account in process) is the result of a year spent in Ahmedabad, the epicenter of the project, gradually gathering together the many threads of the narrative from archives and original participants, who revealed the

[1] Gummerum and Denham (2014) give a powerful description of the potential of the concept as an "integrative concept that recognises the fundamental links between the innovator, the innovation, the contextual challenges and consequential reverberations through society" (p. 586). While this potential was available to the technicians and managers of SITE, for audiences this transforming potential remained out of reach during the one-year project.

nuanced, serendipitous and often tactical ways that creative practitioners integrated with the work of ISRO scientists. Similar to my own experience as an artist collaborating with ISRO scientists (Griffin, 2012), roles, perspectives, methods, expectations and aspirations of the interdisciplinary teams merged in unexpected ways.

The following outlines how, firstly, despite its innovation, the technical architecture of the one-to-many satellite broadcast was mimicked in a similarly top-down approach to program making during the one-year SITE project. The top-down approach restricted the agency of audiences who had no tangible connections to the media. Secondly, how the methods of creative practitioners fuelled the ground-up approach to program making that developed later. Thirdly, some of the reasons the project was abruptly dismantled indicate why cognitive innovation—as the agency of audience to think through what they wanted to appear on their television screens and produce it—was perceived by the state as risky and counterproductive. In conclusion, the paper indicates that the methodology of opening up creative encounters with science and technology in postcolonial contexts exposes delimited agency and where claims of participation are weak. Displacing creativity, in the example used in this paper, was a way of de-linking audiences from available opportunities to use new technologies that had appeared by chance in their neighborhoods. On a larger stage, the de-linking of cognitive innovation from participation that occurred at this significant moment in India's histories of technological innovation continues to haunt the rollout of state-led large-scale technological systems, driven by a societal rhetoric based on questionable assumptions.

Top-Down Architectures of Space Technology and Media Production

In terms of the geopolitics of the Space Race, SITE was hugely innovative in that it inverted the notion that space technology should be used for competitive exploration of outer space for political gain. Instead, India found political gain in using space technology to point its spacecraft towards Earth and mitigate tangible problems associated with poverty. The Satellite Instructional Television Experiment is a well-known episode in the space agency's history and was key in defining it as a societal program for the people. Its founder Vikram Sarabhai famously stated in 1966: "We do not expect to send a man to the moon or put elephants, white, pink or black, into orbit round the earth" (Sarabhai, 1966/2001, p. 92). Instead, India would use space technology to address the pressing needs of its people. In 1969 Sarabhai delivered aspeech outlining the plan for instructional television at the Society for International Development Conference in Delhi (November 14–17; Sarabhai, 1969). His idea was innovative and artfully distinguished India from the ambivalent motives of the Space Race between the United States and the Soviet Union.

However, there were limitations to his vision apparent in his 1969 speech, when he conflated education with knowledge transfer, saying: "The process of education is basically related to an information dissemination/transfer process" (Sarabhai, 1969, p. 5), which suggests he anticipated knowledge only needed to flow to villages and not the other way. He did though recognize that the success of the apparatus would depend on the sensibilities of those building and operating it, adding, "much depends on the objectives and assumptions of those who create the operating system" (p. 6). At the outset, the satellite television technology was imagined as a conduit by which to deliver new farming methods, contraception methods, health information, and, by bringing glimpses of the outside world into settlements unreachable by road, an amorphous belief in modernity. This imagined idea of top-down control and knowledge dissemination was reified in the architecture of the space satellite.

The relation between the imagined idea of the satellite and the imagined idea of what SITE could achieve is captured in a government-funded documentary entitled *Space and India* (Chandra, 1971) in which Vikram Sarabhai appears. In the film he stands in front of a blackboard, chalk in hand, and explains with a kind of breathless excitement a breakthrough innovation. With a new level of power in satellite transponders, he reports, it will be possible to broadcast to the whole of India at a low marginal cost using cheap chicken wire antennas installed in villages. The film cuts to animation of the disproportionately large NASA ATS-6 satellite orbiting above India. Then with great intensity Sarabhai says that in his own opinion the single most important benefit of the satellite system would be "the self-confidence that this will generate." It is the cognitive shift that ultimately matters: the overarching sense of empowerment gained through the knowledge that India could engineer satellites to circle the whole Earth: a compelling image tied to the equally compelling idea that real independence for India would only be achieved with indigenous technical know-how. The film splices between Vikram Sarabhai at the blackboard and audiences watching the first instructional television program for farmers *Krishi Darshan*.[2] Men with weather-worn faces glance uneasily towards the camera observing them visibly compromised, it appears, by the new technology. The link between the orbiting satellite and confidence was in practice going to be less straightforward than Sarabhai's diagram suggested. The images of the audiences portend the ways that knowledge beamed in from space was just as likely to undermine the indigenous knowledge of rural communities as produce the hoped for positive cognitive shift towards confidence.

The operation of SITE was by all accounts multi-layered, exhausting, inspiring and challenging. As it was organized in collaboration with NASA and funded through UNESCO, all eyes seemed to be on the energetic ISRO personnel on the ground ensuring its success. Among the best accounts of these days are a few surviving texts by

[2] *Krishi Darshan* was broadcast from 1969 in the vicinity of Delhi and continues to this day. It translates as "Glimpse of Farming" or "An Audience with Farming," and darshan has a strong association with deities.

Yashpal, the Director of the Space Applications Centre in Ahmedabad, delivered in radio broadcasts (Yashpal, 1974, 1975). Another is a particularly touching account by the representative of NASA Howard Galloway who visited villages to monitor reactions and fix unending technical problems.[3] Nonetheless, this was an extremely tight operation from which results needed to be shown. Many ISRO employees at Space Applications Centre in Ahmedabad were social scientists collecting data using new research methods to understand how audiences reacted to editing techniques such as flashbacks and to animation (Chander & Karnik, 1976). It is in this documentation that the sense of separation of audience from technology is most apparent and the strategic objective of the experiment to change behavior adds a darker layer to the hubris.

Instrumental control of populations by the state, by any means necessary, became a reality in India on June 25, 1975, a month before SITE began, when Prime Minister Indira Gandhi, responding to challenges to her authority and a critical level of political unrest in the country, imposed a state of emergency on India. During this time there was excessive bullying and oppression particularly of lower castes and censoring of the press. The documentation of SITE reveals no evidential link between "The Emergency" and the process of SITE, and yet it bristles with the one-way direction of control. To use the language of the Subaltern Studies Group,[4] nowhere in the historical account is there the "authentic voice" of the audience, who remain the "subalterns" of the technical system (Guha, 1988). The documentary literature from SITE consistently puts the village resident on the back foot, as the subject to be modernized.

Acting on the System

From my interactions with former ISRO producers of the project, this reading is one they would broadly agree with. Many spoke about being changed by SITE and the "learning and unlearning processes" (Baradi, 1978, p. 35) that affected them all profoundly as the top-down approach of SITE radically shifted to ground-up production. After August 1976, when the official SITE project finished, a pilot continued in Kheda District near to Ahmedabad, broadcasting from a transmitter tower set up in Pij that relayed the signal from the Earth Station in Ahmedabad. Though no longer linked to

[3] Howard Galloway's account is a compilation of his Telegram reports to NASA colleagues in which he states at the outset he will try to give the picture of the richness of SITE and his clear love of life in Gujarat. He relates, for instance, the waist-deep floods of Ahmedabad's monsoon and the extraordinary hospitality he and his family received as they visited villages. It is a particularly poignant account because Galloway died suddenly just before the end of the project. Also worth reading for a more heartfelt interpretation of events are the texts by six anthropologists who lived in villages for a year, from six months before SITE, in order to observe changes to daily life (Agrawal & Vishwanath, 1985).

[4] A relatively small and focused group of history scholars working together from the late 1980s on revisionist histories mainly concerned with bringing to light a range of overlooked nationalist uprisings in colonial India.

the satellite, the idea was to develop SITE's achievements in readiness for INSAT, India's own direct broadcast and telecommunications satellites. It was only during this later stage when international focus subsided and there was time to work in a more organic, intuitive and reflective way that ISRO producers began to realize the creative potential that lay with their audiences. To build a picture of how this change came about, the process of inversion from top-down to ground-up methods of TV production needs to be followed from the perspectives of different actors involved. Some of these perspectives are captured in documentation, which original participants helped locate during my year in Ahmedabad. By together revisiting and reflecting on the enduring significance of this phase of practice, a nuanced picture formed of how the methods of creative practitioners influenced the shift in participation.

One of the documents that gives detail to the picture is the diploma project of a student from the National Institute of Design (NID) in Ahemdabad, Dinaz Kalwachwala, who in July 1977, two months after The Emergency was lifted, attended a seminar at the Space Applications Centre entitled "T.V.—For the Oppressed" (Kalwachwala, 1978). Citing this seminar as instrumental in her decision to use her final year diploma project to counter the exploitation of children, her project proposal outlines her plan to make a series of five short television programs in a village, co-produced with children.

It is telling how Kalwachwala identifies in her opening project proposal the strength within creative activity to build with the hand and mind, writing: "Perhaps, if the child is given a chance to question, to create, it would give him satisfaction and confidence that he can create something that is not only a product of his hands but of his mind too" (Kalwachwala, 1978, pp. 1–2). Providing the opportunity for creative activity is, very obviously for her, the route by which children could build resilience to exploitation, because achieving agency within the technological system opened many routes simultaneously to tactical and overt re-imaging of their identities. Turning the tables on the original idea that the state could change rural residents into modern subjects, Kalwachwala's idea, which resonated with that of many other colleagues, began to open the way for residents to send back to the state an image of themselves of which the state, it seemed, had hitherto remained willfully ignorant. The power of the shift in image production is captured in the words with which Kalwachwala (1978, p. 2) begins her account: "The confidence thus gained by the child could be, as one would expect over a period of time, moulded to help him build his inner resistance mechanism, to act upon the situation, rather than be acted on by it." It was only from the position of author that cognitive innovation opened as a possibility.

This is only one of many examples in which the realignment of audiences towards authorship became more tangible. Others include the setting up of writers' workshops by Vishwanath, the former Head of the Film and Television Institute, who led the Kheda programming for a while. The writing not only generated scripts for television programs that drew on local experiences and cultures, but also generated new

work possibilities for these writers together with the confidence and social mobility that was key to the original vision of Vikram Sarabhai. Another important factor in this shift was the technology itself, which ISRO technicians developed so that film cameras by this time were replaced with the new Portapak video cameras. No longer tied to film that has to be processed away from the field, video meant that for the first time programs recorded in villages were viewed immediately. Pushed by budget cuts, actors were now recruited directly from village audiences, and the long process of research, scriptwriting, acting and recording was incrementally replaced as actor/audiences ad-libbed scenarios, picked up the cameras and made the programs themselves. Vishwanath was deeply affected by the scenario of village residents making their own programs, writing: "It started dawning on many of us that the problem was theirs and the performance was theirs and finally whatever was captured on the video tape was going to be theirs" (Vishwanath, 1978, p. 30). He encouraged the use of cameras as instruments of social empowerment.

The space scientist/media producers moving in eclectic social circles between rural and urban contexts with footage shot in villages, depicting exactly the issues residents wanted to draw attention to soon brought extraordinary results, acting as another stream of influence in addition to the broadcasts. E. V. Chitnis, who became Director of the Space Applications Centre following Yashpal in 1981, writes of the contingent opportunities opened up by their work when in a meeting with officials they decided to show a film shot by villagers of an irrigation problem they were facing. He writes: "It had an electrifying effect and that august assembly felt that something startling had come to their knowledge. Kheda TV then arranged a meeting of the aggrieved farmers with the highest concerned who immediately instructed the officials to take steps to solve the problem" (Chitnis, 1978, p. 23). Villagers now had a means of demonstrating maltreatment and countering any false claims made about them by officials, shifting power relations. What appeared as serendipity, for instance the chance meeting of the film crew from ISRO with officials who were neglecting their duties to the lower class rural residents, was also an element of the design of the system of which all concerned would have been aware. Surreptitious spaces of agency had opened up at the edges of the master plan.

Resistance to Audience-Led Production

The demise of the Kheda project, and its diverse methods of developing cognitive agency through creative activity across rural communities and disciplinary domains, is linked to a number of changes in technology, international relations and the path of socialist politics in India. It also links to the tragic backlash against audience-led production. The opening of agency through methods familiar to creative practitioners, such as Vishwanath, who took a leading role in the direction television programming in Kheda took, brought with it responsibilities the ISRO producers were

unprepared for. One of the programs aimed at opening mindsets to challenge exploitation resulted in violent retaliation. In challenging the social order, the space agency was taking on extremely high stakes in instrumentalizing social reform through audience-led television broadcast. The spectrum of resistance to audience-led television is an aspect of the demise of the project that for the original participants remains a disquieting and unresolved legacy.

In the early 1980s when India's INSAT satellites became operational in time to broadcast the Asian Games nationally, a decision was made to dismantle the transmitter tower at Pij and end the Space Applications Centre's Kheda Communications Project (A. Chatterjee, personal communication, May 6, 2016). The decision caused huge protests around the transmitter in Pij, from residents who also wanted access to the entertainment now being broadcast nationally. When finally the transmitter was taken away, the opportunity that had briefly opened for participatory television also closed.

Although too many activities and opportunities were emerging for there to be a single thread to this narrative, it is clear how the larger change emerged through exchange and progression of sensibilities and knowledge amongst participants that also generated and responded to changing technical apparatus. It is clear also how the inclusion within the interdisciplinary teams of creative practitioners lent methods of teaching authorship that were key to locating cognitive innovation with village residents and their concerns and perspectives. Creative encounters with science and technology caused a shift in which for a brief time audiences became the "prosumers"—both producers and consumers. The spaces of agency that brought this shift opened through a process whereby a chain of interdisciplinary practitioners gradually exchanged—through materials, experiences and the handling of technical apparatus—the agency to observe and depict each other. With the removal of the transmitter, the cameras, the ISRO scientists, social scientists and creative practitioners, the productive interstices used by village residents were lost. Articulating the elusive mechanisms by which subalterns gain agency to act and to innovate remains a challenge within contemporary planning for participative technology. Perceiving the symbiosis between creative activity and cognitive innovation through a historical example provides a transferable measure: a technological system that displaces creativity also displaces the agency to act upon the system.

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Response to "Displacing Creativity: Artists, Space Scientists and Audience-Led Television in 1970s India" by Guy Edmonds

This was an inspiring re-discovery of a moment of emergence of new voices. I enjoyed the sense of surprise that is palpable, even amongst their supporters, that the 'villagers could do it for themselves.' This paper is a good example of a prevailing theme of Off the Lip 2017, that of creativity being socially situated.

There are already studies on the uptake of the Portapak by 'artists and political activists' (Slootweg, 2016) and there is a special degree of urgency felt by archivists for Portapak recordings given the fragility of the videotape medium. What was interesting here was that even in the hands of non-radicals, the technology becomes political. Video technology and small budgets created an escape from subaltern existence. It would be good to cross reference this with the studies from the anthology "Mining the Home Movie" (Ishizuka & Zimmermann, 2007), which has a global perspective on the potential of home movies to be a source for subaltern histories.

In terms of co-creation, comparison can also be made to the practices of travelling cinematograph shows of the early cinema era in which showman would ostentatiously film local people as part of their advertising routine. Often films would be developed the same day and projected for an audience of the same local people in the evening. The need for a subject of the camera to stand out from the crowd would lead to extrovert behavior which can be seen as a precursor of the 'hello mum' reflex. The presence of technology initiates a performance which would not otherwise have occurred. What is more melancholic is the insight that this paper gives us into a situation shared with cinema and the internet. It unearths a phase in the development of new technology before processes of standardization and commercialization gain dominance and lock down the possibilities of the initial innovation.

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Thinkering through Experiments:
Nurturing Transdisciplinary Approaches to the Design of Testing Tools

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Abstract

In order to assess and understand human behavior, traditional approaches to experimental design incorporate testing tools that are often artificial and devoid of corporeal features. Whilst these offer experimental control in situations in which, methodologically, real behaviors cannot be examined, there is increasing evidence that responses given in these contextually deprived experiments fail to trigger genuine responses. This may result from a lack of consideration regarding the material makeup and associations connected with the fabric of experimental tools. In a two-year collaboration, we began to experiment with the physicality of testing tools using the domain of moral psychology as a case study. This collaboration involved thinkering and prototyping methods that included direct contact and consideration of the materials involved in experimentation. Having explored the embodied nature of morality, we combined approaches from experimental psychology, moral philosophy, design thinking, and computer science to create a new testing tool for simulated moral behavior. Although the testing tool itself generated fruitful results, this paper considers the collaborative methodology through which it was produced as a route to highlight material questions within psychological research.

Keywords: collaboration; embodiment; methodology; moral psychology; prototyping; thinkering.

In this paper, we suggest that prototyping techniques from arts and design practice can enrich ideation when developing fresh or novel research questions. The act of prototyping discussed here has offered insights arising through an on-going collaboration that explored thinking through making[1] to create a physical tool for psychology experimentation.

Thinking through Making

Thinking through writing is part and parcel of many academic disciplines. However, in the sciences, thinking through making is less explored. This is somewhat surprising, given that in the experimental sciences, the process of designing methodology is integral to the research process. For a psychologist, designing a questionnaire, for example, will involve the formulation and psychometric assessment of items (i.e., questions) designed to measure a particular construct (Kline, 2015). For a graphic designer on the other hand, designing a questionnaire will involve the consideration of font, paper, layout, and coloring. Both the design of the questions and the design of the physical page can have an effect on the outcome (e.g., Christensen, Flexas, Calabrese, Gut, & Gomila, 2014).[2] The process of "making"[3] experimental materials, in terms of its ability to engender new ideas for research, is particularly uncommon in the social sciences. Although psychology acknowledges that interacting with the materiality of our environment is crucial to the way we develop our ability to think and act (e.g., see Piaget, 1976), the integration of material culture in psychology research is still "terra incognita" (Moro, 2015). What often remains unexplored in experimental psychology is the link between this direct engagement with physical materials and the measurement of phenomena (Briazu, Francis, & Haines, 2015). Introducing questions concerned with making can motivate new inquiries in experimental science; how might the physical attributes and stylistic decisions that form the testing tool detach or engage the participant, subsequently influencing the outcome of interest?

[1] A concept derived from Ingold's *Making: Anthropology, Archaeology, Art and Architecture* in which he argues that making builds knowledge (Ingold, 2013).

[2] This notion that how we interpret something, influences how we act, is conveyed in a variety of concepts across psychology and sociology including the Thomas theorem, the Matthew effect, and the Placebo Effect (e.g., DeNora, 2014).

[3] In this case we consider making as exploratory poiesis, as Donahue writes "to make is to explore materials with one's own hands and body as an essential tool, emphasizing the relationship between tool and material and what it can offer the creative process" (Donahue, 2014, p. 7).

Dilemmas of Morality and Measurement

In previous work, we have considered the extent to which incorporating rhetorical and abstracted testing tools, such as questionnaires, can allow approximation of real-world phenomena (Briazu et al., 2015). More specifically, in the domain of moral psychology, we outlined concerns regarding the hypothetical nature of moral dilemmas, seeking to approximate moral decision-making. Using the *footbridge* dilemma[4] as a case study (see Figure 1), we challenged the representation of moral conflicts in text-based vignettes and the dichotomous nature of the questions following these, seeking to measure morality.[5]

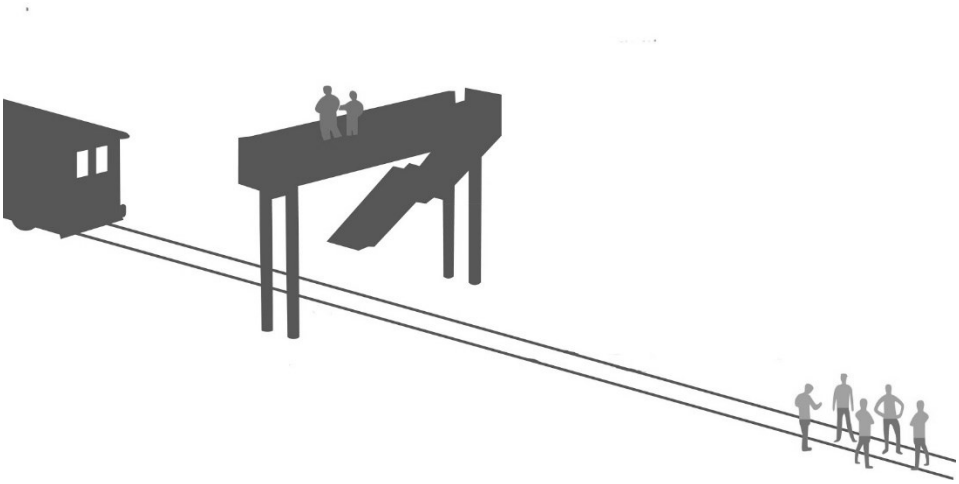

Figure 1. Diagram depicting the *footbridge* dilemma.

Crucially, although these rhetorical materials have provided the foundation for many models of moral decision-making, the materials themselves often fail to uncover valid insights into how people would react to and feel in moral dilemmas, given that they motivate a certain degree of disengagement (Briazu et al., 2015; Terbeck & Francis, in press). By introducing inductive approaches from design research to debates concerning the artificial nature of experimental materials and by adopting a thinking through making approach, we considered the creation of a testing tool that

[4] In the classic footbridge dilemma, an individual must decide whether to push a large person off a footbridge in order to stop a runaway trolley from killing five workers on the track below (Foot, 1978; Thomson, 1976).

[5] These questions often follow the format of a judgment question ("Is it morally acceptable to push the person off the bridge in order to save the five workers on the tracks?") or action-choice question ("Would you do it?") and are followed with a dichotomous scale ("Yes" or "No") or ordinal response scale (such as a Likert scale).

could "establish a physical coupling between experiment and participant" (Briazu et al., 2015, p. 29). In short, our project sought to interrogate and prioritize the physicality of the *footbridge* dilemma. While previous research had attempted to depart from theoretical instances of these moral dilemmas by generating visually salient scenarios using virtual reality (VR; see Figure 2; e.g., Francis et al., 2016; Patil, Cogoni, Zangrando, Chittaro, & Silani, 2014), this research has yet to consider the significance of physical salience in moral dilemmas; what would happen if making a moral decision felt real?[6] This is where a practice-based methodology can offer insights. We examined the function of tactile feedback in resembling the embodiment of realistic actions. Adopting this approach, thus, laid the foundations for the development of an interdisciplinary moral testing tool, shaped by aesthetic realism, haptic momentum, and tactile sensation (Briazu et al., 2015).

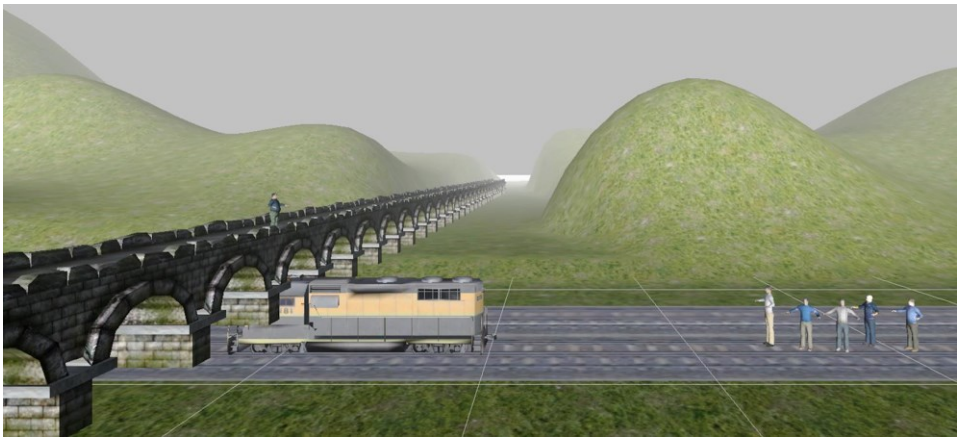

Figure 2. Model of *footbridge* dilemma during development in virtual reality. *Note*. This is not the perspective from which the participant views the virtual scenario.

Distorted Dimensions

Using our initial inquiry as motivation, we began to work on "Distorted Dimensions," an installation designed to situate the measurement of simulated moral actions in corporeal and tangible environments. In the installation, a virtually-constructed *footbridge* dilemma was simulated using the Oculus Rift and a life-like sculpture of the stranger on the footbridge was built to echo its virtual counterpart. The design of the sculpture or testing tool, which was the focal point of Distorted

[6] Using "VR" as a testing material in this case can be challenging as it is often synonymous with "gaming," a problematic coupling for psychology experiments that seek to measure genuine as opposed to detached responses.

Dimensions, pivoted around three central aims. Firstly, the mechanics of the sculpture were designed for interaction, allowing the sculpture to replace typical testing tools such as joystick controllers (Francis et al., 2016; Patil et al., 2014). Secondly, aesthetic realism and tactile sensation were simulated through expandable foam and platinum grade silicone. Finally, the sculpture's weight allowed for the haptic simulacrum of a body free-falling if pushed (see Figure 3). Utilizing this tool allowed us to measure realistic simulations of moral actions and, unlike previous research, also permitted the examination of embodiment and personal force in moral decision-making (Francis et al., 2017).[7]

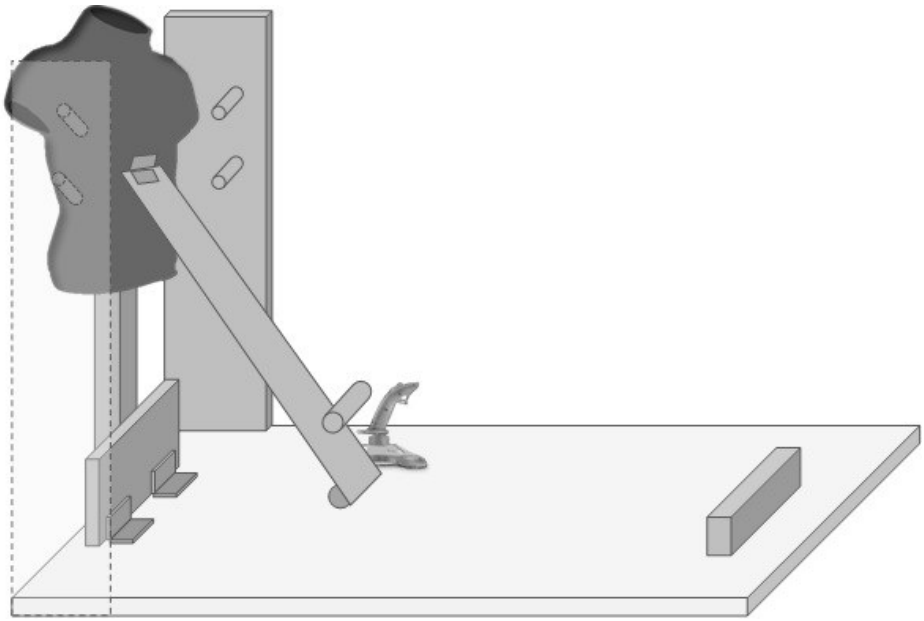

Figure 3. Diagram of the sculpture component of Distorted Dimensions. If pushed, the sculpture's torso would fall forward along the runner, pushing the joystick forward.

[7] From a psychological perspective, arguably we are attempting to enhance sensory similarity (a component of ecological validity or the concept of making an experiment "look" and "feel" more real). Importantly, in the context of this work, sensory similarity does not infer "external validity" (the concept that responses observed in a laboratory setting can be generalized to the real-world setting). We are not suggesting that we are pursuing a "hyperreality" in the making of our experimental tools, or the blurring of lines between reality and simulation. Instead, we are attempting to create an action which is hyperreal, ("the generation by models of a real without origin or reality," Baudrillard, 1994. p. 1) in that it is hard to distinguish from true-to-life action.

The Making of Morality

While the sculpture advanced our understanding of simulated moral actions, these research aims were not the sole outcomes of Distorted Dimensions. There were a number of other aspects at play during the process of the installation's production. In the same way that Christopher Small describes music as being an ideal figment of what he describes as the action of "musicking," (Small, 1998) our sculpture was a figment of the making. The sculpture itself contains traces of decisions that were made during our collaboration and these are visible in its form. In the action of making, aspects of our environment and our personalities played a role in the physical prototype; external conditions dented the trajectory of the making process, altering what it became. In our development of the sculpture, our aim was to facilitate, and not hinder, the flow of the making process and the materials that we were using. Although the object was successful in achieving the initial research aims described above, it was our regard for the making process that prompted and nurtured our insights into collaboration and material (see Figure 4).

Figure 4. Images of the dynamic making process.

It was an active engagement with the materials that shaped our experimental device, allowing for a more thorough construction of the participant's experience and understanding of the topic at hand.[8] Crucially, in order to create an object that can

[8] As Latour suggests, "thinking with eyes and hands" and in our case also "things" (Latour, 1990).

"speak" to an audience in a sensory fashion, we should focus on understanding the agency of the materials that we are using. After all, a practitioner must work *with* their material to produce form. Ingold (2010) likens this to a carpenter following the grain of the wood with an axe in order to generate a favorable cut. The makeup of the materials that we are using also has a "grain." For example, the controllers, questionnaires, silicones and VR in our installation are not inert and it is imperative to consider all of these materials as dynamic. This "grain" represents the complexity of materiality that is often neglected in experimental science, perhaps as a result of scientific reductionism and its motivation to form explanations of the natural world. Taking the complexity of materials into account, the interaction between sculpture and the virtual environment allowed us to shape an experience that was far more provocative and analogous to real-life action than what might be construed by a testing tool that had not been considered in this way. From an experimental point of view, understanding this "grain," becomes pivotal in creating the bond between participant and experiment.

Collaborative Thinkering

As John Seely Brown suggests, the process of prototyping in this fashion might be described as "thinkering." Antonelli (2011) describes this as a form of productive tinkering that involves testing and adjusting with "like-minded spirits and engaging with the world in an open, constructive collaboration" (para. 1). Commonplace strategies for problem-solving and ideation are often constrained by disciplinary norms, but through "collaborative bricolage or tinkering" (Innes & Booher, 1999, p. 12), here defined as thinkering, novel strategies for ideation can develop through "learning-by-doing" (e.g., Donahue, 2014) as group members combine existing ideas, methods, and scenarios to create something new (Innes & Booher, 1999). This collaborative component has been paramount in our work, in both its processes and outcomes; the iterative process of making was invaluable in fostering our creativity and prompting discovery (Donahue, 2014). Most importantly, this process allowed for the emergence of a dynamic system which enabled an open and judgment-free exchange of ideas between disciplines (e.g., Donahue, 2014). In our collaboration, thinkering involved "interacting with a web of knowledge, tools, and distributed communities of practice" (Brown, 2009, p. 4), a working process that fostered a collaborative attitude which was both inspiring and motivating.

Crucially, it seems that it is the willingness to embrace interdisciplinary approaches openly that can enrich fields of research that are so often constrained by single disciplinary approaches. To date, the methods that enable designers and scientists to collaborate in scientific research have been largely overlooked (Peralta & Moultrie, 2010). We propose that thinkering can provide a stage for the manifestation of humor, personal empathy, and proximity between researchers, which Epstein (2005)

regards as essential for collaboration. After all, perhaps the most important aspect of thinkering for the 21st century is "listening with humility with an open mind" (Brown, 2009, p. 8), and we suggest that this approach be unobstructed by disciplinary boundaries. Using collaborative thinkering in this way has allowed us to examine and consider our interactions with the physical material of the world around us, generating mutual insights into psychology, philosophy, and design.

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First response to "Thinkering through Experiments: Nurturing Transdisciplinary Approaches to the Design of Testing Tools" by Alexandra Marian, Paula Moldovan, Beatrix Perde, Roxana Vescan, Calin Hopsitar, & Doris Rogobete

Implications for Measurement in Morality Research

According to Jonathan Haidt (2001), moral judgements are based upon intuition—a fast and unconscious process that is heavily dependent on context. Reasoning comes afterwards and sustains our judgements with well-constructed arguments. As such, "moral judgements should be studied as an interpersonal process" (Haidt, 2001, p. 814), because oftentimes our moral responses and actions are influenced by the cultural norms that shape our current thinking. Therefore, it is important to incorporate emotions, actions and the wider context when we are trying to study morality and moral decision-making in the lab. In the end, this is why these kinds of decision are so hard to make: the person facing a moral dilemma is completely involved in the situation, both cognitively and emotionally. As an example, we might consider the Stanford prison experiment (Zimbardo, Haney, Banks, & Jaffe, 1971). Although controversial, it offered valuable information on how the ecological validity of the experimental context (the 'prison-like' setting, the uniforms of the guards, the rules that were set, etc.) contributed to the shocking decisions made by the 'guards.' In this case, the complete immersion of the participants in the set blurred the lines between reality and 'fantasy,' permitting an insight into how power and authority distorts our thinking and moral actions.

General Implications for Research Methodology

The research conducted by the three authors demonstrates the importance of creating experimental contexts and tools that can produce a 'natural' response from the participant. Given that a person learns and encodes his/her experiences using the sensory–motor neural networks (and others), as the embodied cognition approach states (Barsalou, 2008), recreating the elements of a real situation might produce a similar activation pattern in the brain, thus eliciting a more authentic response from the participant. Therefore, experimental contexts and tools that closely resemble those found in real-life might offer the best of both worlds: *they* improve the reliability and validity of the participants' responses, while still having a more controlled setting that allows us to draw more solid or causal conclusions. Moreover, the process of creating a research tool offers a good opportunity for the researcher to anticipate variables that might influence the result of the test. While involved in 'the making' of tools, the experimenter becomes a part of the process. And this might make him more cognizant about how the testing situation would go and how the person being tested would react.

If we talk about testing children (preschoolers or infants), the process of creating appropriate tools and experimental contexts becomes even more challenging. Young children do not always have the means to answer our questions nicely or to complete a task according to our instructions. When finding himself in such circumstances, the experimenter is 'forced' to create an experimental environment that can sustain a natural response from the child. Sometimes, we even 'become' the child in order to understand his behavior and the processes that sustain it (see Yu & Smith, 2013, for an example).

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Second response to "Thinkering through Experiments: Nurturing Transdisciplinary Approaches to the Design of Testing Tools" by Joanna Griffin

The "footbridge dilemma," or "trolley problem," which is the inspiration for the "thinkering" experiments carried out by the co-authors, has a strong aesthetic. It is a moral psychology problem with a history, even folklore, attached to it. It has a certain timelessness: A tool from the 1960s and 70s associated with work by Phillipa Foot and Judith Thompson, but doubtless drawing on much older stories and riddles that involve listeners, participants and interlocutors in deep engagements with moral questions and contexts. It is a "classic" moral psychology test, coming from the same roots perhaps as the infamous Milgram experiment in which participant "experimenters" were asked to increase the electric shock given to so-called "learners." In that test a theater of authority was created through the materiality of lab coats, control panels, the separation of experimenter from subject as well as through the guiding performance of the scientist-organizers. It highlighted how surreptitious forms of violence become possible when the test is bracketed off from reality and was apparently motivated by Eichmann's acquiescence to violence when he followed orders that allowed holocaust genocide. From my perspective, as an artist, the "footbridge dilemma," has all the traits of a surrealist ruse: it involves potential violence and questions of morality, both attractive to 1930s Surrealist group sensibilities and, crucially, a degree of detachment from everyday reality.

In the redesign of the test you describe, I was struck by the explanation of how *making* opened your sense of the participant experience of the moral dilemma. The test became a "figment of the making," its constitution, and in particular, your own bonds with the experiment, became tangible "allowing for a more thorough construction of the participant's experience." It is these questions of experience and access to experience and how access shifts through making or other creative activities that I want to briefly focus on and point to a text by Sundar Sarukkai in a dialogue anthology with social anthropologist Gopal Guru, *The Cracked Mirror: An Indian Debate on Experience and Theory* (2012). Sarrukkai and Guru debate who has the moral right to theorize another's experience. Their moral question focuses on whether a non-Dalit can speculate on what the experience of a Dalit person is, when the prerequisite for being of this community is that there is no escape from caste: To dip in and out as an ethnographer, Guru argues, is immoral. Sarukkai responds that if our experiences are co-constructed and shared to some extent, there is moral ground to interpret, and he asks: "Is an individual the author of her experiences?" (Guru, 2012, p. 38). This discussion helped me to unpack the experiences of those who made the Chandrayaan spacecraft, also an experimental scientific instrument (Griffin, 2014). It also bears on the paper's insights into "thinkering," because the question of what constitutes an experience is embroiled in questions of "what is the test?" and where

the edges of the experiment appear to be. Your collaboration opens up questions of who authors and interprets the test and in what ways the roles of designer, participant and experimenter are shared, all potent moral frontiers for science.

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Spectres of Ambiguity in Divergent Thinking and Perceptual Switching

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Abstract

Divergent thinking as a creative ability and perceptual switching between different interpretations of an unchanging stimulus (known as *perceptual multistability*) are thought to rely on similar processes. In the current study, we investigate to what extent task instructions and inherent stimulus characteristics influence participants' responses. In the first experiment, participants were asked to give as many interpretations for six images as possible. In the second experiment, participants reported which of two possible interpretations they saw at any moment for the same line drawings. From these two experiments, we extracted measures that allow us direct comparison between tasks. Results show that instructions have a large influence over the perception of images traditionally used in two different paradigms and that these images can be perceived in appropriate ways for both tasks. In addition, we suggest that the connection between the two phenomena can be explored interchangeably through three experimental manipulations: a) using a common set of images across both experiments, b) giving different task instructions for the two tasks, and c) extracting comparable metrics from both experimental paradigms.

Keywords: ambiguity; divergent thinking; perceptual switching.

Introduction

Every day people face situations for which new ways of seeing and thinking are necessary or at least beneficial. How are they able to arrive at these novel interpretations? Here we explore two approaches to answer this question: investigating creative problem solving (novel ways of reaching a goal) and perceptual switching (different ways of interpreting the environment). We also investigate their connection through homogeneous measurements.

Creative problem solving refers to the process of generating original and appropriate responses to reach a goal. The ability of divergent production (the generation of many possible solutions), which is instrumental to creative problem solving (see Guilford, 1967), can be assessed in numerous ways (Runco & Pritzker, 2011, p. 548). Generally, in divergent thinking tasks people are instructed to generate as many ideas as possible for visual or verbal stimuli. The number of generated distinct ideas provides a measurement of fluency or flexibility and is thought to reflect the ability to mentally restructure the stimulus.

On the other hand, consider ambiguous images such as Jastrow's bistable duck–rabbit (Jastrow, 1900, p. 295): people first perceive one of the interpretations, then after prolonged viewing the second interpretation is perceived, after which perception alternates between the two interpretations of “duck” and “rabbit” (Leopold & Logothetis, 1999; Long & Toppino, 2004). The phenomenon of switching between alternative interpretations of ambiguous images is generally known as multistable perception, or as bistable perception if only two interpretations are possible (Leopold & Logothetis, 1999). Multistability is considered to involve restructuring the interpretations of the ambiguous stimulus at higher levels of cognitive processing (Long & Toppino, 2004; Sterzer & Kleinschmidt, 2007).

Both divergent thinking and perceptual switching tasks attempt to measure the influence of perceptual and mental restructuring and are therefore thought to rely on similar processes (Schooler & Melcher, 1995). Phenomenologically, switching between different representations in divergent thinking tasks and different interpretations of an ambiguous image have been described as similar human experiences since the early 20th century by Gestalt theories (Duncker, 1963). Researchers interested in creative problem solving and multistability have been both hunting for and haunted by ambiguity for a long time. However, the commonalities between creative problem solving and perceptual switching have predominantly been observed anecdotally. Only a few studies have empirically investigated the relationship between the two phenomena.

Wiseman, Watt, Gilhooly, and Georgiou (2011) provided empirical support for the connection between perceptual switching and divergent thinking or, in general, creative ability: participants who reported that they could switch more easily to the second interpretation of the Jastrow duck–rabbit image also rated themselves as being

more artistically creative and better creative problem solvers. They also found a strong correlation between self-reported ease of perceptual switching and categorical flexibility measured with a single item unusual uses task. Following up on these results, Doherty and Mair (2012) found that fluency for written responses measured with the Pattern Meanings task (Wallach & Kogan, 1965, p. 33) is positively correlated with the number of switches in perceptual multistability tasks (duck–rabbit, vase–face, Necker cube). The authors speculated that the same executive control mechanisms may be involved in perceptual switching and divergent production, therefore the relationship is worth exploring further.

The effect of ambiguous visual stimuli on divergent thinking was also investigated by Wu, Gu, and Zhang (2016) and Laukkonen and Tangen (2017). In both studies, ambiguous and non-ambiguous images were presented before a creativity task (i.e., an alternative uses task or insight problem, respectively). The results of both studies showed that participants could generate a significantly higher number of solutions in the creativity task if they saw an ambiguous figure instead of an unambiguous image. This was interpreted as evidence that ambiguous images facilitate creative ideas, possibly due to the fact that both involve resolving conflicting sensory input.

The three studies by Wiseman et al. (2011), Wu et al. (2016), and Laukkonen and Tangen (2017) show that performance in creative problem solving and perceptual switching tasks are related and can even influence each other. However, it is hard to accommodate results across tasks and studies that use different measures of divergent thinking and multistable perception.

In this study, we took images regularly used in divergent thinking and bistable perception tasks and explored whether the way they were administered affected participants' performance. Specifically, we investigated whether the images from the two paradigms led to similar temporal measures when administered in divergent thinking and perceptual switching conditions. To explore this hypothesis, we used images from a divergent thinking task, namely the Pattern Meaning task by Wallach and Kogan (1965), and compared participants' task performance with ambiguous visual stimuli such as duck–rabbit, mouse–man, donkey–seal, which are widely used in bistable research (see Wimmer, Doherty, & Collins, 2011). Finally, additional temporal measurements were extracted from the computerized divergent thinking and bistable perception tasks.

With this study, we aim to investigate to what extent task instructions and inherent stimulus characteristics influence participants' responses. Specifically, we ask whether the connection between the two phenomena can be investigated interchangeably by observing three experimental manipulations: a) using a shared set of images in both tasks, b) giving different task instructions, and c) extracting comparable metrics from both experimental paradigms. We also aim to contribute to the growing literature of empirical investigations of the relationship between divergent thinking and multistable perception.

In the first experiment, we explored whether images taken from bistable perception tasks, which are typically considered to have two interpretations, can trigger more interpretations, similarly to the images used in the divergent thinking tasks. Therefore, we presented images from divergent thinking and perceptual switching tasks to a group of participants and asked them to generate as many interpretations as possible. This is a typical administration of a divergent thinking task in creativity research, for example in Wallach and Kogan (1965).

In the second experiment, participants were presented with the same set of images in a perceptual switching task. In this case, participants were asked for an initial interpretation of one image, then shown two possible interpretations and later asked to continuously report their perception for 120 seconds. This is a setup typically employed in bistability experiments. We examined whether perceptual switching dynamics differed depending on the origin of the images.

In addition, we explored ways of directly comparing results from the two experiments. Besides the measurements which are normally used, we recorded the time participants took to generate the first answer in the divergent thinking experiment. This is similar to the concept of an initial reaction time, which is often used in the analysis of perceptual switching tasks, i.e., the time taken to report the first interpretation by button press. An additional measurement was the first phase duration, which denotes the time it took participants to name their first solution in the divergent thinking task and the time until they gave the first interpretation in the perceptual switching task. We were interested to see to what extent these two variables were similar for the same image between experiments.

Experiment 1: Divergent Thinking

Participants

Six postgraduate students aged between 25 and 48 years (mean = 37.17, SD = 8.06) participated (self-reported gender: 1 female, 3 males, 2 unspecified).

Materials and Procedure

Six different images were used, three of them taken from the Pattern Meaning task by Wallach and Kogan (1965), and three frequently used in bistable perception tasks (see Figure 1).

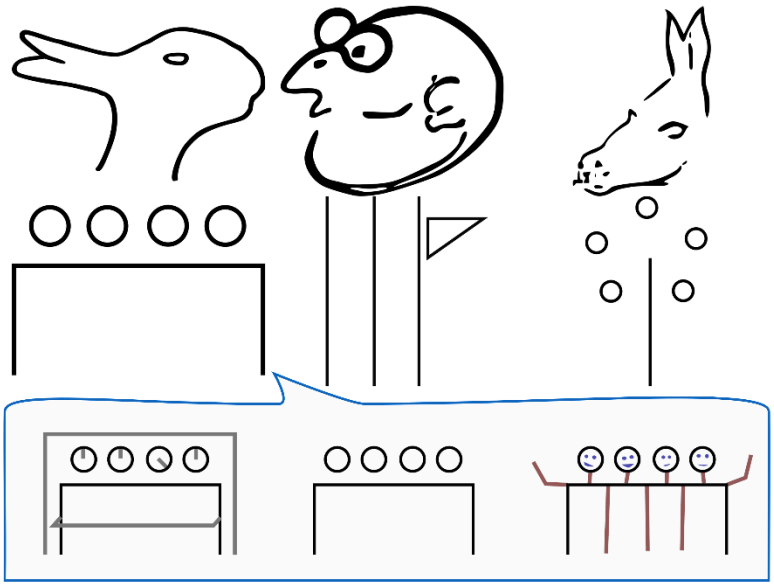

Figure 1. Images used in the two experiments; top row: duck–rabbit, man–mouse, seal–donkey; center row: oven–people, street map–flag pole, sparkling magic wand–flower; bottom row: disambiguated image for oven, ambiguous oven–people, disambiguated image for group of people.

The setup of the computerized task for each image consisted of the following three stages: "instruction," "task," and "break." During the "instruction" stage, participants were told that they should give "as many answers as [they] can" for each of the stimuli and that there were no correct or incorrect answers. Each of the six images was presented for 120 seconds, during which time participants reported their interpretations. This was followed by a self-paced "break."

For this exploratory study, fluency was chosen as one of the main measures as used in the Pattern Meaning task and other divergent thinking tasks because it can be scored objectively for any sample size. Participants' verbal responses were recorded and later transcribed along with the start and end time of each answer. Fluency was extracted as the number of responses generated during the 120 seconds of the "task," the initial reaction time (the response time t_1 from the start of the task until a participant gave the first answer) and the first phase duration (the time participants maintained their first interpretation).

Results

Fluency as the number of generated ideas is summarized in Figure 2. All participants were able to produce two or more distinct interpretations for each stimulus. The average fluency per participant across all six tasks was between 4.17 and 8.33 and the initial answer was produced between $1.67 < t_1 < 8.46$ seconds after task start. The average fluency for images from divergent thinking tasks across all participants (mean = 6.50, SD = 2.31) was very similar to the average for images from perceptual switching tasks (mean = 6.44, SD = 3.17).

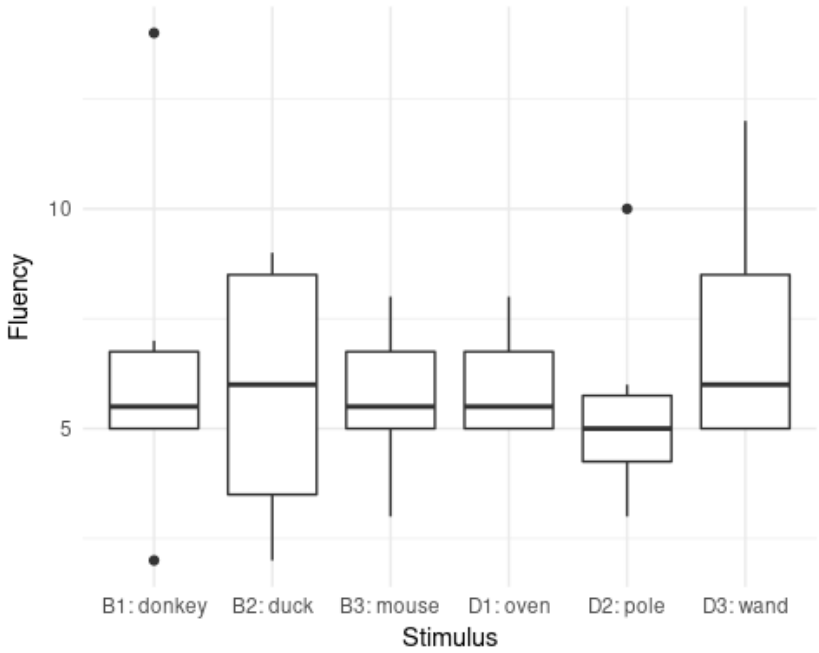

Figure 2. Number of solutions for each stimulus. The six stimuli are displayed on the x-axis and the number of solutions is displayed on the y-axis. Each of the boxes span from the first to the third quartile of the distribution of fluency; the thick line represents the median.

Experiment 2: Perceptual Switching

Participants

Six participants (five females, one male), aged between 27 and 33 years (mean = 30.17, SD = 2.32) participated.

Materials and Procedure

The same six images used in Experiment 1 were presented in a computerized perceptual switching condition (see Figure 1). A sequence of stages was administered for each image: "initial interpretation," "disambiguation," "training," "task," and "break."

Initially, participants were asked to write down their "initial interpretation" of the image. To disambiguate each line drawing from the Pattern Meaning task, the two most frequent interpretations from another study were visualized (see Figure 1). During the "disambiguation," these were used to instruct participants which interpretations of the images they should report. For example, participants who saw the image at the bottom center of Figure 1 were instructed to switch between the "oven" (bottom left) and "people" (bottom right) interpretation. In the self-paced "training," pressing one of the two defined keys on the computer keyboard showed the corresponding disambiguation on screen. During the 120 seconds of the "task," the states of the two keys were recorded continuously. The start and end times for each button press served as the basis to calculate variables such as phase duration (the length of time during which one interpretation is sustained), first phase durations and initial reaction times. At the end of each sequence of stages, participants had self-paced "breaks."

Results

The first phase durations for each stimulus are displayed in Figure 3. The two interpretations were generally well balanced (Moreno-Bote, Shpiro, Rinzel, & Rubin, 2010) for all six images, suggesting that participants perceived equally the two interpretations for each image. This shows that perceptual switching can be experienced in response to images taken from divergent thinking tasks if participants are instructed to do so.

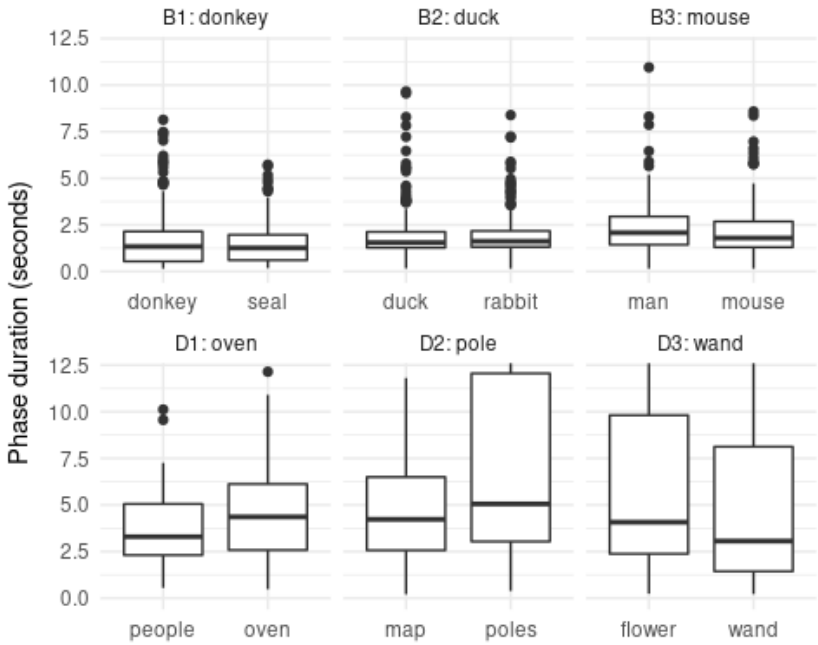

Figure 3. The average phase duration for each interpretation of each stimulus. The phase duration (in seconds) is displayed on the y-axis, while the interpretations of the stimuli are displayed on the x-axis.

In addition to the separate analysis of the two experiments, we explored a direct experimental connection between divergent thinking and perceptual switching. For example, we extracted the initial reaction time and the first phase durations for each image from both experiments.

The initial reaction times of all participants for each of the six images is shown separately for the two experiments in Figure 4. Comparing the same image across the two experiments seems to indicate that the instructions influenced the time it took participants to generate an answer. Specifically, the initial reaction time in the divergent thinking tasks was generally shorter (median = 2.98 s) than in the perceptual switching task (median = 3.44 s), even though the data collected does not provide enough evidence to suggest a significant difference. Moreover, Figure 4 provides no indication that the initial reaction times for the three images taken from the Pattern Meaning task are different from the images taken from the perceptual switching tasks. Nevertheless, Figure 4 seems to show that some images elicit a longer time until the first interpretation in both experiments (e.g., pole–street), while other images (e.g., oven–group of people) cause shorter reaction times in both experiments.

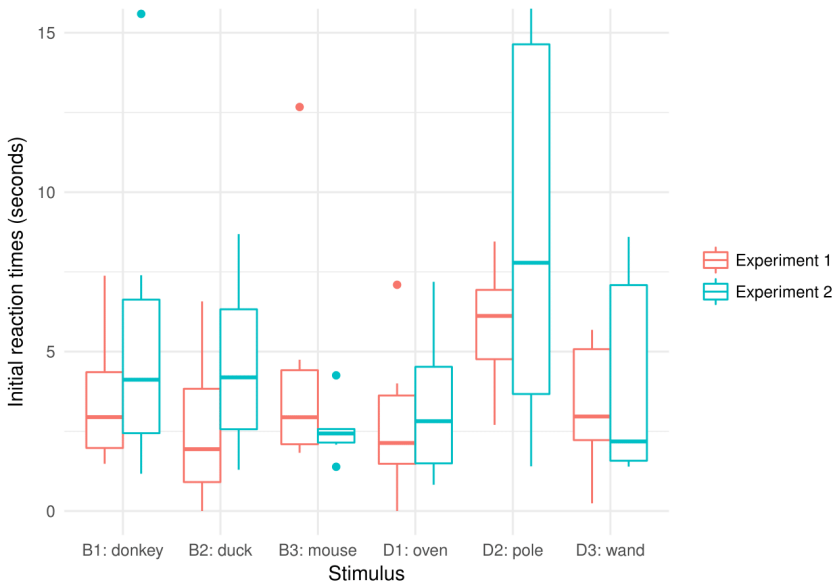

Figure 4. Distributions of the initial reaction times for each of the six images, separately for the two experiments.

Figure 5 displays the first phase duration for each image across all participants and experiments. It also seems to indicate that the first phase duration for some images is short for both experiments (e.g., donkey–seal and duck–rabbit) while participants maintain the first interpretation for a longer time for line drawings (e.g., street map–flag pole). Overall, the first phase duration for the divergent thinking task in Experiment 1 is shorter (median = 1.71 s) than for the perceptual switching task in Experiment 2 (median = 2.52 s).

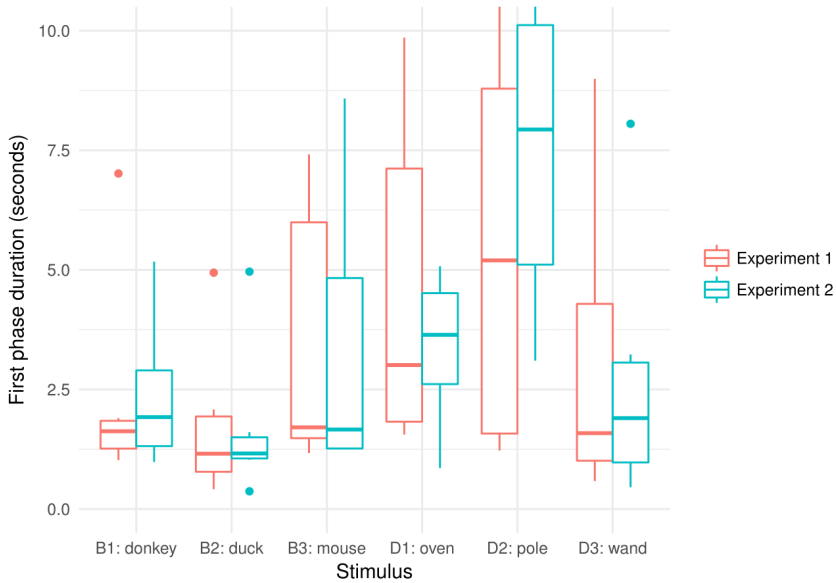

Figure 5. Distribution of the first phase duration for each of the six images, separately for the two experiments.

Discussion

The aim of the current study was to explore the connection between divergent thinking and perceptual switching. To investigate this, we collected a set of images previously used in divergent thinking or perceptual switching tasks. We then observed to what extent this combined set of images can be used in each of the original tasks. Moreover, we aimed to investigate whether participants' responses could indicate whether the original source of the image had an impact on the results. This would allow us to identify whether, except for the instructions, there are inherent characteristics that differentiate the two sources of images.

In the first experiment, images taken from divergent thinking and perceptual switching paradigms were presented to participants as typically done in divergent thinking tasks, while in the second experiment the same images were presented as typically done in perceptual switching tasks. The influence of instructions in the two tasks can

be observed, for example, when we compare the initial reaction times and first phase durations for the same image from the two experiments. For both measures the results showed that instructions lead to different results based on the two tasks that participants were instructed to complete. These results indicate that instructions play a significant role in the way different images are interpreted, a claim that is supported by previous research on the influence of instructions on divergent production (Runco, Illies, & Eisenman, 2005). The role of instructions for perceptual switching needs to be addressed more thoroughly by future research.

In Experiment 1, we found that the number of solutions does not substantially differ depending on the source of the image. This suggests that images previously used in perceptual switching tasks can have more possible interpretations than usually assumed for bistable perception—at least if instructions require this.

The phase durations measured in Experiment 2 do not indicate a clear distinction between the source of the line drawings; i.e., perceptual switching dynamics cannot be used to distinguish between images taken from perceptual switching or divergent thinking tasks. This suggests that bistable perception can also occur to some extent in response to the images taken from the divergent thinking task.

The number of participants in each experiment is small and no statistical inferences can be drawn. Nevertheless, trends indicate that there are individual differences across the selected images, independently of their original source. This result supports findings from bistable research showing that perceptual switching differs across images (see van Ee, van Dam, & Brouwer, 2005). For example, in Experiment 2 the first phase duration for image D2 (street map–flag pole, see Figure 5) is longer than for other images in the same experiment, suggesting that this image is processed differently. Previous studies that examined the connection between creativity and perceptual switching overlooked the role of different types of images (Doherty & Mair, 2012; Laukkonen & Tangen, 2017; Wiseman et al., 2011; Wu et al., 2016). It is possible that the relation between perceptual switching and creativity is found only for some images. We suggest further exploration of the origin of these differences, as they might unveil common factors affecting the relationship between the two phenomena.

One challenge in designing the perceptual switching task for Experiment 2 was to select images that were previously used in divergent thinking tasks and which could be disambiguated. Unlike the disambiguation of images from bistable research which had previously been shown to work, the disambiguation of the line drawings from Wallach and Kogan's Pattern Meaning task had not been used before. We selected the two most common answers from a previously recorded data set for three of the images from the Pattern Meaning task. Subsequently we used them to disambiguate the line drawings by adding lines (for an example, see Figure 1). The disambiguations from perceptual switching tasks, on the other hand, consist of slight changes to the position and shape of key elements of the original image. The current results do not

allow us to draw any conclusions about whether the interpretations we selected for the disambiguation were the easiest to switch between, or whether other interpretations would have worked better. Feedback provided by some participants suggested that they could differentiate between the two types of images based on the way they were disambiguated. Participants described this difference in terms of difficulty to actively imagine additional features for images taken from the divergent thinking task, while for the images from perceptual switching tasks this was easier.

Further differences between the two sets of images are that the images from the Pattern Meaning task are more abstract and are based only on a few geometric shapes such as circles, lines and squares. On the other hand, the images from the perceptual switching tasks can be described as more complex and organic and are supposed to depict real objects (Strüber & Stadler, 1999). Different reaction times to abstract line drawings can be explained by the greater difficulty in processing these images as compared to content-based depictions of real-world objects. This highlights the importance of the top-down effects of imagery and memory on the perception of images, as previously summarized in Scocchia, Valsecchi, and Triesch (2014).

Another limitation of the study comes from the inability to control for participants' prior exposure to the images. Bistable stimuli are well-known images that are often referenced in arts and popular culture and participants could have known some of them. Therefore, individual prior exposure to these images might have influenced the responses in both experiments. For instance, most of the participants reported knowing the duck–rabbit image beforehand. This might have biased their responses in the divergent thinking condition, particularly if they attempted to overcome the initial fixation on the two known interpretations. Previous experience with the images might also have shortened the time of the first perceptual switch in Experiment 2. Future studies should seek to eliminate the effect of stimuli familiarity, which can affect participants' responses.

Conclusion

The present study shows that inherent stimuli characteristics and instructions play an important role in interpreting ambiguous images. Participants respond to images from divergent thinking and perceptual switching tasks according to the instructions. Specifically, participants are able to provide more than two unique solutions when instructed to do so, even for images that are typically considered to have only two interpretations. Similarly, they can be instructed to switch back and forth between two given interpretations for images that are considered to have several possible interpretations. In addition, shared metrics can be extracted from both paradigms which would allow researchers a more direct comparison between the two phenomena.

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Creativity and Blocking:
No Evidence for an Association

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Abstract

Creativity is an important quality that has been linked with problem solving, achievement, and scientific advancement. It has previously been proposed that creative individuals pay greater attention to and are able to utilize information that others may consider irrelevant, in order to generate creative ideas (e.g., Eysenck, 1995). In this study we investigated whether there was a relationship between creativity and greater learning about irrelevant information. To answer this question, we used a self-report measure of creative ideation and a blocking task, which involved learning about irrelevant stimuli. We failed to find evidence for this association, with a Bayes Factor indicating support for no relationship between these measures. While it is possible that a different measure of creative ideation, for example one which does not rely on self-report, may produce different results, a more lucrative research direction may be focusing on the link between creativity and cognitive flexibility, in line with suggestions by Zabelina and Robinson (2010).

Keywords: blocking; creative ideation; creativity; learning; Runco Ideational Behavior Scale; blocking.

Creativity and Blocking: No Evidence for an Association

Creativity is an important quality which has value in problem solving (Sawyer, 2012), education (Lewis, 2009), and has been related to advancements in engineering, mathematics, and technology (e.g., Plucker, Beghetto, & Dow, 2004). Thus, it is important to study creativity in order to identify people, properties and circumstances

associated with it, to investigate the possibility of maximizing related positive outcomes and recognize any associated risks. It has been previously suggested that creative people pay greater attention to irrelevant information (e.g., Eysenck, 1995; Kasof, 1997; Mendelsohn & Griswold, 1966). Because attention guides learning (Mackintosh, 1975), this should result in creative people learning more about irrelevant information. This manuscript investigated whether a measure of creativity was related to greater learning about irrelevant stimuli within a causal learning task.

Causal learning describes a process of acquiring associations between causes and outcomes, allowing people to react appropriately to changes in their environment, predict events, and conserve resources. For example, a causal association may be learned between eating a food and getting a stomach ache, or between pressing a button and sound coming from a radio. A key question within associative learning is what determines the variability in the acquisition of such associations. Influential theories of associative learning have incorporated attention (e.g., Mackintosh, 1975; Pearce & Hall, 1980). In particular, learning and attention have been shown to be greater for cues which predict their consequences very well, compared with cues which predict their consequences poorly (e.g., Le Pelley & McLaren, 2001, 2003, 2004; Le Pelley, Mitchell, Beesley, George, & Wills, 2016; Le Pelley, Vadillo, & Luque, 2013; Lochmann & Wills, 2003).

Attentional processes have also been implicated in creativity. It has been hypothesized that individuals high in creativity will exhibit defocused attention, also referred to as an "over-inclusive thinking style"; they will be more able to connect distant ideas and concepts and utilize information that others might consider irrelevant. For example, Dykes and McGhie (1976) found that participants high in creativity were better at remembering auditory stimuli that were instructed as irrelevant. This defocused attention is proposed to facilitate the idea-generation process of creativity (e.g., Ansburg & Hill, 2003; Eysenck, 1995; Kasof, 1997; Mendelsohn & Griswold, 1966).

Furthermore, creativity and performance in causal learning tasks have been linked. It has been found that individuals scoring high on creativity measures will exhibit greater learning about irrelevant stimuli than individuals scoring low in creativity. This has been evidenced by performance on latent inhibition tasks, involving learning about irrelevant stimuli (e.g., Carson, Peterson, & Higgins, 2003; Kéri, 2011; Meyersburg, Carson, Mathis, & McNally, 2014; Peterson, Smith, & Carson, 2002). In a latent inhibition task, participants experience a repeated presentation of a stimulus (e.g., an image of a food) by itself. When this stimulus is later paired with an outcome (e.g., an allergic reaction), learning for this association is slower than for an association involving a novel stimulus. This is referred to as a latent inhibition effect (Lubow & Moore, 1959). Latent inhibition effect has been found to be smaller in individuals who score high on creativity measures than those who score low, thus supporting the assertion that individuals high in creativity will pay more attention

to irrelevant stimuli. In other words, individuals who are highly creative learn to treat irrelevant information as more relevant, than individuals who are less creative. Given the attentional links with both causal learning and creativity, differences in attention may be one reason for these findings.

While traditionally, the latent inhibition effect has been thought to be due to attention (e.g., Lubow, Alek, & Arzy, 1975; Lubow, Schnur, & Rifkin, 1976), alternative accounts have been proposed (e.g., Holmes & Harris, 2010). In order to investigate whether an attentional link between causal learning and creativity exists, in this experiment we used a different type of learning effect related to irrelevant cues, known as blocking (Dickinson, Shanks, & Evenden, 1984; Kamin, 1969). Blocking was selected due to its more established links with attention (e.g., Wills, Lavric, Croft, & Hodgson, 2007). An example of a blocked stimulus is stimulus B on A+ and AB+ trials, on which stimulus A predicts the outcome, and A and B together predict the same outcome. For example, participants may be told that a fictional patient gets a food poisoning after eating apples (A+), and they get a food poisoning after eating apples and bananas together (AB+). Stimulus B is redundant, because its companion, stimulus A, predicts the outcome perfectly on A+ trials. Dickinson et al. (1984) found that B was thought to have caused the outcome to a lesser extent in a group which received A+/AB+ training than in a group for which A+ trials were omitted (AB+). In the same group of participants, the finding that B is thought to cause the outcome to a lesser extent than D on A+/AB+/CD+ trials is referred to as the blocking effect.

Given the earlier proposed link between higher creativity and greater learning about irrelevant cues, we may expect that participants high in creativity would produce a smaller blocking effect. In order to measure creativity, we chose a measure relating to creative ideation, or ability to generate creative ideas. Because defocused attention has theoretically been proposed to enable individuals to generate creative ideas (e.g., Ansburg & Hill, 2003; Eysenck, 1995; Kasof, 1997; Mendelsohn & Griswold, 1966), such a measure should be best placed to detect a relationship between learning for irrelevant cues and creative-idea generation.

This is what we aimed to investigate in this experiment. Participants were asked to complete a learning task which included trial types necessary for blocking (Table 1). We also asked participants to complete a questionnaire of creative ideation, the Runco Ideational Behavior Scale (RIBS-S; Runco et al., 2014). This measure was chosen due to its focus on the process of generating novel ideas. We investigated whether there was a relationship between the size of the blocking effect displayed by the participants and their RIBS-S score.

Table 1. The design of the learning task. The letters A–J represent different stimuli; "+" represents food poisoning and "–" an absence of food poisoning.

Stage 1	Stage 2	Test
A+	AB+	A, B
	CD+	C, D
E–	EF+	E, F
GH+	K+	K
	L–	L
IJ–	IJ–	I, J

Method

Participants

126 participants in total assisted with this study (110 were female). They were aged 18–42 (M = 20.46, SD = 3.86). They took part as a course requirement at Plymouth University. The study was described as an investigation into learning and personality. Inclusion criteria required participants to be over 18 years old, fluent in English, and have normal or corrected-to-normal vision and color vision.

Materials

The experiment was presented on a 22-inch desktop computer screen with a 1920 x 1080 resolution. The blocking task was designed, presented, and responses were recorded, using E-prime 2.0 software (Psychology Software Tools, PA, US). The questionnaire was designed and the associated data collected using Survey Monkey survey engine.

Blocking task. The foods used in the blocking task were asparagus, aubergine, avocado, carrots, cauliflower, lentils, mushroom, onion, pear, potato, pumpkin, and watermelon, which were randomly assigned to cues A–J for each participant. The outcomes were food poisoning and no food poisoning.

Runco Ideational Behavior Scale: Short form (RIBS-S; Runco et al., 2014). This measure contained 19 statements, which relate to specific examples of everyday creative ideation (e.g., "I have ideas for arranging or rearranging the furniture at home"). Participants were asked to indicate the extent to which these statements applied to them on a 0 (*Never*) to 4 (*Daily*) response scale, with a total possible score of 76.

Procedure

The order of completion for the RIBS-S and the learning task was counterbalanced, with half of the participants completing the learning task followed by the RIBS-S measure and the other half vice versa.

The blocking task was self-paced. An allergist scenario was used for the blocking task, commonly used in associative learning experiments (e.g., Aitken, Larkin & Dickinson, 2000). Participants were asked to imagine that they were diagnosing allergic reactions in a fictional patient. They were asked to observe which foods the patient ate and whether they experienced an allergic reaction or not. Images of foods sized 300 x 300 with text captions above were presented on the screen with black background, below the text "Patient eats the following food(s)": When a trial consisted of one image, this was presented at the center of the screen, while on trials with two images, one was presented on the left and one on the right. The outcomes were food poisoning, signified by text "The patient has food poisoning" and a sad face, and no food poisoning, signified by text "The patient has no food poisoning" and a smiley face. On each trial, participants were asked to rate the stimuli for their likelihood of food poisoning, on a scale of 1–9 (1 = safe; 5 = uncertain; 9 = dangerous). The scale was presented below the images, at the bottom of the screen and participants responded by clicking the appropriate number with a mouse. Immediate feedback followed with the appropriate outcome. The feedback was displayed on the screen for 3000 ms. The progression to the next trial was immediate. Stage 1 consisted of 10 blocks of 4 trial types (A+, E–, GH+, IJ–), and Stage 2 of 5 blocks of 6 trial types (AB+, CD+, EF+, IJ–, K+, L–). The transition from Stage 1 to Stage 2 was seamless. At test, participants were asked to rate individual foods presented in Stage 2 on the same 9-point scale but received no feedback; each food was rated twice at test.

Results

Learning

Responses in Stage 1, averaged across participants, are presented in Figure 1, and responses in Stage 2 are presented in Figure 2. These figures illustrate that participants were able to learn the pairings.

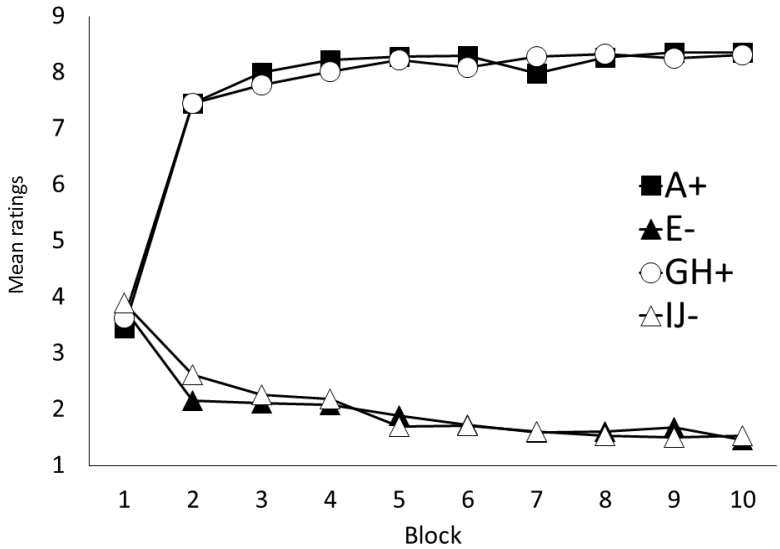

Figure 1. Responses in Stage 1.

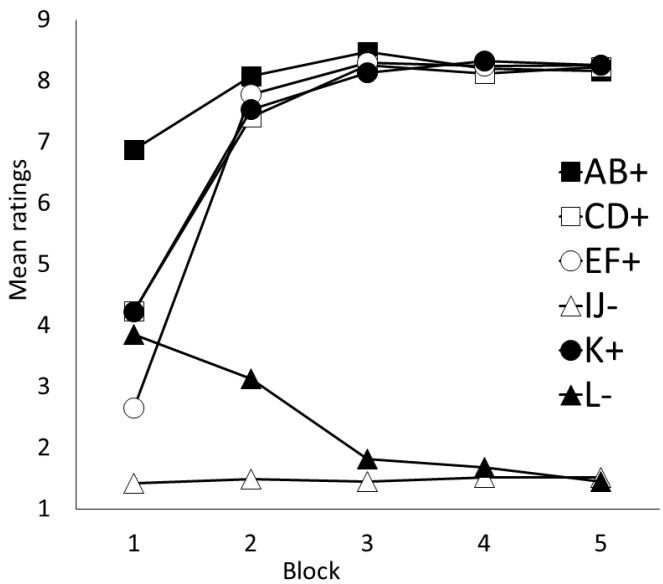

Figure 2. Responses in Stage 2.

Test

Ratings for each cue at test are shown in Figure 3. A one-way ANOVA revealed a significant effect of cue, $F(3.13, 391.33) = 471.09$, $p < .001$, $\eta^2 = .79$. Ratings for C/D were greater than ratings for B, indicating that blocking was observed, $t(125) = 4.41$, $p < .001$.

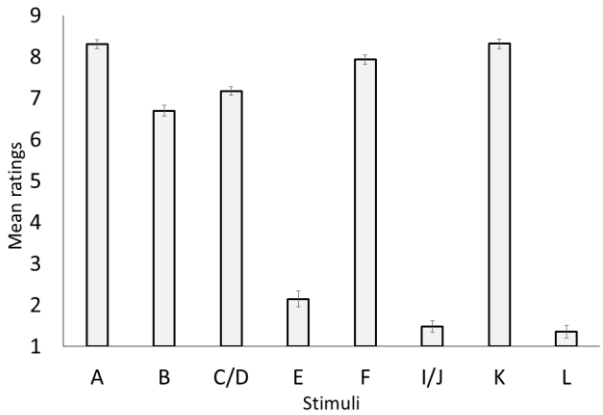

Figure 3. Mean causal ratings at test for each stimulus. Ratings for C and D, and I and J were collapsed because these cues were treated equivalently.

Next we calculated a blocking-magnitude score for each participant by taking away ratings for B from ratings for C/D. In order to investigate whether there was a relationship between blocking and RIBS-S scores, a Pearson correlation coefficient was computed. This was not significant, $r(126) = -.022$, $p = .809$, $BF_{01} = 8.72$ (Figure 4), indicating that there was no relationship between the magnitude of blocking and RIBS-S scores.

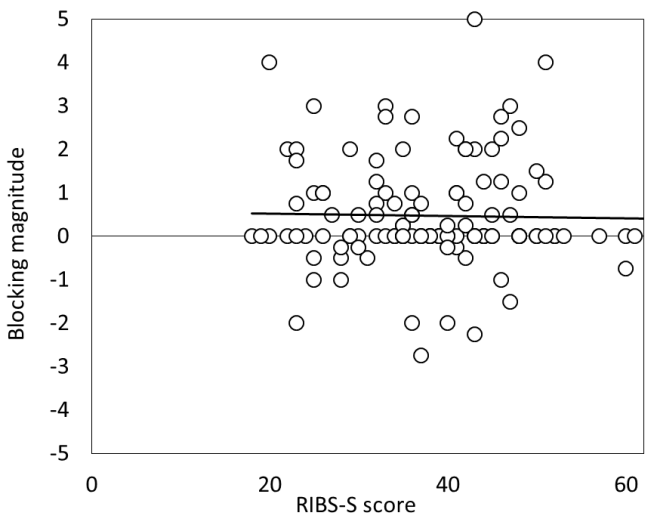

Figure 4. Correlation between blocking magnitude (ratings for C and D – ratings for B) and RIBS-S score.

Discussion

In this experiment we set out to investigate whether the magnitude of blocking, an effect related to learning about irrelevant cues, was related to creative ideation. It has previously been proposed that creative people pay more attention to and are able to utilize irrelevant information in order to generate creative ideas (e.g., Ansburg & Hill, 2003; Eysenck, 1995; Mendelsohn & Griswold, 1966), exhibiting a trait referred to as defocused attention. However, we did not find evidence to suggest that participants' scores on a measure of creative ideation were related to how much they learned about the blocked cue; the correlation between RIBS-S and blocking magnitude was near zero, with the Bayes Factor indicating support for the null hypothesis.

Overall, our findings did not support a link between greater learning about irrelevant information and ability to generate creative ideas. If the link between defocused attention and creativity exists, a relationship between these measures would have been expected. However, we do acknowledge the possibility that a different type of measure for coming up with creative ideas, perhaps one that does not rely on self-report, e.g., divergent thinking, may produce different results; others may wish to investigate this further. However, it is worth noting that Runco et al. (2014) reported a strong positive relationship between participants' scores on RIBS-S and performance on divergent thinking tasks.

If no relationship between these measures exists, then how may these findings be reconciled with previous results? After all, several previous studies have indicated relationship between reduced latent inhibition and creativity (e.g., Carson et al., 2003; Kéri, 2011; Meyersburg et al., 2014; Peterson et al., 2002). One reason for the differential results may be differences between blocking and latent inhibition tasks. For example, blocking is usually estimated once learning for the cues is complete; participants are asked to provide ratings for how predictive a blocked versus a control stimulus is (e.g., Aitken, Larkin, & Dickinson, 2000). On the other hand, latent inhibition often involves time taken to detect a predictive relationship between an incidental stimulus (e.g., the background color of the screen) and an element of the task. It is possible that creativity may be related to faster detection of a causal relationship rather than to attributing greater causality to irrelevant information.

Another difference between the previous studies and the current one is that they focused on creative achievement and personality whereas the present study focused on creative ideation. Arguably, creative achievement is the end result of creative ideation. Therefore it is possible that greater learning about irrelevant cues may be related to a different stage of creativity and not generating creative ideas specifically. In this case, defocused attention may still be related to creativity, but may only be exhibited by creative individuals under particular circumstances. In other words, there will be times when creative people can exhibit defocused attention, but this will not necessarily be stable throughout time. For example, this may only occur when people are

directly involved in a creative activity, e.g., writing a piece of music. In relation to this, Zabelina and Robinson (2010) proposed that creative people, rather than exhibiting defocused attention, are able to utilize both defocused and focused attention, and switch between these two modes of attention as necessary. They referred to this ability as flexible cognitive control. In their study, they found that participants who scored highly on measures of creativity exhibited fewer reaction-time costs in a Stroop task on a trial-by-trial basis. A link between creativity and cognitive flexibility has also been reported by others (e.g., Chen et al., 2014; de Dreu, Nijstad, & Baas, 2011). Given this link, it may be expected that creative participants will outperform others in other associative learning tasks which involve attentional switching. One example of this is intra-dimensional/extra-dimensional (ID/ED) shift (George & Pearce, 1999; Mackintosh & Little, 1969; Shepp & Eimas, 1964). In such a task, participants are presented with stimuli which vary on several dimensions, for example: color and shape. They are asked to sort these stimuli into categories and receive corrective feedback. Over time, they learn that one particular dimension, e.g., color, is relevant and determines the categories. In the next part of the experiment, participants are presented with a different set of stimuli. In this part, for some stimuli, the dimension which determines the categories changes, and a previously irrelevant dimension determines the category, e.g., shape. It has been found that participants incur switching costs, taking longer to learn to categorize stimuli correctly when they are classified based on the previously irrelevant, versus the previously relevant, dimension. If Zabelina and Robinson's suggestions are correct, then participants who are more creative should exhibit lower switching costs than those who are less creative.

However, it is worth noting that creative processes may be the result of a different combination of focused and defocused attention than proposed by Zabelina and Robinson (2010), such that instead of creative participants exhibiting one extreme at any one time, they may utilize both at the same time. For a discussion of this alternative view of cognitive flexibility, please see Ionescu (2012).

To conclude, this experiment investigated whether there was a link between a measure of creative ideation, RIBS-S, and learning for irrelevant cues using a blocking paradigm. We failed to demonstrate this link. Given the theoretical link proposed between defocused attention and creativity (e.g., Eysenck, 1995; Kasof, 1997; Mendelsohn & Griswold, 1966), this link would have been expected. Further studies may wish to investigate whether blocking is related to divergent thinking, and whether creativity may be related to switching performance on an ID/ED task.

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Integration of Processes in the Study of Insight and Innovation

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Abstract

Humans are known to be able to solve problems creatively, but how exactly this occurs is still a matter of debate. Insight problem solving is one important way to study creativity in adults, but studies that use this method with preschool children are rare. In this paper, we present two studies: one in which the problem is solved with known objects (participants were preschool children aged 4 to 7 years) and one in which new objects were created (participants were children aged 5 to 6 years and adults). For both studies, results are discussed in relation to the various processes that can explain insight problem solving. We argue that the integration of these processes under the overarching variability–stability–flexibility pattern might be a better way to investigate insight and ultimately to understand innovation.

Keywords: innovation; insight; novelty.

Introduction

Insight is a highly praised phenomenon when it comes to discussing creativity and innovation. Whenever one is faced with an intriguing problem, an insightful moment is thought to bring the solution all of a sudden; it is the spontaneous manifestation of a problem's solution in conscious thought (Hélie & Sun, 2010). The study of insight was introduced in modern psychology by gestalt psychologists, for whom the insight phenomenon was a perceptual and conceptual reorganization and a sudden transformation of how one sees a problem (Klein & Jarosz, 2011; Ormerod, MacGregor, & Chronicle, 2002). Recent research suggests that insight and creative thoughts make a

decisive contribution to innovation that represents the materialization of the creative process in artifacts capable of inducing change at the societal level (Carr, Kendall, & Flynn, 2016; Gummerum & Denham, 2014). As such, understanding the workings of insight is fundamental to elucidate the processes of creativity and innovation.

Deeply connected to insight is functional fixedness, which represents the fact that the problem solver will encounter difficulties in finding appropriate new uses for a certain object because of previous knowledge of its use (Adamson & Taylor, 1954; Yonge, 1966). An interesting phenomenon that caught the attention of researchers was the discrepancy between children aged 6, who show functional fixedness, and children aged 5, who are not subject to this effect (see Defeyter & German, 2003; German & Defeyter, 2000). German and Defeyter (2000) argue that compared to adults, younger children have wider criteria of what can count as an object's function. More specifically, any intentional use can be its function. The authors interpret this as going from flexible thinking, to rigid thinking, and then back to being flexible during early development. As this remains an understudied issue, we set out to investigate the development of insight problem solving, particularly because we were puzzled by children's progression from flexible thinking to rigidity and then back to flexibility. To this end, we analyzed insight problem solving both with known objects and problems from the literature, and with new objects and problems created in the lab.

The paper is structured as follows: first, we briefly present the two lines of investigation in two studies and their results. The second line of investigation requires further examination before its final objective is achieved, but we present insights from the pilot data that speak for differences between children and adults when it comes to considering what new objects are. Importantly, we will show that integrating children's and adults' behaviors when solving new problems under the variability–stability–flexibility pattern (Ionescu, 2017) may lead to a more coherent picture about the development of creativity. We will end the paper with a discussion of some implications and future directions for this research.

Insight Problem Solving with Known and New Objects

We investigated the way children aged 4 to 7 years solve insight problems for two reasons: first, to investigate younger children to see whether they show the same lack of functional fixedness as 5-year-old children; second, to analyze multiple dependent measures, and not only whether they choose the target object first, as is shown in the current literature. In our first study, we created an insight problem with familiar objects based on the one used by Defeyter and German (2003; e.g., a clear plastic cup and a straw—see Appendix A). The sample of participants consisted of sixty-seven children, divided into 3 age groups: 4–5 years old, 5–6 years old and 6–7 years old. There were two conditions: the experimental group, in which the experimenter

demonstrated the functions of the target objects (e.g., drank with the straw) and the control group, in which the objects were simply placed in front of the children. Participants were scored for the first selected object, the latency before the target object was selected, and the problem-solving behavior (whether they solved the problem with the target object, with another object, or did not solve it).

The results show that regarding the selection of the target object as the first object, the participants' performance increased with age: in the experimental group, 16.7% (4–5 years), 27.3% (5–6 years) and 41.2% (6–7 years), and in the control group, 50% (4–5 years), 63.6% (5–6 years) and 87.5% (6–7 years). We found significant differences in the group of 6- and 7-year-olds between the two conditions which indicate the functional fixedness as reported in Defeyter and German (2003). Still, as the visual inspection shows, children's performance improves in both conditions as they get older; when we tested for the effect of age in the experimental condition, we found none. The latency from the time when the experimenter finished presenting the problem until the target object was selected showed that the children in the 6–7 years old group were faster than the other two age groups. So, how could it be that older children are better (and faster) than the other two groups at selecting the target object, yet also show functional fixedness?

Our second study aimed to analyze the role of set-shifting and knowledge in creative problem solving and to show that flexibility is more than just switching between perspectives (Ionescu, 2012). To this end, we created a new set of objects and piloted them on seven adults (second year undergraduate students) and on twenty-nine children aged 5 to 6 years old. They were presented one by one with the 6 new objects (e.g., five glued wooden blocks, a bent wire—see Appendix B) and were asked what they thought each object was.

Analysis of the answers to this question shows that 76.1% of adults gave answers based almost strictly on the form of the objects, while only 55% of the children did so. Also, while only 11.9% of the adults offered answers unrelated to the form of the objects, 27.5% of the children did so. While adults gave more exact descriptions of what the objects were (e.g., glued wooden blocks for the blocks), children gave more interesting answers, both when they answered based on form (e.g., a tangled shape for the bent wire) and when the answers were not strictly related to the form (e.g., musical instrument, alien or metal detector for the bent wire). We observed the opposite when we piloted the newly created names for the objects (e.g., Aki, Cona): while children were willing to say different things about what the objects were, with the names they were very cautious, with 74.7% of them choosing "I don't know" as an answer. Adults, on the other hand, tended to transform the words so that they become meaningful words in Romanian (e.g., "aici" meaning "here" for Aki or "con" meaning "cone" for Cona).

The results of these two studies can be read from multiple perspectives or, technically speaking, based on the different processes involved. First, we might interpret them using the concept of "creativity 1" (Glăveanu, 2011), or, more specifically, the idea that children are more willing to play with ideas and generate them freely. This is best seen in the results of study 2, in which children went further from the exact shape of the objects that were shown to them than adults did. Moreover, in study 1 this can be inferred from children's willingness to try different objects until the problem is solved. Also relevant here is that the 6-year-olds were capable of overcoming the mental rut (i.e., the impasse caused by the repeated exploration of knowledge elements in the unsuccessful search for solutions that activate incorrect pathways; Defeyter & German, 2003); they solved the problem even if they did not use the target object.

Furthermore, at younger ages, children generate ideas without tying them to a specific purpose. This idea can lead us to a second interpretation of the present results; namely, to goal orientation. In other words, at older ages children have already started to understand that certain problems require solutions with specific characteristics (Magid, Sheskin, & Schulz, 2015). This could show that children start grasping the idea of goals and searching for answers that fit the characteristics of the problem; this is shown by the 6–7 years old children in Study 1, who either solved the problem with the target object or with one that resembled the characteristics of the target object.

A third reading implicates inhibitory control. Developmental studies have shown that preschoolers are in a period when inhibition develops greatly (Carlson & Moses, 2001). Children's performance at solving problems with known objects in study 1 increased with age, corresponding to the developmental pattern of inhibitory control. At 6–7 years of age, children are already better at suppressing irrelevant information and using that which is relevant to make their choices more goal-oriented in problem solving. In contrast, younger children fail to do so, as suggested by the fact that they either try all objects until they find the right one or they fail to solve the problem altogether. Regarding the second study, children seemed to show lower inhibition when dealing with new objects, and better inhibition when dealing with new words, while in adults the pattern was reversed. We will return to this issue in the next section.

The differences between children and adults with unknown objects can also be explained by referring to pretend/symbolic play as the fourth interpretation. Symbolic play reaches its peak at 3–5 years of age and then decreases (Bergen, 2002). Children tend to suggest more uses for an object if they have engaged with it in play beforehand (Dansky, 1980). Pellegrini (1984) explained this phenomenon as a result of the exploration mindset that is favored in play situations, when children build wider associations for objects based on their features. Given that children engage in pretend play more often than adults, it is likely that this activity makes it easier for children to connect the 'what it is' of an object to 'what it can become'. Our second study showed that, as compared to adults, children gave more unusual answers for new

objects. This finding may be closely related to imagination, which provides the individual with the chance to infer a richer set of links between the elements of the situation/object/problem (Magid et al., 2015).

Finally, we can read our results through the lens of the educational environment; more specifically, the types of activities children are engaged in at this age. Preschool children play a lot with objects in different ways, but they do not yet play as much with language as literacy develops during early school years (Cain, 2010). As a consequence, we observed that children were willing to give more unrelated meanings to objects, while they did not "play" with words. In contrast, adults relied on their linguistic experience and rich vocabulary to offer answers closely related to the form of the words.

Integration of Processes and the Study of Insight and Innovation

Because every mechanism presented above is oftentimes explained via other mechanisms (e.g., play and imagination), and because sometimes concepts seem to actually be in opposition (e.g., "playful set" as leading to creativity [Clark et al., 1989], and "mental set" or "the continued attempt to use a previously successful method in problems where the method is no longer adequate" as leading to perseveration [Adamson & Taylor, 1954, p. 122]), we believe that an integrative approach is better suited to describing the phenomenon of insight and to serve as a guide for a new research agenda. For instance, we can see that in order to find a solution to a problem, children progress from a spontaneous, explorative approach to a more deliberate, controlled attitude. This process might be necessary to reach an optimum balance between the two processing modes (Mok, 2014) that can enable them to find a creative solution to a problem. The spontaneous approach young children take might be aided by processes such as imagination or pretend play, which are also interrelated. Imagination can be seen as a cognitive mechanism for efficiently generating new ideas without necessarily assessing their truth (Magid et al., 2015) and could be aided by the broad associations children make during pretend play, when they are in the exploration mindset (Pellegrini, 1984). Defined like this, the process closely resembles creativity 1, or the playfulness of coming up with new ideas (Glăveanu, 2011). As they grow up, children's inhibition and goal understanding develop, thus supporting a more deliberate attitude in problem solving. We therefore propose that going up one level and analyzing the more general states we are in when solving creative problems may lead us to a more accurate description of what is going on. More specifically, we refer to the state of variability (when a cognitive system tries out any response in order to solve a problem), the state of stability (when the system knows the answer and uses it when needed), and the state of flexibility (when the system goes beyond the known answer, explores new avenues, and solves a difficult problem; Ionescu, 2017).

For instance, we can speculate that in study 1, younger children manifest variability when solving a problem, whereas older children show both stability and variability when they approach the same problem. So, what is believed to be functional fixedness in older children (see Defeyter & German, 2003; German & Defeyter, 2000) could actually be stability (Ionescu, 2017). Younger children undergo a process of trial and error when solving insight problems: this can be seen in their tendency to try out several objects and can be considered a variability state; older children—even if they also try—are more influenced by the demonstrated function and therefore show stability. In study 2, we can also ascribe variability to children's behavior with new objects and stability to adults; when it comes to words, we can speculate that adults show flexibility and children stability.

These states include a wide range of cognitive mechanisms (and not only cognitive; Ionescu, 2012) that continuously interact, as explained above. Moreover, some mechanisms can function efficiently and inefficiently at the same age. One such example is inhibition, which seems to be low in the case of objects and high in the case of words in children in our second study. This points to an interesting question: Do preschool children have low or good inhibitory abilities? The literature points to low inhibition in general at this age (Kerns & Muller, 2015), but we see that with words they are very cautious, and as such, may be displaying rather good inhibition. We believe that integrating the processes into this larger pattern of going from variability to stability and then to flexibility might help us clarify how certain mechanisms develop and interact in order to allow us to become creative.

Implications, Future Directions, and Concluding Remarks

Although we know that several processes are important for insight and innovation, we do not yet know how these processes interact in order to arrive at a product that is later called innovative. Looking at this problem via the variability–stability–flexibility pattern could lead us to understand the dynamics of interrelations between different cognitive processes. It could also lead to a better understanding of the flow between these very patterns: they might follow one after another linearly, but might also be incorporated into each other, so that passing from one state to another becomes more fuzzy and nonlinear (Ionescu, 2017). Moreover, by analyzing the passage from one state to another, we might better understand how each state is needed to get to the next one. In other words, maybe we do not need to overcome functional fixedness or stability, but instead need to understand how to utilize this state in order to achieve flexibility. Moreover, looking at insight problem solving through the lenses of this pattern might help us clarify what certain processes are. There is little agreement in the current literature with regard to concepts such as creativity (Simonton, 2016) or flexibility (Ionescu, 2012, 2017); as seen above, even some apparently precisely circumscribed mechanisms are not very clear upon closer inspection (e.g., inhibition during preschool years).

How to further study the proposed approach? A microgenetic study might be well suited to observing the workings of the cognitive system over a brief period of great change (Siegler, 1999). More specifically, over 3 weeks of repeated testing, one could manipulate the aforementioned processes in pairs in different combinations to see which combination is essential for insight to appear. For example, several groups of preschoolers could be involved either in pretend play and games that involve inhibition, or in imaginative scenarios and goal-setting games; their performance in insight problem solving could then be evaluated. Also, the group of children could be split into two subgroups, one that shows variability and one that shows stability, and again their progression to flexibility would be assessed.

In conclusion, we believe that studying these processes together can lead to a more accurate picture of how the system functions when solving problems in a creative way. Even if it might seem difficult at first to put these ideas into rigorous experiments, "the challenge for our field is to prove it," as Russ & Wallace nicely assert (2013, p. 146).

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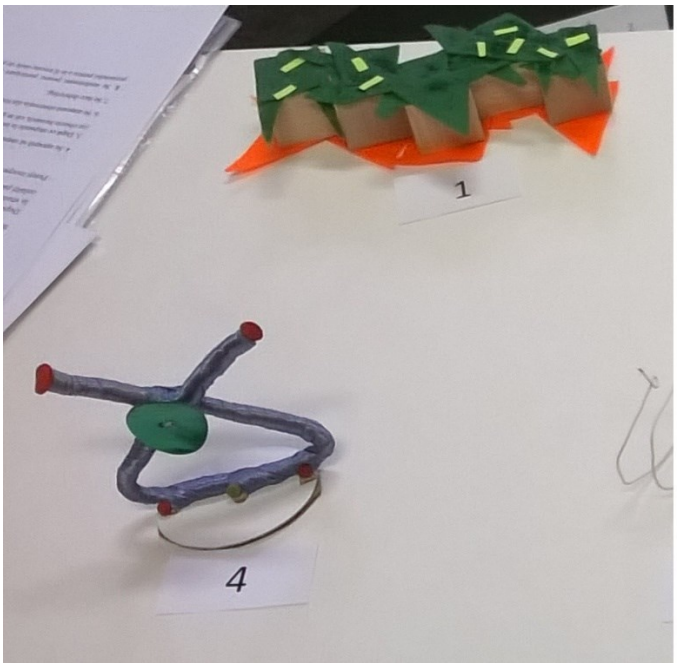
Appendices

Examples of objects from Study 1 (A) and Study 2 (B).

A.

B.



First response to "Integration of Processes in the Study of Insight and Innovation" by Vaibhav Tyagi

This well-presented paper is a reminder that creativity is a complex phenomenon. In his paper entitled *The cognitive neuroscience of creativity*, Dietrich (2004) discussed at least two modes of processing underlying creativity: Spontaneous and Deliberate. This paper discusses the former: Spontaneous creativity in the context of a relatively well-studied phenomenon, Insight and creative problem solving. On the other hand, deliberate creativity can be exemplified through a process of trial and error. For instance, the Mona Lisa was not created in an instance of Insight, instead it took years to finish and allegedly was never complete as envisioned by its creator. Thus, it could be argued that the process of its creation was relatively deliberate. The current paper is a great read and can be supplemented by Dietrich's views to obtain a well-rounded understanding of the process of creativity.

Aside from the question of *what creativity really is*, another question that has haunted the field of creativity for decades is *how to best investigate it*. Researchers such as Vlad Glăveanu and others have suggested three, four and five P frameworks of creativity. In short, creativity can be studied through the process of being creative, through the products that are being created, or even through the person who is creating them. This paper generates interest in the creative process and creative products. For additional reading on the creative person, Mark Runco's work (2014) can often prove quite useful.

Finally, there is the question of *who can be creative*. Researchers have long debated whether animals can be creative, or—a question more relevant to this discussion—can children be creative? Without explicitly going into this debate, the current paper takes a clear stand on investigating creativity in children. However, it might be worth situating the present work in the light of this debate through the works of other researchers. This becomes especially important since, in Dietrich's framework, the mode of processing in children is somewhat limited to spontaneous creativity.

Overall, this short paper is successful at presenting this interesting topic to a wider range of audience.

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Second response to "Integration of Processes in the Study of Insight and Innovation" by Judy Edworthy

Upon reading this paper and noting its results (as a non-expert in this area), the two systems of the dual processing approach to cognition immediately come to mind (Kahneman, 2011; Paivio, 2014). The properties assigned to System 1 (such as unconscious reasoning, low effort, large capacity, nonverbal, contextualized, domain-specific) and, by contrast, System 2 (such as conscious reasoning, small capacity, language-based, abstract, domain-general) seem to cut across the tasks and the results obtained, and thus might provide a further perspective in looking at the variability–stability–flexibility question. In the sense of Haeckel's statement that ontogeny recapitulates phylogeny—a belief/understanding that the development of an individual from birth to adulthood (ontogeny) expresses all the intermediate forms of the species (phylogeny)—we might expect children to demonstrate more aspects of System 1, the old system, than System 2, but for this balance to change as they reach adulthood.

Of course, not everyone agrees with Haeckel, or even with the dual-process theory. One might prefer the dynamic graded continuum (DGC) approach (Cleeremans & Jiménez, 2002), or the fuzzy trace theory (Reyna & Brainerd, 1995) with its distinction between the verbatim and gist memory systems, which also seem appropriate here, as it shows that we rely more on gist than verbatim information as we become older.

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Third response to "Integration of Processes in the Study of Insight and Innovation" by Chun-Wei Hsu

I like the idea of using the variability–stability–flexibility pattern to approach insight and innovation as it can explain more about how we use different cognitive abilities to be creative when doing insight problem solving in different stages of life and how we integrate these processes.

Several cognitive functions are mentioned in the article, including goal direction and inhibitory control. Here, I propose that "attention" may also play a critical role in generating ideas as a certain attentional span is required to solve a problem creatively and the relationship between attention persistence and creativity has been investigated in previous literature. Zabelina and Beeman (2013) examined this relationship by implementing an attention-switching task in which participants had to identify whether the stimulus contained the letters S or H within hierarchically constructed letters (e.g., a large S made up of small Es—global level; a large E made up of small Ss—local level). On the other hand, participants' creative cognition was measured by a self-report, creativity achievement questionnaire (CAQ) in which participants reported their level of achievement in 10 different fields, e.g., writing, visual arts, music, science, etc. They found that highly creative individuals showed higher levels of attentional persistence when they made more errors when switching the level of attention, even after controlling for general intelligence. Therefore, attention might be another important cognitive function in the development of creativity in children; it is still unknown how attention affects creative cognition in children.

Also, working memory, which is another executive function, is strongly related to performance in complex cognitive tasks. Working memory capacity is needed to solve insight problems. Have the authors considered this?

Finally, the authors mentioned that the variability–stability–flexibility pattern might follow one another linearly and might also be included in each other; thus, passing from one state to another becomes more fuzzy and nonlinear. Is it possible for this pattern to go backwards? For example, in study 2, compared to children, adults offered fewer answers that were unrelated to the form of the objects. The authors ascribed stability (i.e., when the system knows the answer and uses it when needed) to adults' behavior and variability (i.e., when a cognitive system tries out any response for solving the problem) to children's behavior with new objects. However, is it possible that children showed the state of flexibility (i.e., when the system goes beyond the known answer, explores new avenues) in this case, as preschool children play a lot with objects in different ways, therefore they can think beyond the known answer and explore a new avenue? On the other hand, the variability–stability–flexibility pattern might go backwards for adults' behavior since they do not play with objects as

often as children. Thus, unfamiliarity with the objects makes them fix their function and the mental state for adults when solving an insight problem might become stability, even though they developed the state of flexibility at some point.

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Creation through Polychronization

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Abstract

I have recently suggested that some of the processes involved in the collaborative composition of new music could be analogous to several ideas introduced by Izhikevich in his theory of cortical spiking neurons and simple memory, a process which he calls *Polychronization.* In the Izhikevich model, the evocation of simple memories is achieved by the sequential re-firing of the same *Polychronous* group of neurons which was initially created in the cerebral cortex by the sensual stimulus. Each firing event within the group is contingent upon the previous firing event and, in particular, contingent upon the timing of the firings, due to a phenomenon known as "Spike Timing Dependent Plasticity." I argue in this article that the collaborative creation of new music involves contingencies which form a *Polychronous* group across space and time which helps to create a temporary shared memorial space between the collaborators.

Keywords: collaboration; composition; polychronization; spike timing dependent plasticity.

Hodgkin and Huxley

In a remarkable paper written in 1976, the biologist Alan Hodgkin describes some of the accidents and designs which led to the discovery of the mathematical physics of the electric current transport through the membrane of the axonal nerve fiber of the longfin inshore squid (Hodgkin, 1976), a discovery which culminated in four papers in 1952 written with Andrew Huxley (Hodgkin & Huxley, 1952) for which they were awarded the Nobel Prize in Physiology or Medicine in 1963 and which still underpin our knowledge of the mathematical physics of the dynamics of neurons. Hodgkin's 1976 paper begins with him as an undergraduate student in Cambridge in

the 1920s working with self-built amplifiers in a second-year laboratory, takes us through collaborative conversations and experiments with colleagues in Cambridge, New York, St. Louis and Plymouth, down blind alleys and through joyous discoveries and disappointments including the final admission of finding their initial hypothesis difficult to prove which meant that, in Hodgkin's words, "we settled for the more pedestrian aim of finding a simple set of mathematical equations which might plausibly represent the movement of electrically charged particles" (Hodgkin, 1976, p. 19). This "simple set of mathematical equations" are now the mathematical cornerstone of brain physics and form the basis for all dynamical discussion of the interaction between neurons.

In the early 21st century, much of the mathematical biological community interested in brain research was focused on the behavior of large networks of neurons and due to the many variables and highly non-linear nature of the Hodgkin-Huxley (HH) equations, simpler equations had to be used to model the very large networks as computing power was not sufficient to calculate the large network dynamics. There are several simplifications of the HH equations, the most simple of which reduce the four variables of HH to a single membrane voltage (the integrate-and-fire model; Lapicque, 1907) and others which reduce the four variables to two interconnected variables (e.g., the Moris-Lecar model; Morris & Lecar, 1981) and the FitzHugh-Nagumo model (FitzHugh, 1955; Nagumo, Arimoto, & Yoshizawa, 1962). One such model is the Izhikevich model (Izhikevich, 2003) which computes the firing times and firing patterns of many connected neurons and which also incorporates the more recently discovered effect of spike timing dependent plasticity (STDP; Song, Miller, & Abbot, 2000), an effect which shows that the synaptic strength of connection between neurons depends upon the relative timing of the arrival of neural signals at the synaptic junctions. One of the main outcomes of the Izhikevich model is the concept of "Polychronization," a term coined by him (Izhikevich, 2006) to describe the dynamics underlying the formation of neural pathways through the mammalian cerebral cortex. The idea is that STDP and the neural firing dynamics conspire to produce a unique polychronous group of firing neurons for each sensory stimulus, and that we can evoke (re-imagine) the original stimulus by reproducing the firing of this polychromous group. The mechanism for the re-imagining remains one of the mysteries of conscious behavior.

Collaboration

In an informal recollection of some of the processes used in the collaboration between myself and Jay Auborn in the making of the music album *Race to Zero* (Matthias & Auborn, 2017), I have suggested (Matthias, 2015) that Izhikevich's idea of Polychronization (extended over weeks, months and years, and between people, not cells) provides an interesting analogy for collaborative artistic creation. I suggest

that the sound of one of our tracks, "Songbird," depends on the contingencies of many events, from the agreement by 17th-century luthiers that the violin strings should be a fifth apart, to the jerky movements of the Company Chameleon dancers (which informed the bowing technique used to create the earlier track, "Birdsong"[1]), to the impressions that Jay and I were doing of Miles Davis in a conversation in Jay's kitchen about the Dorian mode. Each of these events is a kind of "firing," and the track "Songbird" could be said to have its own polychronous group of firing events which led to its unique creation. One attractive quality of this idea is that it implicitly includes the notion of context in artistic creation. There are many contexts in the creation of each collaborative "firing" event, including the economic cultural context of the record company deciding to fund the recording of the album. The creation through Polychronization idea is, in a sense, an extension of David Byrne's arguments regarding the co-evolution of music and architecture (Byrne, 2012, 2017) in which he suggests that musical and acoustic sensibilities co-evolved such that Bach's music, for example, would not have been possible if the acoustic of the church in Leipzig where Bach's music was performed had not allowed for modulations in key during a piece. Byrne's ideas relate to the interdependence of two factors, music and architecture. Here, I am suggesting that the polychronous creation model takes into account the importance of the co-evolution of music styles with architecture but also includes the many other contingent events and contexts which accompany a musical creation, such as economic and technological contexts and whether one person met another at a party in 1956. Furthermore, because the idea of spike timing dependent plasticity is inherently implicit in the formation of Polychronous groups, the theory I am proposing is inherently dynamic and includes a kind of social "Spike Timing Dependent Plasticity": Ideas that happen at the right time tend to catch on (strengthen the social synapses) if the contexts and the ideas line up; if they do not and the time is not right, they tend not to attach. This leads naturally to Polychronous contingency. In Spike Timing Dependent Plasticity, the relative timing of signals dictates whether the synapse between pre-synaptic and post-synaptic neuron will be enhanced or weakened; indeed, the change in synaptic strength depends exponentially upon the relative arrival time and drops off within milliseconds. It would be very interesting to examine whether there is a similar functional form within the model I am proposing here (with a time-scale is likely to be months or years rather than milliseconds).

Betweenness

There is another sense in which Izhikevich's concept of Polychronization can be applied to collaborative creativity which is linked with the network of ideas and experiences which evolve between two (or more) creators. Conversations and actions between collaborators form a kind of inbetween world which becomes a reference

[1] Listen to fragments of "Songbird" and "Birdsong" at: https://doi.org/10.26913/80s02017.0111.0015

point for all further activity. This means that the network of Polychronous cellular activity goes beyond the brains of each collaborator and resides in both and between both. The experience of collaboratively improvising a certain piece or having a conversation about a particular piece of music creates this between-world which is a combination of contexts and occurrences. Reading the account by Hodgkin (1976) also makes it clear that the ideas which I am suggesting also take place within scientific enquiry as well as musical creation. Hodgkin writes about using a particular piece of experimental kit, partly because of his acquaintance with the inventor (Lucas) as a child and because of his relationship with Hodgkin's father and is clear about the contingencies of certain lines of thinking upon particular conversations as well as on the (possible) results of scientific experiments.

"I believe that the record of published papers conveys an impression of directness and planning which does not at all coincide with the actual sequence of events . . . Inwriting papers, authors are encouraged to be logical, and, even if they wished to admit that some experiment which turned out in a logical way was done for a perfectly dotty reason, they would not be encouraged to 'clutter up' the literature with irrelevant personal reminiscences" (Hodgkin, 1976, p. 1).

As Sue Denham has suggested, whether an idea catches on and becomes part of an artistic creation might depend upon this "inbetweenness": "A social mechanism of similar functionality might map well onto the example of Hodgkin and Huxley and the fortuitousness of invention. STDP picks out temporal coincidences without prior preconceptions and therefore can discover unpredicted connections simply on the basis of co-occurrence . . . in some sense the social STDP should work like that too . . . operating on anything and everything" (S. L. Denham, personal communication).

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Appendix

This paper was discussed by Liam Maloney (University of York) and Thomas Wennekers (Plymouth University) who had been asked to give a response. Liam Maloney raised the issue of Lapalace's demon in relation to the above ideas, adding that he was concerned about issues of agency within the argument being put forward. I responded by suggesting that even though one might be able to look at situations and contexts which have occurred over many time and space scales to form a creative idea or object looking *back*, I was not suggesting that all creative ideas were inevitable given a certain set of circumstances, but rather that one should consider context and circumstance when understanding what has happened and what might happen. Thomas Wennekers responded to the idea of Polychronization scientifically, going through the argument given by Izhikevich systematically, considering the argument presented above and questioning whether there might be a correspondence between the two. Thomas was open to the ideas and considered that many of the ideas in the above argument mapped to the Izhikevich ideas, although he was skeptical about the mapping of the mathematical of STDP but felt that the ideas which I have been outlining might be more akin to "Long Term Potentiation." There was an interesting discussion about whether the catching on of ideas over time might indeed follow an exponential dependence, as is the case with STPD. Indeed, as the exponential function is defined as the solution to a differential equation in which the rate of change of a quantity is proportional to the quantity itself, it might well find a correspondence. This will be explored in future work.

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(Not So) Dangerous Liaisons:
A Framework for Evaluating Collaborative Research Projects

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Abstract

With advances in research environments and the accompanying increase in the complexity of research projects, the range of skills required to carry out research calls for an increase in interdisciplinary and collaborative work. CogNovo, a doctoral training program for 25 PhD students, provided a unique opportunity to observe and analyze collaborative processes. We propose a process-oriented framework for understanding research collaborations along two dimensions: interpersonal and project-related. To illustrate the utility of this process-oriented framework, we apply the framework matrix to several collaborations that emerged within the CogNovo program. The framework that we introduce has several advantages over existing metrics. Firstly, we offer a process-oriented—as opposed to product-oriented—evaluation of interdisciplinary and collaborative endeavors. Secondly, we propose a means of assessment that preserves the distinctive profile (or "fingerprint") of a given collaborative project, thus capturing the uniqueness of each project and its environment.

Keywords: collaboration fingerprint; collaborative framework; group work; interdisciplinary research; organizational team performance; research assessment.

With achievements increasingly arising from teamwork, "collaboration" has acquired a vital role in organizational, educational, and research contexts (Larivière, Gingras, Sugimoto, & Tsou, 2014). In particular, *research collaboration* has received increased attention, with many leading institutions arguing that complex contemporary issues (such as health, environment, and mobility) require solutions that combine insights from different disciplines (National Academies, 2005; as cited in van Rijnsoever & Hessels, 2011). The complex nature of these issues increasingly necessitates that knowledge and solutions can be combined from multiple disciplines (Buanes & Jentoft, 2009). Research collaboration has been described in various contexts and by various approaches, with a lack of consensus over its definition; this is why it is often defined under the umbrella term "collaboration" (Bukvova, 2010). What "interdisciplinary collaboration" entails has remained particularly unclear (Huutoniemi, Klein, Bruun, & Hukkinen, 2010).

Nevertheless, a common theme among various collaborations is that they involve engagement and interaction between two or more people at one time or repeatedly, in order to achieve a common goal (Patel, Pettitt, & Wilson, 2012). Identifying which factors constitute "successful" interdisciplinary, multidisciplinary, or transdisciplinary[1] collaboration and what participating members can do to nurture these is "of significant theoretical interest" (Mansilla, Boix, Lamont, & Sato, 2012, p. 2). Beyond theory, shedding light on this "black box" (Kurtzberg & Amabile, 2001) has also become an increasing priority for funding bodies and research in industry (Mansilla et al., 2012).

How to operationalize research collaboration is a topic of debate (Katz & Martin, 1997). Various approaches have been adopted in order to evaluate research collaborations, including bibliometrics, interviews, observations, experiments, and social network analysis (Groboljšek, Ferligoj, Mali, Kronegger, & Iglič, 2014). Measuring publications through co-authorship evaluation, where publications become the ultimate indicator for collaboration success, is particularly common (Bukvova, 2010). More specifically, the mean number of authors per paper (termed the "Collaborative Index", Lawani, 1980; as cited in Savanur & Srikanth, 2010), the proportion of multi-authored papers (termed the "Degree of Collaboration", Subramanyam, 1983), or a combination of these (termed the "Collaboration Coefficient"; Ajiferuke, Burrel, & Tague, 1988) have been used as metrics to assess the scope of collaboration across fields or disciplines (Savanur & Srikanth, 2010). However, an important point that is often overlooked is that not all research collaborations result in co-authored publications, nor are all co-authorships born out of collaborations (Bukvova, 2010).

[1] Although often used interchangeably or without clear definition (Lawrence, 2010), here we adopt the following definitions. Interdisciplinarity "unites" and "synthesises" links between disciplines to form a "coherent whole," multi-disciplinarity draws on information from multiple disciplines but stays within disciplinary limits, and transdisciplinarity brings disciplines together in new contexts and transcends existing disciplinary boundaries (Choi & Pak, 2006, p. 351). Of course, these categories are not always mutually exclusive given the complexity of many research projects (Klein, 2008).

In addition, the publication of interdisciplinary research appears to be more difficult, resulting in a lower number of interdisciplinary publications and co-authorships. Bruce, Lyall, Tait, and Williams (2004) identify the lack of opportunities to publish interdisciplinary results in high-ranking journals as a discouraging factor to work on interdisciplinary topics.

Evaluating collaborations using product-based approaches, in which outputs of collaborations (i.e., co-authorships) are accepted as indicators of collaboration success, has the advantage of using easily accessible and measurable data (see Groboljšek et al., 2014, for a review). However, these approaches often undervalue the importance of the collaboration process. In their literature review, Aboelela et al. (2007) explored the different views on interdisciplinarity in order to compose a theoretical definition of interdisciplinary research. Key components of interdisciplinary research from the literature included: covering qualitatively different research disciplines; creating a continuum of collaboration which varies from brief communications to mutual integration; establishing a platform for cooperation, interaction, communication, and sharing. In fact, this latter component is considered critical in the majority of interdisciplinarity definitions (Aboelela et al., 2007). As such, a process-based framework, which focuses on what Callard and Fitzgerald call the "choreography" (2015, p. 80) of cooperation and integration between group members, could offer valuable insights for understanding and evaluating research collaborations. Therefore, while we cannot deny the value of collaborative outputs, in the present paper, we focus on the process of collaboration and the dynamics of interdisciplinary integration. We interpret examples of collaborations within the same organization on two dimensions: interpersonal and project-based. To capture and evaluate these collaborations, we propose a process-focused matrix. We present several example studies of collaborations that were fostered within the interdisciplinary CogNovo project[2] (Maranan, Loesche, & Denham, 2015), and demonstrate how collaboration success can be analyzed by exposing the processes that occurred during collaborative work.

Process-Oriented Framework

The current framework incorporates observable indicators of collaborations through two main strands: 1) Interpersonal dimension: how the social dynamics, as well as the individual research interests and contributions, shape group collaborations. 2) Project dimension: what specific project tasks and steps need to be completed in order to reach an outcome. Field knowledge, skills, and project commitment are integral to this dimension.

[2] CogNovo is an interdisciplinary doctoral training program jointly funded by the Marie Skłodowska Curie Actions and Plymouth University, comprising a network of diverse researchers from various disciplines, including Psychology, Computational Neuroscience, Robotics, Arts and Humanities.

Of course, any given collaboration will have external conditions for success driven by institutional contexts (Mansilla et al., 2012). The conventions and expectations of both academic fields and funding organizations will inevitably contribute to the collaborative environment and both the interpersonal and project dimensions of any given project. The institutional context initiates, supports, and funds the collaborations and thus has a significant impact on the overall success of the collaborative endeavor. The examples described in the present paper include projects that were all completed within the same institutional contexts. As such, at the end of this paper we offer suggestions on how the process-oriented framework might be extended and adapted to take into account other institutional contexts.

Interpersonal Dimension

Within our process-oriented framework, the interpersonal aspect of a collaboration can arise in three different ways: 1) *Mutual collaborations*: every participant contributes to the collaboration equally and the contribution from different disciplines is weighted equally. Collaboration results in similar outcomes for all involved disciplines. 2) *Assisted collaborations*: the project is led by one discipline and collaborators from other disciplines assist by providing specific knowledge. Collaboration results in progress in the main discipline. 3) *Emergent collaborations*: these collaborations do not require a specific domain knowledge. Collaboration may occur on a primarily social or pragmatic level (e.g., departmental colleagues organizing a research seminar series) involving no particular discipline, or the collaboration may result in progress in a new (or emergent) discipline.

Project Dimension

All collaborations involve a project dimension, where certain tasks must be accomplished in order to achieve the desired outcomes. This dimension involves coordination between the participants' knowledge of domain(s) and relevant skills. For the projects evaluated within CogNovo, we identified the following primary steps: 1) *Objective & Research Question*: formulating objectives and research questions; 2) *Experiment*: formulating and/or carrying out methods; 3) *Analysis*: formulating and/or carrying out analyses; 4) *Communication*: formulating and/or carrying out dissemination strategies to communicate collaboration outputs (e.g., writing papers). Even within the same context, these steps will have different importance and may even be skipped entirely depending on the implementation, aim, and success of the project. Importantly, although stages are described linearly here, the reiterative and adaptive transfer from one stage to another can be both dynamic and unpredictable. For example, it is likely that project objectives and research questions will be frequently revisited and revised at multiple times during a project lifecycle.

Process-Oriented Framework Scheme

According to the process-oriented framework, each collaboration can be evaluated through the interpersonal and project dimensions on a point-based system. We propose that the four stages of a project should be measured independently. In the first stage, *Objective & Research Question*, a research question is generated and a method is explored (and potentially tested). If the research question derives from and seeks to fill a gap in literature in two or more distinct domains, the collaboration can be seen as mutual. Instead, if the gap can be filled by applying knowledge or a method from one of the involved domains, the collaboration is assisted. Finally, if several researchers identify a potentially interesting topic outside of all their domains and create a question and method to answer it, the collaboration could be classified as emergent. Each project stage can be simultaneously mutual, assisted, and emergent to different degrees. An initial scoring of the project can be done in accordance with these three categories: we suggest that the sum of the categories for each row should be 100%. For example, if a participant wants to express that a project was ⅔ mutual, ⅓ assisted, and not emergent at all, (s)he would score it as 67% mutual, 33% assisted, and 0% emergent.

The second stage, *Experiment,* includes any kind of data collection that contributes to answering the questions identified in the first stage. This type of data collection can be either grounded or contribute to several domains, and therefore it can be categorized as mutual. If the methodology is borrowed from one domain to address the data collection from a second one, this could be classified as assisted. Finally, if the method is taken from another line of work in which all participating researchers have only lay-people knowledge, this project would lay in the emergent collaboration category.

The third stage, *Analysis*, involves any kind of data processing that transforms the data collected in the previous stage into knowledge of some kind. The *analysis* may be driven by conventions prescribed by a single discipline. For example, in the sciences, both quantitative and qualitative methods could be applied at this stage, while in the humanities historical methods might be adopted, and in philosophy, conceptual analysis might be favored. It is also possible for the *analysis* to incorporate analytical procedures that combine several disciplinary approaches or that construct approaches that transcend traditional methods bound by a single discipline. Note that the rule of distributing 100% across the three columns also applies here.

At the final stage, *Communication*, results are communicated to others through various ways such as poster presentations, talks, papers, or even through chats and other forms of informal conversation. If a journal covers two or more research areas that the project is situated within, the communication can be seen as mutual. Instead, if the results are communicated at a specific conference but calling for support from a

different domain, this communication would belong to the assisted category. Finally, communications such as open science, code repositories, or public engagements events, are considered primarily as belonging to the emergent category.

In parallel and independent of the measures collected for each stage, the importance (or *weight*) of the stage itself can also be rated. For a project that aims to generate new research questions, the main focus might be on the first and, to a lesser extent, on the fourth stage. For projects that focus on novel analysis of existing data, the second and third stage would receive more weight. The four stages cover the lifecycle of a project, thus the sum across all stages is 100%. For example, if all stages have a similar weight, then they would each receive 25%. An alternative to rating weights in hindsight is the amendment of stage weights based on the project aims.

Table 1 illustrates an example of this matrix system. In this case, the first step has almost ⅓ of the overall weight (30%). This project has no experimental aspect, thus the data collection method is not considered a valuable contribution by the collaborators. Likewise, the analysis plays only a small role (10%). On the other hand, the communication of the results is rated as the most important part of this project and received a 60% weight in the overall rating. Based on this intuitive rating, an overall rating of 41% mutual, 15% assisted, and 44% emergent could be calculated for this project.

Table 1. Illustration of the evaluation matrix of proposed framework.

	Weight	Classification		
		Mutual	Assisted	Emergent
Objective & Research Questions	30	70	30	
Experiment		(N/A)	(N/A)	(N/A)
Analysis	10	20	60	20
Communication	60	30	0	70
Overall rating		**41**	**15**	**44**

CogNovo Project Collaboration Examples

Example 1: "Bisensorial" (Hack the Brain 2016 Hackathon).

Collaborators: Diego Maranan, Agi Haines, Jack McKay Fletcher, Sean Clarke, Kim Jensen, Ricardo Mutuberria

Disciplines: Design, Music, Cognitive Neuroscience, Computer Science, Psychology, Arts

Objective & research questions: Ideate and prototype a "hack" based on the event theme, "Hacking yourself for better or for worse," that maximizes the skills of the participants and the resources available during the hackathon.

Result of design experiments: A working proof-of-concept of a wearable, neuro-adaptive, vibroacoustic therapeutic device.

Communication: Presented at Hack the Brain 2016 event; exhibited at Off the Lip 2016 public engagement event, Bizarre Bazaar; exhibited at the Cognition Institute Conference; to be presented at the Ars Electronica STARTS event; discussed in PhD thesis (Maranan, 2017).

Collaboration type:

Table 2. Evaluation of Bisensorial Project.

	Weight	Classification		
		Mutual	Assisted	Emergent
Objective & Research Questions	50	80	15	5
Experiment	35	30	70	0
Analysis		(N/A)	(N/A)	(N/A)
Communication	15	75	25	0
Overall rating		**64.25**	**33**	**2.75**

Example 2: BRAMZ (Because youR BrAin MatterZ)

Disciplines: Psychology, Linguistics, Human-Computer Interaction

Collaborators: Ilaria Torre, Frank Loesche, Kathryn Francis, Raluca Briazu, David Bridges

Objective & research questions: The main aim of this project was to develop personality measurements through games. Specifically, to build a mobile phone application in order to implement the games and collect data from experiment participants.

Experiment: Prototypical implementation during Computational Modelling workshop

Analysis: No analysis was conducted.

Communication: Grant application for the "StudentshIP Enterprise Awards 2014."

Collaboration type:

Table 3. Evaluation of BRAMZ Project.

	Weight	Classification		
		Mutual	Assisted	Emergent
Objective & Research Questions	30	70	30	0
Experiment	10	20	60	20
Analysis		(N/A)	(N/A)	(N/A)
Communication	60	30	0	70
Overall Rating		**41**	**15**	**44**

Example 3: Impasse in Conversations

Disciplines: Linguistics, Psychology

Collaborators: Ilaria Torre, Frank Loesche

Objective & research questions: Analyze creative problem solving in social interaction, in focusing in particular on how impasses are overcome in conversation.

Experiment: Choice of conversations, data collection not part of the project.

Analysis: Conversation analysis on freely available corpus of spontaneous conversations.

Communication: paper in *Creativity: Theories-Research-Applications Journal* (Torre & Loesche, 2016); Poster presentation at UK Creativity 2017 Conference (Edinburgh)

Collaboration type:

Table 4. Evaluation of Impasse in Conversations Project.

	Weight	Classification		
		Mutual	Assisted	Emergent
Objective & Research Questions	35	80	0	20
Experiment	20	30	50	20
Analysis	20	50	30	10
Communication	25	70	0	30
Overall Rating		**61.5**	**16**	**20.5**

Example 4: Distorted Dimensions

Disciplines/fields: Social Psychology, Cognitive Psychology, Philosophy, Art & Design

Collaborators: Kathryn Francis, Agi Haines, Raluca Briazu

Objective & research questions: Using moral psychology as a case study, we explored the importance of incorporating considerations from design research into the development of testing tools in the experimental sciences. We further considered how the process of "making" might be utilized as a collaborative tool, nurturing successful interdisciplinary endeavors.

Experiments/outputs/results: An interactive and life-like testing tool was constructed and incorporated in an existing moral decision-making experiment.

Communication: (a) Data were collected during an *interactive installation* with members of the public at OTLip16. (b) The data collected were incorporated into a *scientific publication* (Francis et al., 2017). (c) A *conference paper* exploring the use of "thinking through making" as an interdisciplinary collaborative tool was presented at OTLip17 (Francis et al., 2017.

Collaboration type:

Table 5. Evaluation of Distorted Dimensions Project.

	Weight	Classification		
		Mutual	Assisted	Emergent
Objective & Research Questions	19	38	32	30
Experiment	29	48	33	19
Analysis	21	40	30	30
Communication	31	42	20	38
Overall Rating		**43**	**28**	**29**

Conclusions

Research contributions from large and diverse research groups play a key role in the solution of complex societal problems (Buanes & Jentoft, 2009). Encouraging collaboration between various disciplines results in the sharing of domain-specific knowledge, but also in the emergence of new knowledge (De Stefano, Giordano, & Vitale, 2011), thus providing novel solutions for unresolved age-old problems. Yet, what entails "successful" interdisciplinary collaboration has largely remained unclear (Huutoniemi et al., 2010).

To date, existing attempts to evaluate the impact of interdisciplinary research collaborations have sought to assess product-based outcomes, primarily considering co-authorship as a marker of success (Savanur & Srikanth, 2010). Although these product-based approaches have allowed researchers to accurately quantify the impact of various disciplines within a collaboration (e.g., Groboljšek et al., 2014), they often overlook process-based markers of success. This is significant given that definitions of successful interdisciplinary collaborations encompass process-based considerations including mutual integration, cooperation, communication, and sharing (Aboelela et al., 2007).

In the current research, we formulated a novel framework for evaluating, as well as summarizing, research collaborations. By establishing a process-based framework, we have contributed to the literature by complementing the product-based approaches to evaluating collaborations. By generating a collaborative "fingerprint" for each project, the present process-oriented framework allows researchers to examine the interdisciplinary dynamics within a research group. This is significant for several reasons. Firstly, we can shed light on the "black box" that surrounds the understanding of collaborative processes (Kurtzberg & Amabile, 2001). Secondly, we can use the process-based fingerprint to identify which group dynamics and which types of collaboration are more likely to succeed. This might be done by uniting our metric with product-based markers for success and/or measures of researcher satisfaction.

When considering the institutions, organizations, and funding bodies that support these collaborative endeavors, it is important to note that the collaboration examples described in the present paper were supported by the same institution and, as such, were fostered within the same organizational context. In order to extend our process-oriented framework, we suggest that future research should embrace the flexibility of the stages that we propose, adapting the metric to reflect the aims and constraints of their own organizational and institutional contexts.

Overall and through a detailed look at several collaboration examples that took place within the CogNovo project, we have developed a process-based approach for understanding both the interpersonal and project dimensions of interdisciplinary collaborations. Specifically, we have demonstrated that each collaboration is subject to different priorities and pressures. Thus, individual projects can display a unique

combination of interpersonal dynamics and project tasks. Our process-oriented framework and evaluation matrix might be utilized not only to evaluate and provide building ingredients for successful interdisciplinary research collaborations, but also to quantify the impact of these collaborations beyond product-based metrics.

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An Argument for Investigation into Collaborative, Choreomusical Relationships within Contemporary Performance:

A Practical and Theoretical Enquiry into the Distinct Contributions of a Collaborative, Co-creative Approach

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Abstract

This paper argues that for both creators of a choreomusical work, a collaborative creative process must be worthwhile, enjoyable, or contribute something unique to motivate artists to collaborate at a time where, to some degree, technology negates the necessity to do so. Therefore, the scholar interested in choreomusical relationships should also be interested in collaborative, creative methods.

The research considers cross-disciplinary and inter-disciplinary working processes in music and dance in the twentieth and twenty-first centuries to enquire into the ways that choreomusical relationships have developed for composers and choreographers working collaboratively. It asks whether there are factors which should be considered in a collaborative working method between composer and choreographer to achieve a co-creative endeavor which is satisfactory for both parties. Satisfactory, co-creative results are defined by the satisfaction of both collaborators throughout the creative process, regardless of the end result.

These questions were addressed both through historical analysis of collaborations within contemporary dance, and exploration of how choreomusical collaboration can be successful or unsuccessful in terms of co-creation and the satisfaction of each party within current artistic practice. Informed practical research and the use of journals coincide with a grounded theory approach: through analysis of both sets of data, factors which help and hinder choreomusical collaboration in terms of

co-creative approaches were identified. The results of this analysis are presented in a spectrum model of possible working relationships between composer and choreographer; this paper applies this to case studies identified within the research in terms of cognitive innovation.

Keywords: choreography; choreomusical; collaboration; music.

Introduction

The level of co-authorship, satisfaction or enjoyment of a creative working method does not always reveal itself in the result of collaboration; perceived choreomusical confluence can be achieved through a detached process as demonstrated by working methods of much classical ballet.

Research concerning music and dance largely focuses on choreomusical relationships and audience perception of the performance, an example being one of the most significant choreomusical texts in modern dance: Paul Hodgins' *Relationships Between Score and Choreography in Twentieth-Century Dance Music, Movement and Metaphor* (1992). In this text Hodgins actually refers to the nature of collaboration as ineffable; the collaborative process is recognized as being distinct from the environment and perceptions of the piece (p. 9). Research considering cognitive innovation in other disciplines contradicts this, suggesting a process evolves in relational terms with its surroundings and intended audience (Glăveanu, 2014, p. 27).

This lack of research and the importance of this area in the development in choreomusical study is mentioned in several recent choreomusical articles. McMains and Thomas (2013) stress the importance of collaboration when discussing choreomusical relationships:

> Just as great music or dance is produced through informed manipulation of tension and release, meaningful music-dance relationships are created through conscious manipulation of alignment and opposition of the two arts. (p. 199)

Marisi (2014) acknowledges the benefits of a successful collaboration in that the audience will experience a deep cognitive and emotional involvement (p. 32). Hagen & Bryrant (2003) point out that complex music and dance performances can only be created by coalitions with considerable internal stability, yet these performances can be displayed and "decoded" in a very short period of time, which may be a contributing factor in the lack of research into collaborative methods (p. 30).

Perhaps this lack of relevant research into the intuitive collaborative processes which take place between artists is why performance theorist Susan Melrose (2009) believes that "dance experts tend, quite reasonably, to ignore academics."

Melrose expands on this and suggests that academic discourse often analyzes performance as an object, and in doing so ignores the intentions and experiences of the artists themselves (p. 31).

Melrose (2009) highlights how different an expert spectator's view of a performance is to that of a trained dancer or experienced choreographer and recognizes that "expert collaborations, common to much making in the performing arts, are largely mysterious to outsiders" (p. 29). In this chapter Melrose addresses collaboration in terms of the choreographer, allowing practitioners from other disciplines a small amount of creative freedom whilst creating something which is the empirical fit of the choreographer's ideals (pp. 33–34); whilst she acknowledges that the chapter is written in terms of dance, this is arguably a limited view of the spectrum of possibilities within artistic collaboration.

This research is important as it addresses the potential methods and relationships available to choreographers and composers in choreomusical collaboration; previous studies similar to this are limited as they only consider the preferences of the choreographers (McCombe, 1994; Wilden, 2012). For both creators of a choreomusical work, a collaborative creative process must be worthwhile, enjoyable, or contribute something unique to motivate artists to collaborate at a time where, to some degree, technology negates the necessity to do so. Therefore, the scholar interested in choreomusical relationships should also be interested in collaborative creative methods.

Contributions of Technology

Rapid technological progress has continued to advance choreomusical options dramatically. Guedes (2003) developed and demonstrated an expert system that allows dancers to slightly control the tempo of pre-recorded music in order to encourage interactive performance. Sicchio (2014) explored the option of a dance and live-coding system and suggested that "live-coding emerges as a transdisciplinary approach to live performance. It may be used within live choreographic events to create compositions in real time" (p. 39). Working methods and material exchanges are also becoming effortless; a 2014 paper discussing how cloud-based file sharing and different digital representations of music can facilitate collaborative engagement of musicians concluded that "new opportunities result from the digital medium's capacity to handle digitized forms of music that may now span geographic boundaries and foster connectivity amongst the parties engaged" (Vlachakis, Kalaentzis & Akoumianakis, 2014, p. 6).

Choreographers utilizing these inevitable developments to create their own accompaniments could leave interdisciplinary collaboration redundant unless the choreographer feels they benefit via the process. John Cage (1968) recognized the simultaneous composition of dance and music as a "great advantage to the modern dance,"

however he commented that choreographers' "use of percussion, unfortunately, has not been constructive" due to the creators having "not given the sound its own and special part in the whole composition" (p. 88). This observation is relevant as it will become more accessible for choreographers to create their own music; however, without musical skill Cage's generalization could become the most common form of music in modern dance. Allen Fogelsanger (1998) does have a more positive prediction for this and suggests that "in the future, instead of dancers moving to an extraneous sound source, they may be the sound source, and a wonderfully rich one at that" (p. 8).

Methodology

This project has taken two methodological approaches: historical research into twentieth and twenty-first century practices, and sociological and reflexive research into contemporary practices using a grounded theory approach of qualitative research. Firstly, a historical analysis of the potential approaches to collaborative relationships recognizes the cultural specificity of twentieth-century European American post-modern dance practices as creating a distinct genre of work, which has destabilized traditionally intertwined cultural practices of music and dance. This dissertation chooses to focus exclusively on this distinct genre of work and the developments which preceded it; the intention of the spectrum model is to identify the processes currently available in this genre only. Secondly, a discussion of practical knowledge of collaboration articulated by the artists themselves highlights the value of expert practitioner perspectives within the study.

Data was collected through interviews with choreographers and composers, and journals documenting my personal collaborative processes. Due to the relative lack of material reviewed detailing the experiences of choreographers and composers during collaboration, and in light of Melrose's (2009) claim that expert-intuitive practitioner knowledge is often overlooked in arts research (p. 31), it was seen pertinent to use the interviews to focus explicitly on the individual perspectives and concerns of both parties within a collaboration.

This data has then been reviewed, coded, and grouped in order to develop an integrated diagram: a spectrum model of collaborative relationships, which identifies core theoretical concepts determining the degrees of co-creation and satisfaction of both choreographer and composer. This model[1] is based on Jo Butterworth's spectrum model found in "A Framework for Dance Making and Devising" (2009, pp. 187–188).

[1] See Table, p. 188–189: "Spectrum model of the creative processes available to choreographer and composer, and specific requirements of each method."

Discussion

Hierarchal Trends

When asked to define co-creation, the necessity of an equal input was ubiquitous amongst choreographers' answers, however it seems some prefer to direct projects in a similar way to that of devised theatre and this is still deemed co-creation despite the clear existence of a hierarchy; methods such as this are documented in Oddey's *Devising Theatre* (1994) and Lou Cope's research into directing group collaborative work (2016). The composer's definitions were more diverse and for them, as long as a piece is created together, equal input is not a requirement for co-creation; since this trend was amongst all of the composers, it suggests that they do in fact have a more negative or indifferent attitude toward achieving an equal input in a collaboration. It is worth noting that authority is not evenly distributed throughout these standard methods; generally, choreographers have the role of director.

One possible reason for this, highlighted in the interviews, is that choreographers tend to learn the fundamental language of other disciplines more than any other collaborating artist. Therefore, they are able to listen, understand and direct multidisciplinary projects with more sensitivity than other artists may be qualified to do.

Education

Generally, answers from artists who discussed standard methods of young collaborators were varied, but one common, critical point was the lack of imagination shown by young choreographers' choice of non-commissioned music. This same lack of imagination was not identified in composers; however, music is often presented as a lone discipline. Disregarding site-specific pieces, composers in education are not often required to provide a potential setting for the work they submit, whereas choreographers are expected to present ideas about light, costume and sound. I therefore propose that young composers would generally only work with movement in a collaborative environment. Education in music for contemporary dance is not ubiquitous and education of contemporary dance for composers is scarce, so ill-informed choices and bland tastes in the other art form are common. Modules on choreomusical collaboration are not ubiquitous; those which exist may be short and unclear about different collaborative options, leaving students unaware about the breadth of collaborative opportunities available to them.

It is notable that traditional methods, education and training of choreography and composition are fundamentally different; this may be a contributing factor in any potential dissonance between choreographer and composer. Instructional texts in dance-making recognize collaboration as an important part of the creative process: Butterworth's *Dance Studies: The Basics* (2012) advises that decisions about potential

collaborations should be made at the concept stage of the creative process which inevitably maximizes co-creative potential (p. 37). Anna Pakes (2009) recognizes the expectation that choreographers create considering the interdisciplinary:

> Choreography in itself is arguably a form of praxis because it involves collective production . . . Decisions are not generally made according to a technically rational view of how to manipulate the relationships central to dance-making, but rather arise out of the circumstances of the moment and are governed by a different kind of rationality sensitive to contingencies and to the evolving nature of [collaborative] relationships. (pp. 19–20)

In contrast to this, music composition is traditionally solitary; film composer Carter Burwell (2003) admits that he has no interest in speaking to anyone other than the director about his music, claiming it will be of no help to his creative process (p. 198). The traditional methods of both music and dance making have been challenged throughout the development of both popular and experimental music and dance, hence a plethora of working methods are currently available to composers and choreographers; it is arguable that these traditional assumptions are no longer relevant. However, music education often focuses on traditional methods and presentation of work, as composition students are expected to create scores which adhere to instrumental standards with sufficient detail to eliminate need for discussion with the performer(s), or provide tracks of pre-recorded electronic music. Instructional texts such as Paul Hoffert's *Music for New Media* (2007) even encourage composers to create music systematically as a background for media, allowing little creative input and dismissing collaborative opportunities and the integrity of the composer.

In terms of professional artists training in and understanding of the other art form, it seems language is a universal problem within interdisciplinary work, and one that each collaborative method has to negotiate. Most choreographers and composers acknowledged that some training in the language of other disciplines, in addition to knowledge of the modern developments of the discipline, could be useful. Interestingly, many artists pointed out that training beyond this could impede approaching their collaborator's work with an open mind, and did not express desire to have any further training in the other discipline.

The perspective of a collaborator from another discipline was often highlighted as a valuable tool by both choreographers and composers; this is a distinct contribution of interdisciplinary collaboration. An interdisciplinary perspective then emerges as an important feature of this framework of creativity: "one of the key limitations of systemic models is represented by their institutional perspective on who can legitimate creativity within a society and how creations contribute to a cultural domain" (Glăveanu, 2014, p. 25).

Social Factors

In terms of the social dynamic of collaboration, respect and trust of the collaborating artist/s and their work is essentially a ubiquitous requirement amongst identified processes. Assertiveness is a requirement for every method aside from the non-dominant roles in Processes One and Seven. This issue can be further complicated by discrimination against minorities, for example: gender discrimination, or professional status. Mapping artists' personal details, locations and considering their culture, religion and traditions of the location of each artist is also necessary to ascertain the effect of this within collaborative relationships and the working methods available to each individual artist.

For example, it is worth noting that of the four Maltese composers interviewed, a trend of composer dominance was identified. The one Maltese composer who does not work in Process One is generally not authoritative in collaborative relationships and was the only composer to work in Process Six, as well as the only female Maltese composer interviewed. A wider selection of artists would need to be interviewed to ascertain the role gender might play in such perceptions, however it is worth acknowledging the significant presence of Catholicism in Malta, and its influence on power relationships within society.

The artists that were more concerned about the quality of a collaborator's work as opposed to their personal attributes and social skills were generally the authoritative figure in the commission based working processes. Artists often noted a preference to work with the same artist on several projects and develop this relationship. In contradiction, one choreographer pointed out a good collaborative relationship is not essential in every process as she sees "many collaborators work together who can't stand each other outside the studio" (Calleja, personal communication, 2016); thus, one can assume that if they fall within the commission based processes, uncomfortable collaborative relationships can be amicable.

Glăveanu (2014) argues that creativity "emerges as an encounter between person and world, a form of distributed activity that acts precisely on the differences above in ways that acknowledge them, exploit their potential, or try to reduce or bridge them" (p. 27). Regardless of the perceived success of the relationship, the development of and direction of this collaborative process through time is arguably always a contributing factor in the outcome of any process, and the relationship of that outcome with its audience and/or surroundings.

Conclusions

This spectrum could serve as a tool for students to illustrate the possible options and requirements of each party in order to develop clearer and more satisfying collaborative projects. Butterworth's spectrum model, the basis of the model presented in

this dissertation, was developed specifically for teaching dance in higher education, so the potential applications of my spectrum model to pedagogy are significant.

It is important to note that time, funding and other practical considerations are contributing factors of working processes in any given project. Regardless of these factors, this paper has identified that this is an interesting avenue of research with many potentially useful explorations and highlighted that interdisciplinary collaboration does contribute something distinct in a creative working process. I hope that more scholars and artists take an active interest in choreomusical collaboration in the future and further explore the working processes available in order to develop interesting collaborative relationships and choreomusical works.

Collaborative relationships are important throughout the arts and beyond, and all of these processes are worthy and interesting areas of research; future comparison of any similar collaborative research in different disciplines could lead to insightful discovery.

As composer James Wyness (personal communication, 2016) pointed out when discussing this research, "[t]he larger part of the pleasure from working in this field is derived from the process, the journey over the destination or means over ends."

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Appendix

Table. Spectrum model of the creative processes available to choreographer and composer, and specific requirements of each method.

Process	Process 1	Process 2	Process 3	Process 4	Process 5	Process 6	Process 7
Hierarchy	Composer in control.	Composer in control but open to discussion.	Open collaboration with composer as director.	No hierarchy.	Open collaboration with choreographer as director.	Choreographer in control but open to discussion.	Choreographer in control.
Emergence of concept	Composer's concept is realised by choreographer.	Composer's concept is interpreted by choreographer.	Composer's concept is discussed and developed with choreographer.	Concept emerges via both artists OR interests both artists and is created, explored and developed together.	Choreographer's concept is discussed and developed with composer.	Choreographer's concept is interpreted by composer.	Choreographer's concept is realised by composer.
Requirements of composer	Generation of concept, structure, style and musical material.	Generation of concept, structure, style and musical material in relation to capabilities/ style of the choreographer.	Generation of concept/contribution toward generation of concept. Contribution toward exploring/ discovering structure, style, etc. Direction of project where necessary. Understanding of all other art forms involved in project. Generation of musical material. Time.	Contribute ideas and facilitate the shared exploration and discovery of the concept, structure and style of the piece. Generation of musical material, time.	Contribution toward exploring/ discovering concept, style, structure, etc. Generation of musical material, time.	Sensitivity to movement. Generate an audible interpretation of the choreographer's ideas.	Sensitivity to movement. Generate an audible realisation of the choreographer's ideas.

Process	Process 1	Process 2	Process 3	Process 4	Process 5	Process 6	Process 7
Requirements of choreographer	Musicality. Generate a visual realisation of the composer's ideas.	Musicality. Generate a visual interpretation of the composer's ideas.	Contribution toward exploring/discovering concept, style, structure, etc. Generation of movement material. Time.	Contribute ideas and facilitate the shared exploration and discovery of the concept, structure and style of the piece. Generation of movement material. Time.	Generation of concept/contribution toward generation of concept. Contribution toward exploring/discovering structure, style, etc. Direction of project where necessary. Understanding of all other art forms involved in project. Generation of movement material. Time.	Generation of concept, structure, style and musical material in relation to capabilities/style of the composer.	Generation of concept, structure, style and movement material.
Social requirements of composer	Confidence, devotion.	Confidence, communication, listening, devotion.	Confidence, communication, listening, openness, devotion, willingness to take risks.	Confidence, communication, listening, openness, fluidity, devotion, ability to let ideas go willingness to take risks.	Confidence, communication, listening, compromising, willingness to take risks, devotion, openness, ability to let ideas go.	Malleability, altruism, communication, listening.	Malleability, altruism, listening.
Social requirements of choreographer	Malleability, altruism, listening.	Malleability, altruism, communication, listening.	Confidence, communication, listening, compromising, willingness to take risks, devotion, openness, ability to let ideas go.	Confidence, communication, listening, openness, fluidity, devotion, ability to let ideas go, willingness to take risks.	Confidence, communication, listening, openness, devotion, willingness to take risks.	Confidence, communication, listening, devotion.	Confidence, devotion.

First response to "An Argument for Investigation into Collaborative, Choreomusical Relationships within Contemporary Performance: A Practical and Theoretical Enquiry into the Distinct Contributions of a Collaborative, Co-creative Approach" by Joanne "Bob" Whalley

This is a rich seam for discussion, and one which has a deep historical grounding. There is constant curiosity around how the collaborations of John Cage and Merce Cunningham, Igor Stravinsky and George Balanchine, Louis Horst and Martha Graham, for example, were created and maintained. I am interested in the methodology for an investigation into the distinctions between co-authorship and collaboration within choreomusicology. What might be differences, shifts, overlappings, developments, between being both within and without the choreomusical process: are knowledges different for the creators and commentators of the work (and these might also be in the same bodies, so "doing things" differently at different times)?

Concerning the philosophy of collaboration, or collective creation, with its "nonhierarchical, egalitarian nature" (Cull, 2013, p. 45), certainly Deleuze and Guattari can be useful here around questions of authorship, indeed "body without organs," "becoming," "rhizome" and "affect" feature as prominent terms for contemporary dance practitioners. The project appears to seek beyond a democratization of interpretation, and Deleuze and Guattari find means by which ownership is genuinely shared. Critical arguments around authorship and shared knowledge production can be found in Colin and Sachsenmaier's recent book *Collaboration in Performance Practice: Premises, Workings and Failures*. In it Laura Cull Ó Maoilearca states: "[e]ven the most apparently individual or solo practice might in fact contain strong collaborative elements. The creator of a performance may not acknowledge the collaboration of the audience, but this does not prevent that collaboration from happening. And likewise, a project calling itself 'a collaboration' may nevertheless express individualistic tendencies" (Cull, 2016, p. 97).

Founding member of Goat Island performance group Matthew Goulish values collaboration because it offers the chance to "[e]scape from ourselves, from the limited perspective of the individual ego . . . Who we were, when we met, how we proceeded, what we produced, all seem products of the togetherness, the conjunction . . . Escaping our individual limitations was certainly one of our goals—and not only limitations of identity, but also of thought, imagination, history and progress" (Goulish, 2000, p. 15).

Claire Bishop states that "[a]rtists are increasingly judged by their working process—the degree to which they supply good or bad models of collaboration—and criticized for any hint of potential exploitation that fails to 'fully' represent their subjects, as if such a thing were possible" (Bishop, 2006, p. 180). The work of choreographer and composer Jonathan Burrows and Matteo Fargion could be of importance

as current practitioners tussling choreomusically. Sections from some of their collaborations: *Both Sitting Duet* (2002), *Quiet Dance* (2005), *Speaking Dance* (2006), *Cheap Lecture* (2006), *The Cow Piece* (2009), *Counting to one hundred* (2011), *One Flute Note* (2012), *Body Not Fit for Purpose* (2014), can be found at: http://scores.motionbank.org/jbmf/#/set/all-duets. Fargion and Burrows both use scores, separately and together, that kind of notational system that secures against its own disappearance. Of his scores, Fargion says: "At first only way I could think of it was treating it like music, tricking myself into thinking I was playing a percussion piece, which is a trick I sometimes still use. Depending on the performance, the accuracy of the movements comes very much from the musicality: the score is written musically and I am just performing that. The fact that it is bigger movement and does not actually produce sound is immaterial" (Burrows & Fargion, 2008).

And I think Cull finishes best on the thoughts of collaboration:

> Performance thinks in its own, multiple ways: as the emergent, decentralized thinking of collaboration and collective creation, which challenges our habitual, proprietorial thought; as the stammerings, stutterings and whisperings that assure an identity of self and voice as much as they speak difference and vibrate those who hear them; as mutually empowering encounters between the human and the nonhuman, where immanent imitations tend towards one body's continuation of another's movement; as events of experienced insight and attentive respect that increase our participation in an always unfinished, incomplete whole; as an extended 'open-ness' to other durations, to the impatience of waiting sometimes, to the exhaustion of accelerations at other times. Open the window a little wider . . . Open to others . . . For goodness is itself a matter of movement and composition; a part, relative, open. (Cull, 2013, p. 240)

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Second response to "An Argument for Investigation into Collaborative, Choreomusical Relationships Within Contemporary Performance: A Practical and Theoretical Enquiry into the Distinct Contributions of a Collaborative, Co-creative Approach" by Michael Straeubig

The article discusses aspects of collaboration between co-creators. In particular, it is about choreographers and composers who create common works that involve both music and dance. It draws a distinction between the outcome of a creative endeavor and the satisfaction of the participants.

In this response I want to look at the article from three general perspectives.

The first approach is to apply its themes to other creative processes in which practitioners of different media take part to form a common result. An example would be game design (Schell, 2015). Like choreomusical works, games usually include multiple media like audio, visuals or interactive interfaces. Different forms appear in these media, such as rules or narration. Investigating the relationship between these media and between medium and form (Luhmann, 1997, pp. 165–214) in this context seems a promising avenue.

A second general approach would be to observe the interactions during creative collaboration as social systems—systems that operate with communication. This also opens up investigations into sense-making as communicative acts involve expectations, (mis)understandings, meta-communication. "One cannot not communicate" (Watzlawick, Beavin, & Jackson, 2007). Coupled to those acts are feelings and emotions (Rouhiainen & Hämäläinen, 2013).

The third perspective, which is connected to the second one, is about the concept of relationships and power. It is reflected in the article in the form of a categorization based on Butterworth (2009). For me it remains unclear if idealized categories such as "Composer in control" versus "Composer in control but open to discussion" correspond to the reality of a working relationship. Maybe there are descriptions that could mirror more closely the shifting intricacies and dynamics of individual power relations? One such perspective might be resistance, for example (Foucault, 1982).

Finally, it would be interesting to discuss all three perspectives in the context of technology.

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Playing with/as Systems:
Short Paper, Discussion and Demonstration

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Abstract

Complex phenomena such as play, creativity or innovation are familiar, yet difficult to describe in a systematic manner. In this short article I propose six necessary conditions for any comprehensive description of play. Against this background I discuss my systems-theoretic, constructivist and practice-informed approach to play.

Keywords: cybernetics; distinctions; game studies; play; systems theory.

Play

Play is a complex and interesting phenomenon. It is a common experience, yet mysterious and paradoxical in nature. It is free but functional, frivolous but meaningful, cultural (Huizinga, 1955) but pre-human (Burghardt, 2005). From our early childhood we engage in play, but we are far from a firm understanding of it. Various disciplines such as psychology, sociology, anthropology, ethology, cognitive science and the humanities have made attempts to explain and conceptualize play through numerous conflicting theories (Ellis, 1973; Henricks, 2008). Play is also linked to wellbeing, creativity and innovation (Bateson & Martin, 2013). However, approaches that attempt to instrumentalize play have been met with mixed responses from the community of play thinkers and practitioners. Some argue that play should be regarded an autotelic activity, exercised for its own sake and not for any extrinsic purposes (Sicart, 2014). Yet designers of games and playful experiences[1] increasingly make use of experimental findings from psychology and cognitive sciences in order to aid them in creating compelling play experiences.

[1] There are various ways to draw distinctions between games (Salen & Zimmerman, 2003, pp. 70–83) and play (Salen & Zimmerman, 2003, pp. 300–311); for example, one can observe games as media that are particularly suited for forms of play to appear (Luhmann, 2000).

Descriptions

A fundamental theory that would be capable of describing these multiple facets of play currently does not exist. This has been problematized (Sutton-Smith, 1997), however, a solution has not been proposed so far. I argue that any comprehensive description of play needs to meet at least six conditions:

The first condition is an adequate level of abstraction. The description has to be abstract and general enough to cover the wide range of phenomena that are observable as play: free play between children; the ritual of a sports match; non-human (e.g., animal) play; the drama unfolding during a game of chess; metarules emerging from a multiplayer online battle; unpleasant, forced, and dark play (Mortensen, Linderoth, & Brown, 2015); or the experiential quality of a playful encounter between adults. These and many other phenomena have to be considered within a description of play. This high grade of abstraction requires a simple, universal foundation.

The second condition is sufficient complexity: the description has to be complex enough to account for the complexity of play. Note that this and the previous condition act in an antagonistic manner in that high abstraction pulls in the direction of simplicity, while complexity is required to describe a complex phenomenon. This rules out simplistic general explanations in the style of "play is getting rid of surplus energy" (Spencer, 1855) or "play is capitalism" (Nash & Penney, 2015). Throughout the nineteenth and twentieth centuries, many attempts to explain play by single causes have been put forward (Ellis, 1973), a development that can itself be observed as an artefact of the social sciences (Luhmann, 2009).

The third condition is that it has to account for paradoxical and contradictory findings. Is play a biological function to practice useful behavior (Pellis, Pellis, & Bell, 2010), or is it an ambiguous phenomenon that is best described in the form of seven cultural rhetorics (Sutton-Smith, 1997)? One way to make sense of such a contradiction is to include its context in the description. For example, one may choose to not only describe the conflicting observations, but also the observers that are involved. If animals play and if ethologists postulate play as a biological function, we can observe (and explain) this fact because ethology is based on functional explanations.[2] Therefore, a clash with, for example, Huizinga (1955), who posited play as deeply cultural, can be avoided if we carry the context with us. Again, we have relocated our observation from play itself to the scientific system, but we are aware of this shift of perspective. When we talk about a theory of play, we talk about a social system that is different from play, except when we are playing with the theory itself.

[2] Maturana and Varela (1980) calls this phenomenon "structural determinism."

From the previous remarks follows the fourth condition: a comprehensive description of play must be transdisciplinary. While acknowledging disciplinary foundations and methodologies, it has to provide a critical analysis of traditional approaches and must be able to transcend them (Punt & Blassnigg, 2013). This means that there cannot be all-encompassing, mono-thematic explanations that are rooted within a specific discipline or theory like biology, child development or Marxism.

The fifth condition is *Anschlussfähigkeit* (connective capability), a term borrowed from Luhmann's theory that denotes an important characteristic of social systems. Such a system, which operates with communication, ceases to exist when there are no follow-up events responding to previous events. A conversation dies, an institution gets closed, a theory forgotten. To enhance the probability that communication can continue, a comprehensive description of play must therefore ensure its connective capability (for example by continuously publishing articles). However, the necessity of further communication does not imply favorable assessment: critique—even blunt rebuff—is an appropriate continuation for descriptive discourses.

I propose a sixth condition: the description has to bridge theory and practice.[3] A description in this sense includes theory *and* practice: experimental methods, prototyping, play and game design practice, critique, computational models, speculative design, experiential aspects. Thus, a description can be a demonstration, an interaction and an experience. We can actually learn about play by playing.

Playful Systems

Through my PhD project "Designing Playful Systems,"[4] I am developing a description of play that is abstract, complex, observer-dependent, transdisciplinary, and that bridges theory and practice (Straeubig, 2016).

In particular, I observe play through the lens of distinctions (Straeubig, 2015), based on the conceptual work of Spencer-Brown (2008), Maturana and Varela (1980) and Luhmann (1996). Distinctions serve as the universal building blocks required by the first condition. Examples are system/environment, theory/practice, human/machine, play/work or external/internal purpose.

My approach draws heavily from the foundations of Luhmann's general systems theory. While Luhmann himself focused on working out a comprehensive theory of social systems, the general principles can also be applied to psychic and biological aspects of play. In other words, the theory can provide sufficient complexity to describe every aspect of play (second condition).

[3] For this reason, I have used the term 'description' instead of 'theory.'

[4] Available at http://www.cognovo.eu/project-9

Furthermore, Luhmann's theory acknowledges the fundamental role of the observer (third condition). The introduction of the observer into system-theoretic thinking took place during the second half of the last century with constructivist theories and the so-called "second-order" cybernetics (Glanville, 2002). At the price of binning notions of "objective truth," paradoxes and contradictions could be embraced from now on without an imminent collapse of the observing systems.[5]

In order to make sense of the multifaceted nature of play, I draw from the wide range of disciplines that have contributed to research in this area (Straeubig, Hsu, Oztop, & Taranu, 2016) as well as from the relatively young fields of play and game studies (Mäyrä et al., 2015). This approach observes those disciplines as social systems (subsystems of academia) while re-producing its own inherent mode of observation through autopoiesis (Bishop & Al-Rifaie, 2016). Metaphorically speaking, it provides a system-theoretic "glue" through the method of distinction (fourth condition).

At Off the Lip 2017, I gave a short talk about the topics of this paper and demonstrated a work-in-progress playful system, re-implemented from (Karpathy, 2014). The system is based on a reinforcement learning algorithm that draws distinctions from external rewards (Mnih et al., 2013). In this demonstration, theory and practice informed each other and both were exposed to the academic discourse (sixth condition). A playful system, I conclude, is one that draws distinctions for its own sake (Ghahramani, 2004), mixed with motivating rewards from the environment (Arulkumaran, Deisenroth, Brundage, & Bharath, 2017). This will be elaborated in future work, thus contributing to the connective capability (fifth condition) of this work. This article, the discussions during the conference, the presentation I delivered, the demonstration and the responses I received—all increase the surface for communicative acts to follow.

However, a final answer to the question of whether my approach to play is "200mmett200ssfähig" has to be established in the future.

Conclusion

Currently, the problem of how we make sense of complex phenomena that span brains, minds and social systems remains unsolved. If we aim to describe cognitive innovation "from cell to society" (Gummerum & Denham, 2014), if we want to give adequate accounts of creativity (Colton & Wiggins, 2012), we need a framework to do so. In this article, I have proposed six requirements for any comprehensive description of these phenomena and demonstrated how I apply those principles to play.

[5] Pickering (2011) offers explanations why cybernetics has lost in importance over time, but I believe that the final word concerning this issue has not been spoken yet.

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ConversationPiece II: Displaced and Rehacked

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Abstract

Conversations are amazing! Although we usually find the experience enjoyable and even relaxing, when one considers the difficulties of simultaneously generating signals that convey an intended message while at the same time trying to understand the messages of another, then the pleasures of conversation may seem rather surprising. We manage to communicate with each other without knowing quite what will happen next. We quickly manufacture precisely timed sounds and gestures on the fly, which we exchange with each other without clashing—even managing to slip in some imitations as we go along! Yet usually meaning is all we really notice. In the ConversationPiece project, we aim to transform conversations into musical sounds using neuro-inspired technology to expose the amazing world of sounds people create when talking with others. Sounds from a microphone are separated into different frequency bands by a computer-simulated "ear" (more precisely "basilar membrane") and analyzed for tone onsets using a lateral-inhibition network, similar to some cortical neural networks. The detected events are used to generate musical notes played on a synthesizer either instantaneously or delayed. The first option allows for exchanging timed sound events between two speakers with a speech-like structure, but without conveying (much) meaning. Delayed feedback further allows self-exploration of one's own speech. We discuss the current setup (ConversationPiece version II), insights from first experiments, and options for future applications.

Keywords: conversation; dialogue; performance; sonification; sound analysis.

Introduction

Sounds offer a very effective means for communicating as they can be rapidly produced and broadcast into the surrounding medium (air, water) for asynchronous information exchange with others. Consequently, most animals have evolved auditory sensorimotor systems. Communication sounds in most land mammals are made by creating broadband (usually harmonic) sounds using vocal cord vibrations, which are spectrally shaped by changing internal (vocal tract, mouth and nasal) cavities to create resonances (Lieberman & Blumstein, 1988), often supplemented by noises produced by rapid tongue or lip movements. The prosody (pitch and amplitude) of the sounds depends on the vocal cord vibrations, while atomic communication sounds (e.g., speech phonemes) typically depend on the dynamic vocal tract resonances in combination with added noises, and in tonal languages on the dynamics of pitch, too. The wide range of different sounds that can be made in this way and concatenated into sequential strings underpins complex information exchange between individuals.

In general, it is not sufficient simply to broadcast messages to others; it is equally important to know whether the intended information is received and understood. Therefore, communication signals must be exchanged and the timing of the signals regulated in order to optimize the flow of information in both directions. This process of social communication is arguably the most important cognitive function of all, providing a basis for social bonding, information exchange and learning from others; possibly reaching a pinnacle in human conversational interactions. Through the exchange of tightly coordinated multi-sensory signals, people in conversation create a shared mental world. The apparent effortlessness of this process and the enjoyment normally derived from conversations raises the question "Why is conversation so easy?" (Garrod & Pickering, 2004). In an effort to answer this question, Garrod and Pickering suggested that conversation should be seen as a joint (bonding) activity in which interlocutors interactively align their thoughts, actions and perceptions at multiple levels, including basic acoustical properties (speaking rate, phonetic characteristics), phonological, lexical, syntactic, and semantic representations and situation models (Menenti, Pickering, & Garrod, 2012); key to successful communication ultimately is the alignment of situation models and the convergence of conceptual spaces. Alignment is achieved through interaction and the percolation of alignment between levels. The resulting tight coupling of sensorimotor systems is evident in phenomena such as chorusing or completing each other's utterances, and even in the entrainment of brain rhythms (Hasson, Ghazanfar, Galantucci, Garrod, & Keysers, 2012). Coupling and alignment are in a sense artifacts of the interaction but are important for its success; consider, for example, the improved comprehension achieved by imitating the (unfamiliar) accent of another (Adank, Hagoort, & Bekkering, 2010). Alignment has also been linked to predictability and

processes whereby interlocutors infer the intended messages of the other by minimizing their mutual prediction errors (Friston & Frith, 2015; Okada, Matchin, & Hickok, 2017). Eliciting predictable responses to one's own communicative actions provides confirmation of the success of communication, and indicators of new (unpredicted) information when unexpected responses occur.

The ease and rapidity with which people are able to dynamically adapt their communication sounds and gestures in order to reflect the demands and goals of the situation make the subtleties of the interaction very difficult to appreciate. In addition, the grouping processes of the auditory system hide the spectrotemporal intricacies of the sounds from perceptual awareness, so it is virtually impossible to hear out the sonic patterns that are created by the dynamics of formant, pitch and amplitude trajectories. In ConversationPiece II, our aim is to create a real-time system that exposes these patterns, transforming conversations into a kind of musical improvisation that enables listeners to appreciate some of the complexities and nuances of the sound world we all create in our everyday lives.

ConversationPiece II incorporates the concept of performance at the intersection between talkers, basically adding a playful element to conversation: speakers become partly detached from their conversation and act as performers of their own speech, which is transformed and sonified as musical sounds. By incorporating performance into our research, we can conceptualize and sonify the linkages between emerging identities, social behaviors and inter-relational human practice. Performance allows us to study the dynamics of conversations; in particular, how people connect using body language and tone of voice, carefully timed to attune themselves to each other. A conversation is a changing sequence of social interactions, following conventions which may be followed or violated, e.g., words imitated or repeated for dramatic effect, timing changed for emphasis. The transient nature of conversations cannot be separated from the performativity of the interaction. ConversationPiece II therefore depends on the level of performative collaboration that exists between the talkers.

Method

In the main interactive setup, incoming sounds produced by two talkers are processed separately. The sound waveform is first filtered by a bank of bandpass filters with center frequencies arranged on a log scale similar to that of the cochlea, here further restricted to the notes of a pentatonic scale. The outputs of the filters are multiplied by weights that counteract the high-frequency fall-off in power typical of human speech. The problem then is to sparsely sample salient points from the output of the filters that capture key structural aspects of the spectrotemporal patterns in the utterances as a sequence of discrete sound events. Sparse sampling both in time

and frequency space is crucial, as dense clusters of individual sound events are perceptually incomprehensible. Interestingly, this very same information is easily processed when the normal auditory grouping processes are at work. To achieve sparse sampling in continuous time, notes are generated at the pitch of the center frequency of a filter when the integrated filter output passes a threshold. Once a sample is generated, to prevent immediate resampling and dense note clusters, the running integration of the filter output and adjacent filter outputs are reset. The time constant of integration and the reset level determine a soft refractory period for each filter that causes temporal sparseness; the suppression of lateral filters further causes sparseness in frequency space. Neural networks in sensory areas of the mammalian neocortex are known to perform similar selection and lateral suppression operations.

The system has been implemented in custom C-code (called s2m, short for "speech-to-music") to allow for real-time capabilities. We run it under Linux (kernel version 4.11.12-100.fc24.x86_64 with no additional real-time modules) on a laptop with Intel i7-2820QM CPU at 2.3 GHz; on one core it uses up to 20% CPU time. Two microphones, one for each speaker, are connected to the left and right input of the inbuilt audio card (Intel IDT 92HD90BXX, but any card with a latency smaller than about 10 ms should work) and routed into the s2m-program using the Jack audio connection kit. The s2m software implements the processing scheme described above and outputs MIDI-events using the ALSA sound architecture for Linux for each of the speakers. The MIDI-events are routed using Jack into two independent software synthesizers for sonification. A common choice is Qsynth/timidity, a sound font synthesizer that allows the sound events from each speaker's voice to be mapped to a different instrument from the General MIDI instrument set; any MIDI-controllable software or hardware synthesizer could be used. Generated sounds are finally output through a soundcard and played back to the interlocutors by loudspeakers.

The interactive setup sonifies speaker sounds with an imperceptibly short delay (< 10 ms). A second system, s2m-delayed, has been built that delays detected notes in a speech signal before replaying them. The note detection and sonification follows the same principles as in s2m; however, notes are buffered until the speaker pauses for an adjustable amount of time—typically around 500 ms corresponding with common pauses in speech patterns. This allows speakers to "communicate with themselves"—any utterances are returned as musical instrument sounds reflecting the elements of prosody the system picks up (frequencies, pauses, sound amplitudes). The delayed system allows single speakers to observe and explore their own vocalizations in a transformed sound space.

Performing ConversationPiece II foregrounds conversational interactions as field territory and creates a shared mental world that extends the notion of the individual into a mutual prosthesis or collective entity of networked sensations. This amplifies

the heterotopic quality of communication. Assigning a performative value to the mutually reinforcing relationships created in a conversation makes explicit the form, texture, weight and nuances of the interaction. ConversationPiece II therefore immerses the talkers and listeners within a transient state of reciprocity.

Results

A prototype of ConversationPiece (version I) was exhibited at Off the Lip 2016 with moderate success; children in particular were intrigued by the transformation of their voices. In this version, videos of the interlocutors were simultaneously displayed, and as a result, there were two types of interaction with the system; some people watched and listened to others performing and tried to understand what was happening from the produced sound and video, while others actually took part in conversations, with generated sounds played to them. However, listening to the sounds while talking is very distracting, so those who took part in conversations chose either to play with the system to explore how they could generate sounds using their voices, or to focus on the conversation and largely ignore the resulting soundscape.

What we took away from this prototype exploration was that people were very interested in the concept of the system and the performative aspects it offered, but needed time to explore and play with its possibilities before performing with it. One possibility we intend to explore in the latest version is to optionally mix the voice back in to the instrumental output, thereby making the mapping more explicit. Finally, the simultaneous sonification of gestures would allow the tight embodied coupling also to be demonstrated. For this purpose, a lightweight wearable system has now been built which is able to pick up gestures from body motion using gyrometers and battery-powered micro-processor devices. The detected motion can be wirelessly transmitted to a computer and sonified together with the speech-generated sounds. This enhancement encouraged by ConversationPiece I will allow for a more accentuated form of sonification in the future that takes into account speakers' bodily actions to support their messages.

ConversationPiece II was demonstrated at Off the Lip 2017. The voices of two interlocutors were synthesized in real time using different (usually contrasting) instruments for each speaker. The participants in the conversation could hear both, the words and the sounds produced from their speech, while the audience could only hear the resulting soundscape. The questions and discussions which followed highlighted a number of trade-offs which we had made in developing the system: 1) It is possible to reproduce the speech sounds with quite high fidelity even when using discrete samples; for this, it is simply necessary to sample at about 25 ms (40 Hz) to make the speech fairly comprehensible. 2) If one wants to expose the soundscape or "music" of the speech in terms of rhythms and harmonic sound patterns, however, then a slower sampling closer to a few Hz is required, the trade-off being that the speech is no longer comprehensible even though many prosodic features still persist.

3) The use of instruments, while more pleasing to the ear and also necessary if the sounds of the two speakers are to be separable, introduces the overtones and some aspects of dynamics of the chosen instruments into the mix. This can make conversation soundscapes musically appealing, as for example, compared to a sonification in terms of mixes of grains of pure tones only, but it also adds semantic references to knowledge about the instruments used, which can distract from the communicative interaction: The analysis process of s2m intentionally strips out the immediate semantics of a conversation ("what it is about"), thereby exhibiting the spectrotemporal communication structure of the message. The sonification, however, can afterwards add artificial features un-intentionally that obscure the intended structure and make it to some degree unrecognizable, something akin to a "grand-piano effect" (but any instrument used for sonification can distract). Despite or because of this range of trade-offs, we believe that the system may offer some possible applications.

For example, we are currently exploring whether an interactive system of the described form might prove engaging to autistic children struggling with social interactions. They could choose a preferred instrument with which to engage. The delayed form of the s2m-system would then allow them to explore the feel of utterances and interactions (with themselves) without the social complexities they find so hard to negotiate.

At present, the system only includes sonification of voices. A next step is to include gestures (as described above) in order to demonstrate the tight coupling between speech and accompanying gestures. Hard- and software for this are in place, but experience with the ConversationPiece has shown that further careful design is required to ensure that the resulting sonifications are not overwhelming; any too unusual features, not explained by actual speech or action, will attract attention and distract from the communicative act – even if "Conversation is Easy," it still seems highly disruptable. At least, what is required is some first explorative or learning phase during which interlocutors become acquainted with the workings, possibilities, and quirks of the s2m-system in order to make efficient use of them afterwards. This may relate to the learning of a musical instrument (or one's voice) in general. To refer back to Pickering and Garrod: in a communication a mental world has to be created, which requires a bonding activity between the interlocutors. For now ConversationPiece forms bonds that are perhaps too strong between speaker and sonification machine; this counteracts its intended purpose as it distracts from the actual interpersonal communication. Ways are currently being explored to make s2m work more transparently to the speakers.

Conclusion

During the prototype performance, interlocutors became more aware of their voices and the collective soundscape that emerged through their outbursts of conversation. These moments led to a discourse on free improvisation whereby the sounds made

by the talkers became an emergent medium that was manipulated to construct a variety of sonic forms. Rather than a singular monologue which fell into an empty space, interlocutors responded to the voice of the other, creating a more enjoyable plural dynamic. ConversationPiece therefore offers a new, somewhat playful, vehicle for performative social interaction.

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The Displaced *Dispositif*

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Abstract

"*Dispositif*" is a term used in film studies since the 1970s to describe the entire system of mechanical and human factors which together bring about the cinema experience. It therefore refers to (amongst other things) the space of the auditorium, the screen, the projection technology and the physiology of the spectator. Many of its qualifying components are masked from the view of participants in the system. The *dispositif's* purpose is to set up the conditions for a specific type of cognitive experience, one which mirrors and extends (and in some readings, controls) the experience of its participants.

The Displaced *Dispositif* is a performance designed for the space of a cinema theatre, but featuring the projection of fragments of early silent cinema on a coeval (1910s) film projector from the auditorium. The film fragments are live-scored by the sound artist, Shaun Lewin, using a combination of closely mic'd sources on the projector itself, luminance data from the projected image and EEG brainwave data recorded from participants during previous projections of the film. Displacing elements in the *dispositif* in this way, by shifting modalities, situating in parallel, feeding back and layering, draws attention to its hidden existence and creates the potential for a more knowing and informed participation in the cinema experience. It also serves to demonstrate the degree to which *dispositifs* of modern cinema spectatorship, which have morphed and proliferated since the widespread digitization of film heritage, have radically altered both the technological and experiential qualities of the medium. By integrating EEG data, the performance adds the dimension of electrophysiological experience to the long tradition within experimental cinema of artists calling attention to Cinema's hidden structures. As well as challenging the dominance of the worldview propagated

by the film industry, the performance also signals a means of re-engaging with the creative potential of the system itself, once unshackled from its bonds to the reality effect and freed from the limits imposed by its commercializing instincts.

Keywords: early cinema; EEG; flicker; performance; sonification.

Qu'est-ce que c'est, dispositif?

From a technological point of view, what we know of as Cinema is an agglomeration of many different technologies which achieved a certain critical mass in the dynamic interaction of social, economic and technological conditions available in the late 19th century (Punt, 2000). Since then, while retaining the name Cinema, albeit sometimes with qualifying epithets such as Silent or Classical, it has continued to accumulate additional features, most obviously perhaps those which appeal to the auditory as well as visual sense. The concept of sensory appeal itself points to the fact that this composite technological system would be nothing, or rather do nothing, without the human agents who have both designed it and queued up in their masses to experience it. This construction of Cinema, specifically, the projection of moving images, with or without sound, to an audience in the shared space of a theatre, can be contained by the term *dispositif*, first brought into use by the French theorist, Jean-Louis Baudry, in the early 1970s (Baudry, 1970, 1975, 1986). Although translated awkwardly as "apparatus" in some publications, it is now often used untranslated in English texts and has proved useful in defining a concept of the conditions of cinematic reception which can contain a wide variety of practices and experiences. It facilitates theoretical distinctions between one type of cinematic experience and another, and helps in parsing the contributions of the individual components while retaining awareness of a greater whole (Kessler, 2006). It also grants an equal place to those components such that, for example, the human subject of cinema is not lost to sight while considering the role of film technology, and vice versa, making it particularly valuable for interdisciplinary research. As a term, therefore, *dispositif* is valuable to interdisciplinary studies of cinema, describing a system of "surrogate" (Hochberg & Brooks, 1996) experience which includes darkness, a screen, projection equipment, a film, and human spectators and operators. Each of these features bears individual scrutiny and can be examined in much finer detail in terms of their role in the experience of cinema across time, a research process which, in turn, informs our understanding of film history.

One of the joys of studying early cinema is that the components of the *dispositif* are more obviously part of the experience. The subject/participant/spectator is more aware of them because less veils are drawn over the components of the system than in later forms of commercial cinema, which vigorously pursue the ever more virtually real. In contrast to the contemporaneous séance room or even the too-shapely leg of a

table, the pioneer of early cinema, projecting from amongst the audience, took a showman's delight in placing the technological component 'on stage,' a practice which effectively co-opted the auditorium into the performance space, certainly augmenting and perhaps even challenging the spectacle of the screen. By implication, therefore, the spectators were also drawn in to 'treading the boards' and would consequently be more aware of themselves as a component of the *dispositif*.

Within ten years or so of the first public cinema shows, the prosaic demands of fire safety regulations forced a significant change in the *dipositif* by enclosing the projector (and projectionist) in a metal box or bricking them up behind the walls of the projection booths in the first purpose-built cinemas (Enticknap, 2005). At the same time, the projection mechanism itself became more enclosed. For example, individual components such as the intermittent movement were encased in a cast metal oil bath and the external shutter moved closer to the lens and was lost to sight behind a protective housing. The noise of the film advance mechanism became overlaid with the hum of electric motors. This trend towards the black boxing of cinema's components ceded power to the screen and promoted greater immersion in the image. With the bolstering of the reality effect of the screen stimulus, the reflection of the spectators on their own agency would have decreased along with awareness of their presence in a system with potential for creative response and feedback.

Subsequent technological developments, such as the advent of synchronous sound, further rooted attention to the screen such that by the time of television's challenge to cinema's cultural hegemony in the 1950s, cinema's response and argument of differentiation was to expand the size of the screen and attempt to add a third dimension rather than to adopt an alternative strategy of revealing its true nature. This instead was the response of the avant-garde of experimental film makers, whose *dispositifs* of small halls, cafes and basements and portable 16mm projectors re-established something of early cinema's potential for a dynamic viewing environment, which would itself lead to developments termed expanded cinema in the 1960s and 1970s (Youngblood, 1970).

Is Cinema Also Digital?

In the present day, what we know of as Cinema has undergone a momentous decade-long transition, shifting both means of capture and delivery from analog to digital technology, yet this has gone all but unnoticed by its mass audience. However, the gradual convergence of the technologies of cinema and electronic imaging, finally arriving around 2011 into the viewing *dispositif* under discussion here (that of the cinema theatre itself), has led to concerns from cinema's specialists (filmmakers, theorists, archivists and enthusiasts) that the basic structure of Cinema has been too substantially altered for it still to *be* Cinema (Rodowick, 2007). Undoubtedly, these concerns regarding Cinema's ontology have implications for the contemporary media landscape, but they are perhaps most pertinent to the question of how we now experience those films created in what we might retrospectively refer to as the analog era.

What degree of truth is there in the idea that a film made in, for example, 1910 would be gratuitously misrepresented by presentation via a 2010 digital projector, despite the fact that the digital copy (digitization) may be of the best type with no apparent difference in image quality, as would follow with current film restoration practice? Would the different temporal resolution of analog projection (actually theoretically inferior) make a difference not just to an entrained aesthetic experience, but also at a more basic perceptual level? Does the removal of mechanical film technology and the splicing in of video technology affect the other constituent parts of the *dispositif*, especially the physiological response and consequent perceptual and cognitive experience of the human subject? In order to work through some of these concerns, and in collaboration with neuroscientist colleagues Stephen Hall and Edward Rhodes, we collected some data on brain activity (specifically area V1 of the visual cortex) of various volunteers while watching projections of early cinema content. A ten-minute reel of four different clips (representing different genres of film) was presented across two different conditions, the first projected by a 1910s hand-cranked film projector and the second, a 2010s High Definition video projector, typical of the sort used to present archival film in modern exhibition contexts (Edmonds, 2016).

EEG recordings from three sensors in area V1 were taken along with luminance data from the projection screen which determined the flicker rate of each of the projectors: a variable 14–16hz for the hand-cranked projector with a single-blade shutter and 120hz for the video projector with a single Digital Mirror Device chip and a six-blade color wheel. Would the intrinsic brain rhythms of the participants be affected or driven by the similar frequencies of the film projector? What effect would the 120hz stimulus of the video projector create? Could the low frequencies of the film projector create a Steady State Visually Evoked Potential (SSVEP; Herrmann, 2001) which would effectively synchronize the basic perception of the spectator with the technology? Such a link at the level of technology as opposed to higher level cognitive interaction with the image content would suggest a basic framework to the early cinema *dispositif* which is not accommodated by the technically highly accomplished digital projection.

Observations made while collecting the data included the perhaps obvious realization that the projected film image is of much greater complexity than the simple black and white stimuli normally used in psychophysical experiments, which would be more likely to produce an SSVEP. Flicker is much more consciously perceptible in large bright areas of the image than in dark areas, although interestingly both the visual cortex (from the V1 EEG recording) and the photometer picked up the modulated light in the entirely black sequences of the film which linked the clips together, despite this being invisible to the evidently not so 'naked eye' of the experimenters.

Doing for the Ear What the Cinematograph Does for the Eye (and Brain)

Out of necessity, the testing was conducted in a lab in which the non-portable EEG recording device was installed, although ideally it would have taken place in the space of a cinema theatre. Once recorded, however, the data was far more portable and it seemed fitting to take this record of cinema experience and 'return' it to the *dispositif* of the cinema. The question of how to present such data was suggested by another known absence: nearly all the original participants had commented on the sound of the film projector, such that it seemed to be a very significant, yet unrecorded part of the test. By combining a sonification of the existing EEG data with the sound of the projector mechanism, key elements of the *dispositif* could be drawn together and viscerally unified. The data of both the electrical activity of the brain and the screen luminance were sampled at a rate of 2048hz, thus giving a very fine temporal grid against which to isolate brainwaves and light modulation operating at much lower levels. Interestingly though, the ear can discern much higher levels of auditory flicker, "above 1000 interruptions per second" (Miller, 1947), so how better to recast the data than in an ear-readable form? What can the ear tell us that the eye has missed?

A rationale for the sonification of the data was worked out collaboratively between Guy Edmonds and the sound artist, Shaun Lewin. The aim was to incorporate it with the hand-cranked projection of the film used during data collection and present it as a live performance which should afford an individually subjective interpretation of the data alongside other sonic, mechanical and visual elements of the *dispositif*—a modus operandi which allowed for a certain amount of processing to be applied to the raw data, as detailed in the following description.

A Max/MSP patch was used to ratchet the sound of the projector's shutter mechanism to the light-modulated sonification of EEG recordings of 10 spectators, in a system analogous to the tined drum found in player pianos. Each shutter event triggered the playback of 1 frame's duration of EEG data (defined as 62ms, equivalent to 136 data points within the EEG recordings); these values were determined as an average 15 frames per second and derived from the results of the luminance data from the slightly variable-rate projections presented to the 10 subjects. Initial explorations in the sonification of the EEG recordings revealed that the simple transduction of a floating-point data stream into 44.1KHz digital audio produced a sound work that would place substantial demands upon an audience seated for the full duration of the film. Experimentation revealed that adding a second instance of the transduced EEG audio to itself with a very short interval of time separating these instances created a resonant tone with some harmonic characteristics (a process often described as comb filtering). In order to differentiate between the 10 subjects' neural activity, a different interval of time was applied to each EEG data stream's comb filtering; these intervals were determined through exploration of the emergent sound work and do not have a semiotic value

beyond that of an arbitrary index of identities. The intensity of each comb filter is proportional to the quantity of darkness captured by a webcam facing the projector screen, in a negative emulation of the use of a photometer in the original test.

The production of multiple resonant tones with pronounced harmonic and inharmonic components, the complex syncopation of the EEG data streams and the role of the audio within a larger multimedia piece all suggested a relationship with the use of a gamelan orchestra within Indonesian shadow puppet theatre events. This relationship was rendered explicit through the use of audio processing that translates the frequencies produced by the comb filtering into their nearest equivalent within the 7 note Pelog scale (tuned to concert pitch).

The first performance of this Displaced *Dispositif* was given on August 17, 2017 during the Off the Lip colloquium (See Figure 1). Although not scientifically readable and technically needing further development, the performance succeeded in establishing a symbolic link to the operation of brainwaves within the *dispositif*, such that those present may well have questioned their role as the *eleventh* spectator.

Figure 1. Guy Edmonds and Sean Lewin set up the equipment used for the performance of "The Displaced *Dispositif*."

The transferability of *dispositif* is the key to its usefulness as a concept. We can talk of *dispositifs* of early cinema, of amateur cinema, classical Hollywood cinema, avant-garde cinema and indeed digital cinema, and we know we are talking about the specific viewing conditions of a specific type of cinema, all of which differ from each other (Parente & de Carvalho, 2008). For film archives and museums, this 'film as *dispositif*' (Fossati, 2009) concept plays a significant role in modern collection policy, which accepts the impossibility of replicating any one historical film moment in all its complexity and instead offers new *dispositifs* for old films by, for example, self-consciously commissioning new scores for silent films. This is already one level of displacement that our title alludes to; however, with this performance we aim to displace elements within the *dispositif* into other modalities, to make them apparent and call them more powerfully into our conscious experience. Rather than a new score then, this performance invites the audience to listen to that most silent of film accompaniments—the brain activity of the spectator—while hopefully bringing its relation to the rhythmic propulsion of the film strip further into the realm of conscious perception. Notwithstanding the fact that every screening is to some extent a displacement of all previous ones, the performance takes a step further in displacing some of the contents of cinema's black boxes and making the hidden dimensions of the cinema experience more apparent, revealing the potential for 'liveness' in what might otherwise be taken for a uniform product. The show must go on!

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First response to "The Displaced *Dispositif*" by Jacqui Knight

In Edmonds' performance, we are offered a unified experience of both EEG experiment and results that reveal something about the nature of neurophysiological experiments whilst simultaneously exposing hidden elements of the filmic dispositive—the brain activity of the spectator. Using an analogue projector, the flicker, winding noise of the apparatus and the performative presence of the projectionist all typically keep a spectator aware of the production of the filmic illusion. However, Edmonds' performance work further reveals some of the hidden contents of the black box, the component parts of the system which allow him to manipulate the hierarchies in the filmic *dispositif*. Understanding less the specific role of each determinant in the *dispositif* but more the relationships between the film, the darkness, the viewers experience, the apparatus, the projectionist and so on shows the infinite potential of each cinematic experience to unfold differently each time.

The importance of Edmonds' work lies in the transferability of this method, useful in an archival capacity to think about the network of technologies concerning the process of duplication, and in a curatorial capacity to expose new narratives and provoke alternative readings of particular film works. In addition, from a filmmakers' perspective, this method could be used as a device in the creation of new film work. This would follow the Structural Materialist filmmaking philosophies from the 1960s and 70s that attempted to demystify the film process, an antidote to the highly ideological mainstream narrative cinema. You could say Structural Materialists' films explicitly pointed to different aspects of the *dispositif* through using anti-illusive techniques. Your investigation follows and extends these Brechtian traditions, keeping us actively aware of the construction of the cinematic reality but also aware of the emergent, infinite dynamics and relationships between all the determinants of the *dispositif* system. This work then perhaps offers a "New Structural Materialist" approach, drawing to attention other materialisms such as electrophysiological experiences that were certainly not available during this experimental film movement in the 1960s and 70s.

In Edmonds' performance I question whether the sonification of EEG brainwave data and luminance data can actually mirror or give us any empirical information about its participants' cognitive experience, since this interpreted data is already a representation. To make a further reinterpretation of this data (through this performance) is producing something that would probably have no correlation to its source. I suspect this is not the purpose of this performance anyway, and in fact we are offered something more akin to an experimental visualization of this data which questions new ways to understand the cinematic experience, other than those experiences directly articulated to us using our sensory apparatus.

From a performative point of view, I would be interested to see a live sound score taken directly from EEG data of a spectator in situ. The film spectator being part of a more authentic *dispositif* system—within the cinema—which would not isolate the subject from the audience and the cinema context.

Second response to "The Displaced *Dispositif*" by Mark-Paul Meyer

The live performance at OTLip17 on August 17, 2017, was a memorable one. Edmonds and Lewin projected a 35mm film with a hand-cranked projector, accompanied with a sonification of the EEG frequency recordings of persons who had watched the films in a laboratory setting. This performance was highly experimental and not as perfect as Edmonds and Lewin had wished, but overall it was an experience that raised enthusiasm and relevant issues for debate. Concerns about the synchronicity between film and sound were foregrounded during the performance, but for most attendees the performance was an intriguing experience, in particular from the perspective of making visible (and audible) the hidden structures of the cinema *dispositif*.

However, this also raised the question of what we were actually listening to. The sonification of 10 EEG recordings resulted in a noise with little tonal variation and little clearly distinguishable punctuation. The question is whether other strategies of sonification would have had better results. Sonification of data is already a well-developed practice in different domains of scientific research and it seems that much can be learned from these experiences in other disciplines. Without being familiar with these developments it seems that there must be a way to make a sonification that is not only more pleasurable to the ear, but that is also more informative about what is exactly happening in the human brain while watching films.

Since Guy Edmonds' research project is also about the difference between analog and digital projection, there is also a question of whether the sonification of comparable data from a spectator watching a digital projection would result in a noticeable difference. If the claim is right that, for instance, the memory of the spectator is activated differently when watching an analog or digital film, this could partly be supported by a difference in data and a hearable difference in sonification.

This brings me to the title of the paper that Guy Edmonds presented—the 'displaced' *dispositif*, which refers to displacing elements in the *dispositif*—and one could ask whether the activity of the human brain should not be considered an inherent part of the *dispositif* as it is hidden, invisible, almost immeasurable, but nonetheless a crucial part of it. Edmonds does not elaborate much on the term 'displaced,' but I would argue for an 'expanded' *dispositif*, since the cornerstones of the *dispositif* are known and well defined, but a lot can still be said about these cornerstones. If we can disassemble a film projector into its many constituent parts and units to understand its working, we may also be able to "disassemble" the mechanism of human perception and integrate that in the concept of the *dispositif*.

As an archivist, I like to raise the question of whether this expanded *dispositif* can/should be used as a parameter in the restoration, preservation and presentation strategies of historical cinema. In particular with regard to films from the silent era,

but also from the later years of analogue cinema. In the digital era resolution, bit depth, color space and so forth are important considerations which have been identified as being critical to accurately reproducing an analog image in a digital format. This is understandable since visual quality is dominant in all discussions on reproduction of film images. But this paper suggests that invisible properties should also be considered. Differences in frequency between the analog and digital apparatuses—either the cinema machines or the apparatus of human perception—have never been discussed and this paper implicitly poses the question of whether these frequencies should be considered as part of the restoration, preservation and presentation of archival films. Does "authentic perception" of an analogue film exist and is it relevant and possible to recreate or remediate this authentic perception with new digital technologies? It seems that sonification could be an innovative strategy to give a partial answer to this question.

Third response to "The Displaced *Dispositif*" by Aska Sakuta

While watching the film, I felt a strong emotional response, which consisted of three experiential levels (or layers?), each relating to different elements of the experience: the content of the film, the visual quality of the film, and the presence of the conductor (I suppose the proper term is projectionist) of the film.

At the first level, I could see that the film was recorded a long time ago; the sites and people in it seemed to be from previous eras. This made me ponder—as such things usually do—what it would have been like to see, feel, and experience those things then and there.

At the second level, I could also see that the film was in "black and white," shown on a small area of the screen, flickering, and sped up; all of these qualities are different from what we would normally encounter today in a modern movie theatre—all in all, much less "accessible" in terms of one's ability to experience what is happening in the film as if one were there. This "inaccessibility" somehow increased my desire to connect to the content of the film (a desire that had already existed at the first level). It was almost as if I was naturally led to place more effort into achieving that goal, once difficulties appeared in its path. This strong connection (or desire to connect) to the sites and people in the film then led to a piercing realization that these things no longer exist (people have passed, sites have changed...); or, in other words, I can *never* experience these happenings as they had happened in real life. This realization induced a sinking feeling of loss, or perhaps longing. The aforementioned "inaccessibility" of the content of the film seemed to reinforce that realization ("I can never experience this") even further.

Finally, at the third level, I was made hyper-aware of the effort that was put into the presentation of that film—a feeling that one rarely experiences in modern-day film screenings; as the author has mentioned in the paper, the work that lies behind showing a film is usually "hidden." The audience does not even know whether anything is manually operated—for all we know, everything could be completely automatized. However, in this screening, I could see the projectionist and hear the projector; the "work" is exposed. I could see him operating the machine, from beginning to end, never stopping, working with careful precision. I often enjoy such transparencies in live theatre productions (performers, stage managers, lighting and sound technicians, all working together to make the show happen), but for me to encounter this feeling during a film viewing was a novel experience. Nonetheless, my emotional response towards this particular awareness was just the same as that of a theatre performance: deep gratitude and appreciation for the fact that so much work was put into realizing this experience.

The three emotions (curiosity and wonder towards another world, the attachment, loss and longing towards that unknown world, and the appreciation towards the work of "bringing that world back to the present") accumulated into an overflow of emotions, which resulted in tears.

I would say that the levels were all present by the end of the experience, but appeared in the order that I mention, one layer over another (which is why I debated between using the word "level" or "layer"). Interestingly, however, in live theatre performances, the last level (appreciation towards the "work") would normally appear before anything else. My guess is that this is because that level is more viscerally (as opposed to cognitively) grounded than the others, as it is caused by an explicit, real-life exposure to the "workers" in the space—a type of presence that reaches me without the need for conscious interpretation (seeing the performer, hearing an orchestra, seeing the spotlight move across the stage with the actor, etc.). Whereas, the first level (curiosity towards content) takes a more interpretive attitude to access (knowing the intention behind the performance, understanding the aesthetic and contextual value of the work, etc.), and the second level (enhanced attachment towards content due to its "inaccessibility") is almost completely dependent on whether the first level even exists; were I to be uninterested in the content to begin with, its "inaccessibility" would just surface as a mild frustration. In reference to speed, I suppose I could say that the more "visceral" response (i.e., third level) would reach me faster than the "cognitive," but it is interesting that it did not happen in that order during this presentation. It may have something to do with my expectation (or ingrained understanding) towards film screenings; that I am to focus on what is on the screen rather than who is doing the screening. It was not until later that I became aware of the fact that this is in fact also a "performance," and that a person, right here, right now, is putting work into it.

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Dance Improvisational Cognition

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Abstract

Research into group creativity with its dynamic, interpersonal, and multi-perspective character poses many challenges, among others, how to collect data and capture its shared nature. In this paper, we discuss the creative process of an ensemble in dance improvisation as an example of vivid and collaborative creative practice. To identify aspects of improvisational dance cognition, we designed and applied a video-stimulated recall approach to capturing the multiple perspectives of the shared creative process. We tested the method during an improvisational session with dancers, showing how the recordings of dancers' thought narratives and internal states might be used for studying group creativity. Finally, we presented an audiovisual installation *Between Minds and Bodies* that aimed to recreate the dancers' experience and offered immersion into the creative process by accessing individual dancer's thought processes in the improvised performance while watching the dance improvisation.

Keywords: audiovisual installation; dance; group creativity; improvisation; video-stimulated recall method.

Introduction

In this paper we describe the design and application of a video-stimulated recall approach for studying group creativity, and an installation that seeks to recreate and communicate a group's shared creative experience to members of the general public. To do so, we describe three modules we implemented to annotate and observe the creative process in dance improvisation. Each of the three elements "Preparation," "Studio," and "Installation" can be exchanged and used independently. Here they build on one another to provide a conclusive reasoning for decisions we made during

the development. Even though we discuss dance improvisation as an example for a creative process throughout the paper, we are convinced that this method can be applied to a range of tasks and activities to observe and annotate participants' behavior in order to gain a better understanding of their cognitive processes.

Preparation

In the first part we explain the steps that led to the implementation of the video-stimulated recall method as well as some technical preparation.

How to Recollect the Creative Process

Finding a solution or even just an approach to an ill-defined problem often requires the exploration of the problem space. One way to understand the cognitive functions involved in creative problem solving is to learn more about the involved processes. These processes are studied, at least in the domain of creative problem solving, by observing divergent thinking as the generation of several intermediate or alternative solutions, and convergent thinking as the attempt to arrive at a single solution (Cropley, 2006). In some cases, finding the solution is accompanied by a Eureka experience or 'Aha!' moment (Bowden, Jung-Beeman, Fleck, & Kounios, 2005). Most divergent, convergent, and insightful thinking tasks focus on the outcome and the generated product. As a result, they provide snapshots in time through artefacts, but they fail to capture the whole process of problem solving.

Verbal protocols have been shown to provide reliable data about introspection on processes (see Fox, Ericsson, & Best, 2011 for a review). Nevertheless, this is not viable in group tasks as participants' verbal reports would influence each other's performance. One way to avoid this is to assess the process after it has finished and the solution has been found. However, it is unlikely that the memory of the process accurately reflects what happened when solving the problem. Even if people are asked immediately after solving a problem, it is difficult for them to recall exactly what happened, even more so if they experienced an 'Aha!' moment, which has the tendency to be the dominant memory of a problem-solving process, potentially masking other memories. For example, Danek, Fraps, von Müller, Grothe, and Öllinger (2012) showed that people more easily recall magic tricks they discovered themselves through an 'Aha!' moment than those for which they failed to solve or were told the solution. To aid the memory of the problem solvers and help them remember the thoughts they had had, Glăveanu and Lahlou (2012) used recordings of the process. Video recordings are particularly useful if the problem solving process generates artefacts or is accompanied by intermediate output, for example writing, movement, or sound. When considering possible tasks, the given problems

should be solvable within a limited time for pragmatic reasons regarding observation and memory recall. Taking these constraints into account and with the aim to investigate the creative process in contemporary dance, we decided to observe dance improvisation as a vital creative practice in the field of dance. This approach makes it possible to capture both the process and the results of the creative process at the moment it is created (Sawyer, 1999).

Observing Process

Improvisation in contemporary dance serves two main purposes: it is an open-form performance practice and it is widely used for generating novel movement material for choreographic phrases (Carter, 2000). If we consider dance as an ill-defined problem, improvisation, with its unplanned, open-ended form, gives dancers a chance to explore movement beyond habitual patterns; they can discover unknown possibilities and bodily solutions (Forsythe & Haffner, 2012). Creativity in this understanding of improvisation is dynamic: the solution for given problems may occur at any time, while listening to a task or even after the improvisation is finished, and can be triggered by movements or new problems discovered during the dance. 'Aha!' moments—sudden instances of solving a problem in a creatively successful, coherent improvisation piece—come unexpectedly with movement, rather than as a pre-discovered idea (Blom & Chaplin, 1988). As dancers commonly use their bodies and movement as tools with which to experiment (Kirsh, 2011), new ideas appear through dancing while dancers think in a mostly non-propositional way.

In interviews with dancers about how they improvise, Nakano and Okada (2012) show that dancers interact with various stimuli from both internal and external sources: they react to imagery, sensations, and feelings that they entertain during the performance, as well as to music, space, and their audience. Dancers make movement choices by responding to these stimuli and organize their movement extemporarily, using techniques such as switching and changing speed, as well as imagining themselves from the third person perspective (Nakano & Okada, 2012). Their study gives a general understanding of dance improvisation practice; however, it does not examine the dynamics of the process as it happens as the findings are based on dancers' general recollection and beliefs about their practice.

In an in-depth analysis of solo performance, De Spain (2003) explored improvisational cognition using the momentary awareness sampling method in a series of solo improvisation sessions with experienced movement improvisers. He recorded momentary awareness reports by asking improvisers to 'report now' what was in the front of their mind at random moments of the improvisation. Similarly to Nakano & Okada's (2012) results, he found that improvising awareness could be focused on internal sensations, especially proprioception (the feeling from the dancer's body),

mental images related to the body, (like "foot exploring space… have eyeballs in my toes"; De Spain, 2003, p. 31), emotional states, or an aesthetic reaction to one's own movement. At the same time, improvisers' awareness is engaged with the external world, which they sense through seeing, hearing, tactical sensations of skin, etc. Attention can also manifest as visible movement because of the necessity to direct and focus the act of sensing—to turn the head to see or hear in reaction to the surrounding environment, etc. Furthermore, De Spain (2003) pointed out the importance of memories, especially kinaesthetic ones, which might be echoed in movement choices. Finally, the role of awareness of intentionality could be direct ("I'm walking") or indirect ("It moved me"), acting as a filter for movement choices and a feedback loop regarding the whole process.

The current research aims to extend De Spain's (2003) approach beyond the individual, focusing on dancers' improvisational cognition as well as the group dynamics in a shared creative process of group improvisation. The particular focus on group interaction originates in the social aspect of dance practice, as solitary processes are rather unusual in dance creativity in general (Stevens, Fonlupt, Shiffrar, & Decety, 2000). The exploration in this paper is predominantly experiential, as captured in the audiovisual installation *Between Minds and Bodies* (see section "Installation"); however, the methods elaborated through this paper have successfully been deployed in another instance of this project. Qualitative and quantitative studies on shared creativity and flow experience in dance improvisation using a similar method have been published in Łucznik (2015, 2017).

Studio

This section consists of three parts: we explain the general setup of the study in "Setup," the second part explains how the process is recorded, and the third demonstrates how we gathered feedback from the participants using the video recall method.

Setup

Group improvisation brings the richness of interactions and interdependence of choices made by the dancers within a group. We expected that the distributed character of practice would shift dancers' interest from a solo-oriented focus to a collaborative, co-creative, and group-oriented process. One of the challenges was to find the right way to record the multiple perspectives of the group process. A simple adaptation of De Spain's (2003) method of talking out loud proved to be unsuccessful in group settings, as dancers got distracted and influenced by others' comments.

In the field of ethnography, Glăveanu and Lahlou (2012) explored the use of a subjective camera (subcam) to obtain a first-person audio-visual recording of creative action. The collected video material was then used to assess the subjective experience of the participant through a confrontation interview using excerpts from the recording. This approach enabled microscopic, decision-making description of creativity at the levels of both process and content. We considered adapting the method to document creative processes in dance, but quickly realized that it would be highly constrained by the practice. Firstly, dance is a dynamic activity with frequent head movements and changes of levels and focus of the field of view. The image obtained from a body-mounted camera would be too puzzling to watch and too difficult to interpret. Secondly, dancers rely not only on direct visual cues, but also on peripheral vision and other senses like hearing, kinaesthesia, and touch (De Spain, 2003). Finally, even with the current level of miniaturization of electronic devices, the size of available cameras still obstructs and constraints the movement of dancers, particularly in improvisational practice.

Following up on this, we suggested a video-stimulated recall method (Rowe, 2009) to capture dancers' thought narratives and awareness throughout the dance improvisation. A similar method was used in describing the thinking process underlying jazz improvisation (Norgaard, 2001), in which an audiovisual recording of a just finished improvisation was used as a basis for the interview. While watching the video of their performance, musicians were asked to narrate their conscious thoughts, considering questions such as "Where did that come from?" These works inspired our idea of collecting data on participants' introspection on the creative process through verbal protocols (both delayed and outside the group process) and with support for the participants' memories through video-recordings.

The present adaptation of the video-stimulated recall method is implemented with immediate playback. Since we were interested in individual verbal narratives on the group process of dance improvisation, we wanted to give our participants the chance to play the video recording at their own speed and to pause and resume at will. Additionally, we explored the possibility of annotating cognitive states experienced by dancers during the improvisation process. For one derived research study, which looked into cognitive components that enhance creativity (Łucznik, 2017), we asked the participants to report their experience of flow (Csikszentmihalyi, 1975, 1990) using this annotating feature.

The technical setup for the video-stimulated recall method needed to be portable, simple to apply to a flexible group size, and easy to operate for a single researcher. To provide the dancers with a familiar interface, we decided to use tablets with an HTML5 touchscreen interface for the video playback and feedback collection. We used a Wi-Fi network and a local web server to quickly transfer the recently recorded video material to all connected tablets and collect the participants' responses in one central location.

In our setup, we did the video recording (Figure 1a) with a stationary video camera on a tripod with a wide-angle lens, thus capturing all the group's actions from a third-person perspective. In this setup we transferred the video recording on an SD memory card (Figure 1b) to the computer. A laptop (Figure 1c) that was capable of transcoding the videos and running the server software also needed to be set up in the studio. For better control over the signal strength and available bandwidth, we chose to provide our own portable hotspot (Figure 1d), which gave us full control over network authentication of the laptop and tablet devices. Finally, the browsers on the tablets were pre-configured to the URL of the video-stimulated recall application.

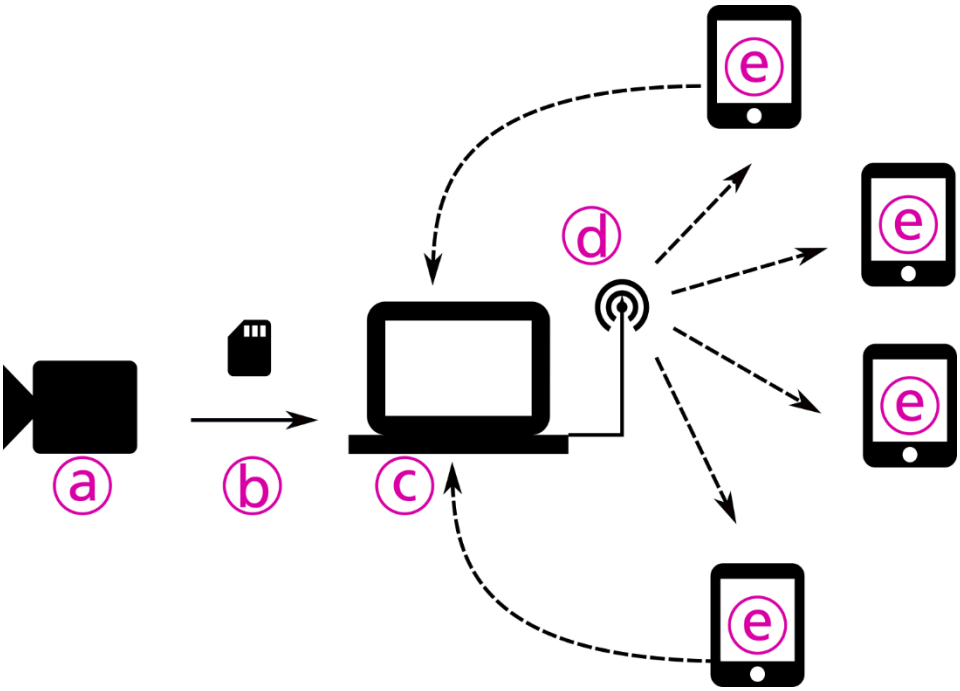

Figure 1. Schematic setup setup with (a) video source, (b) transport to server, (c) WiFi multicast (d) to tablets (e).

Capturing Improvisation

To capture the creative process in dance improvisation, we invited dancers to take part in a workshop. We asked them to engage with several improvisational tasks and reflect on their experience using our video-stimulated recall method of the creative

process. The improvisation ensemble depicted in the supplemental material consisted of four dancers: Ellen Hunn, Kevin French, Saurav Rai, and Klara Łucznik (one of the authors of this paper). In the workshop, the dancers improvised together as a group to a score, which provided a starting point for the improvisation (e.g., "Let your ears listen to the sounds—of your body, of others, of space. Let your feet sense the floor . . . Let all your senses open and lead you for the next few minutes in the dance"). Each score lasted around 4–5 minutes and was ended by the experimenter. The improvisation was followed by the capture process of the video-stimulated recall procedure. This procedure was first perceived as unusual, but quickly all dancers got used to narrating their process. Moreover, they found the procedure interesting and insightful for their own practice.

The camera recording was started and stopped manually at the beginning and the end of the improvised score. Once the recording had stopped, the SD card with the video recording was moved to the computer and a prepared computer script was run in order to fulfil two tasks. Firstly, the high-quality video recording was transcoded to a low bandwidth stream. Secondly, the script started a web server on the local Wi-Fi network. In the first step, the Handbrake[1] software transcoded the latest video file from the SD card to a stream with a resolution of 640x320 pixels, a quality rating of 18, a peak-limited frame rate of 30, and an AAC audio codec with 96kbit/s. The transcoding took about a third of the recorded time using an i7 processor (Haswell generation), for example 1min 30s for a 5-minute improvisation. This step generates a video file that could be transmitted to a large number of clients with the given setup, independent of the type and setting of the video camera. While the video was transcoding, the dancers received tablets with headphones and a short explanation about the next step. Through the web application on the tablet, participants had full control of the playback of the video stream and were also able to report their state of flow using an on–off button. The current position in the video stream and the status of the reported flow states were shown on a timeline. These features were implemented in HTML5 using JavaScript for interactive elements and communication with the server.

The local web server (implemented using node.js[2]) on the laptop was able to serve the web application and stream the video file simultaneously to multiple clients at high-speed while collecting status reports and feedback from the individual participants. The latter included the status of the video playback; for example, when participants started playback, skipped forward or backwards through the recording, and paused the playback. This information was available for use afterwards to

[1] "HandBrake – The open source video transcoder," available at https://handbrake.fr/ (last access: 2017-09-15)

[2] "node.js," available at https://nodejs.org/en/ (last access: 2017-09-15)

synchronize voice reports with video content. The system also recorded and visualized a single tap on the flow button, which changed the reported flow state at the current time in the video from flow to not-flow and vice versa (Figure 2).

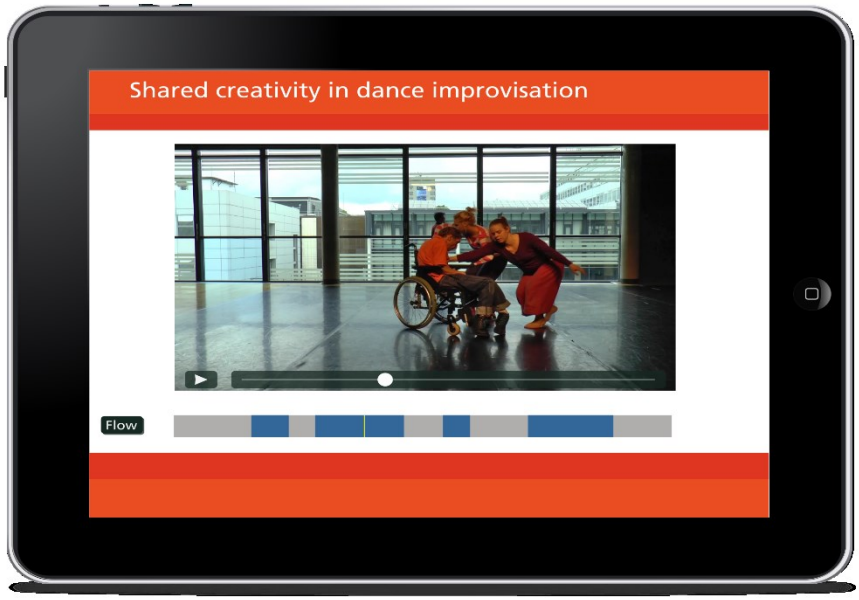

Figure 2. A video simulated recall method—tablet view.

Using the same programming language for client and server proved to be useful for a quick turn-around during the development and prototyping of the video-stimulated recall method. Also, using an HTML5-based client deployed from the central we server reduced the complexity of the technical setup and the interactions that were necessary from the researcher during the experiment.

The voice reports were recorded through separate audio recorders. Due to verbal communication limitations, one of the dancers, Kevin, provided a detailed recollection in written form later during the day of the improvisation. Kevin's condition limits his ability to speak, but he can rely on great memory skills. Since each feedback was given individually and video recorded to support the recall process, this change of procedure was not expected to influence the outcome of our research interests.

The video-stimulated procedure for recollecting the creative process and flow states was found to be fruitful, as measured in collected narratives of several collaborative dance processes that were used to gain further insight into creativity (Łucznik, 2015) and the nature of flow experience in dance (Łucznik, 2017). Finally, the method allowed us to collect materials for the audiovisual installation presented below.

Installation

One recorded instance using the video-stimulated recall method was showcased as *Between Minds and Bodies* during the Off the Lip 2017 event at Plymouth University. The video recordings are also available in the supplementary material of this article. This section provides a description of this installation.

Between Minds and Bodies

The audiovisual installation *Between Minds and Bodies* consists of video materials of an improvising dance ensemble accompanied by dancers' narratives of their creative process obtained from an improvisation workshop. In this particular piece of work, our interest lies in understanding the creative process in dance through experiencing the dancers' thinking processes in improvised performance. The setup includes a large screen and four pairs of headphones. While the group improvisation of the dance ensemble is presented on the screen, each pair of headphones plays back the voice recall of the creative process of a particular dancer, with the other voices playing in the background at a lower volume. The combination of the screen and the four individual headphones allowed the audience to engage with the multi-perspective interactive aspect of group creativity. The four different narratives and their combination reveal the co-agency of dance improvisation in each moment of creation. A spectator has the opportunity to experience and be immersed in the creative process of any of the dancers at any moment during the improvisation, gaining insight into the dancers' choices, interests and thoughts, along with the visual output of the group dance.

Watch the installation at: https://doi.org/10.26913/80s02017.0111.0021

As one of the spectators, Aska Sakuta, shared:

> As an intuitive response to this setup, I decided to look at the screen, listen to the sound, and walk around, all at once. From the headphones flow multiple streams of consciousness, narrated by different voices, some louder than others. Soon, I start noticing subtle consistencies between what is being spoken, and what is being shown on the screen; a voice would say "I just lean in," right as someone on the screen leans on another body, and another voice would say "I feel the floor," as I notice someone's foot sliding across the floor. For a moment, I decide to take off the headphones and watch the video on its own. Remnants of the voices echo through my consciousness, as I notice some motifs that have carried on since they were first presented. I place the headphones back on my ears and notice that the narrations have moved on to a completely different theme—my attention quickly synchs to the narration, as my eyes start to focus again on what is being spoken. This time, however, my body responds to the "movement words" that appear in the narration—"entre," "walk," "balance," "rest"—I am seeing, hearing, and doing the movements all at once, and I feel as though I am the movers themselves, switching from one mover to another, based on the most dominant voice in the recording.

Conclusions

In this paper we describe an end-to-end approach to identifying salient aspects of group creativity by designing a method to capture these aspects. In addition to the technical aspects of this process, we also describe a way of sharing these experiences with members of the general public in an exhibition. The current research has a mostly experiential character of audiovisual installation; the collected material enables third parties, such as a spectator at the installation or a researcher interested in the creative group process, to enter the improvisational process of dancers by engaging with a video recording of improvisation. The multiple perspectives delivered through audible layers of dancers' thoughts from a single group improvisation reveal the complexity and interdependency of a creative group process.

The video-stimulated recall method presented in this paper might be used in the wider context of group dynamic research. We suggest using this method if participants' introspection on processes is of interest. In particular, the video-stimulated recall method has shown to be useful for processes that are accommodated by the generation of intermediate artefacts (Łucznik, 2015, 2017). Tablets offer an easy to administer and time-economic way of capturing the experience and internal states of group members.

Acknowledgements

The authors would like to thank Thomas Wennekers and Aska Sakuta for their detailed feedback, and the delegates at Off the Lip 2017: CogNovo Colloquium on Experiences and Applications of Cognitive Innovation for the interesting and open discussion.

The source code and additional technical descriptions are available on request via the corresponding author.

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Response to "Dance Improvisational Cognition" by Eugenia Stamboliev

The paper provides a very thoughtful insight into its research interests and the challenges of understanding creative dance practice, especially in the context of improvisation and group creativity. It points to the difficulties of recording or explaining the creative and often embodied process of dance improvisation. As such, dance improvisation is considered an expressive bodily enactment that does not follow a preplanned choreography (Nakano & Okada, 2012); therefore, it can only be discussed *post*-practice in the form of a reflection on movement.

The paper does well in positioning the viewer in the process of dance improvisation practice. However, the paper's understanding of the observing viewer of the dance practice could gain from the valuable perspective of the 'participatory observer' provided by anthropology (Jorgensen, 2015), since this position is not a neutral one, but interferes with the observed dance improvisation.

The paper unravels issues with first-person video recording of dance practices as a method of exploration and suggests, with reasonable arguments, why 'video-recall methods' could be a better way to research the process of improvisation.

The only major problem I see (and I assume the authors also do) is that the verbalization of a non-verbal, embodied process constitutes an issue for many artists or creative practitioners. Asking dancers about their post-practice and rationalized movements could lead to a blurry, and maybe inflated explanation of a process that in fact seems less cognitive or rational and much more embodied and non-verbal.

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Counterfactual Imagination as a Mental Tool for Innovation

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Abstract

In the article I demonstrate some of the possible ways by which counterfactual imagination can lead people to innovation and the creation of novel and valuable solutions. I start with adopting the broad definition of counterfactuals, by which counterfactual imagination is understood as the ability to imagine alternative states of affairs which can relate to the past, present or future. I explain how counterfactual imagination differs from other sorts of imaginative and creative thoughts, pointing out that counterfactual types of thinking always rely on facts and involve a change in some features of the actual world, leaving other such features unaltered. I also show that the concept of counterfactual imagination can be useful when we aim to describe the very earliest manifestations of imaginative capacities in children, which can be seen in their make-believe games. All the mentioned characteristics of counterfactual imagination are further used to examine how *what if* and *would be* sorts of thinking and imagining might influence people's creative performance. I conclude with the suggestion that—if guided properly—counterfactual imagination could be a truly valuable mental tool for innovation. This demonstration is partly influenced by Ruth Byrne's multi-faceted analysis of counterfactual imagination, mainly from her book, *The Rational Imagination: How People Create Alternatives to Reality*.

Keywords: constraints; counterfactual imagination; creativity; innovation; possibilities.

Introduction

More than a century ago, John Greenleaf Whittier (1898) expressed the folk intuition which is still vivid in our present times: "For all sad words of tongue or pen, the saddest are these: It might have been!" (p. 153). It leads one to sadness and misery when

one thinks about the possible and promising events that could have happened or could have almost happened, which can be a more heart-breaking case, but that which did not happen. "It might have been a masterpiece!" could be piteously thought by a painter who accidentally poured paint on his canvas. On the other hand, as I aim to show in this paper, such trains of thought as *it might have been* or *what if* are a powerful tool to expand and even enable our human capacity to innovate and create.

Suppose that another painter also thinks that his finished painting *might have been* a masterpiece (but was careful enough not to spill the paint). He is looking at his *almost-masterpiece* and asking a series of *what if* questions, or visualizing some *what if* images in his mind.[1] "What if I (had) used more blue?" "What if I (had) painted more sunflowers?" In this case, it is not hard to predict some further benefits of such *could have been* imagining, e.g., we can suppose he is learning from his mistakes or he is planning how to paint a more beautiful still life painting next time. Indeed, *what if* or *might have been* thoughts have already been shown as thoughts that can yield helpful scripts for future behavior, including creative behavior (Roese, 1994). Nevertheless, there are many more directions in which we can study how such thoughts (hereinafter called counterfactual thoughts) can be linked to innovation and to our general potential to create.[2] In this article I seek to demonstrate some of these connections and several practical applications. This demonstration is influenced by Ruth Byrne's multi-faceted analysis of counterfactual imagination, mainly from her book, *The Rational Imagination: How People Create Alternatives to Reality* (2005).

Counterfactual Imagination That Relies on Facts

Counterfactual imagination is a distinct ability among our other mental capacities with which we consider alternative states of affairs, or, in other words, generate and process counterfactuals (Byrne, 2005). It is said to appear very early in human development at the age of 18 months, when children start engaging in pretend play (Amsel & Smalley, 2000; Harris, 2000; Lillard, 2001; Weisberg, 2015). Moreover, counterfactual imagination is sometimes perceived as a particular evolutionary precedent and as a potential explanation of the unique human cognitive attributes (De Smedt, 2011; Suddendorf, 2013).

[1] I support the view according to which thinking what if does not need to be expressed propositionally since alternative states of affairs can be simply imagined or visualized. This will be more precisely explained later.

[2] I agree with the proposal of Margaret Boden (2004) and Maria Kronfeldner (2009) to treat as creative such cognition that is a basis for giving new and valuable ideas from the perspective of the individual alone, not only for producing what is new and valuable in an objective or communally agreed upon sense.

Although this phenomenon is discussed in the literature as counterfactual thinking (Roese, 1997) or counterfactual reasoning (Weisberg & Gopnik, 2013), I prefer to refer to it here as counterfactual imagination (referring to Byrne [2005]), thus suggesting that we can not only deliberately think or reason about alternative states of affairs, but we can also imagine or visualize them. Moreover, I do not want to treat this ability only as the ability to construct possible scenarios that have to rely on the past, as did Roese (1997) or Kahneman and Varey (1990). Indeed, most analyses have focused on describing counterfactuals as alternatives for past events[3] which are uttered with the formula "What might have been if X had or had not happened?" I argue that this capacity is a more general one, since I define it as an overall capacity for imagining various alternative scenarios.[4] We can construct counterfactuals not only for what has happened, but also for actual and habitual states of affairs, as well as for events anticipated as likely to happen (future hypotheticals). Additionally, we assert the existence of *timeless* counterfactuals, as is shown in the example "If kangaroos had no tails, they would topple over" (Lewis, 1973; Woodward, 2011), where time is neither key nor decisive in consideration of this counterfactual. Therefore, I define counterfactual imagination as embracing all thoughts about alternatives to the here and now, including, for example, thinking about the future and pretend or fictional worlds (Amsel & Smalley, 2000; Edgington, 2011; Gopnik, 2009; Harris, 2000; Woodward, 2011).

When applying such a broad definition of counterfactual imagination, it is important to explain how it is described differently from other sorts of imaginative and creative thoughts; for instance, from the notion of divergent thinking. An important characteristic of counterfactual imagination highlighted in literature is that it *counters the facts*, where *the facts* part is actually highly significant. Namely, we always refer to reality while imagining alternative states of affairs or—to put it differently—while pondering possible worlds. This means that these counterfactual types of thinking involve a change in some features of the actual world, while other such features are left unchanged (Woodward, 2011). Let us go back to the previous example of the painter who thought "What if I had used more blue in my painting?" Actually, there is only one thing that he alters in his visualization: the amount of blue paint. The other features of the actual world (such as the portrayed objects or the size of the canvas) are left unaltered.

[3] Such counterfactuals about the past can be called real-world counterfactuals here and there (Beck & Riggs, 2014).

[4] My viewpoint on this matter is similar to the standard broad view of counterfactuals in which it is claimed that, as counterfactuals, we should perceive not only sentences expressed in the subjunctive mood, but also selected sentences uttered in the indicative mood, such as "If I finish this paper, I will go for ice cream" (see Hoerl, McCormack, & Beck, 2011; Woodward, 2011).

Furthermore, counterfactual imagination can be perceived as ever-constrained by some facts or *commons*, or by particular external and internal conditions (Byrne, 2005).[5] It may be constrained by the need to create minimal changes to reality (Byrne, 1996), or that reality must be recoverable from the imagined alternative (Byrne, 1997). Otherwise, our imagined worlds would be incomprehensible, senseless, or perhaps even not possible to imagine at all because people may understand a counterfactual alternative only through the lens of the facts from which it was created (Byrne, 2005, 2016).

Counterfactual Imagination in Human Development

It is not news to say that children can be highly imaginative; this is mostly because from the age of 2 they engage in make-believe games (Fein, 1981). Talking especially about counterfactual imagination, we could find a number of studies in which pretend play is described as an activity based on counterfactual-like cognitive capacities such as (a) the competence in pondering possibilities (e.g., through a mental *possible worlds box* mechanism [Nichols & Stich, 2000]), (b) suppositional thinking (Perner, 1991), or (c) the mechanism of *decoupling,* thus disconnecting primary representations from their real functions (Leslie, 1987, 1994). According to Leslie (1987), a psychologist broadly recognized for his research on pretend play, in make-believe contexts children create a reality that is an alternative to the one known by them or believed to be true. In this sense, humans at the very beginning of their development are capable of cognitive innovation—with their peculiar imaginative competence they can transcend time, place, and/or circumstance to think about what might have been, design the future, create fictional worlds, and consider alternatives to the actual experiences of their lives (Harris, 2000).

Some researchers have recognized the counterfactual features of children's pretense episodes in a more explicit way (Amsel & Smalley, 2000; Harris, 2000; Weisberg, 2015; Weisberg & Gopnik, 2013). For instance, they say that pretending—as with counterfactual thinking—involves representing possible worlds (Weisberg, 2016). According to Angeline Lillard (2001), performing make-believe games serves a similar function for children, in some respects, as the Twin Earth construct serves for philosophers: it enables them to imagine and reason about an alternative world which resembles reality in some parameters. In other words, while pretending a

[5] Here we see how the notion of counterfactual imagination is contrary to the famous view of imagination proposed by Kant (1781/2000), who claimed that our imagination is completely free from reality: "For the imagination (as a productive cognitive power) is very mighty when it creates, as it were, another nature out of the material that actual nature gives it . . . In this process we feel our freedom from the law of association . . . for although it is under that law that nature lends us material, yet we can process that material into something quite different, namely, into something that surpasses nature" (p. 192).

child is considering and acting out certain alternative scenarios in which some features of reality change, and some do not. Therefore, *ipso facto*, during their play children experience some imaginative constraints and follow some thinking rules.

Although our first impulse could be to claim that children's pretend play (as with imagination) is unlimited and freely detached from reality; however, it is subject to certain regularities. A child does not pretend in a completely free-flowing manner, but preferably by following selected rules and by making his pretense understandable for others[6] (Bretherton, 1989). A child creates alternatives to existing events which, nevertheless, retain causal powers of mundane reality (Harris, 2000). Thanks to this pretense, an imaginative activity in which children posit the existence of fictitious worlds could paradoxically be an important tool for acquiring knowledge about the actual world[7] (Weisberg & Gopnik, 2013).

Applications of Counterfactual Imagination

As my previous analysis shows, one aspect of counterfactual imagination is that it is constrained by facts. Would it be disturbing to say that counterfactual imagination is not as free as we first thought and that it does not help us to act as highly innovative and creative humans?

From some studies and applications of counterfactual imagination in the creative process, we learn that this specific ability of thinking *what if* or *what might have been* can enhance our creativity and innovation under certain conditions. For example, Markman, Lindberg, Kray, & Galinsky (2007) showed that so-called additive counterfactuals, which add new antecedent elements to reconstruct reality (e.g., "If only I owned an umbrella, I would not have gotten wet"), can evoke an expansive processing style. This processing facilitates creative generation or divergent thinking. On the other hand, subtractive counterfactuals (e.g., "If only it hadn't rained today, I would not have gotten wet") evoke a relational processing style that simplifies analytic task performance. Hence, additive counterfactuals can be viewed as more creative—they can "go beyond the original premise set, fabricating novel options perhaps never considered in the past" (Roese, 1994, p. 807). Creative leaders can then encourage people to structure their counterfactual stories to be more *additive* in order to allow them to be open to describing alternative states of affairs which were not part of the factual event. By these means we might boost the probability of creative and innovative performances in individuals.

[6] If interested in the topic, see an illuminating short movie on children's pretense: https://aeon.co/videos/children-at-play-provide-a-rare-glimpse-into-the-imagination-ours-and-theirs

[7] There have been a number of studies on the function that pretend play may serve for children's development, among which the most prominent are the studies on the cognitive connections between pretending and understanding the minds of the others (Gut & Wilczewski, 2016; Leslie, 1994; Lillard, 2001).

Considering the previous applications of counterfactual imagination in innovation as well as in various creativity training programs which do not have to lead to any specific innovative products, we see that there is one well-known method that uses counterfactuals explicitly. Among lots of innovative strategies, there is one based on asking several *what if* questions and searching for original *would be* answers. "What if another advanced species existed?", "What if there were no gravity?", "What if we saw only one color: red?" Such fictitious situations prompt our creative thinking by letting us imagine different possible worlds in which some features do not have to be the same as in the actual world.[8] Hence, this counterfactual method introduces us to the mental state of creative generation of novel, non-actual ideas. At the same time, asking *what if* can be fruitful and is often adopted at the exploratory stage of creative and innovative processes (according to Geneplore model of creativity by Ward, Smith, & Finke [1999]). When we see a possible solution for a problem or when we construct a prototype version for our innovative product, we might ask a series of *what if* questions (e.g., "What if I made it a bit smaller?") to explore more possibilities to find the most creative one or to ensure that our final proposal is appropriate, or as valuable as it could be. Therefore, imagining what *would be* is important both at the preliminary generative stage of innovation and at the exploratory stage, when we evaluate and improve the selected ideas or artefacts. Counterfactual imaginative strategies are used in innovation in many ways and during various periods of the creative process.

Counterfactual Imagination as a Mental Tool for Innovation

To complement the above brief notes on the adoption of the notion of counterfactuals in the creative field, in this section I will follow and develop the analysis of Byrne (2005), who stated that counterfactual imagination shares many similarities with other sorts of creative thought.

Byrne's main idea is that counterfactual imagination should be viewed as rational, since people create counterfactual alternatives by thinking about possibilities guided by a small set of principles. For example, when people create a counterfactual alternative to reality by mentally altering some aspects of reality, some of these aspects, which Byrne calls 'the fault lines of reality,' seem more *mutable* than others. That is, they are readily changed in a mental simulation of an event (Kahneman & Miller, 1986). Time seems mutable in our imaginary scenarios, while our own existence seems not. For example, we would say "If I had no time, I could not write this article" rather than "If I did

[8] Notice that there are at least two possible ways of answering such what if questions: (1) as many different answers as possible (known as divergent thinking) or (2) to explore and develop one answer, e.g., What if kangaroos had no tails? They would topple over and then they could not move so fast (so they would be easy victims for predators, which means they could be in danger of extinction etc.). I would call this second way of processing cascading thinking and would relate it at the same time to exploratory and generative ways of creative problem solving (referring to the Geneplore model of creativity by Ward, Smith, & Finke [1999]).

not exist, I could not write this article." Different people tend to change the same features of the actual world when they think about counterfactual events; therefore, there are remarkable similarities in what everyone imagines. Moreover, thinking about other principles that lead our imagination, Byrne points out that we usually think of just a few (if not only one or two) possibilities to mentally represent some aspects of reality. We also do not tend to focus on impossibilities, that is, things that could never have happened given the way the world is, e.g., "If aliens attacked the city, I could not write this article." Likewise, we do not explain things by mentally altering natural laws; we do not say "It would be harder to write this article if there was too much oxygen in the air" or "She would not have fallen from the ladder if there had not been gravity" (Seelau, Seelau, Wells, & Windschitl, 1995).

All these described principles of the counterfactual imagination seem not to be too friendly to creativity and innovation. Claiming that this type of imaginative thinking shares similar mental features to creative thinking would result in saying that different people guided by similar imaginative rules tend to create similar things when they are situated in the same context to solve. Nevertheless, this is exactly the case. For instance, when different people have been asked to draw an alien from another planet, they tended to picture their cosmic creatures with sensory organs, most commonly eyes, and also with the limbs such as legs (Ward, 1994). People may think of just a single possibility to mentally represent some aspects of reality, such as the presence of eyes or the law of gravity, both of which seem immutable in the sense they are often left unaltered in our imagination.

Does this all mean that counterfactual imagination is counter to creativity and innovation? Not at all. On the contrary, counterfactual imagination can lead us to highly original and valuable ideas and objects. Accordingly, I see some possible paths of interpreting Byrne's studies in favor of the creative power of the counterfactual imagination.

The main path I will sketch here could be called the meta-cognitive one. It shows that it is helpful for one to have and develop original and novel ideas when one has a sort of meta-knowledge of counterfactual imagination. (Of course, Byrne's principles are taken into account.) To be innovative, we could try to break some of the imaginative rules, as most creative nonconformists usually do. These are the possible ways to do it:

1. Instead of making minimal changes to reality in your imagination, think bigger and alter more.
2. Do not rely solely on the elements of your conceptual knowledge that first come to your mind when creating: add more alternatives, take a look around, travel to a new place, etc.
3. Instead of using 'close counterfactuals' which are close to reality, ("If I finish the paper, I will go to sleep"), try to use remote ones ("If I finish the paper, I will go to visit one of the possible worlds").

4. Make mutable what seems to be immutable, e.g., imagine an alien without eyes and legs (!).
5. Try to change the diagnostic aspects of a concept which seem least mutable, e.g., if prickly spines are typical of a cactus, think about a cactus that does not have them, or imagine shoes without soles.
6. Alter the laws of nature when trying to be innovative.[9]

Following these suggestions, we could make use of counterfactual imagination at its best in our innovative and creative performances. To put it differently, good imagination management could lead us to novel and original solutions, and this would be the evidence that counterfactual imagination is a truly valuable mental tool for innovation.

One Last Thing of Importance

Finally, I will point out the most basic and fundamental function that counterfactual imagination might serve for our creativity and innovation. Namely, it facilitates us to alter reality and to invent anything with a touch of or a basis in the actual world, for all inventions consist of alternations or developments of reality. Why in the Upper Paleolithic era, around 10,000 years ago, did an extraordinary *cognitive revolution* in human culture occur? According to Harris (2000), this was caused by the appearance in humans of the capacity to invoke imaginary possibilities. Such a cognitive revolution of counterfactual imagination enabled the invention of tools and new strategies for hunting. In contemporary times it enables us every day to think up new ideas and to invent either simple or complicated useful objects such as teapots or robots. To be creative, we certainly need to guide and use our counterfactual imagination properly, as how revealing it is can be seen from Erin Hanson's question:

"What if I fall? Oh darling, what if you fly?"

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[9] There is a truly original children's book about a boy who defies the laws of gravity: *The Terrible Thing That Happened to Barnaby Brocket* by John Boyne.

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Response to "Counterfactual Imagination as a Mental Tool for Innovation" by Hannah Drayson

The paper proposes a number of ways to use counterfactual imagination as a method in design practice. In the following, I refer to a number of complementary references for this area of enquiry from literary theory and science and technology studies.

First, the observation that counterfactual thinking is conformist suggests a connection to writing in literary theory on the topic of alternative worlds. This work considers the way in which the familiar and unfamiliar are held together in the practice of creating complex alternative scenarios. As science fiction scholar Darko Suvin defines it, sf is "a literary genre . . . whose main formal device is an imaginative framework, alternative to the author's environment" (Suvin, 1979, pp. 7–8). Some of the concepts generated to analyze these writing practices might offer another dimension to the discussion, for example: Suvin's theory of the sf *novum,* a single, scientifically plausible innovation around which a story is told and which produces an experience of "cognitive estrangement" (inviting speculation in the reader about possible alternatives to the status quo). Other work in this vein connects with thinking about the relation of the counterfactual to creative imagination; according to Arne Zettersten (2011), J. R. Tolkien's belief in myths was as transcendent truths (complicating the definition of factual and counterfactual).

This paper appears to raise a definition of counterfactual imagination that invites further questions, possibly because of the slippery meaning of the word "fact." If—as it is defined here (p. 243)—"counterfactual imagination [embraces] all thought about alternatives to the here and now," then where does factual information that is *not* about the "here and now" fit into this definition? The difficult processes by which matters of fact come to acceptance are an object of study, as much in the humanities (Latour & Woolgar, 1979) as in the sciences. However, this definition seems to assume that what we directly experience and what is "true" are the same thing. Take, as an example, a "fact" that kangaroos have long tails. In terms of my experience of the "here and now," there is very little to distinguish this "fact" from other thoughts or imaginings that I might entertain, and what of thoughts that I have which are mistaken? With the paper's goal to instrumentalize counterfactuals for the purposes of enhancing creative innovation—the definition of a counterfactual thought may have to include the coda that it is counter to the facts as understood by the individual who is imagining them. This individual perspective may offer a further line of exploration.

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When Is a Cognitive System Flexible?
The Variability–Stability–Flexibility Pattern on the Way to Novel Solutions

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Abstract

Creativity and flexibility are considered by many to be inextricably linked. However, the current literature does not offer a clear view about their relationship and flexibility is not a unitary construct in psychological research. In this work, I present a new theoretical approach that considers flexibility a recurrent property in and of the cognitive system and I argue that flexibility is best understood as a link in the variability–stability–flexibility pattern. Investigating this pattern and looking at the dynamic flow from variability to stability and then to flexibility in the functioning of the cognitive system can lead us to better grasp how the system arrives at novel solutions in creative problem solving.

Keywords: creative problem solving; flexibility; pattern; property.

Introduction

Why do humans seem to be special? Some argue that it is because we can adapt quickly and invent new things. These two behaviors have been present since the beginning of our species, but despite being investigated in several scientific domains over the last two centuries, we have no clue yet about what exactly enables us to perform them. In other words, there is little understanding, let alone agreement, in the literature about what flexibility, creativity, and innovation are.

In this paper, the focus will be on flexibility, which can be seen as being at the heart of human achievement (Carr, Kendal, & Flynn, 2016), because it helps humans to identify and follow new ways of seeing things or solve problems. I will start with pointing out the lack of clarity in the current studies on flexibility and creativity; a new theoretical proposal regarding flexibility will then follow, one in which flexibility is seen as a link in the variability–stability–flexibility pattern that characterizes the functioning of most processes in the cognitive system. In the end, I will discuss the implications of this proposal. Understanding what mechanisms are involved in the emergence of flexibility, creativity, and innovation would help us explain a whole plethora of human behaviors, from artistic creations to everyday solutions and scientific discoveries.

The Need for Conceptual Clarity in the Study of Flexibility and Creativity

More and more recent studies point to several flaws in our field, and more specifically to the need of agreed-upon views about the concepts we study in psychology (Aldao, Sheppes, & Gross, 2015; Carr et al., 2016; Dietrich & Kanso, 2010; Ionescu, 2012; Simonton, 2016; Ziegler, Stoeger, & Vialle, 2012). Overton (2015) asserts that vocabulary matters and shows that in general in the field of human development, there is the need for more conceptual clarity. In the same vein, I start this paper with the assumption that the field of creativity would move forward faster if there were more agreement and clarity about the mechanisms that lead to creativity. For example, how can we say that flexibility is a sine qua non condition for innovation and then not have an agreed-upon definition of flexibility? Or how can we say that we should foster creativity and innovation when we do not agree on what exactly these two terms mean?

If we consider flexibility, the literature offers us at least four views (see Figure 1, Panel A; see also Ionescu, 2017, for a more detailed description). First, some authors equate cognitive flexibility to the ability of shifting (Chan, Shum, Toulopoulou, & Chen, 2008; Cragg & Chevalier, 2012; Diamond, 2006; Garon, Bryson, & Smith, 2008; Vandierendonck, Liefooghe, & Verbruggen, 2010). Under this view, flexibility is considered to be the ability to shift attention from one rule or task to another. Second, in creativity studies it often represents a measure in the Alternative Uses Task, namely the number of types of ideas one can come up with (Dietrich & Kanso, 2010). Third, in personality studies, flexibility is associated with "openness to experience" (Chung, Su, & Su, 2012; Kalbitzer et al., 2009). Fourth, in different research areas, flexibility is seen as a property of the investigated processes. For example, authors speak about flexible language (Naigles, Hoff, & Vear, 2009), flexible categorization (Ionescu, 2007; Ross & Murphy, 1999) or flexible emotions (Hollenstein, 2015). After reading about these views one is left with an essential question: which one is required for creativity and innovation to emerge? Furthermore, are all of these necessary? And if yes, how to combine them? One solution maybe to change the lenses through which we look

at flexibility. The next section proposes a new perspective with the hope that this will lead us eventually to more conceptual clarity in order to understand how we arrive at novel solutions when confronted with intriguing problems.

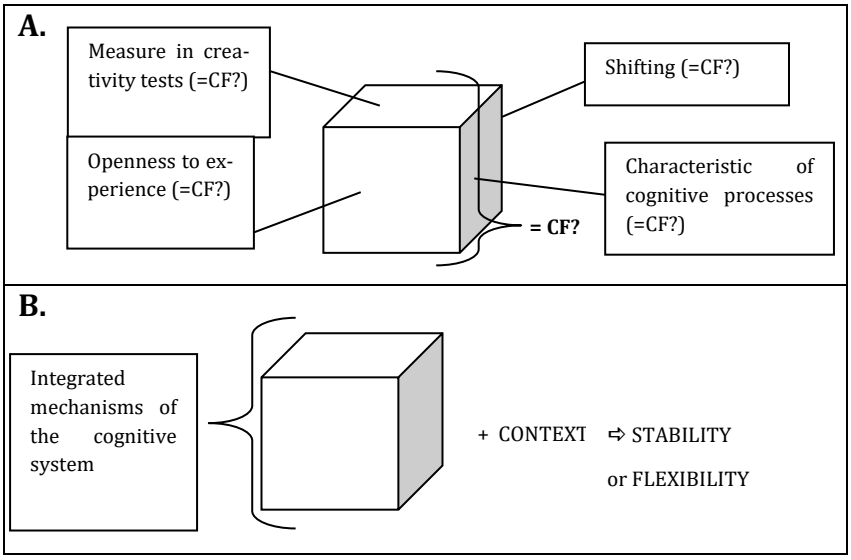

Figure 1. A depiction of: some of the sides of cognitive flexibility in current literature (Panel A); the proposed integration of cognitive (and non-cognitive) mechanisms with context for the emergence of the stability or the flexibility of the cognitive system when solving problems (Panel B). (CF = cognitive flexibility)

When Is a Cognitive System Flexible?

The question that opens this section is a fundamental one because before we can analyze what flexibility is we must describe instances in which the system is flexible. Usually when the system does multitasking, when it changes its behavior according to changing rules, when it finds new solutions or creates something new, it is said that it behaves flexibly (Crone, Bunge, van der Molen, & Ridderinkhof, 2006; Gibson, 1994; Goldstone & Landy, 2010; Leber, Turk-Browne, & Chun, 2008; Monsell, 2003). If one analyzes these instances carefully, one can see that each of them entails a combination or an integration of several processes. For example, in order to find a new solution, one has to activate previous knowledge to make associations between bits of knowledge, to shift perspectives, to use selective and focused attention, to shift attention, to monitor conflictual information, and so on. After all these happen we say that the system was flexible if it found a novel and appropriate solution. In other words, flexibility emerges as a consequence of all these mechanisms working together (Ionescu, 2012).

Furthermore, oftentimes we see that flexibility comes after a time of stability, or that when solving a problem, the system passes from moments of stability (e.g., when working with previous knowledge and known strategies) to moments of flexibility (e.g., when new ways of seeing the problem emerge). As such a pattern emerges, one that starts with variability (when the system tries out anything in order to solve the problem) then passes to stability (when the system knows the appropriate answers and follows them) and finally to flexibility (when the system changes old ways of solving problems to different/new ways; Ionescu, 2017). This pattern can be observed in the development of various processes (e.g., insight problem solving, categorization, language, or theory of mind; Ionescu, 2017) or when solving a particular problem at a particular moment in time. In the latter case, different dynamics of this pattern can emerge, such as going linearly from one state to another or passing nonlinearly from one state to another embedded one into another (see Figure 1 in Ionescu, 2017). More specifically, when we consider the flexibility of the cognitive system in general, we might observe that the route is not simple and linear (e.g., going from variability to stability and then to flexibility), but more circular or embedded (e.g., going from variability to stability and then jumping back and forth from stability to flexibility to stability to flexibility and so on; or showing a larger variability state in which sometimes the system reaches stability and in which sometimes the system gains flexibility).

Taking things one step further, we might also want to consider the role of context for the emergence of flexibility. Flexibility is present "when abilities are well tuned to changing demands" (Ionescu, 2017, p. 6). When analyzing problem-solving, we can speculate that finding new solutions might rely on a fine tuning between what the system already has (e.g., knowledge, abilities) and the way it pays attention to what the problematic situation asks for, or to the context. If this link functions well, flexibility emerges and the system solves the challenge successfully (see Panel B of Figure 1).

Considering all the aforementioned aspects, let us analyze how we can use this pattern to better understand creativity and innovation. When we are faced with novelty, be it the need to solve a difficult problem or the need to create something, the cognitive system has to use all the resources it can to find the solution. In other words, it will use mechanisms such as shifting, working memory, inhibition, and conflict monitoring together with its knowledge base (from long term memory) and it will try to change perspectives according to the task demands. These mechanisms are combined dynamically in either the state of variability (trying out various ways to solve the problem) or stability (staying with previous solutions) or flexibility (envisaging and changing ways of solving). All these states, no matter if they follow linearly or not, help us better grasp the interaction of the mechanisms enumerated above. As a consequence, by trying to sketch a more general picture of what the system does when it creates (i.e., the aforementioned states and what they entail) we might be better able to see the dynamics of creativity and innovation.

In order to study all the above assumptions, one could investigate improvisation. When improvising, one passes quickly through these states and we could analyze, on the one hand, the dynamics of these states, and on the other hand, the role of stability for flexibility. More specifically, we could analyze whether the pattern is linear and whether one always needs stability before flexibility. At a more general level, we could arrive at a learning account that explains how the system becomes flexible. By analyzing the integration of mechanisms (and not only the mechanisms taken separately) we could arrive at a more accurate picture of flexibility and the dynamics of the creative process. It might be that because there is no single ability that we can call flexibility, all we will be able to educate in the end is the readiness for flexibility. If we want to borrow from how gifted people learn and work, we can speculate that they are immersed in their domain of interest (Ionescu, 2014)—they play with ideas (variability), then repeat endlessly everything in their domain (stability) until they are better at using their knowledge and abilities flexibly. The implications for teaching may be profound: in this era of technology there is the risk that children do not form sufficiently well-organized knowledge bases to support flexibility. If we only focus on innovation, they might be at risk of not having the basic knowledge with which they might innovate. As such, investigating this pattern can have broad implications that might be helpful for understanding and fostering innovation.

Concluding Remarks

The present paper has argued that in order to reach the conceptual clarity needed for a science to mature, we need to carefully analyze the concepts that we use. In the context of creativity and innovation, I have analyzed the concept of flexibility and proposed that if we consider it a property of the cognitive system and look at it in the more general pattern of variability–stability–flexibility, we might be able to better grasp the dynamics of all the mechanisms that are in play when we create. This is only a first step toward disentangling the process of creation. Thorough experimental studies are needed to prove these assumptions—studies in which we also take into account the contextual challenges when investigating creativity and innovation (Gummerum & Denham, 2014).

If we look again to Figure 1, we can say that in order to understand flexibility maybe we first need to think out of the sides of the box (i.e., out of the one-sided current views of flexibility, namely the squares of the cube in the figure), and then to think outside the box (i.e., out of the cognitive system—the cube in the figure—to include the complex interactions with context). In this way, looking at this overarching pattern might help us widen our perspective and observe important aspects that are not visible when we only look at small components.

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First response to "When is a Cognitive System Flexible? The Variability–Stability–Flexibility Pattern on the Way to Novel Solutions" by Pinar Oztop

The current paper suggests understanding the role of flexibility in creativity and innovation as a cognitive system that integrates flexibility with variability and stability.

The Dual Pathway of Creativity Model by Nijstad, De Dreu, Rietzschel and Baas (2010) argued that creativity is a function of both cognitive flexibility and cognitive persistence. In this model, the flexibility pathway represents achieving creativity through problem-solving or producing different ideas in broad range of categories and shifting between these categories. The persistence pathway represents achieving creativity through a more systemic exploration of an extensive amount of information and persistence in only a limited range of categories. The two pathways are not described as negatively related, but are instead seen as complementary. It is acknowledged that creativity can also result from switches from more flexible to more systematic modes. The current paper defines stability as the opposite of flexibility. What Nijstad et al. (2010) argues is that persistence can help turn stability into flexibility. It would be advised to implement this point in the current paper's cognitive system of flexibility. Is stability just a phase inside the cognitive system that is ideally expected to lead to flexibility, or is stability a dynamic phase that supports systematic thinking, which is also necessary for flexibility? I would like to understand more about the inter-relations between these different phases of the cognitive system and the different ways in which the system can integrate these phases.

The dynamics of the proposed cognitive system can vary according to the task, domain, culture, and the age of the person. The author briefly mentions the role of context and gives the example of problem-solving. This is a valuable point which can be elaborated by also referring to divergent thinking, artistic thinking or design thinking. How does a cognitive system of flexibility vary according to the demands of different tasks? Context can also be approached from the point of domain: how does a cognitive system of flexibility function in artistic, organizational or educational domains? The author also states that improvisation can be a unique context for observing flexibility. Further elaborations with a focus on the nature of improvisation and how/why it can provide such a valuable context for understanding the flexibility of a system would bring valuable insights. Is it the momentarily, unpredictable flow of actions, or is it the richness of variation in improvisation that links with the proposed system?

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Second response to "When Is a Cognitive System Flexible? The Variability–Stability–Flexibility Pattern on the Way to Novel Solutions" by Kathryn B. Francis

In this proposed holistic model of innovation and creativity, the author discusses how a pattern of variability, stability, and flexibility can, as cognitive states, provide a picture of how we arrive at novel solutions in creative problem-solving.

This paper provides a valuable contribution to the literature surrounding creativity and Cognitive Innovation in that the author presents a broad definition of 'flexibility,' encompassing varying conceptualizations from the literature and proceeds to successfully unite them within a cognitive framework for creative problem-solving.

In the three-step pattern proposed, variability, stability, and flexibility are connected in both linear and non-linear mappings to link available methods, tried methods, and new methods of problem-solving. Through this characterization, the author refers to the potential for a learning account to explain how this pattern might integrate to explain the dynamics of creation. Following from this, I wonder whether the three-tiered pattern proposed could incorporate an additional state or stage that explicitly accounts for learning, allowing for successful shifting in future instances of creative problem-solving? In this sense, the model might act like a continuous feedback loop, through which reinforcement learning mechanisms enhance the factors that steer our readiness to be flexible. It would also follow that this circular feedback mechanism increases the breadth and quality of stable states. Given that both flexibility and adaptability have been linked to the "darker side of creativity" (e.g., deception, criminality; e.g., Runco, 2014; Gino & Ariely, 2012), it might also be constructive to explore how these self-regulatory processes contribute to both adaptive and maladaptive features of creative thinking, thus extending the application of this model into social domains.

The broader spectrum account of the mechanisms underlying creative problem-solving presented in this paper endorses and follows from the notion that creativity is a complex (Mumford, 2003; Runco, 2014); for any researcher studying creativity, this is undeniable. While the author presents a model that views creative problem-solving at this complex process level, future discussion rests in where the individual might sit in this picture, or how their personality might shape the processes and outcomes of such a model. Is the creative individual the person who is most proficient at being flexible in a given context? Does the pattern assume that creativity and innovation are processes that can be nurtured in anyone, or do individual differences in learning affect ability? After all, the term "flexibility" is often encompassed in summaries of the creative individual (Stein, 1975), which begs the question of how the variability–stability–flexibility pattern unifies person, process, and outcome.

Overall, the pattern proposed by the author offers a compelling story of creative problem-solving. Emphasizing the need to clarify the concepts of creativity and flexibility, the author argues that "the field . . . would move forward faster" (Stein, 1975, p. 283) if we were able to underpin these concepts and their relationships to one another. This approach offers some headway in achieving this, with extensive potential application in other domains.

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On *Spillikin – A Love Story*:
Issues around the Humanoid Robot as a Social Actor on Stage

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Abstract

The inclusion of media technology in theatrical plays (Saltz, 2013) follows a contingent fascination and entanglement between human actors, technology and automata (Reilly, 2011) on stage. The contemporary play *Spillikin – A Love Story* places a new digital 'actor' in this debate: the humanoid robot as a socially interactive agent (Breazeal, 2002; Fong, Nourbakhsh, & Dautenhahn, 2003) and caring companion. This paper discusses the exhibition of sociability through the robot's humanlike gestures and its ability to decipher human gestures on stage. The aim is to point to the ethical consequences for the audience concerning the robot's implied autonomy to interact socially.

Keywords: digital media; ethics in science and technologygestures; humanoid and social robots; performance studies; social interaction; tracking technology.

On *Spillikin – A Love Story*, or on the Issues around Technology Performing Sociability

The relationship illustrated in the play *Spillikin – A Love Story*[1] critically addresses the contemporary debate on the use of technology in elderly care (e.g., Bunting, 2016) and points to the difficult question of whether a robot can be a companion for the elderly or people with dementia. It is challenging to fully predict how humanoid technology is about to change our societies and specifically, elderly care. Therefore, it is admirable that the dramatic context is risking critical engagement and debate.[2] According to the

[1] The play was attended by the author in early February 2017 at the Theatre Royal, Plymouth.

[2] See Reilly (2011) for a history on early automata on stage.

artistic production company, Pipeline Theatre (2015b) the engineering company, Engineered Arts (2017), and the reviews on the play (Pipeline Theatre, 2015a), the dramatic focus is on the exhibition of interaction and sociability[3] from Spillikin, the humanoid,[4] towards Sally, the human suffering from Alzheimer's. The relationship discussed here does not only look at the technological issues behind the social interaction on-stage, but refers to the ethical dimension of their application off-stage.

The play develops around the relationship between Sally, a woman in her 60s suffering from Alzheimer's disease, and a humanoid robot named Spillikin[5] who assists her throughout the play. Designed and updated by Raymond, Sally's recently deceased husband, whose nickname was Spillikin, the humanoid is supposed to comfort and assist her by drip-feeding her clusters of the memories she is about to lose. The humanoid is a fusion between a SociBot head consisting of an adaptive, digital 3D screen as a face, and a robust, mechanically stiff RoboThespian body (Engineered Arts, 2017) that barely moves throughout the play.

The play does well in unpacking the challenges of recreating 'autobiographical memory' through technology, considering it develops "during the lifetime of a human being and is socially constructed through interaction with others." (Breazeal, 2002, p. 238). Multiple scenes amplify the realization that memory is more than data and is instead attached to human interaction and shared experience; for instance, when Sally asks to hold Spillikin's hand when he recalls a memory, or when her increasing mental confusion makes Spillikin's comfort become pointless. These scenes not only illustrate the problematic concept of technology's role in memorizing and dealing with diseases such as Alzheimer's, but they also thoughtfully bring up questions on what it means to be patient with someone who is losing or has lost their memory and sense of the present or self. What is woven into the reflective dialogues is that comfort, as much as memory, has its limits, especially when one party is drifting into mental confusion or aggression and losing their ability to interact or to remember who they are.

On the level of technical implementation, the makers of Spillikin, Engineered Arts (2017), claim that "the charm of Socibot lies in its sociable qualities [and to the] ability to detect faces, features, emotions, speech and gestures . . . the eyes follow you around the room; the expression changes to reflect its mood (or yours!)." This implies that Spillikin should be able to read faces and gestures expressed and therefore

[3] Sociability is "the quality or state of being sociable; also: the act or an instance of being sociable." (see Sociability, n.d.)

[4] Short for "humanoid robot."

[5] This paper is not addressing robotics in general, but unpacks the anthropomorphizing of humanoid robots (Duffy, 2011) and the use of strategies to attach social or emotional traits to their exhibited movements, or to their gestures (Breazeal 2002; Fong et. al. 2003).

act autonomously with Sally. But is he? Because of VISAGE, his embedded visual capture system, Spillikin should be able to track visual movement and respond to it. The idea of the robot's abilities to be social is further intimately bound to him executing humanlike gestures and social cues (Breazeal, 2002, p. 236), but not necessarily to autonomous or interactive responsiveness. It seems useful to clarify why interaction and sociability are based on different ideas, but blur into one another. Kanda and Ishiguro (2013) suggest a context-dependent understanding of the humanoid interaction that is bound to the "daily environment [in which the] robots encounter humans" and in which "they have to interact with them" (p. 2). Breazeal instead moves the quality of being 'socially interactive' (Breazeal, 2002, p. xii) away from the robot to the human tendency to anthropomorphize humanoid robots by treating them like humans. The distinctions of being 'socially situated' and 'socially evocative' as suggested by Fong et al. (2003, p. 145) seem clearer. Breazeal's idea of 'socially interactive' further implies a wider agency of communicating, expressing and receiving emotions, learning and developing social competencies, while 'socially situated' (Fong et al., 2003, p. 145) refers to being placed in a social context and 'socially evocative' (Breazeal; as cited in Fong, 2003, p. 145) amplifies the robots' reliance on the human response to their humanoid features. These views support the understanding that Spillikin's gesturing on stage might be socially situated and evocative, but not necessarily interactive. However, the prolific nature of scientific rhetorics undoubtedly imply a blurriness around these terms, making it hard to pinpoint the essential differences. The understanding of the robot's interactive sociability must ultimately combine what is already possible and what is yet to come. However, the relevant concept used in this text comes from performance studies, not robotics. LePage (2015), director of the Robot Theatre, sees the issue of humanoid social interaction as being intertwined with the issue of liveness and presence, qualities which are, according to her, still lacking in humanoids, thus discrediting them as stage performers.

LePage's arguments are illustrated in the play. Despite the appraisal of the social interaction by the engineering company (and in reviews; see more on Spillikin as an 'actor' in Kettle, 2015), several cues point to a lack of the previously acknowledged qualities. Since Spillikin's personality is based on him executing gestures or responding to Sally's mental state by inclined head movements, (seeming) eye contact, questions about Sally's well-being, etc., the audience can easily derive his interactive capacities from the visual similarity to a human–human interaction and by him responding or making humanlike gestures (Duffy, 2011). When taking a closer look at two scenes in which Sally (often quietly) enters the room while seeking his attention, one notices that she is not positioned in his field of vision, but slightly behind him. Yet, Spillikin responds and 'interacts' as if he can see or hear Sally (Figures 1 and 2). This partial "lack of vision" of the robot makes it technically very difficult for Spillikin to interact live with Sally, yet, it remains almost unnoticeable for an untrained audience.

Figure 1. Scene of the play *Spillikin – A Love Story*.
Image rights with the author.

Figure 2. Scene of the play *Spillikin – A Love Story*.
Image rights with the author.

The social cues and gestures are executed so smoothly that the lack of presence and aliveness remains unnoticeable; even if the robot appears to be live and autonomous, the interactions and dialogues are partially recorded in advance or remotely controlled from backstage.[6] This indicates that the humanoid's ability to track and decipher faces and gestures (Bréthes, Menezes, & Lerasle, 2004) is barely (if at all) in use, despite it being advertised as technically possible. Assuming these scenes could have been a perfect opportunity for the robot to prove its technological advancements and engage with Sally in some degree of sociability, the result is the opposite of what is advertised. Without judging this as a mistake or intentional deception, it is more likely that the promotion of Spillikin's sociability and his role a social (inter)actor simply collided with the technological reliability to deliver. Considering the sensitivity of the topic, the risk of the robot failing to be responsive and thereby unsettling the audience must have seemed too great.

These issues do not yet explain why this deception of a 'not yet possible' interaction becomes ethically problematic, as suggested at the beginning. The argument here is that the focus on the staged interaction supports the illusion of a social interactivity that might not be possible, while it masks the actual abilities of the robot to track movement. The decision not to use the humanoid's technological abilities to track Sally's expressions suggests they are not developed enough, therefore the robot is far from being alive or autonomous. However, the audience might not be able to come to such a conclusion. Their lack of technological knowledge to recognize what is possible on- and off-stage adds an ethical dimension by allowing for deceptive promotion of the humanoid's technological advancement to appear more autonomous than it could be without having recorded it in advance. If the audience has not experienced any interaction with humanoids previously, the exhibited mimetic qualities might be projected (see "onto-epistemic mimesis" in Reilly, 2011, p. 7) onto the ontological abilities of the humanoid. This means that the audience could leave the theatre believing that the staged qualities of the humanoid are present in its abilities off-stage and consequently also in its caring abilities.

One could argue that the stage is allowed and encouraged to create an illusion and deception around technological progress to provide an entertaining or appealing script.[7] Styan (1981) correctly argues that "the playwright's task is to flex the aesthetic distance between the illusion on stage and the reality in the auditorium, matching the doubts in our minds with the stage action in order to create a dialectic of

[6] The review on *Spillikin – A Love Story* in the *Time Out* magazine (Hobson, 2015) points to the robot being remotely controlled.

[7] *Spillikin – A Love Story* is understood as a modern/realistic drama, grounded in a narrated, two-character based dialogue and story line that encourages a realistic understanding on the humanoid abilities to be as interactive off-stage as on-stage (see Naturalistic/realistic drama, n.d.).

feeling" (p. 81). But again, in this case, this *flexing* could become a problem for an off-stage understanding that—coming back to Reilly (2011)—could end up in an ontological inference trap.

Ultimately, *Spillikin – A Love Story* does well in linking the discussion on technological applications in care to the embedded ethical issues (see Bunting, 2016; Dakers, 2015), even if it neglects certain issues this paper raises. It is therefore considered a reflective play and script. The critique here amplifies that the stage is not a neutral space. The dramatic exhibition of technologies, from automata (Reilly, 2011) to computer screens (Saltz, 2013) co-shapes their understanding off-stage. Considering humanoid robots are increasingly affecting people's privacy and data (Royakkers & van Est, 2016), the possible ethical conflicts seem significant enough to be addressed.

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Haunted Bodies:
Cell Switching, Getting Lost and Adaptive Geographies

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Abstract

This article proposes the ideas of stochastic resonance and noise as devices with which to think of the body or self as plural and porous. Boundaries and surfaces are proposed as indefinite; cell switching and narratives of the self are discussed in relation to external forces, via Arendt's *inter-subjectivity* and La Celca's *colonization as infection*. The sonic artwork *Ghost,* which uses models of spiking neurons to materialize endogenous and exogenous composition in relation to noise and sonic memory is presented as an exploration of the boundary or limit of the notion of self. This paper, which serves as a *cogitatum* (a force) rather than *cognitio* (the result), articulates the human body as a complex and open system that steers towards chaos by adapting and accepting further complexity as, and within, constantly adaptive networks of creativity. We suggest that by focusing on the porosity of boundaries and the mechanisms that underlie their permeability, problems around identity and subjectivity might be seen in a new light.

Keywords: boundary; cell switching; hauntings; heteropathic exchange; sonic memory; surface; symbiogenesis; transfection.

This writing, produced through two disparate bodies in two distinct fields, serves as a *cogitatum* (a force) rather than *cognitio* (the result). This writing "between two" is an attempt to look at that which is captured, and that which escapes the frame. It is an action where "the event of performance can be said to enact the crisis of representing something fleeting and phantasmatic that persistently proliferates outside of its frame" (Alifuoco, 2017, p. 128). Its narrative begins from an articulation of the

human body as a complex and open system that steers towards chaos by adapting and accepting further complexity, and pervades the constantly adaptive networks of creativity. As in the yoked researchers generating this paper, cogno-innovative knowledges serve as "an endless cycle of exploration, exploitation and explanation" (Gummerum & Denham, 2014, p. 586) that can both cleave apart and together new understandings of the corporeal.

Porous Boundaries of the Self, the Cell and the City

At the level of single cells or their small clusters, our bodies are both endogenous and exogenous, responding both to internal and external sources, the skin the seeming boundary of our selves a porous envelope. In their paper "Nature, Nurture, or Chance: Stochastic gene expression and its consequences" Arjun Raj and Alexander van Oudenaarden (Raj & Oudenaarden, 2008) present a study of cell switching in which small groups of cells commit a proportion of their population to stochastically "attune" themselves to exteriority. These groups of cells resonate with the external environment and become peripheral, whilst still embedded in the biological host. This seemingly random attribution of a portion of cells, allowing a simultaneously inward and outward focusing, resonates with the biological metaphor the artist and writer Victor Burgin offers in his essay "The City in Pieces" (Burgin, 1993/2009). The biological narrative he offers positions the city-scape as not only porous, but requiring the subject encountering the city to become soluble, allowing for the experiencing of a Freudian oceanic-bliss to emerge as she becomes "at-one" with her surroundings. For Burgin, this shift to a more porous city is a by-product of the softening of political boundaries, assailed by market forces, which require a freer movement of capital, which he articulates as "the economic and political equivalent of 'osmosis'—the movement of fluid through a semi-permeable membrane, from the weaker to the stronger solution" (Burgin, 1993/2009, p. 236). Surely, this transformational osmosis also imbues "a pathological horror of mixing" (p. 236) with fluctuating systems of kyriarchical implications: responding to interconnecting social structures of domination, oppression, and submission.

The pathological horror to which Burgin refers reinforces further the biological narrative as a means to understand the social, developed by Franco La Cecla's narrative of infection (La Cecla, 2000) in which he counsels cautions in those moments of traversing unfamiliar territories, warning that when we travel, we are in danger of "colonizing with our presence every step of the journey" because "[t]o know new places corresponds in this century with denying their difference" (La Cecla, 2000, p. 34). We are borrowing here from the writings of theatre academic Nicolas Whybrow (2005), who positions Burgin and La Cecla in dialogue, but we offer our own development of his reading through the cellular understanding of the heteropathic and cannibalistic via the writing of Kaja Silverman (1992), who offers a further note of caution. For

Silverman, when the subject aims to go outside the self, which might be akin to Burgin's solubility, rather than an oceanic feeling of oneness, the exchange is cannibalistic. As newness is experienced, the subject cannot help but absorb the novelty, and what results is a heteropathic exchange in which the self is protected at "the expense of the other who is in effect 'swallowed'" (Silverman, 1992, p. 205).

Symbiogenesis as a Form of Haunting

In an echo of Silverman's process, Donna Haraway (2003) offers a kind of phantasmatic exchange, when she imagines a ghosting of her cells by those of her dog's: that some sort of exchange is occurring at the macromolecular level. She refers to this cell-mediation as "transfection":

> Ms Cayenne Pepper continues to colonize all my cells—a sure case of what the biologist Lynn Margulis calls symbiogenesis. I bet if you were to check our DNA, you'd find some potent transfections between us. Her saliva must have the viral vectors. Surely, her darter-tongue kisses have been irresistible. … I'm sure our genomes are more alike than they should be. Some molecular record of our touch in the codes of living will surely leave traces in the world, no matter that we are each reproductively silenced females, one by age and choice, one by surgery without consultation. Her red merle Australian shepherd's quick and lithe tongue has swabbed the tissues of my tonsils, with all their eager immune system receptors. Who knows where my chemical receptors carried her messages or what she took from my cellular system for distinguishing self from other and binding outside to inside? (Haraway, 2003, p. 15)

Both Haraway and Ms Cayenne Pepper's abject kisses, and the osmotic principle outlined by Burgin, cause a social horror, not because of what is absorbed, but because the resulting admixture is foreign; the host is haunted by that which it consumes. Quite what, or who, is being ghosted here in any given moment, we are not fully sure, but we feel that the inevitable (at least) doubling that occurs in these moments results in more than a simple consumption: a *both-and* pharmakon of cellular understanding.

These transfections unsettle the autopoietic state, which the writing of Niklas Luhmann (1999) extends beyond biological scapes, towards non-biological systems. Luhmann, a sociologist interested in systems theory, describes the relationship between environment and systems thus: "[t]he environment receives its unity through the system and only in relation to the system . . . It is different for every system because every system excludes only itself from its environment" (Luhmann, 1999, p. 17). An autopoietic system reproduces itself from within itself, and is able to reproduce and maintain itself. For Luhmann, the human agent sits outside such systems, with a focus upon the strict adherence to boundaries central to his thinking. And this is where the autopoietic fails as a way for us to understand systems, as its hermetic nature seems to preclude the messiness that we experience as human-things carried around by a constantly mutating meat sack. Human-things occupy the

position of abject, where the abject refuses to "respect borders, positions, rules" rather disturbing "identity, system, order" (Kristeva, 1982, p. 4). The assumed guarded nature of the boundary defends against encroachment, keeps the surface intact and the "messiness" contained.

Information Exchange as a Kind of Haunting; the Self Passing through the Boundaries of the Self

Freud proposes that the skin, the seeming surface and boundary of the self, is crucial in understanding the construction of the psyche. This "energetic" boundary is at once both a physical and psychical entity with interchanging internal and external representations. The architect Jane Rendell (2017, p. 6) quotes the philosopher Elizabeth Grosz: "On the one hand, the ego is on the 'inner' surface of the psychical agencies; on the other hand, it is a projection or representation of the body's 'outer' surface".

In daily use, we tend to think of ourselves as being inviolable, with the barrier of the skin as sacrosanct, as something that it is broken through by accident or medical necessity. The scalpel or the graze blurring the boundaries of where the body ends and begins. This is an explicit moment of trauma.

And there is an explicit moment of trauma built into this writing. This writing began as a presentation, and acknowledges the ghosting between its authors, but also extends this to include the haunting presence of the reader. It references what Fischer-Lichte (2004/2008) calls the "bodily co-presence" of performer and audience (p. 38). It thus entertains and holds within it embodied knowledges. Dubreuil (2015) further describes this haunting as an "intellective space":

> We say more than we think; we think more than we say. This does not sum up all of our lives, but, at least, it describes where we are now, you and me, and where we stand each time we reflect on something or exchange ideas and signs. This strange place, I call it "the intellective space," that is, a putative space where thought and knowledge are performed and shared. (Dubreuil, 2015, p. 3)

This intellective space recognizes that knowing is inseparable from the doing, and that all knowledges are situated and performed in social, cultural and physical contexts.

Sensory Systems as Mechanisms for Negotiating, Rejecting and Assimilating the Self and the Other

This intellective space creates problems for the moment where the words on the page are loosened from the bodies that speak them. André Lepecki (2004) problematizes the theorization of performance ephemerality as "the body's self-erasure in time" (p. 5). He suggests we consider how that "presence" challenges the very stability of the body, how it can shift our cells. We can never witness ourselves at a cellular level, except through the mediated force of medical technologies. And as with any

mediated forces (see the extended debate between Phelan and Auslander in the field of performance studies), the mediated is always something other than the thing itself. It is a thing that stands in for, and arguably, in Western medical parlance, where new technologies increasingly replace the "touch" of the physician, it is possible to think of this lacuna between the cell and the self as the apotheosis of Baudrillard's simulacra (Baudrillard, 1988).

Whilst moving about the world, we are continually aware of things, beings, and objects, of phenomena, on vast or minuscule scales, our bodies, senses, thoughts and memories, focusing on, or filtering out, information. Retelling Sigmund Freud, recent neuroscientific research states that it is our subconscious that shapes our experience of reality, that the internal and inaccessible parts of our being are the foundation for how we live in the world (Big Think, 2016). Our sensory systems are a dynamic mechanism for negotiating, rejecting and assimilating systems of other things at the level of movement, touch, taste and smell, and also at the level of cells, the body's unconscious, epigenetic realm.

Noise as the Source of Intersubjectivity

The paper "Nature, Nurture, or Chance: Stochastic Gene Expression and Its Consequences" by Arjun Raj and Alexander van Oudenaarden (2008) presents a study of noise, cell switching and fluctuation in single and small group studies of cells. The authors discuss a study in which small groups of cells commit a proportion of their population to stochastically anticipate the arrival of food sources. This is a neater way of detecting food and a viable and probable alternative to a situation in which cells firstly sense food directly in their environment and only then activate their metabolic network. The former strategy shows that "stochastic switching is a viable alternative to sensing and that it is most effective when the switching rate is closely tuned to the rate at which the environment fluctuates" (Raj & van Oudenaarden, 2008, p. 221), or resonates, even when this strategy sacrifices the switching group to "suboptimal" growth.

This noise in the bodies of things and beings, resonating with multiple exteriors of the other things and beings, points to the necessity of thinking of the self as a mutable fluid thing, the surfaces of the self negotiable. We are already inter-subjective.

How do we know that we are a self? Is it the narrative of time, of stories, of experiences, of memory? In his novel *Invisible Cities*, Italo Calvino (1972) writes that in looking into darkly reflective surfaces we may see ourselves, the lives that we may have lived, the characters we may have been, had our seemingly linear paths taken a different route. Hannah Arendt's inter-subjectivity places plurality at the center of selfhood, an inversion of subjectivity, where the inner life of the subject converses freely with the world, where subjectivity "is turned 'inside out,' like a glove, and enacts itself in the world. It is out there in the world and it is *of* the world in the fundamental sense

that being and appearing coincide" (Loidolt, 2014, para. 3). Here we regulate our personal relations between our internal world, our narrative and that of the external, of people and societies, developing a form of relationality in which we might form and reform concepts of the other, the alien, the imaginary and the abstract. Stories and narratives are where our imagination dwells, where we inhabit the inter-subjective place between worlds, between species, other timescales and the alien.

To point to or to name things, beings, or objects, it is easier to think of them as discrete, as bounded things or beings with definitive edges. To think of things, beings or objects as isolated between the individual and the world, the earth and the sky; the world and the solar system, for example, is to neglect the complexity of relationships between things and the effect that each thing has on the other; the gravitational tug of Saturn's rings, the gentle explosive effect of the production of hormones, the effect of the sun on our earth's ionosphere. Boundaries are relational, ever changing, mutable and often fluid. The resolving of our internal and the external narratives are a series of ever shifting boundaries. These porous and indefinite narratives or stories are a way in which we make sense of our world and the cosmos, of emotions, histories, futures and deaths.

Nothing Is Ever Truly Discrete; Everything Bleeds into One Another

One way to capture the ideas described in this paper is material form. The surface or "skin" of things or bodies are both exogenous and endogenous, an excitement of relations. Encountering our "outside material world" is a subjective experience; one that is both closed down and opened up by language. The complexity of our experience of things, of bodies, of relations and our movement is moderated by distinctions, at the edges of things. The architect Juhani Pallasmaa (2005) writes: "[t]he senses not only mediate information for the judgement of the intellect, they are also a means of igniting the imagination and of articulating sensory thought" (p. 45). Pallasmaa regards all of the senses as an extension of touch.

Karen Barad, the quantum physicist and feminist theorist, investigates the connection between the physical world and the world of relationships to quantum physics. Barad uses the term entanglements not only for matters of the quantum world but also to draw attention to relationships of enfolding or becoming with the "other." She describes how we are bound to the other and in developing Deleuze's différance writes that the relation of the self to the other is an entanglement, "a diffraction and dispersion of identity" (Barad, 2007, p. 9).

Here, the very nature of matter entails an exposure to the Other: "[r]esponsibility is not an obligation that the subject chooses but rather an incarnate relation that precedes the intentionality of consciousness. Responsibility is not a calculation to be performed. It is a relation always already integral to the world's ongoing intra-active becoming and not-becoming. It is an iterative (re)opening up to, an enabling of responsiveness.

Not through the realization of some existing possibility, but through the iterative reworking of im/possibility, an on-going rupture" (Barad, 2010, p. 265). Barad also addresses the idea of intimacy and the impossibility of touch. At the center of touching something, or someone, is an electromagnetic interaction, it is an aversion of electrons within atoms, repulsion is at the core of attraction. It appears that forces, not things, are at the center of relations.

Applying the Idea of Intersubjectivity as a Kind of a Haunting in a Material/Artistic Form

In 2011, co-author Jane Grant made the artwork *Ghost*. At the core of the work was a small brain network that had been embedded with a sonic "memory," a drone sound that kept the network stimulated. The work was installed in the Maksem in Taksim Square as part of ISEA 2011 and the Istanbul Biennial. Once installed, live sounds picked up by microphones outside of the building in the busy Taksim Square stimulated artificial spiking neurons modeled in the computer to "fire," sending small fragments of sound to the eight speakers inside the building. If the external sounds fail to reach a particular threshold, the "memory embedded" sounds begin to be heard. Over time, the external sounds start to embed themselves into the model, gathering sensory information and sonifying both the past and the present, a form of cortical haunting. In space the microphones picked up the sounds of traffic, sirens and the Adhan from a nearby mosque. The sounds became fragmented, reconfigured, overlapping, a sonification of neurons firing with external and endogenous patterns and rhythms, sonic ghosts, merging the neural past with the neural present.

Figure 1. Grant, J. *Ghost*, ISEA Istanbul, Istanbul Biennial, 2011.

If bodies are haunted, attuned to exteriority and mutability, and as Franco La Cecla (2000) writes, "we are molded by light, walls, mountains, and cities and learn how to mold ourselves in new landscapes and streets" (p. 30), how might we get lost within our own bodies, to rediscover their materiality? Grant's *Ghost* might then serve as an act of physical and theoretical palpation to explore the intellective space between the researcher-performers and audience, to acknowledge transdisciplinary narratives and begin to ask how we might open up the body as a site, one that can be understood as agentic, but not preeminent, within any given system of exchange.

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Response to "Haunted Bodies: Cell Switching, Getting Lost and Adaptive Geographies" by Diego S. Maranan

Who am I, and what does it mean to *be* me given that I am also ever-changing? Confronting this dilemma, Denham and Punt (2017) suggest a process—the cognitive innovation function—in which being and becoming human are integrated into a unified explanatory framework. However, the underlying processes that contribute to the function are left for the reader to fill in. In Grant and Whalley's paper, one such process is suggested, organized around the role that *boundaries* play in mediating the (internal) self and the (exterior) other. A boundary defines that thing that it bounds. The skin, for instance, physically marks the extent of an individual; a city's borders not only circumscribe but define the city. However, the boundary is also a site of negotiation—for entries and exits, for information exchange, for movement. Negotiation at boundaries (this paper could be seen to suggest) is one of the processes underlying the cognitive innovation process. (Perhaps it is in this sense that the authors mobilize the concept of performance, though the discussion around this could be developed further, or parked for another discussion altogether.) Inspired by biology, the paper cites processes in living organisms that render boundaries temporary and porous: cell switching, osmosis, infection, and (to a lesser extent) autopoiesis. The authors then discuss examples in which biological processes might be seen to figure: cities, performance, relationships, art, architecture, cosmology. As an explanatory tool, metaphors are powerful but tricky: using processes occurring on the scale of cells as a metaphor for what might happen on the scale of human individuals or societies carries risk. For one, there is scale fallacy; the processes at play at one scale may not play a significant role in another (although properties and behaviors that operate on a smaller scale often create properties and behaviors that operate and are observable on a larger scale). Quantum effects are an example. However—and this is important to stress for the interdisciplinary audience of Off the Lip—this paper does not intend to propose an explanatory framework. Instead, what it offers is an invitation to reflect on what kinds of process happen in the boundary of living systems that *might* be able to account for the kinds of change that lead to the changes in the phenomena world, and to what extent these processes might be present, fractal-like, across scales.

A related concept to negotiation at boundaries is that of touch. The authors cite Palasmaa, with the idea that all of the senses are an extension of touch. It is worth noting that a precedent for this assertion is Rudolf von Laban (see Schiphorst, 2008, p. 195). Touch involves two boundaries coming into contact into each other and potentially transforming if not the boundary themselves, then that which the boundary bounds. In my research at CogNovo, and drawing on Shusterman's philosophy of somaesthetics, I highlighted the role that the act of touching a surface (and attending to the contact that one's body makes with the surface) contributes to knowledge not only

about this exterior surface, but also to the state of one own's body. For example, I argued that a flat, horizontal, sufficiently springy surface allows one to make systematic comparisons of their proprioceptive and kinesthetic experiences while walking, standing, or lying down. Here, boundaries (the surfaces of the skin and of the environment) also instigate changes in the organism's perception of themselves. The literature on the theoretical dimensions of touch is substantial, but perhaps there is a gap in theorizing of the role that touch—in the sense of two surfaces in contact and in negotiation with each other—has in the evolution of cognitive systems across multiple scales.

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A Relational Ecology of Photographic Practices

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Abstract

This paper proposes a relational history of media artifacts, which decentralizes the dominance of the photographer or filmmaker as the absolute author of the work. It adds an alternative account to understanding the creative process and the subsequent study of media forms by discussing film and photographic practices as the reciprocal affective relationship between the maker, their intentions, materials, technologies, non-human agents and the environment. By reorganizing the anthropocentrism of art historical narratives, which typically exclude corporeality and materiality as drivers of human history, we are able to discuss the complex dynamic meshwork of determinants that bring photographic artifacts into existence: the lived, animate, vital materialism at once emergent and mixing of different causalities and temporalities.

Within this position, I will provoke discussions of cognition and photography by recalibrating the moment of acting to a model that recognizes a distributed nature of human action into the material world of things. This new materialist position has repercussions for the way we understand processes of creativity and the emergence of media artifacts—seeing these as always already entangled and enmeshed across various corporeal and material, platforms and scales.

This paper uses photography as a case study to discuss the broader theme of co-creation between humans, machines and the environment. Using documentary evidence from the archive, I sustain this argument by making a close reading of a particular photographer's contact sheet, which shows up some of the dynamics of the relational meshwork playing upon the photographer in the field. Through this reading we can

begin to think about the implications for the way we understand the emerging aesthetic discourse of technological photographic practices and, more broadly, the co-creative domains of all human activity.

Keywords: decisive moment; distributed cognition; entanglement; new materialism; relational ecologies.

In traditional accounts, photography's mode of making gives the illusion of a seamless continuity between the world and its representation, producing the illusion that the world is co-operating with the photographer. Photography's innate relationship to indexicality has reinforced this. Contrary to the dominant literature which places the all-intentional photographer as the central driver of photographic artifacts, I want to consider the reverse aspect of this—that photographs can show up how uncooperative the world can be, drawing attention to the importance of thinking about creativity as contingent to a world that always wants to do its own thing.

What is offered here is another way to look at photographic material that recognizes the reciprocal affective relationships between photographer, apparatus and subjects by adopting new materialist theories that acknowledge the agency in the creative process as variously distributed and possessed in relational meshworks of persons and things. Photographs do not simply appear; they are co-produced by a complex, transformational meshwork of determinants that include the photographer, their apparatus, culture and the world.

With its acknowledgement of agential matter, material forces and physical processes, new materialism and similar object-orientated theories question the anthropocentric narrative that has underpinned our view of humans in the world since enlightenment, "a view that posits humans as makers of the world and the world as a source for human endeavours" (Barret & Bolt, 2012, p. 3). Thinking about these theories in relation to creative activity offers an alternative narrative to the received history by which the study of media forms have typically been positioned.

In recognizing and refiguring the "organizm" the photographer works within, this study proposes a relational ecology of film and photographic practices. Through a close reading of photographic artifacts, the traces of the apparatus and some of the environmental conditions the photographer works within, we are afforded a direct insight into the relationship between affect and effect, seen in the subsequent photographic image.

Although using historical examples from documentary photography, it is intended this study would point to the broader theme of co-creation between humans, machines and the environment. In particular, this approach also suggests a way to understand the scope and limitations of the diverse spectrum of technological photographic practices that are calling for an alternative photographic theory since they displace human agency and we can no longer talk about the different uses of eye and hand to observe and record.

The Meshwork

The idea of a meshwork as Tim Ingold (2007, p. 82) describes it, is a relational field, not of static, interconnected points as in a network, but of interwoven lines, a meshwork of interaction, a system that is woven together by a web of movements. Ingold's meshwork of entangled lines of growth and movement is therefore distinct from a network as in Latour's Actor Network Theory (ANT): "action is not so much the result of an agency that is distributed around the network from node to node, but emerges from the interplay of forces that are conducted along the lines of the meshwork" (Ingold, as cited in Knappett & Malafouris, 2008, p. 212). In a meshwork it is the entangled relationships that are more important than the transportation of heterogeneous bits of information from node to node.

If we take the view that all things are enmeshed and entangled in a dynamic emergent system, this means the photographer works with and against many other agential, affective forces such as: the camera with its many program settings, the conventions of visual culture, a dynamic world of objects and other people and non-human entities which have their own temporalities and so on. Within Ingold's animistic ontology, we see that enskilled photographers and filmmakers do not propel themselves across a ready-made world but rather move through a world-information, along the lines of their relationships.

Figure 1. Spot the Ball game. Image rights with the author.

Using as an example a game of Spot the Ball, I want to briefly focus attention on the kind of specific relationships in a dynamic meshwork. In its 1970s heyday, Spot the Ball was played by three million people a week (Cocozza, 2015). To win, a player has to mark the exact position of a missing ball, erased from a photograph of a live-action football game. The photograph freezes the meshwork for us to analyze it, but one actant, the ball, is removed. We could say the absent ball is the organizing principle in the meshwork. In order to decipher the position of the ball, the game requires you to forensically study the relationships *between* not only the players but every tangible and intangible object in relationship to one another: the football pitch, the goal, shadows, eye contact, gestures, gravity, imagined speed, weight, negative spaces, perspectives, the rules of the game, we might also identify the particular style and tactics of known players and so on. The only way to make any guesstimate is to study the entanglement and interrelations of both human and non-human entities, rather than exclusively examining the inter-actions between humans.

In 2015, several newspaper articles questioned why this hugely popular game hadn't had a jackpot winner in ten years. You'd think one out of three million people and a cash prize to motivate and sharpen the attention might have pinpointed the one missing element in the meshwork.[1]

A player of Spot the Ball laments: "it was always hard. The pen nib was too thick, usually two players were looking in different directions. I don't remember any of us winning" (Cocozza, 2015).

Of course, the game is too difficult because trying to understand all the determinants in a meshwork is problematic, particularly when you are not part of it. The meshwork is its own infinite organism and the players within it are anticipating the future in different ways, eyes and heads in different directions. As indicated in Ingold's diagram, there appears to be no focal point, there are many possible streams of interactions, with differing affective hierarchies at different moments.

[1] According to the Gambling Commission, newspapers were able to run football competitions like Spot the Ball legally as a prize competition rather than a lottery, as long as it was without charge and the competition required "an element of skill, knowledge or judgment that is reasonably likely to prevent a significant proportion of people who wish to participate from doing so, or prevent a significant proportion of people who participate from receiving a prize." For example, if a panel of judges determine the position of the ball and participants have to apply judgment, skill or knowledge to match their own decision of where the ball is with that of the panel, it is more likely to be a prize competition than a lottery.

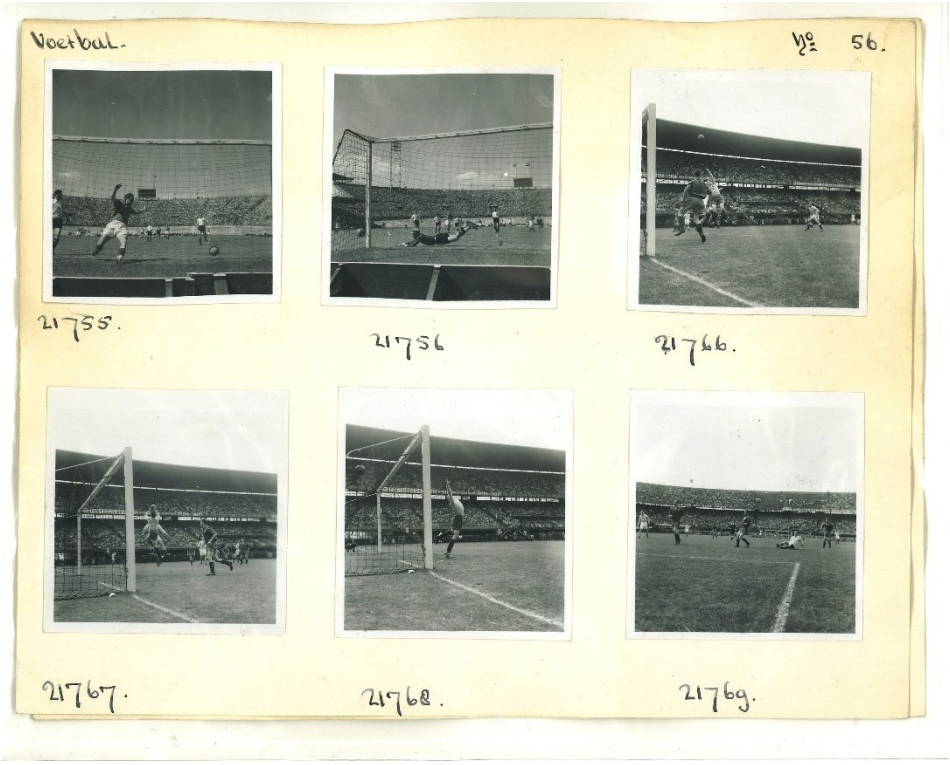

Figure 2. Voetbal contact print no.56 by Kees Molkenboer. © Kees Molkenboer / Nederlands Fotomuseum, Rotterdam.

A series of contact prints made by Dutch photojournalist Kees Molkenboer features two separate football matches taken on the same day, February 25, 1952, at the Olympic Stadium, Amsterdam, and Feyenoord Stadium, Rotterdam. In making a close reading of these contact prints, it is possible to trace some of the determinants within a dynamic meshwork and to understand the co-authorship of the photographer's creative process with technology, culture, and other non-human agential matter, material forces and physical processes.

This method will not explain "why" or "how" a meshwork takes the form that it does, nor can it disclose how to harness and measure the conditions of a creative moment in order to understand the mechanisms of it. Rather, this is a method for understanding the manifestations of human engagement with matter, exploring the relational ties within a meshwork when human and non-human meshworks come together to act as a whole. For photography, this approach reconsiders the impression that the photographer creates a representation of the world that is separate and stands apart from the photographer. When it is recognized that the world is an active agent, the world as an agent is playing a role in the co-creation of the artifact.

In this regard, the photographers contact print or proof sheet are valuable artifacts that not only record the action of the camera but also provide evidence of some of the intentions and decision-making processes of the photographer "*with* and *in* the field." We are afforded something of the photographers self-corrective thought processes as he or she reconciles their experience of the world. But in as much as the typical contact sheet provides a record in time, it can also reveal the sequence in which an event unfolded and a trace of the relational meshwork of determinants that press upon the photographer in each given moment; the process of interaction that does not privilege one between the photographer, their apparatus, other subjects and the world.

When I am looking at Molkenboer's contact prints, my primary understanding is that these photographs were manufactured by a visually intelligent mind with technical competence, experience, sensibility and understanding. But what doesn't normally get factored into the media history texts is the degree to which the instrument itself is in dialogue with the visual intelligence of the photographer and has some agency in determining the final image. The camera is not simply procedural and cultural, but ontological; it has a being of its own, and seeing is a consensual action with the apparatus.

Molkenboer preferred to use a Rolleiflex camera which is used by holding it at the waist and looking down into the viewfinder mounted on top of the camera. This camera, a twin lens reflex, has two lenses: one which gives you what you see when you look through the viewfinder, and the bottom lens that takes the picture. This means there is a slight offset between what the photographer frames through the viewfinder and what the camera photographs. For Kees Molkenboer, accounting for this offset would have made the difference between capturing and not capturing the fast-moving action of the game. It is precisely in these moments of recalibration, in accounting for something, such as the limitations of the technology, is where a certain embodied symbiosis starts to happen between the photographer and the camera, an extended cognition, a thinking that occurs *through* and *with* the apparatus.

Additionally, using this camera, the body of the photographer is implicated in this way of seeing and composing. The camera is held at the waist, tilted slightly up towards the action. The photographer works by looking up to locate the action, then looks down to quickly frame it in the viewfinder, working to establishing a composition that is felt as much as seen.

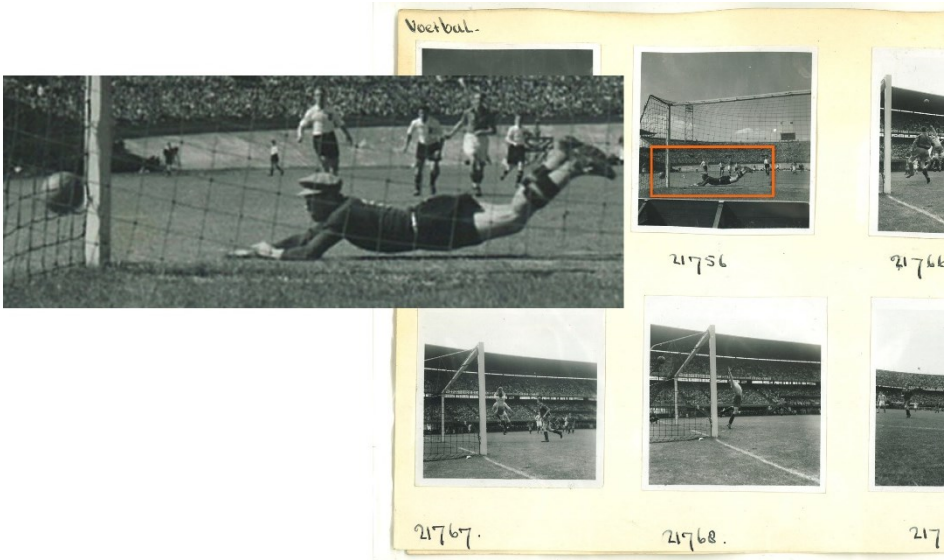

Figure 3. Voetbal contact print no.56 by Kees Molkenboer. © Kees Molkenboer / Nederlands Fotomuseum, Rotterdam.

Molkenboer's contact prints show a method of working that requires a highly concentrated level of decision-making, which is not only imposed by the speed of the football match; this acuity is also enforced by the number of exposures he is afforded, the gauge of the film and the type of camera. In contrast to digital photography, film photography is restrictive and unforgiving.

In the moment of photographing a goal, the decisive moment is culturally anticipated by the visual culture of football and the newspaper format. His medium format camera produces 6x6 square images, yet typically, portrait and landscape images, determined by column sizes, were used in newspapers. Molkenboer prefers to work with this camera but knows that the image he frames will have to contain the action in either a parallel strip or vertical strip, but never horizontal from corner to corner. The conventions of press photography impose a way of seeing and subsequent framing of the game unfolding in front of him. The technical system that this photographer is working within has recalibrated him. There are over two thousand of these football contact print sheets by Molkenboer, each shows more or less the same agenda and formula for photographing the moment of a goal.

Figure 4. Voetbal contact print no.56 by Kees Molkenboer. © Kees Molkenboer / Nederlands Fotomuseum, Rotterdam.

But for a photographer who has never played football, would they be able to get the image of the match in the same way? Their experience would tell them they need to be looking at the ball and not the goalkeeper. Manifested in the contact sheet will always be the phenomenological history of experiences, beliefs, desires and prejudices of the photographer. These past experiences are in constant dialogue with the present moment within which the individual is engaged. For Kees Molkenboer any prior experience of playing or watching football will come to bear upon the moment of depressing the stutter, a complex web of knowledge and experience that factors gravity,

weight, falling, the particular style and tactics of Dutch football, together with the conventions of sports reportage photography and so on. He will predict where to place himself for the optimum alignment of these dynamics. It's here we witness a curious circuitry, a shared theory of mind between both the photographer and the goalkeeper. The athletic goalkeeper and the athletic photographer, both highly enskilled and actively engaged, their concentration exists purely for the ball. Just as the goalie knows he must watch the ball to predict a goal, the photographer also watches the ball and not the goalkeeper to predict the just-before-moment, in which he will need to depress the shutter to account for the millisecond lag of the camera.

The general thrust of photographic discourse suppresses the randomness, accidental and uncertainty in photographic practices to the smallest size and instead maximizes the intentionality of the photographer as far as it will go. However, if we take the view that photographic artifacts are the manifestation of human engagement with matter and environments, we come to realize that the photograph is not an outcome, nor is it an instant or individually authored action but rather a momentary arrest of many animate meshworks in action. Causality is not a linear process; everything that is ever made comes out of a self-organizing system, which the photographer is part of and responds to. As Manuel DeLanda (1997) states, "there is no one determining agent in a things creation."

The fabled "decisive moment" that was typically attributed to the all-intentional photographer is therefore distributed, it is everywhere at once; there is no one causality. There is a movement in agency and decision making that is distributed amongst all the actors of the meshwork in differing measures, thus shifting the proportionality of decision making. Photography extends the human through a complex network of apparatus and any "decisive moment" is distributed through and amongst that dispositif. Every decision is technologically mediated by a technologically extended mode of seeing which collapses space and time into a new mode of perceiving the world, and this mode of seeing is all part of a contingent system.

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First response to "A Relational Ecology of Photographic Practices" by Guy Edmonds

Firstly, I would like to congratulate the author on having unearthed an almost entirely neglected class of media artefact. I think we both share an interest in searching out the most infrequently visited nooks and crannies of the archive. To paraphrase the way in which Joel Pearson described his research during the colloquium as "addicted to discovery," I would say we are "addicted to re-discovery" or perhaps even better, "discovery through re-discovery."

Although study of the contact sheet may be neglected, it does have a popular life as a trope of graphic design, less so today for sure, but I think it could be productive to look at how graphic artists and the odd fine artist such as Richard Hamilton, with his "My Marilyn" series of prints, have appropriated its aesthetic and if there are any instances of the notion of a cognitive trace which have appeared in these graphic or fine art re-workings. Hamilton's print in turn reminded me of Robert Rauschenberg's screenprint paintings, which also seem to be concerned with mental mapping, and I feel sure there must be a body of interpretive work connected with them, although I have not researched this.

It seems to me that in engaging with the contact sheet you are talking about a subset of photographic practices which might be summed up by the term 'reportage.' You are not considering, for example, the mass of amateur photographers on the one hand, or high-end studio photographers using plate cameras on the other, neither group having cause to make use of contact sheets. Or, to take a specific recent example, an artist photographer such as Gregory Crewdson, who uses large format cameras and exerts a vast degree of control over his subjects.

If we consider reportage photographers or artist photographers who are seeking out a vision rather than filling one in, then perhaps we can conceptualize them as riding a flow of experience (within the meshwork that you describe) in an alert state, sensitized and ready for a decisive moment, but not instigating it. I see a kind of tipping point within the meshwork, or rather various different potential tipping points and a good photographer is simply good at finding them, at increasing the chance of a hit. Some of this is down to strategies such as roaming the streets to all hours and taking lots of pictures, but part of it is to do with the photographer's prior experience and internal being. That would be a truly personal cognitive trace which would require more extensive mapping across all surviving contact sheets and many other sources besides.

Second response to "A Relational Ecology of Photographic Practices" by Pamela Gloria Cajilig

Jacqui Knight's discussion of co-creation between humans, machines, and environment as meshwork (as borrowed from Ingold, 2007) and call for decentralizing the role of the human in photography signposts important debates about the nature of creativity. Her paper also alludes to the problematic distinctions between "nature" and "culture" that underpin scholarship in the humanities and sciences and which continue to shape divisions in academic disciplines (McLean, 2009 p. 215).

Knight's paper aligns with studies that resist dominant and hylomorphic constructions of creativity that privilege form over relationships and processes (Deleuze & Guattari, 1980/2004; Gatt & Ingold, 2013; McLean, 2009). This hylomorphism has moreover led to "an exclusive preoccupation with cultural creativity as a specifically human mode of engagement with the world: that is, regardless of how creativity is defined, it is human beings who alone are shown to practice creativity" (McLean, 2009, p. 214). This view constructs non-humans as simply canvases, tools, and handmaidens of human imagination and endeavor while discounting the possibility of creativity as immanent to the material substance of the universe (Crutzen, 2006; McLean, 2009).

Knight's work also joins a growing body of literature across several disciplines that resists the distinction between "nature" and "culture" and argues for a re-conceptualization of these two spheres in non-oppositional terms (Gunn, Otto, & Smith, 2013; Haraway et al., 2015; Ingold, 2010). McLean in particular noted how anthropological studies have emphasized the lack of distinction between "nature" and "culture" in many non-Western societies (McLean, 2009, p. 215). Meanwhile, science studies have shown that even in self-styled "modern" Western societies, the definitional separation of nature and culture, along with the institutional separation of the natural and social sciences, has often served to obscure the degree of actual trafficking between the two spheres (McLean, 2009, p. 215).

Meanwhile, the processual and relational approach to creativity encapsulated in Knight's examination of photographic archives certainly has applications beyond the visual arts, and inquiry along this thread can also accommodate different modes of temporality. While Knight employed a historical approach, this formulation of creativity can also apply to speculative endeavor: the urban design initiative "Urban Animals and Us," for example, recognizes the agentic potential of both birds and humans, and experiments with interspecies co-design to explore the possibilities for sustainable futures (Lenksjold & Olander, 2016).

As a contribution to Off the Lip 2017, Knight's paper has the potential to provoke reflexive discussions about how the broader environment of knowledge production regarding creativity has led to the reproduction of the usual troublesome distinctions between "nature" and "culture." More importantly, it offers a pluralistic and multi-agent approach to creativity that will hopefully spark transdisciplinary engagement, which would best capture the spirit of Off the Lip 2017.

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Third response to "A Relational Ecology of Photographic Practices" by Michael Punt

This is a closely argued and well-honed discussion that tries to retrofit an understanding of photography as a manifestation of human engagement with matter. It draws benefit from the new insights that machine vision, digital photography, and photographic simulation can yield. Its intervention is in the extent to which it refigures the pre-digital practices of photography as an inevitable feature of both human social predisposition for co-production (collaboration) and an apparently equally irresistible cultural predisposition to disavow such co-production. From this, the paper suggests—but does not develop—a line of argument that creativity may owe much to the contradictory tensions between these two. In this sense, the paper offers an insight into collaboration and creativity that is original. The author develops some key texts in ways that are grounded in the texts and also provocative (Ingold, Da Landa), and certainly beyond what the original authors envisaged.

The paper is simply written for such an ambitious conceptual challenge and clear to follow. There is a suggestion in the text that just as the current photographic practices have revealed something of the concealed strategies of the past, so as the paper is developed, its extent and intervention might also become clearer.

Fourth response to "A Relational Ecology of Photographic Practices" by Mark-Paul Meyer

Largely been informed by a dominant anthropocentric narrative, Knight's premise that Western culture and philosophy—and subsequently art history and the history of photography—creates a fascinating opportunity to study photography in a new and challenging way. It reminds us of the fact that art history has been shaped by a limited number of books that have gained authority over the last century. That art history may consist of many narratives of which many have been systematically overlooked is probably one of the most challenging research areas for the coming years. Knight is taking an important step when she puts traditional concepts and questions of originality, genius, authenticity, artists' intention and authorship, the artefact and the masterpiece on a side-track to allow new questions and issues to come to the foreground. Knight challenges the concept of the all-powerful artist-photographer by studying contact sheets and, consequently, the complex interaction between humans, artefacts and machines. You could say that Knight creates a "method" to "read" contact sheets, and deducts from these sheets the creative and decision-making process of the photographer.

Knight refers to the meshwork as described by Ingold and distinguishes it from the Latourian network theory in stating that the relationships are more important than the nodes. It may become clearer from the close reading of Molkenboer's contact sheets, but from the text it is not immediately clear why the one model privileges over the other model, or even what the differences exactly are.

The questions that stick to my mind are whether the analysis of contact sheets may not only help to define and fine-tune a model of interactions, but whether it also allows to distinguish new narratives and what examples of narratives we could think of? In other words: will this 'method' allow to (re-)write the history of photography focusing on narratives that have long-lasting been ignored or neglected?

It would also be interesting to know whether other research areas can be identified that allow for the study of 'unknown' narratives. For instance, personal archives of photographers, which may be organized in completely different way before they are swallowed by the conformity of official archives. Or, I can also think of stacks of printed photographs that have been printed but have not been used for publication. Or dummies of photobooks.

A critical question regards Knights conclusion that the photograph is not an individually authored action but "rather a momentary arrest of many animate meshworks in action" (p. 291). The question is then how this 'momentary arrest' is realized, other than by the photographer who – being part of the meshwork – decides to freeze the activity of the meshwork and pushes the button of the camera. This brings us back to

anthropocentrism which may undermine Knight's argumentation. Or does she see her argumentation in the line of new materialism, and would she consider the meshwork to be a kind of organism, a subject that interacts and speaks to us. But the question remains to whom the meshwork relates? To the photographer?

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Let's Improv It: The Embodied Investigation of Social Collaboration

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Abstract

How do we share embodied knowledge? How do we understand the world through our bodies? How can we effectively interpret and communicate somatic experiences to a wider audience? These questions emerged during a collaborative research project Let's Improv It (August 2016, Plymouth University), which set out to explore how kinaesthetic empathy and multisensory perception help us to understand our own actions, intentions and emotions, as well as those of others. We additionally questioned the role and perception of physical and emotional touch within embodied knowledge.

After a five-day practice-led investigation, a 20-minute improvised somatic movement score was developed with the aim of providing a novel experience of touch and movement.

The authors collectively delivered the score and reflected on the outcomes of this experience over the course of a year (2016–2017). In this paper, we explore how our research project expanded the boundaries of the conventional concepts of knowledge and cognition. We see such participatory sessions, in which movement and embodied experience freely unfold in time and space, as a 'laboratory' in which we examine the underlying mechanisms of collaboration. We reflect on how such an experience can be seen as a creative process, or as an emergent, collaborative artwork. The participants are both the creators and, simultaneously, the audience of our improvised experience. The experience provided a non-judgmental context for physical engagement and observation, which is an outcome that will be introduced

alongside participants' feedback. Overall, the project revealed that shared embodied knowledge is highly appreciated, particularly among those without previous experience with embodied enquiry or movement research.

Keywords: dance; embodied cognition; empathy; improvisation; participatory performance.

Introduction

As a social species, humans are experts in collaboration (Theiner, 2014). However, our understandings of the 'social glue' (Dijksterhuis, 2005, p. 207) that allows us to coordinate complex actions within dynamically changing environments is still limited and speculative in nature. In this research, we focus on how embodied knowledge and embodied cognition in social interactions (Ignatow, 2007) can be investigated through collaborative movement improvisation as a mode of practice research. Movement improvisation is a free-form, momentary practice, in which participants simultaneously generate and share their ideas without pre-planning or preconception, making each improvisation a unique singular social encounter (Blom & Chaplin, 1988). Such a setting offers an opportunity to observe and experience spontaneous social interactions as they happen (Benjamin, 2002, p. 43; Sawyer, 2000). Due to the mostly non-verbal character of the practice, it allows greater focus on embodied means of communication.

Ribeiro and Fonseca (2011) suggested that collaboration and communication between improvisers are mediated by 'kinaesthetic empathy.' This they define as the ability to understand others' actions and emotions through embodied feelings, which tend to match others' states. Kinaesthetic empathy allows us to anticipate the intentions of others and to make decisions based on shared cognitive structures. The mirror neurons hypothesis (Gallese, Keysers, & Rizzolatti, 2004) was suggested as a possible neuronal mechanism that enables awareness of others' emotional states and movement intentions. They suggest that we do not just perceive (i.e., see or hear) others' actions or emotions, but rather experience them in the same way as our own actions. The same neural structures are activated during first-person (*'I feel it'*) and third-person (*'I see her/him feeling it'*) experiences. Thus, social cognition is not only a thinking process in which individuals simulate each other's minds (Goldman & Sripada, 2005), but an experiential, embodied one, wherein we sense each other's physical and emotional states (Gallese, 2003).

This almost automatic, yet highly interdependent and interactive character of basic human interactions is highlighted by the joint action theory (Sebanz, Bekkering, & Knoblich, 2006). The theory describes how people manage to coordinate their actions swiftly and effortlessly without much verbal communication. To coordinate any joint action, for instance, something as simple as 'moving a table together,' people have to: (1) share representations of the collaborative task; (2) predict actions

of partners in an interaction; and (3) integrate those predictions with one's own actions. Hence, any social interaction or shared action needs constant, improvised adjustment of each other's plans and actions.

We cannot speak about the embodied aspect of social interactions without discussing the role of touch. Touch has a crucial role in human development, especially within its social aspect (White, 2004). Tactile communication is as important in early development (Feldman, 2011) as it is in adulthood relationships (Chatel-Goldman, Congedo, Jutten, & Schwartz, 2014). David Linden (2015, p. 7), when analyzing social interaction in various situations including caregiving, sports, and social support, argues that skin can be seen as a social organ. Social touch can promote trust and cooperation (Jones & Yarbrough, 1985; Kraus, Huang, & Keltner, 2010), and allow individuals to read and communicate emotions (Hertenstein, Keltner, App, Bulleit, & Jaskolka, 2006).

Drawing on the perspectives above, social interactions can be seen as deeply embodied, improvisational acts that happen in our everyday life. The current paper focuses on the social processes of collaboration through the perspective of real-time, embodied interactions in movement improvisation.

The Process of Exploration

Our interdisciplinary backgrounds (dance, music, developmental/clinical psychology, cognitive science, eastern philosophy, and cultural studies) brought together a variety of perspectives and approaches to the idea of improvisation, which resulted in a group dynamic that constantly shifted and changed. This diversity was contrasted by a single commonality: as all members held a background of practice-based or practically grounded research, our discussions tended to blur with our hands-on investigation. Our daily work was held in studio spaces and outdoor locations, wherein we invested ourselves holistically (i.e., both physically and mentally) in the unfolding topics of the project. In one session, we would improvise freely in response to a set of prompts deriving from scientific literature; in another session we would brainstorm our ideas by creating word clouds with the notes that we had taken throughout the preceding days.

Related cognitive theories on kinaesthetic empathy, joint actions, the role of touch, etc. were introduced through *radio lectures*,[1] during which the group listens loosely as they move through their physical warm up. The listeners responded, or not, to what they heard, whether it manifested as influences in their movement or flow of thought. This way of providing information allowed the movers to directly integrate new knowledge into their physical practice, share that experience with others, and

[1] The idea of presenting the theoretical background of the project through a radio lecture format was inspired by the classes of Rick Nodine, who used similar format to introduce physiological knowledge to students (London, Spring 2016).

to reflect on the experience in an embodied way. We noticed that the immediacy with which the information became embodied and integrated in movement allowed for a more fluid, quick communication of our moment-to-moment interpretations of the presented material. Noticing the differences in which one piece of information can be processed allowed for each individual to self-reflect, both physically and cognitively, on the unique nature of their own perspective. The radio lectures created the foundation of a space in which fluid and immediate communications and reflections would occur, priming the dynamics of the group for further improvisational movement explorations.

We decided that the most valuable contribution of our process is to highlight the efficacy and significance of improvisational (or explorative) discourse—both in the verbal and non-verbal sense—as a tool for studying social collaboration. Communicating this to those who do not regularly participate in improvisational modes of investigation (whether it be academic research, professional work, or self-discovery) became our main area of interest. We concluded that the best way to share our findings is to provide experience, rather than explanation. We sought ways to translate our ideas, sensations and embodied reflections into a structured 'experience space' that invites others to delve into this non-linear process of exploration. We aimed to show how 'solutions' and 'answers' are not necessarily the most important elements in the process of 'being'; there need not be an 'end-goal,' but there is always a need for curiosity, and one can merge with this process of investigation through a non-verbal, sensory mode of improvisation.

The Experience

Through the five-day practice-led investigation, we developed a 20-minute improvised somatic movement experience, primarily aimed at non-dancers. This experience has been delivered twice so far: once at the end of the ColLaboratoire Summer School, and once at the Dance and Somatic Practices Conference in Coventry (July 2017). One distinct characteristic of the experience is that it is delivered in darkness and silence, drawing on the idea that a large part of human knowledge is shared and developed through embodied and kinaesthetic experiences (Ignatow, 2007). As facilitators, we collectively and non-verbally guide participants through our developed improvisation scores. While the experience has an overall structure and a rough estimate of duration, it is designed to allow fluidity in its transitions between the scores.

The participants are invited to enter a dark "experience space," with only dim lighting placed just for safety. The intention is to reduce visual information—one of the most dominant sensory inputs in everyday life (Posner, Nissen, & Klein, 1976)—as much as possible, in order to sharpen participants' haptic/tactile perception and proprioception. By sharpening these non-visual sensory pathways, we aim to highlight the experiential (rather than descriptive or interpretive) aspect of the

movement improvisation that would follow. At the beginning, participants are asked to lie on the floor, close their eyes, and follow a stream of imagery tasks which aims to heighten their somatic consciousness—their awareness of bodily sensations. After the verbal guidance, participants are invited to stand up and are told that they may receive a tactile sensation, upon which they can "simply react to the touch received, with any kind of moving reaction." The facilitators give participants various forms of tactile input (e.g., brushing with fingers, pressing with palms, giving weight through the torso, etc.) and gently guide them (non-verbally) to connect with each other. This is followed by the introduction of more interactive scores, based on basic social principles such as leading and following, mimicry, and maintaining a shared gaze (Dijksterhuis, 2005, p. 207). These scores are introduced in a random, momentum-based sequence, with the six facilitators approaching each participant one by one. The participants are encouraged to explore space and movement independently, or by interacting with each other. The movement improvisation gradually unfolds as participants become accustomed to the sensory space, start to experiment with momentum, and, eventually, travel through the space in relation to others. The experience involves multiple simultaneously occurring variations in forces and dynamics, which eventually becomes a shared run around the room, and then a physical rest (Figure 1).

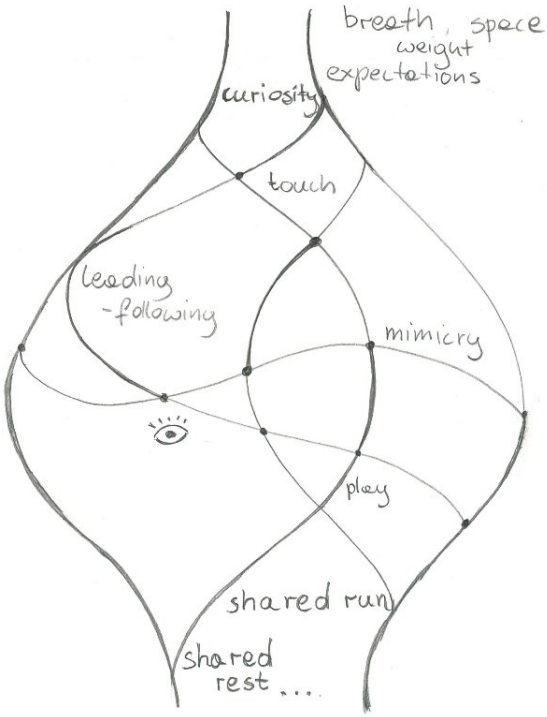

Figure 1. The graphic representation of improvisational score used in the shared experience.

After the experience, we open a conversation among the group members wherein participants are invited to share and exchange their thoughts and reflections on the experience. Here, participants have the opportunity to recall, put into words, and freely communicate their experiences. For the two most recent deliveries, spoken responses were recorded on a voice recorder, while written responses were gathered through a short questionnaire. Participants' feedback was used to build an in-depth reflection on the findings of our project; this will be discussed below.

Reflections

By inviting non-dancers to participate in our somatic movement experience, we have expanded the boundaries of the conventional idea of performance. While the concept of "movement/dance improvisation" can typically be perceived by non-dancers as an activity open only to the "performers" of the event (Carter, 2000), in our session, the participants were the performers, movers, and creators of the work, all at once. At the beginning, participants are told that they can sit out and observe the workshop if they wish. However, whether they explore movement on their own or observe others' movements in a static position, all individuals are partakers in the occasion, continuously shifting, changing, and crafting the interpersonal, kinaesthetic connections (Foster, 2003). They recognized this particular quality of experience, commenting that there were newly found emotional and physical sensations evoked by the environment, yet arising from within:

> Just watching, observing the connections and shapes was an amazing experience. The touching would have been awkward, but it was liberating! A shared experience of the senses!

It was through perceiving, sensing, and acting within this transformative environment that the participants became attuned to their individual embodiments and encountered the dense currents of 'kinesthetic touch':

> The stage where everyone moved in the space, bonding through touch with each other, became deeply sensual over time. I had never thought that touch, with people I don't even know, could be so sensual.

This type of process is mentioned by Savrami, who claims that, in dance improvisation, the 'living body' is invited to directly respond to internal or external stimuli through the experiential practice of active bodily perception (Savrami, 2017).

The darkness of the room played an important role for the experience in creating a visual and social ambiguity:

> Darkness supported special liberating moments connecting with others. Touch & kinesthetically. Hands connecting. Shapes/ movement/ connection.

In everyday life, we are hyper aware of others' appearance, which holds encoded and decodable *'social meanings'* (Burgoon, Guerrero & Floyd, 2016). For instance, an individual's outfit can hold intentionally or unintentionally encoded *'meanings'* on the individual's gender, cultural background, etc. This information is then processed by others, thus influencing their decisions and choices. The lack of light in the room creates an environment in which participants are deprived of such visually-based social cues.

> I felt that physical interactions were more sensual and deprived of social meaning. I felt triggered into some actions just by seeing other people involved in them and not because I was invited to.

Consequently, they must rely on other senses such as hearing, touch, and kinesthesia, in order to develop social connections with others, while having little to no knowledge of 'who' that person is, nor what one's socially prescribed relationship with that other person is (Gallese, 2003; Hertenstein, Keltner, App, Bulleit, & Jaskolka, 2006; Ribeiro & Fonseca, 2011; Verstegen 2005, p.22). Sensing another's presence can guide one to move closer or further; feeling another's touch can cause one's body to react with new movement. Even listening to the vibrations of the floor can change the state of one's body. In other words, the process of social 'meaning-making' shifts into a tactile and kinaesthetic experience of others. This shift opened up the possibility to 'see' others through a different lens, as well as to reflect on oneself in a more raw (bare) way, which resulted in the fading of 'roles' in their traditional (social) sense; the lack of visual input created a non-hierarchical, inclusive and transformative environment.

> I liked seeing people dance—to me it felt like they were creating an "energy" and it was being shared. I could "feel" the energy.

The fluidity in which the participants' 'roles' shifted (e.g., mover to perceiver to creator), as well as the interconnectedness of these roles (e.g., observers and movers influencing each other) highlighted the idea of joint actions (Sebanz et al., 2006) in that participants fluidly and non-verbally negotiated their continuously shifting, interdependent 'roles' in the space, thereby inherently sharing a collaborative task, predicting actions of others, and integrating those predictions into their next action.

Like visual processing, verbal communication is another, highly dominant tool for social interaction (Ng & Bradac, 1993). The lack of verbal instructions in the experience, alongside the tactile interactions initiated by the facilitators, led the participants to 'forget' about speaking (and what had been said) for the duration of the experience, thereby creating a collectively facilitated, extra-ordinary space of full non-verbal interaction.

> There was a moment when my hands were touching another person's hands and very slowly our hands moved away from each other... But somehow the connection was still there, or the thought of the connection at least was. I was led away, engaging in other

> interaction, however after a while, the exact same situation happened (hands touching) with the same person, but now in a less "explorative" way, more in a "happy" way, like when seeing an old friend.

Consequently, participants became more attuned to their tactile sensing, which caused a stronger connection (or, at least, an awareness of the interactions) between their emotional states and the experience of touch. The emphasis on touch-based communication seemed to evoke a heightened awareness towards the in-the-moment nature of the experience, allowing participants to linger in liminal mental spaces, such as 'just doing what comes up,' 'being influenced in an indefinite way' and 'being playful.' As noted by Hertenstein and others (2006), these responses support the efficacy of social touch in emotional communications in that participants seemed to naturally embrace the open and non-judgmental nature of touch-based interaction.

The result was an artwork to be felt, and not seen: the participants were not performing, they were experiencing. The carefully created non-judgmental environment supported a temporary realm in which everyday gestures and simple physical contacts were given as many meanings as there were participants; everything was experimental, and nothing was wasted in the experimentations. Participants became free and unbound to ask, 'what if I…?,' 'what is this?,' and 'where is this going?' No one knew the answers, yet each person governed the turns in which every unfolding moment could take.

We noticed the choreographic potential of this non-hierarchical, inclusive and transformative environment. For instance, what are the implications of recognizing and illuminating organically occurring, everyday kinesthetic interactions between individuals as an artistic theme, and presenting this idea through an extended version of our project? How would such a presentation affect audience members? Moreover, would there be any boundaries between performer and audience? Moving forces and dynamics continuously unfold in time and space, no less in everyday situations than in improvisational 'performances.' Our experiential participatory performance created a co-performative context, which has redefined the ubiquitous experience of shared embodied interactions as a choreographic or performative tool. In this sense, our project expanded the boundaries of the conventionally defined concept of artistic performance: facilitators and participants as creators, performers and audience.

Conclusion

This project introduced an explorative method of investigating social interactions through the practice of movement improvisation. We argue that this type of shared experience can tap into an individual's ability to gain a deeper understanding on how our bodily senses, perceptions, and micro-actions play a role in our embodied interactions with others. At the same time, the project revealed that shared embodied knowledge is

highly appreciated, particularly among those without previous experience with embodied, movement enquiry. It allows for a more fluid, honest, and raw mode of social cognition. We expanded the traditional boundaries of creative artwork; the participants were the 'creators' and 'audience members' of improvised experience, creating and attending to an experiential process that could be meaningful, both experientially by delving into a new sensory experience and artistically, as a work in progress.

Let's Improv It has an expansive character as a project 'in motion.' It could serve as an educational tool in dance education, which allows insight into movement experience from different perspectives. Additionally, it could be seen as performative event that connects performers and audience by offering an insight to the artistic creative process.

Acknowledgements

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Response to "Let's Improv It: The Embodied Investigation of Social Collaboration" by John Matthias

This is a really interesting paper—the methods undertaken within the improvising group are very pertinent and questions and contexts posed in the opening paragraph warrant major attention. Given the nature of this work and the importance of this kind of interaction, it seems important to ask the question: "why is this kind of interactive activity not a more common everyday activity in the West?" It feels as though the group-based movement-based creation such as outlined in this paper should be integrated soundly within our education system. The comment about the dual role of participants and audience is particularly interesting and perhaps offers one possible answer to my previous question. Perhaps we are still not used to being participants in art-creation as a whole and are more comfortable with a more passive role? It would be good to have a discussion about how we could bring group movement practice such as that outlined here more into mainstream practice as is more common in other cultures.

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Jane Grant is an artist and writer. Her work explores ideas in art and science, specifically astrophysics, neuroscience and the history of scientific ideas. Her sonic artwork Ghost was premiered at ISEA Istanbul. Jane sometimes works collaboratively creating award winning works such as The Fragmented Orchestra, a vast sonic artwork based on neuronal firing patterns in the brain, which won the PRSF Award for New Music and an Honorary Mention at PrixArs and Plasticity. She recently created Fathom, a huge artwork that sonically immersed participants in an underwater sound environment by creating a sonic surface 6ft above the floor.

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Joanna Griffin is an artist/researcher. She completed her PhD at Plymouth University in 2014 (funded by the Arts and Humanities Research Council) where she was based with the Transtechnology Research group. Her thesis considered the ways that space technology is experienced in the social domain and was based on her experience of leading a creative education project at Srishti Institute of Art, Design and Technology in Bengaluru called Moon Vehicle in collaboration with Chandrayaan mission scientists at ISRO.

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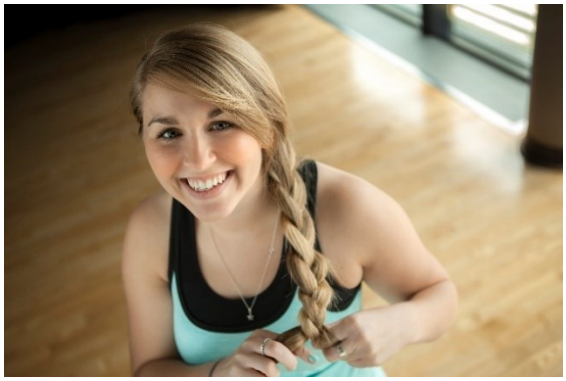

Abigail Jackson is an PhD candidate with Transtechnology Research at Plymouth University, funded by AHRC's 3D3 Centre for Doctoral Training. Her multidisciplinary research aims to facilitate improvised, responsive, movement sessions, in the development of a creative intervention, for autistic children, with digital mediation embedded in its investigation. This project is aligns with research concerning the affiliation with technology, for the autistic child, which is reflected in her position of SEN Research and Development Associate at The University of Lincoln.

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I am generally interested in epistemological, methodological, and semiotic questions regarding the relationship between phenomenological perception, language and principles of cognition, especially in relation to auditory meaning making. The theme of my current research is innovation of ethnographic methods to capture, measure, and structure the cognitive ecology of highly alarm-dependent sociotechnical environments. My work revolves around the particular contexts of intensive care and space mission control operations. It aims to provide a data-rich multi-layered and multi-perspectival account of alarm-related interactions; that is, a deep analysis of local events in relation to more global events, integrating first, second and third person perspectives. The more general vision of my research is to address fundamental challenges of developing the pre-empirical conceptual frameworks that structure and shape how we measure, think and talk about evidence in the social sciences.

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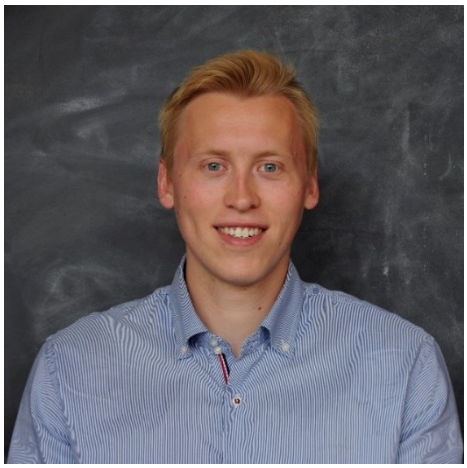

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This work has had an impact upon me that exceeds the interests of my customers, so I share sounds, images and words that constitute my making sense of making sense of the world.

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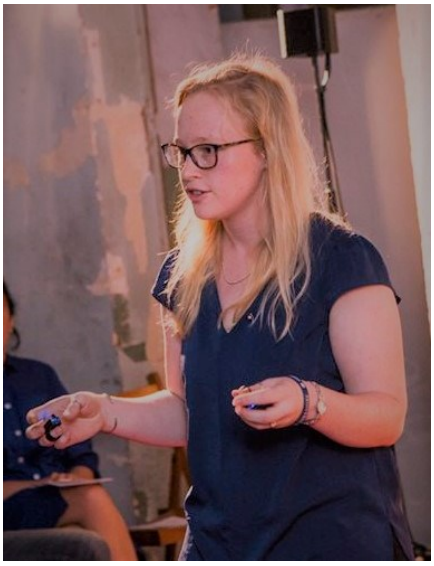

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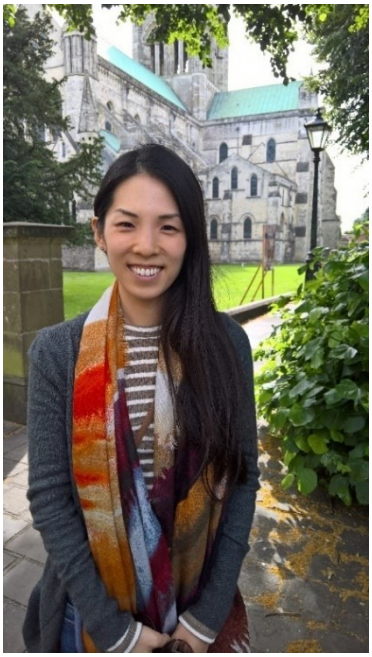
Jess is a composer and academic from the UK; she read music at Bath Spa University and completed a research based masters at the University of Malta. Jess has presented research at academic events both in the UK and abroad. As a composer Jess recently worked on collaborative projects with Zfin Malta and Jess' recent works have been performed at festivals including the Strada Stretta Concept, the Malta Arts Festival, the Mdina Biennale and the Holburne Museum Partnership. Jess is a co-founder of For Your Ears Only! the only organisation committed to showcasing contemporary music in Malta, and founder of the Malta Sound Women Network.

Aska Sakuta



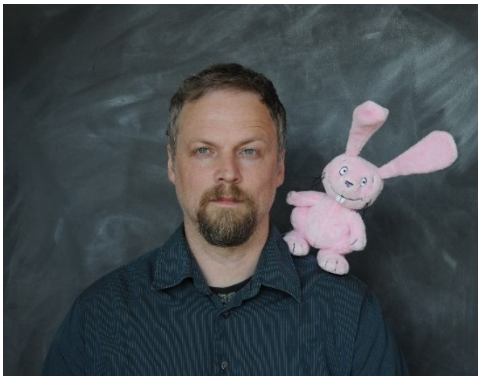
Aska Sakuta is a Ph.D. candidate at the University of Chichester, working on an interdisciplinary research project (Dance/Sports & Exercise Science) focusing on the experience of Flow which appears during meditative movement performance. She holds an M.F.A. from the University of California, Irvine, specialising in improvisation and Eastern movement philosophies, and a B.A. from Waseda University (Japan). Her current research project extends the context of Eastern philosophy to multiple academic fields such as psychology, cognitive science, and neurophenomenology.

Eleonora Siarava

Eleonora Siarava is choreographer, performer and researcher. She holds an MA in Dance Making and Performance (Distinction) from Coventry University and a BA in Psychology (Greece). Her doctoral thesis is about "The multiple meaning in Abstract Dance: The choreographic synthesis and the possibilities provided by Perception Theories" (AUTH-Department of Theatre). Her research and artistic practice refer to the relationship between aesthetic forms, cognitive principles, moving patterns and kinesthetic empathy. Currently she is making part of her research at Giessen University and the Academy for Performing Arts in Frankfurt. She is the artistic director of Per_Dance, a platform of choreographic research www.per-dance.com

Eugenia Stamboliev

Eugenia Stamboliev is a PhD fellow in Media Philosophy/Digital Humanities as part of the Marie-Curie network, CogNovo. In parallel, she is a PhD student in Philosophy and Critical Thought at the European Graduate School and contributes as an associated researcher to the Transtechnology Research group at Plymouth University. Her current PhD research explores the dependence between gestures and digital technologies, specifically, by focussing on the ethical and social dimension of tracking gestures. She further researches on (non)representative interventions on migration and displacement in documentary film.



Michael Straeubig

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Michael Straeubig (@crcdng) is a game designer, computer science graduate and creative coder, exploring the relationships between systems, games and playful experiences in various media with a focus on mixed reality and posthuman play. Published games include “Secret City - Missing Max,” “Speed Gardening Guerrilla,” “Tidy City,” “Eine gegen Eine,” and a number of events and theatrical / experimental interactions. Michael is a Marie Curie Fellow / PhD candidate at Plymouth University and a Lecturer for Game Arts and Design at Plymouth Universtity.

Ligia Suciu

Ligia Suciu is psychologist in private practice. She is a psychotherapist and Certified Parent Educator - Circle of Security. She is assisting parents to build secure relationships with their children. She is collaborator of Developmental Psychology Laboratory of Faculty of Psychology and Sciences of Education, Babeş-Bolyai University, Romania. Her interests include: cognitive and behavioral inhibition, dynamics of family relationships, cognitive flexibility, and applications of human development research in clinical practice.

Mihaela Taranu

orcid.org/0000-0002-3673-2751

Mihaela Taranu held a Marie Curie Fellowship at University of Plymouth (2014–2017). Her interests are in perception, cognition and consciousness and in why do we perceive the reality the way we do. In her thesis she investigated how our perceptual systems can consistently disambiguate and interpret ambiguity from the environment in order to obtain a stable perception of the world. Her scientific interests are addressed within an interdisciplinary context, with experimental psychology, developmental psychology and neuroscience methodologies. In future research she wants to bridge these disciplines with the study of individual differences, atypical development and mental disorders.

Iliara Torre

orcid.org/0000-0002-8601-1370

I am interested in the amazing capabilities humans have to convey meanings with a limited set of phonemes and with very small changes in the speech signal. It's fascinating how such minimal changes are perceived and immediately reacted upon by the listener. In my PhD as part of the CogNovo programme, I investigated how voice influences trustworthiness attributions in listeners, and how this perception is shaped by behavioural experience. I used a methodology based on game theory, which allows to collect implicit measures of trust. I hope to keep working on similarly innovative practical research in the future.

Vaibhav Tyagi

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I am a cognitive neuroscientist with a background in neuroimaging, social psychology, machine learning and bioinformatics. I am currently interested in investigating factors that influence creativity such as social risk taking, political affiliation and predictors of prejudice (such as right-wing authoritarianism). My doctoral research was embedded within an interdisciplinary collaborative research program (CogNovo) which focused on exploring the cognitive, computational and artistic dimensions of creativity. I believe research collaborations such as CogNovo are at the heart of most successful experiences in research and can contribute immensely to the personal and professional development of researchers.

Roxana Vescan

Roxana Vescan has a Master's degree in Counseling and psychological interventions in the human development, Faculty of Psychology and Sciences of Education, Babeş-Bolyai University, Cluj-Napoca, Romania. She works as a vocational counselor at the Career Center, Babeş-Bolyai University and she is also a research assistant in the Developmental Psychology Lab, in the Flexibility and Grounded Cognition group. Her research interests are: insight problem solving, volunteering and the effects of volunteering on the development of young adults.

Thomas Wennekers

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Thomas Wennekers studied Physics at the Heinrich-Heine University (Duesseldorf, Germany) and Computer Science at the University of Ulm (Germany), where he received a PhD in Computer Science in 1997. He was postdoctoral research fellow at the Max Planck Institute for Mathematics in the Sciences (Leipzig) from 1999 to 2003, and Juniorprofessor in Theoretical Neuroscience at the Ruhr-University Bochum in 2003. Since November 2003 he is Reader in Computational Neuroscience at Plymouth University (UK). His research interests are large-scale spiking neuron models of sensory, perceptual and cognitive functions, and their application in future computing technologies.

Joanne “Bob” Whalley

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Whalley is Lecturer in Theatre & Performance at Plymouth University, UK and has a private practice as a TCM and Five Element acupuncturist. Her key interests are 'patient practices' within a medical humanities context, and she teaches medical humanities to third and fourth year medical students. Other research interests include intersubjectivity and shared affect, collaborative strategies, site-specific performance, the radical domestic, traditional Chinese medicine, and animality and performance. Her research as a performance practitioner and scholar, is cleaved with Lee Miller with whom she undertook a joint practice as research PhD.

Tara Zaksaite

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Tara Zaksaite is a Research Associate in the True Potential Centre for Public Understanding of Finance, at the Open University. As part of an interdisciplinary team she is exploring an effectiveness of an intervention aimed to encourage people to save money, so that they can avoid debt in case of a financial emergency. Part of her PhD work explored the link between measures of creativity and learning about irrelevant information. Her research interests include attention, learning, reasoning, and decision-making.

This special issue of AVANT concerns Cognitive Innovation - a concept that has evolved through the research carried out in CogNovo, an interdisciplinary and international doctoral research training program. In annual CogNovo Off the Lip events, organized over the last three years, a multidisciplinary network of researchers has explored and elaborated the notion of Cognitive Innovation. Off the Lip 2017 took the form of a novel symposium format that we developed to collaboratively create a publication, this special issue of AVANT. At the heart of the resulting seemingly heterogeneous collection of papers and images lies the all-embracing flexibility of Cognitive Innovation. We hope you, the reader, will find the writings in this special issue a thought-provoking and intriguing input to the next iteration of your process of Cognitive Innovation. We also present this special issue as an invitation to you to get involved in the CogNovo Foundation, an organization aimed at fostering the spirit of interdisciplinary, collaborative research; join us at https://CogNovo.org.