

Title – Making space for creativity in dance science
Lucie Clements and Rebecca Weber

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Abstract

Creativity, as a research discipline, is largely grounded within psychological discourses. Within the psychology literature, creativity is commonly recognised as a complex phenomenon; one which entails a range of debates around definition, process and product, domain-specificity and cross-discipline generalisability, and appropriate testing measures, and indeed the extent to which such a phenomenon can be quantified. The psychology of creativity in dance has found a fitting home in dance science, although this categorisation, too, comes with a number of complications. In this article, the authors offer an overview of some existing research, outline some of these complications, and consider barriers to--and recommendations for--the future development of this area of dance science.

INTRODUCTION: CREATIVITY IN DANCE SCIENCE

The study of psychology of creativity in dance appears to find a fitting home in dance science, a field invested in 'understanding of the biomechanics, physiology, and anatomy of the human body,' with objectives to 'assist the dancer to make full and proper use of her body for the purposes of dancing' (Reed, 2011 p.8). Indeed, the International Association for Dance Medicine and Science (IADMS, 2015), the predominant professional organisation for the field, states in their mission statement that: "IADMS enhances the health, well-being, training, and performance of dancers by cultivating educational, medical, and scientific excellence." Further, the *Journal of Dance Medicine & Science* published by this organisation features articles "drawn from the fields of: Anatomy and Physiology; Biomechanics; General Medicine; Sports Medicine and Surgery; Physical Medicine and Rehabilitation; Physical Therapy; Dance Education; Kinesiology; *Psychology*; Nutrition and Diet" (IADMS, 2015, emphasis ours). Similarly, the UK-specific professional body for dance science (founded by One Dance UK), the National Institute of Dance Medicine and Science (NIDMS), asserts that their mission is "to develop, implement, and disseminate scientific knowledge and evidence-based practice centred on the promotion

and optimisation of health, well-being, and performance in dance” (NIDMS, 2015). Their mission is delivered via three programmes: education, research, and clinical practice; psychological studies are identified as a field of study in their research and clinical practice programmes (NIDMS, 2015). With this marriage of psychological studies, wellness, and anatomical understanding and embodiment, the dance science field initially appeared to be a suitable area for investigation into creativity in dance.

The authors note our affiliation with and commitment to these organisations (both IADMS and One Dance UK), and both recognise and praise their ongoing work within the dance science field. However, after attending discussions and presentations at the 2015 DanceHE (the British dance in higher-education network) and One Dance UK (the professional body for dance in the UK)—which included a sub-convening of IADMS’ Healthier Dancer Programme, alongside the 2017 IADMS convening, it came to the authors’ attention that adhering rigorously to a dance science-based approach might not only limit potential participants (for one example, through the exclusion of dancers in wheelchairs when conducting postural assessment testing) but also might perpetuate an external and/or medicalised perspective to dance and the body that is counter to the aims of some dance practices, such as somatic practices, which seek to support individual autonomy and first-person phenomenological knowledge and perspectives (Weber 2018a, in press). Gardner (1994, cited in Reed, 2011 p.11) states that, “still today, in mainstream culture the body appears as the product of a number of discourses and institutions that are essentially positivistic and objectifying: they create the biological body, the medicalised body, the sporting body, the marketable body of advertising, to name but a few,” and these problematic and limiting ‘bodies’ appear to be the ones which dance science has, thus far, been almost exclusively interested in engaging. For example, to demonstrate ‘improved’ alignment through postural testing inherently carries a value judgement on what an improved, or ‘better’ dancer looks like physically, which reflects a narrowed, reductionist view of who can be a ‘good’ or professional dancer—these implicit values are arguably counter to the widening of the field supported in post-modern, new dance, and somatic practice ideals (to name a few). As Reed (2011, p. 9) states, meetings of these organizations in the past, “maybe unwittingly, highlighted a particularly medicalised approach by the professionals treating dancers’ injuries and psychological problems.”

This emphasis on optimal performance within dance science remains almost exclusively considered from an athletically-focussed perspective, leading to a tendency to focus on

enhancing technical skill in dance. Perhaps this focus is due, in part, to the genealogy of dance science, which has generally followed in the path of its parent disciplines of sports science and sports psychology. The focus of sports psychology is, most often, to optimise performance in ways that can be reduced to objective values or numbers, such as finishing position or rank in a race or league, distance travelled, or time taken to complete an action (Weinberg & Gould, 2014). Whilst there is general agreement across dance experts that optimal performance can, primarily, be assessed through objective factors such as turnout, flexibility and strength, dance is also assessed through less objective criteria (Haroutounian, 2017; Warburton, 2002). It is widely recognised that dance differs substantially from sport; whilst dance indeed relies on the athleticism and strength of a sportsperson, success as a dancer may also emphasise aesthetics and beauty, factors less often attributed to sport (Yannakoulia & Matalas, 2000).

Furthermore, dance science's emphasis on scientifically measurable aspects of a dancer—their flexibility, stamina, muscular power, or alignment—reflects a bias towards a particular ideal in dance technique, namely a 'classical' western performative/concert dance preference characterised by upright alignment that is heavily influenced by a history of ballet technique—an ideal which is not always in congruence with the ideal in other genres and forms (Volinksy, 1983). This ideal, which reflects an emphasis on dancer-as-athlete and thus a slant toward physical prowess and spectacles of flexibility and strength in 'good' or professional-level performance dance, also neglects to take into account other aspects of successful dance theatre, for example: stage presence, emotional responses, fluidity of movement, inventiveness and execution of conceptual work, creativeness of movement invention, individuality, authenticity, political or community impact, or risk-taking beyond the physical. In many ways, the current—perhaps insidious—underlying values within dance science to date are well-suited to some forms, but exclude those for whom these alternative (often subjective, immeasurable) values are primary. Furthermore, the role of the audience as well as this focus on the body for aesthetic or artistic rather than functional purposes implicates an array of additional factors, many of which can be considered for assessment in terms of the impact on the audience, rather than the individual's specific, quantifiable attainment. The inclusion of such aspects of dance has been of interest for dance researchers, cognitive psychologists, and neuroscientists, who have begun to study and measure the ways that dance impacts the spectator, with a particular focus on the role of expertise in dance audiences (e.g. Calvo-Merino, Ehrenberg, Leung & Haggard, 2010; Calvo-Merino, Glaser, Grèzes, Passingham & Haggard, 2005; Calvo-Merino,

Grèzes, Glaser, Passingham & Haggard, 2006; Daly 2002; Hagendoorn 2004; Martin 1939; Reason 2010; Reynolds & Reason, 2012; Stevens 2005a; Stevens 2005b;).

One area with a paucity of research within dance science is the relevance of creativity in the dancer's training and career. This is despite the recognition of creativity as an important facet of talent in dance (Redding, Nordin-Bates & Walker, 2011). Whilst there is general recognition of dance as a creative activity (e.g Farrer, 2014; Fink & Woschnjak, 2011; H'Doubler, 1998), questions relating to optimal performance in dance science have mainly considered dance as a technical activity, focussing on the individual as an executor of performed technique, rather than as a creator or artist (Thomson & Jaque, 2017). Research into education and environmental correlates of optimal performance also tends to focus on the measurement of psychological variables in relation to technique classes or technical performance and skill execution, rather than the creative class or performance (see Quested & Duda, 2010; for example of technical emphasis). The relevance of inter- and intrapersonal, environmental, and situational psychology in achieving optimal creativity in dance is yet to be considered, despite the significant interest in creativity research within the field of psychology (Łuczniak 2015, Kirsh et al. 2009, Muntanyola Saura 2011, Muntanyola 2014, Stevens & Leach 2015). Unsurprisingly then, dance science is yet to truly recognise the dancer as a creative artist, and further still, to understand the relevance of creativity within the health and wellbeing of dancers. Yet, it is clear that there is a place for creativity within dance science. Potential areas of investigation include the identification of creative talent, understanding environments and teaching methods that nurture creativity, the relationship between technical ability and creativity, dancer's own understanding of creativity, the impact of particular training forms such as somatics on creative ability, and the possibility of training creative skills whilst a dancer is injured. If dance is inherently creative, there are countless possibilities for undertaking dance research within creativity, and a logical starting place for a dance scientist is to look to the psychology of creativity, where considerable expertise and publications exist. In this article, we consider barriers to the future development of this area of dance science.

LIMITATIONS TO STUDYING CREATIVITY

Definition

We propose a number of limitations as to the development of research into creativity within dance science. Within the psychology literature, creativity is commonly recognised as a complex phenomenon, which presents a challenge in defining the meaning of *creativity*. The layman's

view of creativity is often equated to “thinking outside of the box” (Kaufman & Beghetto, 2013); yet, as one researcher vividly comments, “what creativity is, and what it is not, hangs as the mythical albatross around the neck of scientific research on creativity” (Prentky, 2001, p. 97). Within psychology research, creativity has typically resisted definition or clear operationalisation, particularly when applying this to specific research settings (Plucker, 2004; Runco, 2014). It is imperative to acknowledge this complexity, which exacerbates the challenges of researching a previously un- or underexplored area of creativity, such as dance.

Despite recent advances in theory, research and measurement of creativity, as well as the modern day value placed on creativity, no clear definition or consensus exists (Silvia, 2014). In a meta-analysis aiming to reveal trends in definitions, Plucker, Beghetto & Dow (2004) selected 90 articles published in scientific peer reviewed journals with the word ‘creativity’ in the title. Only 38% of their chosen publications either explicitly defined creativity, or passed comment on the challenges of providing a definition (but in doing so, did not define it). Plucker et al. (2004, p. 87) note that when authors do offer a definition, it is often “Prefaced with an ‘Oh, by the way’ tone.” An argument is made that failing to provide a definition impedes any effort to meaningfully measure creativity (Lloyd-Evans, Batey & Furnham, 2006). This is exemplified when applying methods, which assume an understanding of creativity, to new and previously under explored contexts such as dance. It is important to consider how the term *creativity* is being defined and understood in a new research setting, however the authors note the challenges of developing an operational definition of creativity in dance.

However, within cognitive psychology, where the field of creativity research lies, an operational definition has been in use consistently for more than six decades (Barron, 1955; Guilford, 1950; Stein, 1953) and is still widely recognized today (Amabile, 1996; Campbell, 1960, Kaufman, 2016; Kirsh et al. 2009; Koestler, 1964; Runco, 2007; Sawyer, 2012; Sternberg, 1999; Stevens, Malloch & McKechnie, 2001). Indeed, a claim has been made that research, such as those from other fields with less rigorously circumscribed theories characteristic of cognitive science and psychology, that claims there is no definition has neglected to undertake a full and complete literature review (Cropley, 2015). This definition comprises two main criteria--namely that creativity involves the production of something both novel and useful.

This definition, however, provides further complication, as it necessarily designates creativity as productive in nature. This leads to the phenomenon of emphasis on product dominant measures

in creativity literature, and raises criticism of the emphasis on the product to the neglect of the process and a lack of interest in the relationship between the two (Sawyer, 1992). Some applications of the novel and useful definition assume *creativity itself* to be a product, for example those which define creativity as “novel work that is accepted as tenable or useful or satisfying by a group in some point in time” (Runco & Jaeger, 2012, p.94). A bias towards creativity assessments with a focus on the product has been observed in psychology research, as the creative product is often tangible and therefore easier to measure than the process, person or product. When the creative product is used, the tendency is to look at the product as domain specific (Baer, 1998; Silvia et al., 2009). Whilst there has been some criticism of the product-based approach to creativity, Mackinnon (1978) counteracts criticism of the focus on just the product, arguing that the product is the clearest moment at which something creative emerges from the mundane. However, Batey (2012) notes that methods which assess the product are often criticised for failing to take into consideration the process, to the extent that the process is often ignored. Still to date, much of the existing creativity research frames a product as creative—or creativity as the generation of a novel, useful product (Sawyer, 1999, p. 463), whether the product is tangible or conceptual (Ward, Smith & Finke, 1999, p. 190).

Product versus Process

Contrastingly, in dance, there is no *tangible* product as a result of the creative process; dance performance is ephemeral—always in flux, polysemic, and non-linguistic, and therefore difficult to capture or measure (Batson & Wilson, 2014; Weber, 2016; Weber, 2018b). In dance choreography, though products are created in the form of dance pieces, in creative practice the process is emphasised (Sheets Johnstone, 1981; Fraleigh 1987, Foster 2003), particularly following the postmodern era, in dance performance is a heightened emphasis on process over product. Furthermore, newer forms of dance blur the boundaries between process and product, and, much of what is designated “creative” in contemporary dance forms is exploratory and process-based; as noted by Weber (2016, p. 108-109):

“Choreographic creativity may be evidenced in the performance arena, but it is enacted in the artistic process preceding the performance-product. [...] It should be noted, too, that contemporary practices may blur the traditional boundaries of process and product as separate entities, often presenting process-as-product, in which the multimodal meaning-making processes for dancers in both ‘stages’ entwine as one-and-the-same.”

In terms of creativity research, this process might be defined as a series or sequence of events which leads to an outcome which is both novel and useful (Lubart, 2001). Studies of process are concerned with the actual experience of creating, and the iterations by which an individual is creative over time, resulting in a creative outcome, or product. Process-based approaches have been discussed for many decades; for example, one early conceptualisation of creativity was “the defeat of habit by originality” (Koestler, 1964, p. 96). An individual removes themselves from preconceptions through the generation of unusual ideas to overcome habitual tendencies. This definition emphasises the crucial role of the process; without the initial generation of unusual ideas, Koestler’s ‘habit’ cannot be defeated and the product will be neither novel nor useful. Barron (1988) emphasises the complexity of the process in relation to the other P’s, by suggesting that creativity is a product of the creative process done by a creative person. Plucker, Beghetto, and Dow (2004, p. 90) likewise emphasise process as an integral part of defining creativity, when they note that creativity “is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context.”

Subsequently, a common theme is that in order to be attributed the term creative, an individual must generate novel ideas *and* evaluate them in order to choose those of value. Finke (1996) argues that creative processes in the arts are a combination of both structured thinking and free processing. In structured sections, artists, or dancers, are working to seek connections that are inherent to the art form, whilst creative moments are more imaginative and free to explore in a novel way. Likewise, Stevens et al. (2001, p. 60) make a case for creativity in dance choreography as resting as much in the connection of parts of a dance as in the novel movement generation for those sections, further pointing to the importance of the evaluative and processual nature of creativity in dance over the end result. Meanwhile, both qualitative research fields and higher education mission statements emphasise the relevance of process in pedagogical training approaches in dance (Watson, Nordin-Bates & Chappell, 2012).

Creativity has been argued as crucial to the development of choreographic movement (Davenport, 2006), and the contemporary dance rehearsal process is argued to provide a rich environment for understanding creativity. Lavender (2009) outlines stages of choreographic creation and thinking in his IDEA model. He argues that much ‘set’ choreography stems from improvisation. Ideas are then developed into material through a number of choreographic devices such as reversing, lengthening and compressing, changing speed or linking phrases. In

the evaluation stage, the choreographer recognises whether or not the outcomes being produced are effective, before assimilating the work, where smaller pieces of dance are put together to complete a final product. Although this model provides a brief outline for the stages of a choreographic process, in general most teachers do not actively teach such a linear creative process which results in the creative product. Furthermore, in a pedagogical setting, not all creativity is performance (or product) oriented (Brodie & Lobel, 2004; Batson & Schwartz, 2007; Green 1996), which may alleviate pressure by allowing engagement in process more thoroughly (Davenport, 2006). Therefore the process is heavily emphasised in contemporary dance choreography and education.

Nonverbal Processes

May researchers argue that creative processes in dance are embodied, achieved through physical exploration (Gallagher 2014; Grove et al, 2005; Kirsh, 2011; Henley 2014; Kogan, 2002; Lucznik, 2015; Stevens et al, 2001; Stevens 2005a; Stevens 2005b; Stevens et al. 2003; to name a few). These processes occur in a way which utilises space, time, motion, and physical expression, with less emphasis on the verbal and greater emphasis on nonverbal communication (Batson & Wilson 2014; deLahunta, in press; Sheets-Johnstone 1999; Thomson & Jaque, 2017). This way of thinking uses both declarative, or verbal, and procedural nonverbal memory, thus choreography is a creative practice grounded within physical knowledge and embodied explorations (Stevens & McKechnie 2005). Many definitions of choreography have been posed throughout dance literature, with no unified perspective. However, most definitions of choreography highlight a creative process (Blom & Chaplin, 1982; Humphrey, 1959).

Choreography, as 'set' movement, often develops through the generation of movement to create phrases that are crafted together into a finished work (Smith-Autard, 2002); whereas choreography in improvisational, experimental, or newer forms, as noted above, blends the concept of process and product into one. Either way, choreography can also be seen as a process guided by the personal experience and expertise of the choreographer or practitioner (Smith-Autard, 2010) and has been described as occurring through cognition involving organisation of knowledge, typically through memory, language and perception to result in the making of movement (Bläsing, Puttke & Schack, 2010). Within contemporary dance, there is often no preset plan to guide the choreographic process, and the work may begin from a very vague idea, and often material is shaped by external influences such as poetry or art--indeed, the source material for dance is often multimodal in nature (Stevens et al, 2001; Weber, 2016).

Furthermore, dance creation involves multimodal, often nonverbal, imagery (Weber, 2016). The role of imagination has been identified as key to the creative process in dance, and is under considerable investigation within the “In the Dancer’s Mind” research project (2015). Interaction with imagination and ideas often acts as the starting point for much creation in dance. Imagination in dance is often used in an intentional way, as a trigger for creativity (Policastro & Gardner, 1999). This can occur, for example, through the use of tasking (May et al., 2011). Imagination encourages ideas that do not yet exist, and the reinvestigation of new ideas.

CREATIVITY AND THE ARTS

Runco (2007) notes the difficulty of researching creativity in the arts generally, but some parallels between artistic modalities and dance may be worth exploring. Research within other creative domains has supported the mapping of artistic creativity to proposed psychological theories of creativity. For example, Botella et al. (2013) interviewed professional artists and included questions which required the artist to reflect upon the creative process and articulate their approach to creating. Using discursive analyses, it was found that the artists reported their work to align with traditionally cited creative processes. The analysis supported the initial stages of ideation, the analysis being closely related to the problem finding activities described by Getzels and Csikszentmihalyi (1976). The second phase was found to correspond to the generative processes associated with the search for ideas (Finke et al., 1992). Finally, the third and final stage of the artistic process was found to be cyclical and iterative in nature, resulting in the artistic product (Mace & Ward, 2002). It is worth questioning whether similar processes are operating across disciplines, and occurring similarly in dance.

Furthermore, creativity research in other arts domains may shed important light on creativity in dance-specific circumstances. For example, looking generally at creative processes in music, Jones, Roy and Verkuilen (2014) found that rumination played a role in the process of musical creativity. This indicates a longitudinal process of creativity, intersected by psychological manifestations which are not considered elsewhere in creative process model but have recently been emphasised (Verhaeghen, Trani & Aikman, 2017). It has been argued that ruminating may play a role in reflection to encouraging a mastery and analytic approach to performance, which distinguishes performance based creativity from other domains (Thomson & Jaque, 2017; Thomson, Keehn & Gumpel, 2009). Such considerations are imperative in dance, where psychological challenges such as anxiety and stress have often been documented (e.g. Carr &

Wyon, 2003; Quested et al., 2013). However, understanding the relevance of such additional factors is limited in dance until creativity in itself is fully understood.

Likewise, Bourgeois-Bougrine et al. (2014) argue that, in the context of artistic screenplay writing, the stage-like models of creative processes discussed so far do not adequately explain artistic creativity, and that creative processes are domain specific, with the role of interpretation and performance of another's work taking a far larger role than has been expressed elsewhere. It is questionable to what extent this remains true in contemporary dance, where interpretation is less emphasised; yet this may partially explain the neglect of contemporary dance creativity research within psychology. It has also been argued that even when a dancer or performing artist is simply interpreting, for example in reconstructions or ballet, performers are actively engaged in creativity through self-exploration and self-realisation (Copeland, 1994). Thomson and Jaque (2017) support that the creative process in the performing arts warrants further domain-specific consideration. An understanding of dance creative processes must be open to all possibilities expressed in the psychology of creativity literature.

Dance scholar Brooks (2014) argues that the reality of the creative process in dance is complex, whilst psychologists Basadur, Runco and Vega (2000) highlight that the creative processes described by Campbell (1960), Finke (2002), and Wallas (1926) are overly simplistic in their linear nature. Therefore, it is important not to make assumptions about linearity of process. Basadur et al. (2000) emphasise that creativity should be recognised as a continuous, changing, self-repeating process. Bink and Marsh (2000) support that the creative process is made of repetitive steps between generation and selection of ideas. This cyclical, nonlinear process has been supported by visual artists' reports of alternating between rough sketchings of ideas and critiques of those ideas to inform their next cycle of sketching (Elamil, Dobson, Beeman & Christoff, 2012), and may well apply in dance choreography as well.

The non-linearity and complexity of the creative process in dance is complicated by the multiple methods of creating dance, in particular the frequency of shared creation in choreography (Brooks, 2014). This idea was initially conceptualised as co-authorship (Preston-Dunlop & Sanchez-Colberg, 2002), but is now commonly referred to as collaboration throughout contemporary dance education (Butterworth, 2004). The popularity of collaboration in dance making and movement creation is reflected in a research shift towards understanding the socio-cultural nature of creativity (Snowber, 2012). This is one area in which models from other arts

may already be beginning to be illustrated in current research on dance creativity; for example, Sawyer (1999), in examining creativity in improvisational theatre context, claims creativity lies in collaborative emergent phenomena which arise from the collective activity of social groups. He goes on to claim that emergent processes, which he believes are not product-producing, are more a 'series of steps,' pointing to the processual nature of creativity in performing arts (p. 466).

Sawyer's proposal that creativity may be social has parallels in other theories of social creativity (e.g. Amabile 1983, 1996; Csikszentmihalyi 1999) and indeed, some research in dance has already investigated the idea of distributed cognition in creativity--or the sense that the social nature of creation impacts creative output. In this, researchers point to, not only the individual contributions to a creative product, but also the context inherent in dance creation--as Stevens et. al state, "An explanation of creativity in choreography must therefore address the complex of dynamics and interactions among dancers and choreographer in this community of creative minds" (Stevens et al., 2000, p. 2). Their dynamical system, composed of the choreographer, performer and observer each as actors, highlights the social nature of choreographic creative process. Likewise, Lucznik (2015) claims dance improvisation is a co-agentive process which is distributed across group interactions. Another study on distributed creativity in dance, examined improvisational tasking either alone, with a familiar partner, or in an unfamiliar pairing, and showed qualitative differences in movement generation in social creation (Stevens and Leach 2015). Furthermore, a study on the creative process in social interacting in dance rehearsals examined individual creative choice-making for dancers, and claimed that patterns interactions shape individual creative choices in movement production, and that choreographic instructions are necessarily interactive, and thus social (Muntanyola Saura, 2011). Moreover, Kirsh (2011), in a longitudinal cognitive ethnography that is grounded in theories of distributed creativity and embodied cognition, reports the effects on a distributed system to encourage multimodal transfer between various forms of imagery which becomes the impetus for movement generation and greater variance in generated movement ideas. These ideas are posed contrary to the traditional idea of the creative individual as a lone genius, and the tendency to focus on creative geniuses (Barron, 1988; Craft, 2005).

The choreographer, students or performers and audience can therefore be seen as co-participants in the creative process (Corazza, 2016). The status of the current dance ecology is beginning to see the relationship between choreographer and dancer as blurred, with the

choreographer no longer deemed the creative (Farrer, 2014). Instead, the performers share the dance making process with the teacher, contributing material, and the teacher or choreographer tends to take on the role of the audience, considering how an audience member would view the piece externally. Brooks (2014) notes that due to the collaborative nature of the creative process, common goals were achieved by shared critical reflection. Of interest in the collaborative dance making process is the recent finding that some dancers still attribute the choreographer as the sole creative individual, appearing to overlook their own contributions (Farrer, 2014). Brooks (2014) argues for further research into creation methods to explain the lack of understanding of the choreographic process. It is of future importance to observe the contribution of each individual dancer and assess their perception of their own contribution when considering choreographic creativity.

Within the artistic literature, two main approaches have been used to study the stages of the art-making process (Locher, 2010). The first of these involves direct observations of artists at work. The benefits of this are abundant in allowing the researcher to obtain clarity and detail surrounding the chosen methods and materials and to see the development and realisation of ideas and concepts in real time. However, more commonly used is the archival study method whereby reflecting back on the artistic process helps the artist to identify factors that influenced the creative process. Research has also tended to use qualitative interviews to explore processes, for example in how artists produce works for upcoming exhibitions (Mace & Ward, 2002). In this research, artists were interviewed during the course of making the artwork on three separate occasions; at initiation, around the midpoint of the process and at the conclusion, when the work was almost finished. At the end of the process, the work was assessed for its creativity, and, in line with suggestions by Getzels and Csikszentmihalyi (1976), work was deemed more creative by experts when the artist reported that they delayed defining their artistic problem until later in the process. These approaches have been common in dance literature, however they are purely artistic, and few researchers have attempted to understand the relationship between the creative process and product within a psychology of creativity framework, instead aiming to create their own models (as in Brooks 2014). Although this model comes from data collected from a collaborative process, it is of interest to develop the understanding of the process and product/performance relationship within the psychology of creativity framework. This qualitative approach may also have limitations in the applicability to dance science, where quantitative research with large sample sizes allows for generalisation.

Although there are a number of proposed models of the creative process within psychology, as well as recent attempts to describe the creative process of choreography, few attempts have been made to combine the two fields of research (Weber, 2018b; Weber 2016), and it seems that dance scholars have largely not considered work by psychologists. Furthermore, there is little research that provides a clear understanding of creative processes which lead to a product deemed to be creative or highly desirable, rather than a creative process leading to a product that is considered to be non-creative or routine (Howard, Culley & Dekonick, 2008).

COMPLEXITY IN DANCE

Dance is a gestalt (Batson & Wilson, 2014, Stevens et al, 2001; Stevens et al. 2003; Stevens, 2005b)—a meaningful whole made up of many parts, many perspectives, which exceeds the mere sum of those parts, for, as phenomenologist Sondra Fraleigh illustrates, the dancer is both many selves and more-than-self (1987) and the body is inseparable from the dance. Dance exists beyond the individual experience, inhabiting places within and between a variety of perspectives, at the convergence of choreographer, dancer-as-choreographer's-object/instrument and dancer-as-subject/experiencer, and audience (also, through a witnessing perspective, re-presenting the dancer-as-object again). Even if one is to take the perspective solely from the experience of a dancer—excluding choreographer or audience for the meantime—dance is a complex whole made of many parts, situated in a rich context: “from the phenomenological perspective, the dancing body is not a material thing separate from dance, but a holistic gestalt manifesting as dance. The body-in-dance is a process of being in the world” (Batson & Wilson 2014, p. 58).

Because of this extreme complexity, much of the current dance scholarship spans knowledge bases situated in a multiplicity of academic disciplines (Green 2007, as cited in Batson, Quin & Wilson, 2012). Unlike some other art forms, dance encompasses many aspects both internal (i.e. kinaesthesia, affect, somatic experience, etc.) and external (i.e. rhythm, percussion, visual aesthetics, temporality, spatial dynamics, vocalisation and the spoken word, and more). Multi-sensory, multimodal exploration is how meaning is created and new movement generated in choreography (deLahunta, Barnard & McGregor 2009). Dance is a dynamic and complex system. As Batson highlights, 'dance is more than phenomenal. Dance is research that contains many complex tangible and non-tangible phenomena. It is a continually shifting movement fabric in which many elements intrinsic to dancer and context converge to become the dance'

(Batson and Wilson 2014: 57, emphasis original). Researchers in choreographic cognition, Stevens and McKechnie, also emphasise the multimodality of dance in their recognition that choreographic source ideas are 'not simply visual or verbal as has been assumed in most cognitive theories to date' (2001: 60) as they analyse choreographic cognition in Shirley McKechnie's *Red Rain* with converging methods (2001: 157-158, Stevens et al. 2003, Stevens 2005b).

Reiterating this, Batson states that because of the complexity of dance, 'dancemaking requires unique cognitive processes that demand deeper description and analysis [...] research in cognition and dance making remains isolated and in need of greater global visibility and cohesion' (Batson & Wilson 2014, p. 22-23). As these researchers identify, dance in particular calls for a multimodal, interdisciplinary, mixed methodology because of its multifaceted nature. Dance features dynamical complexity—it is not merely one thing; it is not easily measurable, and thus it resists reductionist analyses (Batson & Wilson 2014, p. 57). Further, 'a methodologically diverse way of researching is fundamental to capture the important aspects of a multifaceted activity, such as dance,' echoes mixed-methods dance researcher Sara Houston (Houston & McGill 2013, p.103). 'This is especially the case in a research field where quantitative results have dominated, but where, [...] qualitative analysis has much to offer' (Houston & McGill 2013, p. 103-4) like psychology. Just as the choreographic process is a practice of finding emergent meaning, so too research around creativity in choreographic practices needs to be open to discovering emergent information and theories.

CREATIVITY TESTING AND RECOMMENDATIONS

Despite such barriers, and the proposition that noted that trying to understand and learn about the nature of creativity may impose limits on creativity and squash potential ideas (Claxton, 2006), we recognise the many strengths of capturing dancers' creativity within the scientific framework. Arguably, creativity might be accurately captured by holistic approaches traditionally side-lined in a positivist, empirical discipline like dance science (Batson & Wilson 2014; Batson, Quin & Wilson 2012). Such standardised creativity measures are based on psychological ideas about creativity and predominantly assert that creativity is measurable, through the quantifiable assessment of divergent thinking. Divergent thinking is an approach to problem solving, where individuals seek unconventional responses that are useful, numerous, and varied instead of the convergent (one, single, or 'correct') answer, which is more common; in psychometric testing environments, this means the ability to offer many solutions in response to a given problem

(Kaufman and Sternberg 2006). Divergent thinking is commonly used as a measure of creative potential (Wallach & Kogan, 1965; Wallach & Wing 1969, as cited in Runco 2014) to this day.

Furthermore, Stevens et al. (Stevens & McKechnie, 2005; Stevens et al., 2001) take issue with the precept that in most creativity and cognition research, mental processes rely on language and visual representation, because dance ideas are shared ‘in both words and movement’ (Stevens et al., 2001 p.55) and choreographic cognition is ‘hidden, rapid, multimodal, and non-verbal’ (Stevens 2005a, p.155). Especially in forms like contemporary dance, movement is often not as codified as in some established or traditional techniques. And as stated earlier, much of dance choreography occurs through nonverbal processes. This understanding of movement as a creative and cognitive process in its own right is supported by not only these psychological critiques, but also across dance research literature (for some examples, see: Batson & Wilson, 2014; deLahunta & Barnard, 2005; Hanna, 2015; Kirsh, 2010). Current psychological testing, such as the divergent thinking tests, exists primarily in pencil-and-paper form relying on verbal processes, or, sometimes ‘fixed’ visual imagery, neither of which reflect the embodied meaning-making or multimodal nature of creativity in dance, and future dance-domain specific research would be wise to address this gap.

Our criticism of the implicit limitations and hierarchies in dance science is not to imply that there isn’t value in the empirical ethos or positivist methodology in the psychology and dance science paradigms—indeed, as psychologists Robbins and Aydede assert, phenomenal consciousness is “arguably the last bastion of Cartesian internalism,” thus methods ought to go beyond phenomenology and consider more empirical cognitive psychological methods addressing the embodied perspective on the mind are required if they are to be aligned with dance’s prioritization of embodied knowledge, reflected in the field’s recent formulations such as “choreographic thinking,” “thinking with the body,” or “bodymind” currently permeating dance studies (see, for example: deLahunta et al., 2012; Kirsh, 2010; Manning, 2013; Rethorst, 2012). Though previous research has attempted to investigate the intersection of dance science/psychology and embodied or experiential knowledge, such an approach is not without its dilemmas: as Batson, Quin & Wilson claim, “Despite successful attempts at convergence between dance science and somatics, problems remain in integrating the pragmatic field of somatics with the theoretical paradigms of dance science. For example, somatic experiences are not often explicitly grounded in scientific constructs, and dance science experiments often exclude somatic principles and experiences” (2012, p.185). It is important, then, to mitigate

these concerns through a purposefully integrated research methodology, led by researchers with dual competencies

As Batson and Wilson claim, “dancemaking requires unique cognitive processes that demand deeper description and analysis [...] research in cognition and dancemaking remains isolated and in need of greater global visibility and cohesion” (Batson & Wilson, 2014, p. 22-23). Drawing on the work of somatic psychologist Paul Vermerch, they call for researchers who have dual competency in psychology and dance in order to build a body of valid research that evades dualistic concepts of mind and body while preserving the integrity of each field’s ideology, methodology, and language—to build non-dualistic dialogues and understandings between the scientific and artistic/embodied while still “preserving [dance’s] unique integrity as a non-reductionist reality of the unity of body, brain, and thinking” (Sheets-Johnstone, 2009 as cited in Batson & Wilson, 2014 p.23).

One recommendation is to consider studying, through the more circumscribed theories and investigative rigour of dance science, techniques pervasive in the field of dance which problematize the traditional hierarchies inherent in dance science, such as somatic practices. Though some dance science has studied physiological aspects of the practice, as an effort to unify body, brain and thinking, the field of Somatics is another rich area for creativity research that has not been mined by dance scientists or cognitive psychologists. Somatics researchers claim many benefits to somatic practice, including creating “dancers who can move easily in many different styles” and having effects that “strengthen technical capacity, expand expressiveness, and reduce incidents of injury” and increased embodiment, empowerment and well-being as well as facilitate “new variety in movement quality and patterns,” and “greater creativity and autonomy within their dance practice” (Berardi, 2007a p.33; Eddy 2009a p.21; Weber, 2009 p. 251). These claims, stemming mostly from small-scale qualitative studies and personal accounts, are ripe for testing in larger samples and empirical methods as well. Such an approach will not only broaden dance science’s understanding of widely-recognised yet understudied sections of professional dance, but also addresses a stated need in existing literature for development of reliable and valid measures to quantify benefits of somatic training (Chatfield, 1991/1992; Eddy, 1991/1992; Krasnow, Chatfield, Jensen, Barr & Dufek, in press; Myers, 1986; Todd 1959-- all as cited in Gamboian 1997).

Thus, the authors recommend the development of interdisciplinary research teams which facilitate a multifaceted approach to creativity research in dance science. We have discussed the difficulties in defining *creativity*, issues around the multimodal and social nature of choreographic practice, questions of implicit value in dance science approaches, as well as the range of what constitutes *choreography*--a query which itself illustrates the range of valuation of process and/or product as primary in both dance and psychological discourses. We have discussed limitations of current creativity theories and testing models, with an eye to how future dance creativity research might ameliorate some of these issues. Such an approach, with a consideration of all of the complexities and complications, is the only way to approach an understanding of creativity within the domain of dance which is holistic, non-reductive, and generalisable--combining the strengths of psychological approaches *and* research paradigms from the humanities in order to address these complexities.

[WORD COUNT: 6729]

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