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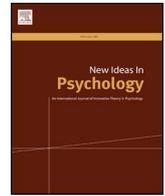
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An ecological approach to creativity in making

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ABSTRACT

Cognitive accounts of creativity generally assume that novel ideas originate in the head and precede the actual materialization of them. Over the last decades, this cognitive view has been criticized by, among others, proponents of a sociocultural perspective. In the present paper, we aim to further this critique by developing a genuine ecological approach to creativity in making. We do so by incorporating Ingold's theory of making into the ecological perspective that was initiated by Gibson. It is argued that because action is not preplanned but continuously unfolds over time, creativity is to be found in the process of making. Indeed, creativity can be conceived of as the discovery and creation of unconventional affordances (action possibilities) of objects and materials. Discussing the primacy of exploratory actions in this process, we argue that the concepts and research tools of ecological psychology may help to deepen the understanding of the creative process.

1. Introduction

[T]he drawing is not the visible shadow of a mental event; it is a process of thinking, not the projection of thought. (Ingold, 2013, p. 128; emphases in original)

How is it possible that humans come up with ideas, thoughts, products, and ways of acting that did not exist before and are meaningful? Unsurprisingly, in addressing questions like this, different academic disciplines have paid attention to different aspects. Within the fields of arts, architecture, and archeology, the focus tends to be on the novel material product that is realized and the historical and social context in which that happened (e.g., Gombrich, 1950/1995; Frampton, 1980). In psychology on the other hand, the focus is not so much on the material object per se, but on how the new idea in the mind of the designer or actor takes shape (e.g., Jung-Beeman et al., 2004; Kounios & Beeman, 2014; Nijstad, De Dreu, Rietzschel, & Baas, 2010; Simonton, 2007a, 2007b). Yet, the underlying theory in these different academic disciplines tends to be the same. They generally adhere to what Ingold (2013) referred to as “hylomorphism”,

This is to start with an idea in mind, of what we want to achieve, and with a supply of the raw material needed to achieve it. And it is to finish at the moment when the material has taken on the intended form. (p. 20)

The novel idea in the mind of the designer and the material object that is subsequently constructed are isomorphic. The mental idea is

supposed to instruct the (mechanical) body to impose the novel form on the material.

Over the last years this approach has been criticized by several authors (e.g., Costall, 2015; Glaveanu, 2014; Glaveanu, Gillespie, & Valsiner, 2015; Ingold, 2013; Malafouris, 2013). Shifting focus to the sociomaterial processes, they argued that creativity does not reside in the mind of the individual but is relational and extends into the (social) world. Glaveanu (2014), for example, argued that “creative action is distributed between multiple actors, creations, places and times” (p. 2; emphases in original). In the present paper, we aim to further the critique on the cognitive account by developing a genuine ecological approach to creativity, focusing on how goal-directed activity comes about. We will do so incorporating Ingold's recent ideas of making into the ecological framework that was developed by Gibson. It is argued that because behavior is not preplanned in the mind, but emerges out of the interplay of movement and information, creativity does not so much exist in the head but in the unfolding of action (see Hristovski, Davids, Araujo, and Passos (2011) and Orth, van der Kamp, Memmert, and Savelsbergh (2017) for accounts of creativity in movement sciences that follow a similar line of thinking). Moreover, we claim that Gibson's conceptual framework can further the investigation into creativity. It not only allows us to define creativity (see also Glaveanu, 2012; Yakhlef & Rietveld, 2017), but the ecological concepts of information, attunement, and exploratory behavior can also further (empirical) investigations into making and creativity.

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2. Some cognitive perspectives on creativity

Cognitive theories of creativity come in many forms. Applying the principles of classic cognitive psychology, Simon and colleagues defended the idea that creativity can simply be understood as general problem solving (e.g., Newell & Simon, 1972). Qin and Simon (1990), for example, conducted an experiment in which participants were to discover one of Kepler's laws, and the problem-solving searches of the participants were recorded. Based on their results, Qin and Simon concluded that, "the data for the successful subjects reveal no 'creative' processes in this kind of a discovery situation different from those that are regularly observed in all kinds of problem-solving settings" (p. 281). Indeed, one can write a computer program to solve this problem. Other researchers, however, have argued that unlike the deliberate analytic problem solving, creative insight genuinely reflects certain cognitive processes working together (e.g., Kounios & Beeman, 2014). Moreover, individual differences in solving problems in a sudden flash of insight are associated with different patterns in resting-state brain activity, particularly in the anterior cingulate of the right hemisphere (e.g., Jung-Beeman et al., 2004; Kounios & Beeman, 2014). In fact, researchers have stimulated these brain areas to try to facilitate creative insight (e.g., Chi & Snyder, 2011).

Earlier, Campbell (1960) defended a theory of creativity that is based on the Darwinian idea of variation and selection (see also Simonton, 1999). In his view, knowledge processes, including creative thought, are governed by a "blind-variation-and-selective-retention process" (Campbell, 1960, p. 380). New ideas "uncorrelated with the solution" (Campbell, 1960, p. 381) to problems are produced and amplified, and some of them are selected. In laying out his theory, Campbell focuses on scientific discoveries that he illustrated with reflections of scholars as Bain, Mach, and Poincaré. However, his theory is also used to understand artistic creativity of musicians and painters (see e.g., Simonton, 2007a, 2007b). The overall claim is that generating more ideas, typically through many years of persistent effort, should lead to more ideas that are creative. Creativity thus arises from sheer productivity, not from special psychological or cognitive predispositions.

Trying to combine many aspects of the above accounts, Nijstad et al. (2010) developed a "dual-pathway theory of creativity". According to this theory, there are two ways to achieve novel and creative ideas: through the "flexibility" pathway and through the "persistence" pathway. Flexibility indicates that creative ideas can be generated by switching to a different approach, considering a different perspective and by making remote associations, but creativity can also be achieved more analytically through systematic, focused, and effortful thinking. To generate creative ideas in problem solving, people interchangeably use the flexibility and persistence pathways but to different degrees depending on the individual's psychological and cognitive dispositions (e.g., working memory) and traits (e.g., mood and attention) and on situational factors (e.g., insight versus divergent thinking tasks). Hence, the interaction between flexible and persistent ways of thinking together with the factors that modulate them account for (variation in) human creativity.

Although cognitive theories of creativity can be rather diverse, they share, arguably by definition, the assumption that creativity resides in the mental realm—the formation of novel ideas occurs in the head. And when the idea concerns a novel object or product, the idea can (or cannot) be materialized through a process of making, but this latter process is not considered to be constitutive of the creativity. Indeed, the idea emerged prior to the construction of the product, the latter being a mere materialization of the mental idea.

3. An ecological view on how action emerges

The above line of thinking, in which the idea exists prior to the actual product or the creation of it, is deeply rooted in Western

thinking. When patterns are to be explained, Western scientists generally assume that this pattern already existed, albeit in an abstract form. Ingold (2011) referred to this as the "logic of inversion" (p. 68). In the field of biology, for example, it is widely assumed that the genes contain a blueprint of the animal that guides the developmental process such that a certain animate form is realized. And traditional accounts of human movement claim that movement patterns are the result of a motor program, residing in the brain, which instructs the body what to do. Hence, in these accounts it is assumed that the animate form and the movement already existed in abstract forms in either the genes or the brain, respectively. Drawing upon the work of Gibson and Ingold, we describe an ecological approach to action that takes aim at this "logic of inversion" and holds that behavior continuously unfolds. Such an account necessitates a theory in which creativity resides in the unfolding of the action.

3.1. Gibson's ecological program

In the 1960s and 1970s Gibson developed an approach to psychology that was diametrically opposed to the dominant cognitive tradition. Indeed, Gibson took aim at the idea that the brain controls action, an assumption that holds psychology captive since the late 17th century (e.g., Martensen, 2004; Zimmer, 2004). As he stated in his last book, *The ecological approach to visual perception*, "[l]ocomotion and manipulation [...] are controlled not by the brain, but by information, that is, by seeing oneself in the world. Control lies in the animal-environment system" (Gibson, 1979/1986, p. 225). Gibson developed several concepts to understand how behavior can "be regular without being regulated" (Gibson, 1979/1986, p. 225). For now, the concepts of information and affordances are most important.

Gibson introduced the concept of affordances to refer to the action possibilities of the environment for a certain animal.

The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill. The verb *to afford* is found in the dictionary, but the noun *affordance* is not. I have made it up. (Gibson, 1979/1986, p. 127; emphases in original)

So, for example, for a human being a chair affords sitting and the floor affords walking. By stressing that the environment consists of possibilities for action, and that animals perceive their environment in these terms, Gibson emphasized that the world is not primarily to look at but to act in. Moreover, the concept of affordances indicates that the environment in which animals live is a meaningful one. Being rooted in the mechanization of the worldview, psychology has traditionally assumed that the environment simply consists of matter in motion and that meaning has to be attached to it in a perceptual process (e.g., Neisser, 1967). However, if the environment consists of possibilities for action, then meaning does not have to be imposed but can be discovered. Indeed, "the meaning or value of a thing consists of what it affords" (Gibson, 1982, p. 407).

To understand how the animal can perceive the affordances and regulate their encounters with them, the Gibsonian concept of information is crucial. Gibson stated that in the ambient arrays surrounding an animal there are patterns available that inform about the available affordances. Moreover, this information can also guide our activities in the environment to use an affordance. A classic example is the use of optic flow fields to guide locomotion (Gibson, 1958). Imagine a bird flying through the air. The movement of the bird through the air gives rise to an optic flow field that provides information about the animal's movements through the environment. Consequently, this information can guide the bird's behavior. The focus of expansion (the point at which the motion appears to arise), for example, coincides with the direction in which the bird is heading and can thus be used to navigate through the environment.

Hence, goal-directed behavior can result from the interplay of movement and information—the animal's behavior can be guided by

the information in the optic flow that is the result of its movements. Ever since Gibson laid out his programmatic approach, ecological psychologists have applied his ideas, often in combination with the theory of self-organization, to a variety of tasks (e.g., Fajen, 2007; Kelso, 1995; Kugler & Turvey, 1987; Warren, 2006). Importantly, this program of work demonstrates that goal-directed actions can be explained without recourse to motor programs residing in the brain. Indeed, the underlying idea of all these applications has been that goal-directed behavior emerges from the interactions between animal and environment. “[A] pattern of behavior [...] does not reside a priori in the individual components of the system but is a consequence of their interdependence and interaction” (Warren, 2006, p. 362).

If there is no ideational preplanning involved in the generation of behavior, as the ecological approach suggests, then the mainstream cognitive perspectives on creativity, in which an idea first emerges in the mind that then instructs the body, are misguided from the very start. Indeed, the premise that the interaction between animal and environment is foundational implies that creativity is to be sought not in the head but in the unfolding of the action; that is, in how the animal encounters the environment, in the perception, creation, and use of affordances. This brings us to the insights of Tim Ingold.

3.2. Ingold's theory of making

Ever since the 1990s, Ingold has been inspired by Gibsonian thinking (see e.g., Ingold, 2000). Although the references to Gibson's work are scarce in his latest books (Ingold, 2013, 2015), the influence of the founder of the ecological approach to psychology on Ingold's thinking persists. In his book *Making*, Ingold (2013), too, argued against the idea that the brain imposes behavior. Indeed, in his account of creativity, Ingold puts the process of making center stage (see also Glaveanu, 2014; Malafouris, 2013).

I want to think of making [...] as a process of *growth*. This is to place the maker from the outset as a participant in amongst a world of active materials. These materials are what he has to work with, and in the process of making he ‘joins forces’ with them, bringing them together or splitting them apart, synthesizing and distilling, in anticipation of what might emerge. (Ingold, 2013, p. 21; emphasis in original).

Hence, the maker is not imposing form on the materials of the world, rather he is working with them.

[t]he most he can do is to intervene in worldly processes that are going on, and which give rise to the forms of the living world that we see all around us—in plants and animals, in waves of water, snow and sand, in rocks and clouds—adding his own impetus to the forces and energies in play. (Ingold, 2013, p. 21, p. 21)

Ingold argued that there are only soft boundaries between artifacts and patterns in nature. Indeed, the difference between a statue and a stalagmite is not that the former is made and the latter is not; rather the statue is *partly* the result of human intervention and the stalagmite is generally not. Indeed, in the formation of the statue, the sculptor used her tools to “release the form” out of the lump of marble. But, among other things, the qualities of the marble that are the result of its formative history also play an important role in this process. Hence, the sculptor does not impose the form on the material; rather it is in her “engagement with materials” (Ingold, 2013, p. 22) that the form takes shape.

The research of Bril and colleagues on stone knapping of Indian craftsman provides an apt illustration of this (e.g., Nonaka & Bril, 2012, 2014; Roux, Bril, & Dietrich, 1995). They analyzed the hammering behavior of Indian craftsmen who make stone beads. In one hand the craftsman holds a piece of stone to position it against the tip of an iron bar and in the other hand he holds the hammer. The hammer strikes the stone three to four times each second to fracture the stone, while the

stone is continually repositioned. By detaching flakes, the stone is shaped into the desired parallelepiped form. Nonaka and Bril (2014) showed that hammering is not stereotypical, but that strikes vary from one repetition to the other in both amplitude and pace. In fact, they argued that the exhibited knapping behavior is an example par excellence of what Bernstein (1996) called “dexterity”—the knapper's actions “exhibits exquisite context sensitivity, implying the efficacy of exploration to detect the task-relevant information” (Nonaka & Bril, 2014, p. 218). The observations of Bril and colleagues demonstrated that the production of beads is a far cry from merely instilling a form on a rough material. Dexterous making requires high sensitivity to the material one is working with.

Ingold (2013, 2015) introduced the concept of correspondence to explain the character of the process of human intervention in the “worldly processes”. It is important to stress that Ingold did not use the concept of correspondence to refer to a mediational theory of knowledge, in which a mental representation and the world correspond (see Dreyfus and Taylor (2015) for a nice description and critique of this position). Instead, in Ingold's view the maker and the material she is working with co-respond. The maker applies forces and the material responds, which, in turn, leads to a response of the maker and so forth. To explain this process to his students in his exceptional course *The 4 As*, Ingold (2013, pp. 22–24) went to the beach with his class and asked each student to create a basket. To that end, a fair amount of branches were placed vertically in the sand, in the form of circle. These branches were tied together at the top to form a frame, and the student was to horizontally weave branches through this frame to make a basket. Many of the students were surprised by “the recalcitrant nature of the material” (Ingold, 2013, p. 22); it was not easy to bent the branches in the shape of the basket, but it was through the ensuing friction with the other branches that the basket eventually took shape. Hence, “[t]he form was not imposed on the material from without, but was rather generated in this force field, comprised by the relations between the weaver and the willow” (Ingold, 2013, pp. 22–23). Indeed, to master the skill of basket making, one has to learn to “join forces” with the force field that results from the maker's weaving together of several branches, arguably each with their own character.

An important implication of Ingold's perspective is that it entails that creativity abounds in animal life. It is not simply an idiosyncratic quality of a genius who develops something that did not exist before. Rather, also the students who aim at making a basket for the first time were creative in that they had to improvise in the process of weaving the branches into a basket. As Ingold and Hallam (2007) put it, “People have to work it out as they go along. In a word, they have to improvise” (p. 1).

4. But what about the creation of new objects?

One might argue that the above argument simply aims at shifting focus in the study of creativity. Whereas the cognitive accounts concentrate on the mental origin of new objects, the above perspective redirects the attention to the qualities of the process of making them, that is, towards the engagement with the material. Indeed, reading the above, an advocate of hylomorphism might admit that there is creativity involved in the process of making, but does not find a compelling argument against her view that novel ideas (the objects' blueprints) originate in the head. Yet, grounding creativity in the unfolding of the action aims at overturning the theory of hylomorphism (see also Glaveanu, 2014; Glaveanu, Gillespie, & Valsiner, 2015; Malafouris, 2013).

After scrutinizing the process of making and the phenomenon of correspondence, Ingold claimed that the traditional theory that assumes that the idea exists prior to the creation of the object has it completely backwards. A craftsman (or any other person) does not “*make through thinking*”, but “*thinks through making*” (Ingold, 2013, p. 6; emphases in original). It is in the process of making that creativity emerges.

[d]rawing that tells is a correspondence, of kinaesthetic awareness and the line of flight. In this correspondence, as Bryson says (2003: 154), 'the mark on the paper leads as much as it is led' [...]. Thus the drawing is not the visible shadow of a mental event; it is a process of thinking, not the projection of thought" (Ingold, 2013, p. 128; emphases in original).

There is no mind hidden behind our actions (e.g., Reed, 1996; van Dijk & Withagen, 2014). Note that the correspondence perspective does not imply that ideas are not involved in the creative process. Rather, it asserts that ideas do not originate in an isolated brain, but emerge in the practical engagement with materials. Hence, ideas are not the starting point of working with materials, and by no means *instruct* the body. Instead, we believe that ideas are better thought of as constraints that originate in the correspondence of maker and material. It is important to stress that this general portrayal of the creative process leaves room for the different types of creativity that have been distinguished in the literature (e.g., Galenson, 2006; Glaveanu et al., 2013). It is compatible with the experimental (i.e. trial-and-error) approach of some artists, but also with the more conceptual way of working in which artists are constrained by ideas. The correspondence perspective has just a different stance on the origin of ideas and what they do.

Although being inspired by Gibson's thinking, Ingold did not adopt Gibson's conceptual framework in his account of making and creativity. However, in the remainder of this paper, we will argue that Gibson's ecological framework can further the investigation into creativity and making. It not only allows us to define creativity (see also Costall, 2015; Glaveanu, 2012; Yakhlef & Rietveld, 2017), but can also guide the empirical research into it.

4.1. Creativity from an affordance perspective

In his chapter on affordances, Gibson (1979/1986) had already emphasized that generally one can do many things with an object.

The fact that a stone is a missile does not imply that it cannot be other things as well. It can be a paperweight, a bookend, a hammer, or a pendulum bob. It can be piled on another rock to make a cairn or a stone wall. (Gibson, 1979/1986, p. 134).

Indeed, a single object generally affords multiple actions to an animal. Cutting (1982, p. 216) once enumerated the actions a single piece of paper affords a human being. It affords "writing gibberish and sonnets", "making a map", "writing nothing upon", "making paper dolls", "cleaning gaps between teeth", and so on.

Yet despite this almost infinite number of actions that a single object may afford, objects tend to be used in particular ways. Within the sociocultural setting that we inevitably act in, there are conventional and normative ways of using objects. Over the last decades, a growing number of ecological psychologists have stressed this sociocultural perspective on affordances (e.g., Costall, 1995, 2012; Heft, 2001, 2007; Rietveld & Kiverstein, 2014; Withagen & van Wermeskerken, 2010). Second, we learn the affordances of our environment through other people. Drawing upon the work of Leont'ev (1981), Costall (1995) claimed that we do not simply encounter objects in the world but are "introduced to them" (p. 472; emphasis in original). Indeed, in what Reed (1996; see also Reed & Bril, 1996) called "the field of promoted action", adults direct the children's attention to certain affordances of objects and show how the objects ought to be used (see Withagen & Caljouw, 2017; for an example in the field of playgrounds).

In the context of this sociocultural perspective on affordances,

Costall (2012, 2015) introduced the concept of canonical affordances.

Canonical affordances are conventional and normative. It is only in such cases that it makes sense to talk of *the* affordance of the object. Chairs, for example, are *for* sitting-on, even though we may also use them in many other ways. (Costall, 2012, p. 85; emphases in original)

As already argued by Glaveanu (2012) and Yakhlef and Rietveld (2017), this sociocultural perspective on affordances allows us to conceive of creativity as the unconventional use of an object's affordances. Two obvious examples are Picasso's sculpture *The Bull's head* (see also Costall, 2015) and Nouvel's *Dollhouse*. The canonical affordance of a bicycle's saddle is to sit on, and that of a bicycle's steer is to hold on for balance and changing direction. Yet, Picasso showed that when the saddle and the steer are combined, they also afford the visual impression of the head of a bull. And Nouvel changed a toolbox into a dollhouse. Although the canonical affordance of the box's compartments is to store tools, now each compartment was a room with a specific purpose in the house. Small windows were made in the exterior of the box, but because the toolbox could be opened at the top, all rooms were easily accessible (see Hertzberger, 1999, p. 35).

We believe that this conceptualization of creativity as the unconventional use of affordances can also be applied to working with materials like clay, paint, steel, and stone, and thus covers arguably all craftwork and art forms. As an example, one can argue that Mondriaan discovered and created new affordances. In an endless process of corresponding with (colored) lines and rectangular forms, Mondriaan revealed a way of painting that gives rise to new impressions of rhythm and nature (e.g., Janssen, 2016). Obviously, Mondriaan could not go beyond the affordances of the material he was working with (canvas, paint, and, in a later stage, tape) but he used them in a way that was not conventional in the art of painting at his time. In like fashion, one can think of creativity in other art forms, working with different materials.

It is important to stress, though, that an unconventional use of affordances is only a necessary condition for creativity in making, not a sufficient one. The use of the affordances should not simply break the convention but should also be meaningful, or as Boden (1996) claimed in her classic paper on creativity "interesting" (p. 75). In Ruspoli's (2010) movie *Being in the world*, Dreyfus mentioned the example of a person undressing himself and rolling in a flower field while his colleagues are having lunch in that garden. Although such an action is certainly exceptional, it is by no means meaningful and, thus, not creative. Indeed, to be meaningful it should have some continuity with the norms and values that are shared within the sociocultural practice the agent is acting in (e.g., Glaveanu, 2014; Glaveanu et al., 2015). Picasso's, Nouvel's, and Mondriaan's creations obviously do so within the domain of art, but the person taking a flower bath is not acting within the confines of the shared norms in his culture.

4.2. The primacy of exploratory behavior in creativity

As Gibson (1966, 1979/1986) had already emphasized, the perception and discovery of affordances is a process in which the body actively explores the environment. Over the last decades, the primacy of the body's exploratory behavior for the perception of affordances is well documented (e.g., Cole, Robinson, & Adolph, 2016; Gibson, 1963; Mark, Jiang, Steinbach King, & Paasche, 1999; Riley, Wagman, Santana, Carello, & Turvey, 2002). Although this research has focused on the discovery of conventional affordances, there is no reason to assume that exploratory behavior is not equally important in the discovery of unconventional affordances (e.g., Hristovski et al., 2011; Malafouris, 2013). Indeed, in their ethnographic research on the design process, Rietveld and Brouwers (2017) pointed at the active bodily engagement of the architects. These authors studied the designing of *Secret Operation 610*, a mobile sculpture/office that provided a working environment for researchers/designers. In the process of

developing the sculpture, exploratory behavior appeared to be crucial.

When RR moves the cardboard model around on the table, he lets go of the model when he seems satisfied with its position and immediately starts looking for the best position in relation to the model by moving his chair around and bending forward. When designing the architects often pick up a model, draw or sketch. They sometimes hold a model up in front of them in the air and turn it around while they try out different positions. They move their bodies and aspects of the surroundings such as their chairs in relation to the design as it is made at that moment, and the other way around. They only stop when (sufficient) optimal visibility is achieved; moments at which RR often sighs: ‘Okay, now I can see it (better)’. (Rietveld & Brouwers, 2017, p. 555, p. 555)

Although such ethnographic studies are very insightful in revealing the exploratory behavior of the makers (see also Malafouris, 2013), we think that they can be complemented and arguably deepened by applying the concepts and research tools of the ecological approach. Indeed, this is likely to provide a more precise account of the information that is used in the creative process and the exploratory behavior that is accompanied with it. For example, in their study on the haptic perception of hand-held objects, Riley et al. (2002) showed that the exploratory, wielding behavior depends on which of the object's affordances is perceived. The tools to study such search or exploratory behavior (e.g., recurrence analyses; fractal scaling) can be used to reveal what exploratory movements are required for an (unconventional) affordance to be perceived. Relatedly, there is a growing body of research showing that skilled agents rely on different informational variables than novices (for overviews see e.g. Dicks, van der Kamp, Withagen, & Koedijker, 2015; Jacobs & Michaels, 2007). As already argued by the Gibsons (Gibson & Gibson, 1955), expertise is partly determined by what informational variables one is *attuned* to. To use one of their examples, a connoisseur is able to detect information in the wine that a novice wine taster is not capable of. Hence, revealing the information that a maker detects might not only help in understanding her skilled, sentient correspondence with the material she is working with, but might also account for her creativity. After all, creative individuals (or teams) might attend to different informational variables than people who are less creative.

It is important to stress that such ecological studies would not necessarily turn the research on creativity into a laboratory science, putting the maker into a sterile, completely controlled environment that might kill any creativity from the very start. Indeed, the ecological studies of Bril and colleagues (e.g., Nonaka & Bril, 2012, 2014; Roux et al., 1995), that we referred to in Section 3.2, offer a case in point. Many of their studies on stone knapping is genuine field work in which the maker is studied in his natural habitat. Yet the ecological concepts and research tools proved their mettle in understanding the context-sensitivity of the knapping, the different levels of expertise, and how the skill is acquired.

5. Concluding remarks

In the present paper, we have sketched the outlines of a genuine ecological approach to creativity in making. We did so by embedding Ingold's theory of making in the ecological framework that was developed by Gibson. Although the sketched approach has some continuity with a recent sociocultural perspective on creativity (e.g., Glaveanu, 2014; Glaveanu et al., 2015), it focusses explicitly on the goal-directed and exploratory activities of the maker. By arguing that behavior is not preplanned but unfolds over time, we argued that creativity has to be found not in the head, but in the process of making. As Malafouris (2013) eloquently put it when discussing pottery,

[T]he constituents of the creative process are not to be found before or outside the throwing or shaping of the pot. The constituents of

creativity are *in the throwing, in the shaping*. The creative process becomes, then, a binding of materials—a dynamic flow of the organic into the inorganic that can be understood as a new or ‘surprising’ blend of ingredients that can act or be acted upon. (p. 212–213; emphases in original)

That is, creativity does not precede making, but is an integral part of it. Although the concept of affordances has already been adopted by a few experts on creativity (e.g., Glaveanu, 2012, 2014; Malafouris, 2013), Gibson's overall conceptual framework has received scant attention in the creativity literature. Yet, as we have argued in the present paper, the ecological concepts of information, attunement, and exploratory behavior (and the tools to study them) are likely to help in deepening the understanding of the skilled and sentient correspondence of maker and material, a process in which the creativity resides.

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