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Abstract What is the goal of creativity? Is it just a symbolic reshuffling or a moment of semantic extension? Similar to the contrast between syntax and semantics, creativity has an internal and an external aspect. Contrary to the widespread view that emphasises the problem-solving role of creativity, here we consider whether creativity represents an authentic moment of ontological discovery and semantic openness like Schopenhauer and Picasso suggested. To address the semantic aspect of creativity, we take advantage of recent externalist models of the mind suggesting that the mind is more than symbol recombination.

Keywords Creativity · Internalism · Recombination · Discovery · James · Fringe

1 The semantic aspect of creativity: discovery versus recombination

Allegedly Picasso claimed that "You don't' make art, you find it" (Richardson 1996). What did he mean? After all, isn't art the paradigmatic example of a human endeavor in which creativity has a paramount role? What kind of creativity was he after?

Picasso's view may help to shed light on the semantic aspect of creativity. In fact, creative processes are often described in terms of their ability to produce something new or, as is the case in AI and cognitive science, in terms of problem solving skills (Newell et al. 1958; Newell and Simon 1972; Russell and Norvig 2003). Yet, there

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is a different aspect of creativity which is not simply the result of cognitive symbolic reshuffling, namely the ability to grasp something radically new. A creative thinker, thus, is not only capable of finding new combinations of existing concepts or symbols; he or she must be able to expand the semantic domain to totally unexpected and new concepts and ideas.

As a paradigmatic example of the contrast between discovery and recombination, consider the Columbus' egg anecdote—which was likely due to Brunelleschi rather than to the Italian traveler. In the anecdote, there is an apparently unsolvable problem—to make an egg stand on its end without any help—which is solved once the solution space is extended to consider unexpected possibilities—i.e. gently breaking the bottom of the egg. The well-known nine dots puzzle is another example—it is unsolvable unless one consider solutions outside the original solution space. In both cases, a creative solution requires a genuine discovery of a new space. This anecdotal evidence epitomizes the traditional dichotomy between convergent and divergent thinking. Here we want to stress that creativity requires the explicit access to new aspects of the external reality.

In a slightly more formal way, there are two views as to what a creative process may lead to. The most widespread view suggests that the process of creation is targeted to the solution of a problem more or less clearly stated. According to this view, there is a symbolic space and the solution is a point inside that space (Newell and Simon 1972; Wagner et al. 2004; Dijksterhuis and Meurs 2006; Kounios and Beeman 2009). On the contrary, an alternative view suggests that the process of creation may single out a new aspect of the problem that no one had envisaged before. Thus, the solution is obtained only expanding the semantic solution space. The first option reduces creativity to the ability to recombine the existing symbols and then to locate a solution. The second option suggests that creativity might require extending the semantic space to new orthogonal dimensions.

In this regard, Arthur Schopenhauer stated that talent hits the target others cannot hit while genius hits the target others cannot see. The abovementioned dichotomy is clearly addressed by cognitive science and AI in most available models of cognition (Pfeifer 1999; Russell and Norvig 2003). Problem solving is perhaps one of the best examples. A conceptual domain is more or less well defined and constrained. The cognitive agent has to isolate the best option inside a predefined but unexplored solution space. This is consistent with Schopenhauer's understanding of talent. Yet, it is still a far cry from geniality. In fact, geniality in art or science is often correlated with the expansion of the conceptual domain to unbeknownst new dimensions. In human creativity, the capability to access to radically new semantics is key.

Thus, it is not surprising that the result of creative thoughts often defiled and challenged their owners. Creativity may lead outside the scope of the original conceptual space. Incidentally, Max Planck is known to have fought long and hard in his mind against the consequences of his own quantum concept. The statistical and indiscriminate nature of much of modern physics was not to his liking—that is the penalty of greatness. Sometime, the outcome of creativity may go against everything had been defined so far. This is clearly related with Thomas Kuhn's doctrine of scientific revolutions (Kuhn 1962). However, here we are not concerned with its epistemological meaning, but rather with its mental underpinnings.

Borrowing again from Picasso, to understand creativity, it is mandatory to understand how the mind may expand to new conceptual spaces not reducible to previously settled ones. It is a fact that disciplined insight came first, and the application of more formalized analysis afterwards. Essential as the latter is, momentous advances usually begin with remarkably simple premises and correspondingly narrow conceptual domains.

To recap, it seems that there are two contrasting notions of creativity—symbolic recombination versus semantic extension (Fig. 1). As to the former, the creative process is self-contained and consists mostly in the fastest way to find a solution inside an already defined conceptual framework. As the latter, creativity is the mental capability of peering beyond its current limitations and hence to expand to something potentially contrary to everything achieved so far. This capability is semantic in nature in the sense that it allows to refer to new meanings and state of affairs.

In this paper, we will address a rather speculative idea—namely that James' notion of fringe may model some of the creative processes singling out new aspects of reality. Furthermore, we will suggest that this role of the fringe may be better understood adopting an externalist approach as to the mind. In this way, it will be possible to envisage how the mind may expand to new concepts thereby addressing the semantic aspect of creativity. In short, the "semantic extension" model of creativity is connected to an externalist approach to the mind because externalism shows a way to address the semantic aspect of the mind. Thus, externalism shows how the innovative aspects of creativity may target new findings in terms of the dynamic and physical coupling between the subject and the external world.

2 Fringe, creativity and the external world

If creativity is related to a new, original and significant idea or action, it is fair to maintain that it must depend on a mental activity, a cognitive restructuring or an insight (a mental restructuring that generates a sudden gain of explicit knowledge

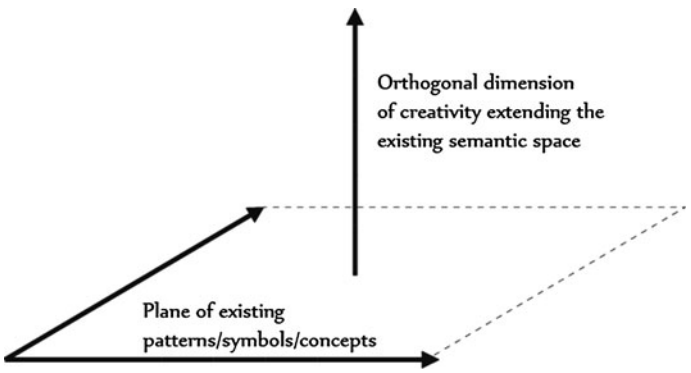

Fig. 1 Creativity does not take place inside the available semantic space

allowing a different qualitative behavior, Wagner et al. 2004: 352) that takes place in a specific person's mind/brain. However, it has to be stressed that such cognitive restructuring has the power to address new targets in the surrounding worlds. In this section, we will consider whether James' notion of fringe (Lavazza 2008; Topolinski and Strack 2009) may help to understand how the mind may grasp something that lies outside its current focus. In fact, the creative solution cannot be the target of attention since, as a matter of fact, the solution is not yet available.

Thus, a creative process brings inside the scope of consciousness something that is not there. The role of the fringe is similar—it mediates the shift from an unconscious domain to a conscious one (Mangan 1993a; Topolinski and Strack 2009). It is clear that here we adopt a realist position with respect to what creativity may lead one to discover. The target of a creative insight may be either a perceptual form or an abstract thought—in either case; it is a state of affairs in the outside world that becomes part of the mind.

At the onset, we outline a few aspects of creativity that may be of some help in addressing the issue. First, creativity seems to be made of various phases—incubation being one of the most significant (Boden 2004). Secondly, most authors agree that the most relevant part of processes leading to a creative act are indeed unconscious and thus more likely related to parallel processing than to sequential thought. Third, creativity is not just recombination of existing symbols inside an available domain. On the contrary, it requires a semantic expansion of the solution space. As we will see below, all these findings are consistent with the hypothesis that there is a relation between fringe and creativity. Therefore, to understand creativity, it is necessary to unsnarl the knot between conscious processes, insight, semantics, and cognitive processing. Each of these factors seems to play a relevant role. The fringe may help us since it is a notion that is aimed at describing the fuzzy area between conscious and not conscious content.

A classic model of creativity were developed by Csikszentmihalyi (1990, 1996) who outlined the flow theory as the interpretative key of the psychology of discovery and invention. First of all, he points out the five phases that are usually used to describe the creative process. The first phase coincides with the preparation period: immerging oneself, more or less consciously, into a group of problematic themes that stir up interest and curiosity. The second phase is called the incubation phase, during which ideas are tossed around below the threshold of consciousness. Unusual connections will probably be formed in these moments. "When we intend to solve a problem consciously, we process information in a linear, logical fashion. But when ideas call to each other in their own, without our leading them down a straight and narrow path, unexpected combinations may come into being" (Csikszentmihalyi 1996, p. 79). The importance of the incubation phase is underlined by the many accounts of the authors of discoveries who only remember a sudden insight in the nature of the problem but no intermediate mental stage between the approach to the case and its solution. Incubation, therefore, seems like a necessary interval—with unknown characteristics—of the conscious process. The third stage is marked by genuine intuition, the so-called "Eureka" phase, that can manifest itself several times between the incubation and reflection phases. The last two phases are more connected to the social context, as they involve the insight's

evaluation (whether it is significant or not) and elaboration (hence developing and formalizing insight).

Rejecting the Freudian interpretation of the repression and sublimation of sexual stimulation, incubation has to be explained in cognitive terms. The basic assumption is that some form of information processing occurs in the mind even when we are not aware of it. A classic example is offered by the (anecdotal) case of the chemist Frederich August Kekulé von Stradonitz (1829–1896) that explained that his insight as to the ring shape of the benzene molecule was the result of a day-dream of a snake biting its own tail. This vision, he said, came to him after years of studying the nature of carbon–carbon bonds. And anecdotal evidence for incubation is abundant (Koestler 1964; Schooler and Melcher 1995; Claxton 1997). Thus, incubation is some kind of cognitive processing that does not require explicit conscious awareness. Incubation is the process whereby any form of conscious thought is followed by the setting aside of the problem itself. Subsequently, an idea or solution manifests itself without a new conscious thought being focused on the problem (Bowers et al. 1990).

Recent experiments also prove that sleep can favor insight through restructuring previously accumulated mnemonic elements. But this only happens if there has been a specific training (Wagner et al. 2004). In unconscious processing rational control does not censure unusual or bizarre connections; the apparently irrelevant ones disappear and are forgotten, others with stronger aspects last long enough for them to become conscious.

Schooler and Melcher (Schooler and Melcher 1995) suggested that distraction can lead to "set-shifting." People often approach a problem with the use of wrong cues, wrong heuristics and/or wrong information. A period of distraction causes such wrong approaches to become less accessible or to be forgotten altogether. The effects of distraction on a change of mental set can be both strong (such as when one tries to solve a chess problem and initially gets truly "fixed" in thinking along a wrong line) and fairly subtle. Putting a problem aside for a while allows for a fresh, unbiased new start: "But explaining effects of incubation in terms of set-shifting makes the role of the unconscious merely passive. The term incubation suggests more, though. It suggests that the unconscious also "actively thinks and contributes to solving a problem" or to create something (Dijksterhuis and Meurs 2006).

Unconscious thought is hypothesized to work "bottom-up" and is relatively insensitive to highly accessible cues. It allows to consider a higher amount of content and create links in the style of the diverging thought between them, overcoming the limits of conscious thought (Wilson et al. 1989, 1993; Wilson and Schooler 1991; Schooler et al. 1993; Schooler and Melcher 1995).

So far the main focus has been on aspects linked to decision and choice (Dijksterhuis and Meurs 2006) without considering the complementary contribution of the use of the theoretical framework provided by the concept of fringe consciousness. The recent studies on implicit learning (Norman et al. 2006) are based on this. Implicit learning is the learning of regularities in the relationship between stimuli in the perceptual environment, in the absence of explicit awareness of the nature, or sometimes, even occurrence, of those stimuli relationships. In other words, "implicit learned information that it is not in itself introspectively accessible to consciousness can give rise to consciousness feelings or 'intuitions' that act as

metacognitive summary of aspects of implicit information", Norman et al. 2006). The interesting aspect of this research is that an empirical correlation was found between the effectiveness of the task (participants were asked to make fast key-press responses to a series of visual targets whose locations follow a structured sequence) and the degree of Openness to Feelings, subscale of the NEO-PI-R (Costa and McCrae 1992). The variability in this personality measure, chosen to reflect the ability to introspect on fringe feelings, influences both learning and awareness in the serial reaction time test.

Even if they are considered preliminary results—to be replicated—these are the first attempts to empirically correlate the listening capacity of one's fringe with implicit learning. One could thus think of extending the test to the so-called feeling of knowing (FOK, an individual may fail to recall an item from memory but still feel that it would be recognized on a later test), a general category that can include the phenomenon of the tip of the tongue (TOT).

Along this line of thought, we could possibly assume that—like sensorial data, that is capable of reactivating and making the galaxy of episodes linked to a particular moment of the past conscious, "recuperates" and connects elements of the "unconscious" episodic memory—"creative" or "innovative" mental procedures can also exploit a similar mechanism to create a "horizontal" link between cognitive contents. In other words, the same neo-Jamesian scheme can be tested as an explanation of creativity, discovery and intuition. A theory that, for example on the level of empirical verifiability, may turn to brain imaging, but also to experiments through which one can value how much the variation of the sensorial-cognitive stimulation can influence the *moments bienheureux* of invention or discovery.

The importance of fringe lies in offering a working model of the shift from an unconscious to a conscious domain. The unconscious domain is not necessarily already embedded inside the agent neural structure. Neural rewiring may be necessary but the accessed content is not necessarily already inside the system.

The "freer" we allow the neuronal paths to be in the described scheme, the more new conscious connections can be created. A conscious experience requires an intentional object of some kind and thus there is a strong relation between building new connections and building new semantic links with the world. The signs and sense of direction described by James (and by Mangan 1993a, b, 2008) as being typical of the current of thought seem to precisely be markers of the creative process inside specific and special circumstances. Thus, the fringe is also projected towards the unknown—to some extent towards the external world. According to James (James 1890, p. 253), the assumption is that a third of our life consists in these rapid, premonitory, not yet articulate ways of seeing schemes of thought in perspective. In what way the sense of "right" leads down unexplored paths is still an open issue. Yet, these paths may lead to new target in the outside world .

3 Externalism and creativity: insight versus outsight

We may now try to merge the notion of creativity with an externalist perspective. As it will be clear, this move will extend naturally to the notion of fringe as a way to model the acquisition of new mental concept. On one hand, the fringe models the

interplay between various aspects of the mind—some of which key for creativity. More speculatively, the fringe may model the intermediate zone between the mind and what is not yet mental. In this regard, an externalist approach suggests that the mind is actually extended to various extent to the environment (Noë 2004; Manzotti 2006, 2011; Menary 2010). If this view has any merit, the fringe would be likely to model the part of the world, which is in the process of being embedded into a mind.

Of course, this does not rule out that the fringe has neural underpinnings. In fact, there have been findings showing that there are neural correlates of the fringe (Epstein 2000; Galin 2000; Epstein 2004; Norman et al. 2006). In particular, Epstein stressed that the fringe is connected both with the TOT and with the feeling of knowing something. The fringe would thus allow solving the contrast between a partially unconscious smooth flow of experience and the discrete and sequential nature of conscious experience. In fact, since James many authors have emphasized the fact that consciousness seems to be structured in a series of discrete unities rather than being a seamless continuous field: "Either your experience is of no content, of no change, or it is of a perceptible amount of content or change. Your acquaintance with reality grows literally by buds or drops of perception" (James 1911).

These "buds or drops" would correspond to the nucleus of the mind and the fringe could be the process by means of which the world singles out that unity that we refer to as an individual mind. In this regard, James stated that "The unity—into which the present mental state binds the individual past facts with each other and with itself—does not exist until the thought is there" (James 1890).

A common misconception as to externalist views is that they discard neuroscientific findings. This is far from the truth. In fact, externalism does not set aside neural activity. On the contrary, neural activity is the mandatory causal nexus allowing to various the entanglement of environmental causal chains. In this respect, it is enlightening that the processes usually connected with insight are those taking place in the right hemisphere, which correlates with the processing of visual information. There is evidence that the right hemisphere plays a unique role in insight (Bowden and Jung-Beeman 2003; Kounios et al. 2008). Therefore, we have multiple correlations: to a certain extent, fringe and insight seem to share common underpinnings.

If we consider our neural activity as a way to peer into a vastly unknown world, being creative may be equated to a way to see more things. By restructuring our cognitive gears during incubation, our brain would developed the capability to see things that would go otherwise unnoticed. The Eureka moment, or *Aha-Erlebnis*, would thus be the exact time in which finally we see something that leaves us surprised. Externalism would thus explain why the conscious epiphany is necessary. In fact, the incubation process would not create the content we refer to, but rather it would be the phase in which the system constructs the tools to see something. Eventually, the subject gets into contact with something new—that is the time when the subject has the insight.

Consider a perceptual example. You listen to classical music but you are unable to appreciate the subtle variations of Bach's Prelude of Cello Suite No. 1 in G. You keep listening to it, though. After some time you get absorbed by other topics and

you forget it. Yet, because of your prolonged attention, inside your brain there is a neural and cognitive restructuring going on (likely in the right hemisphere). Somehow the process of incubation is working. However, this does not mean that you hear literally the subtle variation in Bach's prelude. You are getting ready to listen to them, though. Eventually, you listen to a wonderful execution and, in that very moment, you have an epiphany. For the first time in your life, you may hear those patterns.

The perceptual example just mentioned is useful since it allows contrasting in a rather sharp way the restructuring of cognitive processes with the moment in which the cognitive gears is actually put to good use. Without the actual listening to Bach there would be no perceptual insight. The external world is thus constitutive of the creative process which consists mainly in a perceptual reconfiguration. In many respect, this approach is akin to the Gestalt spirit.

What about non perceptual cases of insight? Like when you devise the solution of a mathematical theorem or when you understand who had been the murder in a complex narrative plot? Is it still possible to single out the moment of actual conscious experience of the insight? We may list a few issues.

First, it is a fact that there is a strong, perhaps necessary, connection between insight and consciousness. An insight has to be a conscious insight. As such it could be argued that the act of having an insight must have an object and a phenomenal content (although it has been maintained that the two are the same, Manzotti 2006). Assuming that the matter of the phenomenal content is settled, at least for the sake of discussion, what about the object? What is the object of an insight? Is it a purely mental object or is it a state of affairs in the world. Here, without being able to properly discussing the issue, we claim that it is a state of affairs in the world. When the abovementioned Kekulé von Stradonitz had the vision of the self-biting snake (which is a common symbol that he may have likely seen somewhere), it was the outcome of years of carbon–carbon bonds study. In other words, the insight came to him with a precise phenomenal content. Furthermore, the insight was related with other perceptual experiences.

Creativity realizes a "transition from unconscious mental operations to consciously experienced outputs" (Topolinski and Strack 2009, p. 609). Yet, it is not enough to consider the switch from unconscious mental content to conscious thought. In fact, creativity realizes a transition from what is not yet inside the mind (both conscious and unconscious) to what is already inside the mind. In this sense, the insight ought to be more properly called an *outsight* since it stretches the mind beyond its current limits. Here we want to stress the semantic side of creativity that is not just an arbitrary internal recombination but it allows grasping something that was unavailable.

As to not perceptual content, a view that may endorse the view presented here is Zeki's theory of creativity as perception of ideal forms (Zeki 2000, 2001, 2002). Zeki claims that our brain has two main aims: economy and efficiency. To achieve both objectives, the brain develops prototypes that merge together many different particulars and that corresponds to higher and higher level of abstraction. Such higher levels of abstractions are akin to the ideals that artists strive to embody into artworks—they are the targets of their creative process. The hypothesis is consistent

with recent findings that show a substantial uniformity in the algorithm implemented in different cortical areas (Sur et al. 1999; Dileep 2008; Bullmore and Sporns 2012). This homogeneity suggests that between art and other forms of knowledge there may be a lot in common. Zeki's view may be interpreted in a realist fashion. Namely, it suggests that even abstract thoughts may have an external counterpart in reality in terms of complex relational structures between events or states of affairs. In fact, it has been suggested that the perception of an abstract form is simply the ability to perceive a class of particulars as a whole (Zeki 2000).

A by-product of Zeki's theory about ideal formation in the brain is that artistic creativity is a kind of perception by means of which the artist actually perceives what he or she eventually tries to express through artworks. By and large, this view is consistent with the idea that creativity has a semantic aspect. Creativity is thus the capability to expand the sphere of semantic reference and perceptual objects.

Creativity establishes unexpected links between consciousness and both the cognitive unconscious and the external world. The fringe is a somewhat dynamically changing zone modeling the context in which creative thoughts take place. Although it is impossible to outline satisfactorily the cognitive underpinnings of the fringe (Epstein 2000; Dresp-Langley and Durup 2009), it is worth to stress the connection with dual systems theories (Evans 2003, 2008). According to these theories (cf. Kahneman 2011), there are two cooperating and competing cognitive systems: the first system that implements fast, automatic, and unconscious and the second system that implements processes slow, deliberative, logic and conscious processes. Such a separation is relevant because it suggests that the two systems may play different role as to creativity. The first system may have a greater role during the incubation phase. Yet this is not certain since the correlation between consciousness and the cognitive processes of the first system is not conclusive. For instance, there is evidence of implicit unconscious reasoning. We are not going to enter into this debate. What concern us is that there may be a connection between semantic expansion and the interplay between the two systems. In other words, while creativity entails a semantic expansion, the two systems are responsible for accessing different kinds of semantic content. Namely, the first system will access perceptual content while the second system will address higher order content. However, both systems will contribute to the global semantic space. This will be consistent with two further approaches—namely the global workspace theory (Baars 1997; Baars and Franklin 2003) and the idea that consciousness may corresponds to an intermediate cognitive level (Haugeland 1998). In other words, consciousness may result from the bottleneck between the two systems—a bottleneck likely due to memory constrains, limited access bandwidth and control-architecture requirements. This location will explain while consciousness is able to access both higher order thoughts and low-level phenomenal content.

The above cognitive architecture will be consistent both with the semantic side of creativity and with incubation. In fact, in such an architecture, both high order, logic, linguistic processes and low-level, experiential, perceptual processes may take place unconsciously thereby explaining why creativity may benefit from unconscious activity at all level (Wagner et al. 2004). Furthermore, such an architecture will also suggest different ways in which creativity may expand the

available solution space: on one hand by increasing the conceptual dimensionality through the first system and on the other hand by extending the perceptual grounding through the second system. However, both systems will be ground in the external world and will constitute a cognitive whole by means of the unifying action of the conscious bottleneck.

4 Conclusion

Consider two examples of mathematical creativity. In the first case, a student has to find a solution to a difficult algebraic problem. The student may apply all known rules and the solution lies somewhere inside the huge solution space offered by traditional mathematics. In the second case, consider the invention of imaginary numbers. They allow the solution of otherwise intractable mathematical problems but at the cost of expanding the original solution space. Creativity is involved in both cases, but there is a clear difference between the two. The former does not emerge from the original solution space, while the latter reaches a new state of affairs in the world (all those situation that may be conveniently modeled by imaginary numbers). Yet, even the second case is not a totally arbitrary addition to the original space. In fact, if one could arbitrarily add new rules, it would be possible to solve any problem simply by imagination. This is not the case. There is a sort of creative imagination that is able to provide new rules and a new solution space that have some sort of coherence with the external world.

In this paper, we have considered the often-neglected relation between semantics and creativity. We have suggested that creative processes have a syntactical side and a semantic one. Each of the two sides depends on the other. There is no creativity without either internal cognitive or syntactical restructuring. Likewise, there is no creativity without accessing some kind of validating external meaning. External meaning is the ultimate criterion for any internal syntactical symbolic reshuffling. Finally, we have considered the role played by the fringe. The fringe helps to model the transit from the world to the conscious sphere—the fringe being the intermediate area that is not yet available to conscious thought and yet offers the proper context. Thus, there are four domains (partially overlapping): the consciously available contents, the fringe zone, the cognitive unconscious and the external world (which is the ultimate source of meaning in an externalist perspective). Creativity is a complex phenomenon crossing the boundaries of these domains.

The traditional term to refer to the act of creation is “insight”. Yet, such a word is slightly ambiguous since it may mean either to look inside things or to look inside oneself. In fact, an insight is something that one reads inside oneself. With a pun, we may suggest that a better word may be *outsight* to stress that any act of creation must look outside oneself. We create when we see something that we weren’t able to see before. We don’t make creations, we find them.

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