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Innovative scaffolding: Understanding innovation as the disclosure of hidden affordances

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RESUMEN

Los estudios sobre innovación han prestado mucha atención a sus bases cognitivas. Esa perspectiva corre el riesgo de caer en los supuestos internalistas tradicionales. Nos oponemos, pues, al contraste entre el procesamiento cognitivo interno y las prácticas y tecnologías públicas externas que dichos sistemas cognitivos producen y usan. Sostenemos que la innovación se entiende mejor desde la noción gibsoniana de *affordance*, y que muchas prácticas innovadoras emergen del *scaffolding* externo de procesos cognitivos. El carácter público y participativo que permite sacar a la luz *affordances* escondidas no es solo propiedad de los productos cognitivos, sino de procesos cognitivos. En nuestra propuesta, recurrimos a la teoría de Dutilh Novaes sobre los lenguajes formales como tecnologías cognitivas y a la teoría de Hutto acerca de las prácticas narrativas. Esto allana el camino para bosquejar algunos principios generales acerca de cómo perseguir estratégicamente la innovación rastreando affordances ocultas.

PALABRAS CLAVE: Innovación, *affordances*, *scaffolding* cognitivo.

ABSTRACT

Much attention has been drawn to the cognitive basis of innovation. While interesting in many ways, this poses the threat of falling back to traditional internalist assumptions with regard to cognition. We oppose the ensuing contrast between internal cognitive processing and external public practices and technologies that such internal cognitive systems might produce and utilize. We argue that innovation is best understood from the gibsonian notion of affordance, and that many innovative practices emerge from the external scaffolding of cognitive processes. The public engageability that allows the disclosure of hidden affordances is not only –not even primarily– a property of cognitive products, but of cognitive processes. We elaborate on this claims by drawing on Dutilh Novaes' account of formal languages as cognitive technologies and Hutto's Narrative Practice Hypothesis. This paves the way to sketch some general principles on how to strategically seek for innovation by targeting hidden affordances.

KEYWORDS: Innovation, affordance, cognitive scaffolding.

1. INTRODUCTION

Although innovation has been long held to be a multifaceted and complex phenomenon, the academic interest on innovation, driven by economic and managerial concerns, was once dominated by accounts focusing on the social and organizational determinants of innovation. Such an scenario is changing, though, as the spotlight is being shifted from the external factors of innovation to the internal ones (Clapham, 2003; Shavinina and Seeratan, 2003; Simonton, 2003; Sternberg, Pretz and Kaupfman, 2003). Shavinina and Seeratan clearly illustrate this ongoing trend: «A growing body of literature suggests that innovation originates from within the individual, that is, from his or her new idea(s). Various definitions, models, and theories of creativity and innovation include the 'generation of new ideas' as one of their components» (2003, p.31).

Much attention has been drawn to the psychological processes that underlie innovation (Kaufmann, 2003; Root-Bernstein & Root-Bernstein, 2003; Weisberg, 2003), and even to the neurophysiological basis of innovation (Vandervert, 2003). While interesting in many ways, this poses the threat of falling back to traditional internalist assumptions with regard to cognition. Until recently, and without denying that the external world plays an important role in mental phenomena, cognition has been commonly approached as a set of internal structures and mechanisms whose operations are explanatorily autonomous from the world, shielded by some sort of sensorimotor interface. The ensuing opposition of internal and external factors is visible in the way Shavina and Seeratan frame their desiderata for research on innovation:

> There is a need for a new direction for research that considers individual innovation as the sum of its two important aspects: its external manifestations and its psychological basis. (…) From this fundamentally changed viewpoint, scientists should study an individual's mental or cognitive experience—more precisely, the specificity of its structural organization. We assert that the individual cognitive experience is the psychological basis of individual innovation (2003, p.32).

We oppose such contrast between the internal cognitive processes leading to innovation, on the one hand, and the innovative uses of external resources, public practices and technologies that such internal cognitive systems might enable, on the other hand. Far from being clearly distinct dimensions of innovation, we believe that internal and external factors are deeply intertwined in any feasible explanation of

innovation, and that to equate internal with cognitive factors and external with noncognitive, social or organizational factors is misleading. Despite how tempting it might be, the divide and conquer strategy of isolating either the internal or the external rests on an assumption of organismic 'boundaries of cognition' which should not be taken for granted, as it is nowadays reasonably contested (Clark & Chalmers, 1998; Hutchins, 1995; Menary, 2007, 2010; Sutton, 2010).

2. INNOVATION AS THE DISCLOSURE OF HIDDEN AFFORDANCES

Innovation is characterized in many ways across the literature (Fagerberg, 2004). Some authors opt to take a broad approach. Shavina and Seeratan claim that «many innovation scholars —including us— would agree (…) that innovation is the generation, acceptance, and implementation of new ideas, processes, products, or services» (2003, p.32). Whether we take such a broad notion of innovation or a more technical one, such as that presented by Sternberg, Pretz and Kaufman (2003), it stands to reason that innovating has something to do with the employment of previously unused or rarely used resources and strategies to alter some aspects of a certain situation. For that to be possible, the situation itself has to fulfil an objective condition: it has to provide the agent with some possibilities for action that were not actually in use prior to the innovation (or at the very least, not in a regular manner). This condition obtains both if the possibilities previously provided by the situation were not actually in use and if they simply were not there (i.e., if they genuinely appear with the innovation).[1]

The crux of the matter is not whether this condition is fulfilled by 'internal' or 'external' means, but that if the word 'innovation' is to refer to something else than a very subjective appraisal of the value of an action course, it has to involve in some way the existence of unactualized possibilities for action. Those possibilities, in turn, have to be both adequate to the agent's capacities and skills and independent of his or her understanding of the situation at any given moment. While the realization of the possibilities may depend on 'subjective' conditions (i.e., it may require awareness or even deliberation on the side of the agent), the possibilities as such are independent of the agent's perception.

We believe that the gibsonian notion of affordance (Gibson 1977, 1979) fits wonderfully in place here.[2] Gibson's affordances are defined as objective relational features of an environment, considered with regards to a specific agent or kind of

[1] However, it is not necessary to go into metaphysical questions about novelty to follow our argument.
[2] Not to be confused with Norman's (1988) early use of the term "perceived affordances". A clarification of the uses of the term can be found in McGrenere & Ho (2008).

agent. They are, in a sense, ready to be used by the agent, but their being there does not depend on what the agent ultimately does. For instance, the presence of a fruit at a certain place can afford humans in the neighbouring area the possibility of grasping it and eating it. The graspability and eatability of the fruit does not depend, however, on any human actually doing anything at all: most affordances do, in fact, stay unused. Besides, not all affordances are as "natural" as the graspability and eatability of ripe fruits. We will encounter examples of this kind below.

Obviously, the mere fact of it involving affordances does not make a situation suitable for innovation. For innovation to appear, at least some of the resources or strategies used (i.e., some of the actions afforded by the situation and actually performed by the agent) have to fulfil two already cited further conditions: that of contributing to deliberate problem solving, and that of not being usually employed. Grasping an apple may help solve a problem, but it is not an example of innovation unless one does it in a very non-standard and yet advantageous way.

Luckily, Gaver (2011) defines a subcategory of affordances that automatically meets this condition: hidden affordances. A hidden affordance is an affordance which remains unperceived by the agent due to a lack of directly related available information in a certain situation; its existence, however, can be inferred from other evidence.

Keeping close to this definition we can further specify two kinds of hidden affordances. The first kind includes those affordances which are neither actually in use nor properly perceived as such prior to their explicit discovery, but which can be considered, however, to have been implicitly perceived before that, such that e.g. the agent just has to single out some properties that were perceptible but not salient to visibilize the affordance. A wooden chair, for instance, can be used as fuel for a hearth fire in some situations, but this 'comfort-providing flammability' tends to remain undetected.

In contrast to hidden affordances of the 'chair-burning' kind, there are some occasions in which an affordance is not just not salient, but hidden in a stronger sense. In many of these cases the hidden affordance exists as a result (either wanted or unwanted) of a goal-oriented design of some kind. The paradigmatic case is that of the room containing a secret door: by gibsonian (and graverian) standards, the presence of a secret door affords any person in the room the possibility of walking through it. Unearthing this affordance, however, involves a lot more than 'singling out' unobvious properties, as the idea of a secret door implies the presence of deliberate concealing mechanisms.

Of course, this is an intuitive distinction, which admits a lot of in-between situations and does not intend to 'carve nature at its joints'. It could be argued, for instance, that in the case of organic matter natural selection can function as something akin to a design, and even account for the presence of concealing mechanisms. Besides, many situations which do not imply any kind of concealment are still far from the mere 'low salience' of chair-burning affordances. We believe, however, that hidden affordances broadly following under the 'secret-door' description are those more interesting for the study of innovation. While it can occasionally lead to innovation, the unmasking of chair-burning affordances is usually more directly related to other kinds of progress, such as the fine-tuning of previously existing strategies and mechanisms. Secret-door affordances, on the other hand, can be used to explain most of the paradigmatic cases of innovation, in which both the acquisition of truly new information and a conscious search for unnoticed structures and elements of a situation are involved.

Even if the distinction between 'internal' and 'external' resources is not crucial to the analysis of innovation and can be beneficially avoided in many cases, there is a coincidence between those situations matching our 'secret door' scenario and those described in some of the extended cognition literature. Many of the cases traditionally labelled as 'scaffolding' are at least very good candidates for 'secret-door-like affordance hunting', as they involve both goal-oriented activity and the kind of designed, complex objective situations in which aspects leading to the appearance of relevant affordance may remain undetected by an agent.

In the following sections, we will assess two crucial cases of innovation on our cognitive capacities and processes, in which innovation appears through the detection of previously hidden, 'secret-door-like' affordances of scaffolded cognitive practices.

3. THE NARRATIVE PRACTICE HYPOTHESIS

We believe that Hutto's Narrative Practice Hypothesis (NPH) offers a highly paradigmatic example of the 'secret-door-hunting' kind of innovation presented in the previous section, and at the same time provides some hints on the general strategies that can be used to promote further innovation of the like. Hutto offers an account of the human capacity to understand reasons for action that stands in direct contrast with the more widely known proposals, Theory Theory and Simulation Theory. According to the NPH, the ability to understand reasons is ontogenetically and phylogenetically posterior to the ability to use language in advanced ways (Hutto, 2008: 129-142,

233-243), and does not depend on the existence of neither interiorized, contentful 'rules and principles', nor any internal module specialized in simulating reason (Hutto, 2008: 61-63). Furthermore, Hutto denies the necessity of postulating any mechanism akin to Fodor's Language of Thought (Hutto, 2008: 88-95), and with it the plausibility of the idea of propositional content being involved in the most basic forms of cognition. Instead, the role of conveying propositions is exclusively fulfilled by human language itself, and the basic capacity to interact with one another's motives and reasons is acquired through the agent's immersion in second and third person narrative practices, such as storytelling.

According to the NPH, mature folk psychology and the recognition of reasons for action are, in a certain sense, a by-product of the structure of advanced language: while early hominids and children are able to involve in relatively complex cognitive tasks through the use of non-(propositionally)-contentful intentional attitudes and with the help of retention and imagination, the use and understanding of reasons is made possible only after the complexities of a fully developed grammar is available.

Although Hutto does not use this description himself, we can characterize his account appearance of folk psychological abilities as an example of innovation through the unearthing of secret-door affordances. If his explanation is right, the possibility of using the kind of logical, combinatorial resources needed to understand proper reasons for action was already implied in the symbolic structure of fully developed human languages well before the use of socio-cultural narrative practices made Folk Psychology as we understand it now appear. Such an appearance was as late as between 60000 – 30000 BC, i.e. not amongst early hominids, but at the moment of the cultural bloom of homo sapiens. And, as with any culturally-based species of cognitive scaffolding, the long-term development of these practices surely required an effort in deliberate research and experimentation, without which the potential afforded by the use of language in narrative situations would not have been determined at such fine-grain level.

This suggests also the salient possibility that this development is still occurring at some level today. While it is a fact that most human communities are now able to use folk psychology to understand proper reasons and explain actions, it is reasonable to suppose that the specifics of modern narrative practice (and any number of supplementary activities, such as scientific inquiry) still have an import in defining what it is to 'understand reasons' in a proper way. With regard to this we believe, again, that the exploration of the uses of language, its different vehicles, and very specifically the

investigation of basic narrative forms is a privileged example of the practice of secret-door affordance hunting.

4. FORMAL LANGUAGES AS COGNITIVE TECHNOLOGY

A second illuminating episode of cognitive innovation, later on the cultural development of humanity, is the development of formal languages as cognitive technologies. In her recent book *Formal Languages in Logic* (2012) Catarina Dutilh Novaes argues that «reasoning with formal languages and formalisms can have a truly mind-altering effect; it may allow human agents to counter some of their most deeply engrained cognitive biases, such as the tendency to rely on and seek to 'hold on' to prior belief» (2012, p. 248).

Human reasoning tends to doxastic conservativeness. We typically display many biases that have to do one way or another to the tendency to take our previous beliefs to bear in reasoning. Deductive reasoning serves to counterbalance such doxastic conservativeness. The development of deductive reasoning in dialogical practices of adversarial communication, where the role of each contender is to try to rebut the claims that the other advances (Mercier and Sperber, 2012; Dutilh Novaes, 2013) is in itself a very interesting case of cognitive innovation through scaffolding. The social distribution of the roles of constructing arguments and evaluating arguments makes balanced reasoning emerge from the group. But Dutilh Novaes' focus is more specific. She takes the development of formal languages on the wider context of the development of mathematical notations and, more generally, of writing systems, which was guided by the search for more efficient tools for calculation. From here she argues that «formal languages are an even more powerful debiasing technology to counter doxastic conservativeness in specific contexts» (2012, p. 159).

The role of formal languages in reasoning, according to Dutilh Novaes, is best understood from a framework that rejects absolute divides between internal cognitive processing and external resources, such as Sutton's 'second-wave extended cognition' (2010) or Menary's 'cognitive integration' (2007). This claim is backed with empirical evidence from the neuroscience of reading and writing, and from results by Landy and Goldstone (2007) that show how sensorimotor processing is crucial in dealing with formalisms, or to put it more crudely, that formal reasoning is mostly about "pushing and dragging symbols".

> From an extended cognition point of view, manipulating formal languages and formalisms is constitutive of the cognitive processes in question; as such, the

> perceptual properties of a formalism become crucial in that these manipulations are bodily engagements which elicit sensorimotor systems in human agents. Moreover, I have argued that this externalization of reasoning processes does not only extend the mind; it actually alters the mind, albeit perhaps temporarily, in that it allows the reasoning processes to run on a different software, as it were, countering some of the well-documented reasoning biases. (Dutilh Novaes 2012, p. 196)

The upshot of formal reasoning is its debiasing effect. This is achieved in virtue of the de-semantification inherent in the formalization. Sometimes debiasing is also due to 're-semantification'. That is, «the possibility of applying a given formalism, which is developed against a specific background, to a different problem, phenomenon, or framework» (Dutilh Novaes 2012, p. 7). This effect is most relevant when logical or mathematical apparatuses are used as tools for scientific inquiry, as formal reasoning increases the chances to come to unexpected results. When squared within a suitable cognitive framework, this amounts to the externalization and automatization of the reasoning process, is compellingly cast in a famous quote by Whitehead, which sees in this phenomenon a major vector of human innovation:

> [B]y the aid of symbolism, we can make transitions in reasoning almost mechanically by the eye, which otherwise would call into play the higher faculties of the brain. It is a profoundly erroneous truism […] that we should cultivate the habit of thinking what we are doing. The precise opposite is the case. Civilization advances by extending the number of important operations which we can perform without thinking about them. (Whitehead, 1911, p. 61).

5. CONCLUSION

Both the development of Folk Psychology through narrative practice and the development of formal reasoning through linguistic and material scaffolding are not only highly paradigmatic examples of what we have called the secret-door hunting style of innovation, but also clear instances of proper cognitive innovation: the result of this scaffolded advances is precisely an enhancement of human cognitive abilities.

By focusing on the innovation processes underlying cognition, we aim to recast the cognitive processes underlying innovation in general into a different perspective. Innovation, we suggest, would be best understood as a scaffolded process of disclosure of hidden affordances. Although the cases discussed might seem to be very distant to current talk of innovation, one of the morals of the view we propose is that the gap between cognitive innovation and innovation in general is indeed not so big as it is typically believed.

First, with regard to the timescale, we must take into account that many of the processes of cognitive innovation that occurred thousands of years ago on the cultural evolution of the species, are still somehow reproduced on the individual level. Dutilh Novaes remarks this in the case of formal reasoning: «When it comes to deduction, we may say that ontogeny –the onset of deductive reasoning in an individual reasoner– to some extent recapitulates phylogeny –the historical emergence of the concept of deduction» (2013, p. 453). Something similar might apply to the development of folk psychology through narrative practices.

Second, although purely accidental innovation (i.e. that in which there was not even a deliberate intent to discover through experimentation) is surely possible in some cases and individual instances of innovative advances are not necessarily relevant to the cognitive capacities of agents, any general strategy for promoting innovation can be considered a cognitive resource in itself. In this sense, both of the affordance discovering strategies commented here ('chair-burning' and 'secret-door-hunting') are instances of cognitive scaffolding, as they use the environment and its properties to enrich the agents' knowledge and to solve problems.

Third, the blurring of the line distinguishing properly cognitive innovation and 'general' innovation is also, to an extent, the result of the very gesture of integrating the 'internal' and 'external' dimensions of the explanations of innovation. Inasmuch as we take transcranial aspects of a situation to be part of cognitive processes, innovations that seemed entirely non-cognitive before (such as a new way to handle a tool, or a new computer interface) can be seen as having a cognitive import.

Furthermore, we contend that in order to maximize innovation, ‘secret-door hunting’ strategies like the examples discussed illustrate pay off more than ‘chair-burning’ strategies, which are common in phases of technique refinement. That can be done in different ways. Making inferences and hypothesizing possible ‘secret-door-like’ hidden affordances is probably the best strategy to find them, but brute force experimentation with unusual actions could also work. That’s more or less what serendipity cases are instances of. This, of course, falls short of a recipe for innovation. But further research from the point of view here sketched could well develop more thorough guidelines for systematic innovation enhancement.

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