Reification and Cognitive Science

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* The ideas appearing in the paper have not been previously shared or presented at conferences, meetings or on websites

Abstract

This paper aims to show how many cognitive constructs within cognitive science are easily subject to a form of "reification", which is the (often implicit) belief that cognitive functions are "things" and, therefore, unitary, inherently enduring, and isolable both from their environmental conditions and from other cognitive functions. After introducing the notion of reification and its relevance to cognitive science, I will discuss how the reification process leads to cognition being seen as isolated from its environment and internally characterized by hyper-specialization (*reification in cognitive science*). Secondly, the paper highlights that this phenomenon has a cognitive-linguistic origin and that it strongly depends on the linguistic forms we use to describe cognitive functioning: different verbal labels lead to the belief that different substances exist (*reification explained by cognitive science*). Finally, I will show how some recent theoretical approaches and experimental discoveries suggest instead that the verbal labels we use to describe cognitive functioning (and some resulting dichotomies) in fact conceal processes that are extremely interconnected, interdependent and integrated. It will also be highlighted that some of these experimental data are considered "discoveries" precisely because the implicit starting points are characterized by over-categorization and de-contextualization (or at least interpreted based on these assumptions).

Keywords: reification, cognitive science, embodied cognition.

Public Significance Statement

The knowledge of cognitive science is dominated by a "metaphysical framework of substance", according to which cognition can be easily decomposed into single and separate substances, i.e. into different cognitive functions. In this paper, I show how this is at least partly due to the phenomenon of reification: the (often implicit) belief that to every noun corresponds a "thing" and, therefore, a unitary, inherently enduring, and isolable entity. The phenomenon of

reification is related to some linguistic practices that scientists often use, such as “nominalization”, i.e. the use of nouns instead of verbs. Since recent theoretical approaches and empirical evidence seem instead to suggest that the verbal labels we use to describe cognitive functions conceal processes that are extremely interconnected and integrated, this article discusses the importance for cognitive scientists to be aware of some linguistic practices that can easily have distorting consequences.

Introduction

In the first year of a psychology degree, students in a general psychology course are usually asked to study manuals that are structured according to a simple categorization: one chapter for each cognitive function. Thus, there is a chapter for 'perception', one for 'attention', one for 'memory', another for 'reasoning', and so on (e.g., Eysenck & Keane, 2020). The individual chapters are structured in the same way. The chapter on memory, for example, consists of different sections, each relating to a specific memory store (see the "multistore" model of memory, Atkinson & Shiffrin, 1968).

Although the pragmatic value of this categorizing approach is undisputed, and a different approach would probably not be as effective in introducing students to the general processes that govern the human mind, I would argue that this practice, more generally, is a good example of what often happens in cognitive research as well. This paper shows that the use of various categorical verbal labels to describe cognitive processes hides and causes a form of "reification", which is the idea of cognitive functions as independent and isolable "things" (Zahnoun, 2020). This linguistic contingency leads to the mistaken assumption that many cognitive systems distinguished by cognitive science correspond to "substance ontologies": the idea that cognitive functions exist as independent, isolable, stable, and enduring entities.

It has been emphasized that psychology, more than other disciplines that are "processes-oriented", is "stuck in pursuit of stable and universal entities" (Van Geert & De Ruiter, 2022, pp.14-15). This paper argues that this depends, at least in part, on the linguistic tendency to use categorical verbal labels to think about, study and communicate the findings of the cognitive literature. If such a praxis[1] is not object of critical discussion, it can have negative consequences, such as de-

[1] The term "praxis" here, as defined by Van Geert and De Ruiter (2022), refers to all the ways that scientists use to obtain, describe, and communicate their results.

contextualization, i.e. studying cognitive functions as if they were isolated ontologies, and over-categorization, i.e. creating arbitrary boundaries, often in the form of dichotomies.

What Is Reification?

In general terms, "reification" can be defined as "the process of regarding or treating an abstraction or idea as if it had concrete or material existence" (see Gunderson & Gunderson, 2006). Thus, the term "reification" has been used to describe the act of creating ontologies for abstract entities (the terms "thingification" or "encapsulation" are also used with a similar meaning, e.g., Dubinsky, 1991). By analyzing the etymology of the word "reification" (the Latin 'res' means 'thing'), it is possible to describe it as the act of "conceiving of something which is not a thing as a thing" (Zahnoun, 2020, p.81). In this view, 'things' are thought to be characterized by an independent spatiotemporal existence (i.e. finiteness in space and time), by physical properties (and thus observable), by classifiability and by causal efficacy. In philosophical terms, they are "substances", i.e. things that can exist on their own and are independent from other circumstances and contingencies (Smith, 1997).

The phenomenon of reification is a prevalent feature of cognition itself that is at play in different contexts. We tend to interpret non-substance entities such as processes, actions, events, rules, and norms as if they were "things". Reification is so pervasive in human cognition that it lies at the heart of some fundamental philosophical problems (for a discussion of reification in Heidegger's philosophy see, De Oliveira, 2012), and it is a crucial construct in political science and sociology (for a recent discussion see, O'Kane, 2021). For cognitive science, I will argue that a form of reification underlies the implicit assumption that drives both cognitive research and interpretation of results: the assumption that different cognitive levels and functions exist as 'things' and therefore are a-temporal, isolable and enduring.

To fully understand what reification is, before discussing reification in the context of cognitive research, I would like to introduce forms of reification that govern more general psychological constructs. First, reification processes seem to be linked to the construct of "self". In this view, reification led to the implicit belief that what we call "self" is a unitary substance, inherently enduring and independent of the variables and circumstances surrounding it (Dahl et al., 2015). What an extensive body of literature seems instead to suggest is that what we call "self" is rather a process, non-unitary and for some authors even a "metaphysical fiction" (Di Francesco & Francesco, 2013) or a "myth" (e.g., Metzinger, 2009). According to De Ruiter and colleagues (2017), the experience of the self is a higher-order process that results from the interaction over time between self-related experiences such as thinking, feeling and acting. What we call "self" is an intrinsic dynamic process that depends on other self-related components as well as the context, i.e. a self-organizing process that emerges from the interactions between multiple components, rather than an agent or a substance (De Ruiter et al., 2017)[2].

Recently, other constructs have also been discussed as being dominated by forms of reification, as the construct of "self-esteem". Van Geert and de Ruiter argued that in developmental research, this construct is studied and communicated as if self-esteem were a "thing", i.e. as a (measurable) substance rather than a process (2022). The conceptualization of self-esteem as a universal substance "is most broadly enacted when researchers reify self-esteem, meaning that an abstract thing is regarded as a concrete thing that exists universally. Self-esteem thus becomes a kind of 'thing', a thing that we all 'have'" (p. 65). Put in other words, "it is as if the person were the vessel for a plethora of substances, like vapors or liquids that are concealed inside them" (Schiff, 2017; p.3). In this regard, Pomagalska (2005) has shown how psychologists convey concepts and insights about self-esteem in a reifying-language that makes it, for example, an agent that causes or

[2] Wittgenstein came to a similar conclusion affirming that there is no such thing as a "self that thinks", and he also emphasized the linguistic origin of the reification process: "a substantive [a noun] makes us look for a thing that corresponds to it" (Wittgenstein, 1958/1972; p.1).

does not cause certain choices and behaviours (as an object that has a 'life of its own', see next section). Further, she has also highlighted the consequences of this reification for readers, namely that self-esteem is often seen as a tangible entity that characterises and defines every person.

Finally, the same reasoning has also been used to describe the reification underlying the construct of 'mental representation' and the reification underlying clinical categories. For instance, Di Paolo and colleagues (2017), as well as Zahnoun (2020) argued that internal mental representations are usually viewed as *things* that can be owned and produced, exactly as any other thing. Similarly, Hyman (2010) claimed that modern DSM-V system, "intended to create a shared language, also creates epistemic blinders that impede progress toward valid diagnoses" (p.155), as it reifies hypothetical concepts into things that people do or do not possess.

As Levy (2019) pointed out, it is easy to forget that such psychological constructs are "not some objective thing that an individual actually 'has' […]" rather, they are "hypothetical concept[s] that we have created to help us organize and make sense out of people's behaviour" (p.325).

Why Reification?

Why does the phenomenon of reification occur? This section highlights how reification depends on some of the linguistic practices that researchers use to describe and communicate their knowledge.

In general terms, having different words and different labels leads us to believe (implicitly) in the existence of different categories, ontologically independent and isolable exactly as words and labels are. In other words, and as cognitive science itself shows, verbal labels and nouns increase the tendency to categorize stimuli and thus to create ontologies (e.g., Dietze, 1955). As pointed out by Engel (1995), "we have come to realize that how we talk about a thing – how we describe it – determines how we come to see it, what we come to believe about it" (p. 42). Similarly, Sapir (1929) argued that the 'real world' is to a large extent unconsciously built on the linguistic habits used to describe it.

In this regard, Van Geert and De Ruiter (2022) stated that "The way that we describe these research settings and outcomes - the language we use - is an integral part of how we come to understand or explain experiments […] and […] outcomes. The way we talk about research is thus far from superficial" (p.103). This linguistic-cognitive effect can have detrimental outcomes when used in relation to hypothetical constructs. For example, the visual-cliff experiment (Gibson & Walk, 1960) is presented as an instrument for measuring or demonstrating infants' ability to perceive depth (depth perception). Scientific explanations interpret infants' success or failure by focusing on the *presence or absence of a categorical entity*, i.e., "depth perception", rather than considering that the infants' actions may have more complex origins than one prior cognitive function. Van Geert and De Ruiter (2022) conclude that: "this type of explanation is typical of a substance philosophy, focusing on substances or essences in the form of isolable abilities (depth perception) associated with certain categories of people (infants)" (p.103).

But let's start from the beginning, i.e. from a linguistic feature of the grammatical structure of many languages, the so-called "hypostatization" phenomenon. Hypostatization occurs every time we regard an abstract word as if it were a concrete word (Engel, 1995). Engel (1995) uses the phrase "Nature decrees what is right" as an example of hypostatization. In this example, the abstract concept of nature is treated as a concrete entity: it is seen as a unitary entity that is able to dispose of or keep something and to evaluate what is right or wrong (i.e. as a personified agent that can do things). Since it is able to decree and evaluate on its own, it is also considered a unitary, isolable, and independent substance.

From a linguistic point of view, hypostatization is therefore an idiomatic phenomenon in which the grammatical category of nouns is used to describe non-substantive entities such as processes, series of actions or properties and qualities. For example, the noun "journey" is used to describe a series of actions, and similarly the noun "walk" is used to describe the activity of walking. However, the use of single nouns facilitates the interpretation of "journey" (or "walk") as

a kind of independent thing, whereas in reality it is a dynamic process rather than an independent substance. Hypostatization is then an example of grammatical derivation, in which the "derived 'noun' term does not literally refer to a substance" (Zahnoun, 2020, p.87).

As Billig (2013) has shown, this linguistic practice is particularly relevant in the social sciences, where complex processes are often described as static and independent substances. Crucially, Billig has shown how technical terminology in this field tends to be based on what he calls "nominalization", that is the tendency to use nouns, even in the form of neologisms, rather than the corresponding verbs[3]. Psychology as well as social sciences, whose object of study is inherently complex, increasingly use a noun-based style of writing, which in Billig's theory (2008; 2013) has important functions. Among these, Billig mentions the function of *deleting agency* (the sentence "The police attacked the demonstrators" can easily be transformed into the sentence "An attack on the demonstrators took place" that contains less information) and the function of *reification*: by transforming verbs into nouns, it is conveyed that these entities "have a real and necessary existence" (Billig, 2008, p.786). Through "nominalization", processes and qualities assume the status of objective and unchangeable things (Fowler, 1991; Billig, 2008).

Therefore, the linguistic phenomenon of categorical substitution leads to the psychological phenomenon of reification. In other words, the effect of hypostatization (or nominalization in Billig's terminology) on cognition is what is called reification: "nouns lend themselves much more readily to a conceptualization of what they stand for as 'tilings', and this greatly encourages the illusion of reification. In actual fact, different shell nouns provide gaps for ontologically different types of entities" (Schmid, 1998; p.5). In the context of this paper, reification is not seen as a deliberate function of a nouns-based terminology as in Billig's theory (which is also sometimes understood as ideologically determined; Fowler et al., 1979), but as an (often implicit) effect of

[3] Nominalization is itself a nominalization that conceals an extremely complex process (for a more detailed analysis of the different types of nominalization processes, see Billig, 2008).

linguistic practice on some cognitive processes such as categorization and perception. That is, whereas for Fowler and colleagues (1979) reification is a consequence of cognition ("ideologically charged"), in this paper reification is presented as a cognitive consequence of linguistic practice (thinking in terms of substances is considered an implicit consequence of a specific terminology).

This view is consistent with the so-called "Sapir-Whorf hypothesis" (e.g., Whorf, 1956), according to which the linguistic forms we use to communicate and explicitly convey our thoughts are also a factor that can shape important aspects of the cognitive system[4]. In a pioneering study of Dietze (1955), one group of young children (pre-school), during a concept formation task, learned names (pronounced by the experimenter) that were similar in their language structure, while a second group learned names that were very different from each other. For example, the first group learned names such as 'been', 'meem', and 'peem', i.e. nonsense names chosen to be alike except for the aspiration of the initial consonants, whereas the second group learned 'jod', 'daf', and 'meep', i.e. names chosen to have different initial and final consonants and different vowel sounds. Dietze (1955) found that the different-names group categorized faster than the similar-names group.

Similarly, and more recently, a number of cognitive science experiments have shown that being exposed to a particular set of names indicating categories has several cognitive effects. Research on the use of words to designate colors, for example, shows that the more names we have at our disposal, the more likely we are to assign stimuli to a different colour category. Humans learn to name colors with categorical labels that are specific to each language and culture, for example, "red", "green", "yellow" and so on. Categorical labels also depend on specific experiences and interactions with the environment. For example, professionals for whom color distinctions are essential (e.g., painters) may develop a very extensive color vocabulary. The key point is that this system not only facilitates communication, but also influences how colors are perceived. In a recent

[4] This hypothesis was first put forward by the American anthologist and linguist Edward Sapir (1929) and then reformulated by Benjamin Lee Whorf (1956).

study, immediately after hearing a colour word/label, participants discriminated more between colors from the named category and colors from nearby categories in an untimed task (Forder & Lupyan, 2019). It is interesting to note that hearing the word also increases the distinction between typical and atypical category members. In contrast to verbal cues, a preview of the target color (as noted by the authors, arguably a more informative cue) did not lead to a change in discrimination tendency. Otherwise put, colour words have a strong influence on color discrimination, suggesting that verbal labels reinforce our tendency to categorize stimuli (Forder & Lupyan, 2019).

The crucial feature of this phenomenon is that it is somehow stable and pervasive (or in other words, stored in our long-term memory). Indeed, these data have often been used to formulate the so-called "label-feedback hypothesis" (Lupyan, 2007), according to which labels, once learned (visually or auditorily), are also re-activated during visual experiences "and this activation feeds back to affect ongoing visual processing" (Foster & Lupyan, 2019, p.1110). This sort of "representational warping" caused by the use of specific verbal labels is demonstrated by the augmented tendency to separate category members from nearby non-members (e.g., under the influence of the label "green", the representations of green colors move away from those of blue colors) (Lupyan & Swingley, 2012). The presentation or even the self-production of a label before the presentation of a set of inputs results in the inputs being processed in the light of the "categorical prior" created by the label (e.g., Lupyan, & Swingley, 2012). Exploiting the same mechanism, Lupyan (2009) demonstrated how verbal interference during a classification task affected selective categorization and the literature on aphasic patients suggests that the categorization ability (e.g., to classify objects on a specific dimension) is often impaired in patients that are not able to produce verbal labels (e.g., Langland-Hassan et al., 2017). Further, since linguistic labels reify categories and since linguistic labels vary across languages, it has been shown that categorization changes across cultures (Winawer et al., 2007). There is also evidence that categorical perception is stronger in the right visual field (which projects to the left hemisphere, the

linguistic one), thereby confirming the relationship between the tendency to categorize and linguistic processes (Drivonikou et al, 2007).

In sum, while the tendency to categorize is obviously an intrinsic feature of human cognition, it is reinforced by the presence of verbal labels that expand cross-category differences and increase within-category similarities. A possible explanation for these effects is that there may be no homomorphism, no similarity in terms of form, between the empirical system (i.e. what happens in the world) and the formal system that is used to describe it (i.e. the language). Taking as example the domain of emotions categorization rather than colours, Van Geert & De Ruiter (2022) highlighted the gap between the "open collection of all possible, concrete manifestations of emotions" in individuals (better understood as fuzzy sets with gradual rather than strict boundaries; see Kazemzadeh et al. 2013), and the system of labels used to describe them (a limited set of emotion terms that implicitly belong to different categories, e.g., happy, angry, sad, etc.).

Why is the Phenomenon of Reification Important in Everyday Cognitive Science?

Why is reification important for cognitive research? The aim of this section is to show how reification phenomena are implicitly at the basis of some "standard" cognitive theories and how, at the same time, some alternative theoretical approaches and findings conflict with the substance-view implicitly induced by reification phenomena.

For cognitive science, one form of reification underlies the implicit assumption that drives both cognitive research and the interpretation of results: the assumption that different cognitive levels and functions exist as 'things' and are therefore a-temporal, isolable and enduring. The use of different nouns to describe the components of cognitive functioning led to the implicit assumption that they are also different "things" that can be studied in isolation and independently of each other as if they had clear boundaries. This approach has led to an "over"-categorizing tendency (the idea that all things can be classified into different groups; Dika, 2020) which is typical of Cartesian

dualism (Basar, 2011) and results from the rigid separation between res-cogitans and res-extensa (the two main categories: cognition and the body)[5]. In cognitive science, this led to human cognition being seen as constituted by different sub-ontologies (i.e. distinct and independent cognitive entities), often resulting in juxtaposed metaphysical categories.

This Cartesian view was adopted by the "amodal" cognitive perspective, in which the conceptual level is distinguished from the sensorimotor level according to the formula that an action is first conceived by means of abstract mental representations and only then executed through the activation of specific motor programs (e.g., Fodor, 1975; Mahon, 2015). Therefore, one can see reification in the classic "three-level" architecture distinction (Searle, 1983) between what is called "perception" (the structure able to catch stimuli coming from the environment), "cognition" (the csystem which processes such stimuli) and "action" (the component able to generate a response), i.e. the separation of perception and action from a central control system (see Hurley, 2001). The implicit and crucial assumption deriving from this view is that these three levels are strictly separate and ontologically independent (i.e. they are reified).

Crucially, the same reasoning can also hold between different cognitive systems: the implicit assumption that has long prevailed in cognitive science is that there are distinct substance-entities (categories) such as memory, perception, motor control, reasoning, etc., that have clear boundaries and function independently of each other. This theoretical perspective has produced an oversimplified, static, and generalized lens through which researchers view cognition, a kind of "cartesian-split-mechanistic ontology" (Overton, 2015), which implies that the whole can always be split into independent parts, and that it is possible to isolate these parts from each other (De Ruiter, 2023). Simultaneously, cognitive functions, viewed as "substances" (and thus isolable), are considered and studied de-contextualized from the environment in which they operate.

[5] In this regard, Ryle (1949) accused Descartes of having made a "categorical error" by treating the mind as if it were an independent "thing" in contrast to the body.

In cognitive science communication (e.g., scientific articles), the habit of referring to cognitive functions in terms of substances is repeatedly affirmed, leading to the psychological effect of conceiving these hypothetical entities as ontologically independent and with clear borders. Billig (2013) and Notterman (2000) pointed out that scientific communication practices tend to overemphasize the uses nouns to denote complex phenomena instead of the verbs needed to describe the underlying processes, a kind of "nominalistic reductionism". The problematic aspect of this point for cognitive science is twofold. The most obvious, is that such entities are not things or substances, but *processes* by which, e.g., we recover, perceive, we pay attention to given stimuli and so on (Van Geert & De Ruiter, 2022). As processes, they are not stable and unitary. Cognitive functions are all in a state of flux of interacting processes (Gernigon et al., 2023). Second and consequently, they are not easily separable and isolable, even from a theoretical point of view as Gibson (1975) reminds us:

> "For where is the borderline between perceiving and remembering? Does perceiving go backward in time? For seconds? For minutes? For hours? When do percepts stop and begin to be memories or, in another way of putting it, go into storage? The facts of memory are supposed to be well understood but these questions cannot be answered. Equally embarrassing questions can be asked about expectation." (p.299)

Having different verbal labels leads to arbitrary demarcation lines, a kind of "linguistically induced" distortion, in which arbitrary boundaries on dynamic and continuous dimensions indicate qualitative discontinuity (Van Geert & De Ruiter, 2022).

Recently Gatti and colleagues (2022), implicitly adopted a substance-view, stated: "Every part of our lives has to do with memory, and memory is present at multiple levels within each functionality, from language to spatial perception, from thinking to reasoning" (Gatti et al., 2022; p.139). However, still embracing a substance-view, one could also claim the exact opposite, that is that every other cognitive function is present in every "memory" process. For example, if I try to

remember what I was doing at 6 p.m. yesterday, I have to focus my *attention* on internal information and ignore the information coming from the environment; if the information does not automatically come to mind, I have to *reason* about what is plausible or not at 6 p.m., and so on. Therefore, different cognitive levels and functions are in constant interaction, to such an extent that it is difficult to separate them even theoretically. In an interactionist and processual ontology, the nature and meaning of these functions depend on their interactions with each other, and not on intrinsic, essential properties that are independent of any interaction with other functions.

Exactly as Zahnoun (2020) pointed out with regards to the concept of inner "representations", many of the classical cognitive systems distinctions (e.g., different and separated cognitive functions) therefore derive from "pre-theoretical elements" or "linguistic contingencies".

Fragile Borders: Some Theoretical Approaches

This section aims at presenting some theoretical approaches suggesting that dynamics and interconnectedness are natural parts of cognitive functioning. The fragility of some definitions and the difficulty of drawing neat boundaries between different cognitive functions is in fact what a large body of literature over the last two decades seems to indicate.

Recently, Viale (2023) has emphasized the so-called "horizontal relationship" between cognition, the body with its postures and movements and the environment: while a vertical relationship is hierarchically structured and the work of one component is subordinate to the work of the others, a horizontal relationship is characterized by recursive interactions between them. The following theoretical approaches emphasize the need for a "processual nature view" of cognitive functions rather than "substance" one (Van Geert & De Ruiter, 2022). I will focus my analysis on three main perspectives: (1) the embodied/enactive approaches, (2) the interactivist model and (3) the "complex dynamic system" framework.

The embodied and enactive approaches are important here because they emphasize the inherent recursive relationship between cognition, action and environment. In this view cognition is

not limited only to what is contained in the individual's skull (Noë, 2009), but it is extended, for instance, to other people (Krueger, 2011), other bodies (Ianì, 2021; 2022), mnemonic supports (Heersmink, 2017) and external computing devices (see, e.g., Clark & Chalmers, 1998).

Specifically, starting from the work of Gregory Bateson (1972), enactive approaches proposed that mind and nature have to be considered a "necessary unity" (Drury & Tudor, 2023). Enactive theories emphasize how much of what we call "perception" is inherent and immediately tied to cognition, to such an extent that it is impossible to separate them; they are "fundamentally inseparable in lived cognition" (Thompson, 2007). Therefore, there is inseparable continuity between both the mind (the "subject") and the environment (the "object"). In this context, the concept of "affordance" (Gibson, 1979) is relevant. An affordance is neither a property of the subject nor a property of the object: "An affordance cuts across the dichotomy of subjective-objective and helps us to understand its inadequacy. It is equally a fact of the environment and a fact of behaviour. It is both physical and psychical, yet, neither. An affordance points both ways, to the environment and to the observer" (p. 129). According to this view, there is also inseparable continuity between the subcomponents of the mind, such as perception, motor control and cognition, emphasizing indeed the circular pathways between cognitive processes and those involved in planning and control movements (Drury & Tudor, 2023). Likewise, various cognitive processes are inherently relational and circularly influenced (Di Paolo & De Jaegher, 2012).

As pointed out by Di Paolo and Thompson (2014) such a relationship is not merely causal (action processes *cause* changes in higher cognitive systems, i.e., memory, language etc…), but it is "constitutive": motor, perceptive and cognitive processes are ontologically connected. They are essential parts that enable the recursive self-maintenance of the entire system. This means that it is not possible to draw clear boundaries between them unless one uses conventional and arbitrary definitions (Di Paolo & Thompson, 2014). According to the enactive view, "the explanatory unit of perception (or cognition) is […] a dynamic relation between organisms, which include brains, but

also their own structural embodied features that enable specific perception-action loops" (Gallagher & Bower, 2014, p.242).

Another theoretical approach relevant to the topic of reification processes is the interactionist model of Mark Bickhard (2009). The interactivist model of cognition is an "action and interaction based approach" (p.547). The starting point of such theoretical perspective is that the cognitive system is a "self-maintenant autonomous system" that "does things in and with its environment […] in at least a minimal sense, it is an agent." (p.569). What consequences does such a view have for the ontologies of cognitive functions? For example, perception, rather to be modelled as an input-receiving phenomenon as standardly viewed (e.g., Fodor, 1975), becomes a kind of interaction between our functional abilities and the environment. In this sense, perception is not the passive processing of input and memory is not a passive reappearance of specific memory traces neatly stored somewhere in the mind. They are both "here-and-now" constructive and interactive process (Bickhard, 2005). Bickhard (2009) also emphasized the need to shift toward a new theoretical perspective, namely from a "metaphysical framework of substance" to a "metaphysical framework of process". The former involves the split between mind and body as well as the split between different cognitive functions. The latter induces to study inherently complex phenomena that are constantly changing and that "do not have inherent boundaries" (p. 553).

A third theoretical approach that emphasizes the need to re-consider some arbitrary boundaries, and that implies the need to study cognition as inherently processual, is the "complex dynamic system" (CDS) framework (e.g., Vallacher et al., 2015). Thelen (2005) criticized the dominant metaphor in cognitive science according to which the mind is like a computer that elaborate information units. She suggested another metaphor, namely, cognition as a "mountain stream". In this sense it "is moving all the time in continuous flow and continuous change" (p.259), and it is not possible to say what directly causes what. Cognition is a *nonlinear system* as, depending on the conditions, large changes in the system may be generated by small differences

and it is dynamic as continuous in time. In other words, “mental activity is the product of many interacting parts that work together to produce a coherent pattern under particular task, social and environmental constraints” (Thelen, 2005; p. 261).

Thelen’s argument is based on a very basic but overlooked consideration: humans perceive and move constantly every minute. This point implies that any complete analysis of a given cognitive process cannot exclude or consider perceptual and motor processes as secondary. Secondly, since cognitive processes are continuous in time, the state of the system at any point in time depends on the previous states and, at the same time, they are the starting point for a coming state. These processes are therefore completely nested within one another. Therefore, not only can we not draw a spatial boundary between different processes or functions, but also no temporal boundaries: “it is all change over time” (p.262). Similarly, van Gelder (1998) pointed out that, differently from computationalists, “dynamicists […] think of processes as always ongoing, not starting anywhere and finishing anywhere” (p.621). Further, dynamicists tend to see cognitive processes as not static, and operating in parallel. This means that the cognitive system has structural complexity in which there is simultaneous, mutually constraining interaction between several different components. CDS literature is rapidly growing, covering an increasing number of applications. For example, the CDS framework contributes to non-substance or entity oriented views on the nature of psychopathology (Wichers et al., 2015; Scheffer et al.; 2024), as well as on the development of cognitive abilities from childhood to adulthood (e.g., Kaplan & Garner, 2017).

CDS framework is also important from a neurocognitive perspective. While there is no doubt that there are neural systems responsible for macro cognitive functions, it is also true that they often interact to produce complex and inherently dynamic cognitive states (Gernigon et al., 2023). In contrast to a substance-view, Pessoa (2022; 2023) pointed out that even the brain cannot be easily reduced to separate units: “we don’t have to put functions inside little boxes in the brain and tell neat stories. Reality is immensely more complex” (2022; *preface x*). Pessoa’s analysis emphasizes

that cognitive functions depend on large-scale distributed circuits (networks); in other words, the brain is not a rigid modular system. And even from a neurocognitive perspective, it is difficult to draw clear boundaries between different anatomical areas. For example, subcortical areas have several subdivisions (see e.g., the amygdala and the cerebellum), and some of them have boundaries that are more like fuzzy zones (Pessoa, 2023). Recently, Stringer and colleagues (2019) discovered that the activity of more than 10.000 neurons in the mouse visual cortex also reflects more than a dozen features of motor information. This is particularly interesting because it seems to suggest that visual perception and action themselves cannot be considered as two isolated and serial systems, but rather as a ubiquitous system mixing sensory and motor information.

Moreover, parts of the brain should not be considered as isolated islands. The *white matter* (the tissue containing the nerve fibres that serve as a communication highway between different areas) is very extensive compared to the *grey matter* (the tissue containing the neurons), and connectivity studies have identified about 20 major pathways connecting different lobes. Further, even when two areas are not directly connected by anatomical pathways, their work, i.e. their neurochemical signals, are synchronised. In other words, their activities are in some way correlated, which indicates the presence of multi-component functional units (Pessoa, 2022). As Pessoa stated, "we need to dissolve boundaries within the brain" (p.229).

Fragile Borders: Some Experimental Data

The creation of systems for classifying phenomena (i.e. taxonomies) is certainly important for scientific activity. It permits to organize research projects and to share a common ground by which it is possible to communicate scientific findings. The aim of this section is to highlight problems concerning the individuation of mechanisms based on the standard taxonomy proposed by cognitive psychology. In other words, the aim is to show data that indicate that supposedly independent functions are in fact so strongly coupled that we cannot regard them as isolable and unitary.

Let us take the paradigmatic case of theories about the functioning of memory, as it describes well why we cannot draw clear boundaries between action and cognition. The first theoretical perspective was dominated by the idea that memory as a kind of repository of discrete and immutable elements neatly stored in our brain in different and isolable cognitive stores (see, e.g., the "multistore model" of memory, Atkinson & Shiffrin, 1968). Even in later theories (e.g., the "network model", Collins & Loftus, 1975), memory was still understood as something that has nothing to do with action and perception, but as a kind of isolable and independent multi-store (a "thing"/"substance"). However, exactly as a "walk" is not a "thing" but the dynamic process of walking that integrates many other processes at the same time, memory is the process by which people try to retrieve information and that requires many other processes to work, such as those involved in perception and action.

Several lines of research have shown that body and movement manipulations are inseparable dynamic aspects of what we call memory. In particular, many studies have shown that the body, its position in space and its movements are dynamic components of the process of remembering or emotionally evaluating past events (Ianì, 2019). This idea was first developed experimentally by Dijkstra and colleagues (2007) when they decided to investigate the role of posture in remembering autobiographical events (e.g., the last visit to the dentist). The study participants were therefore asked to adopt a certain posture, which could be congruent (lying on a chaise longue, for example) or incongruent (an upright position) with the one adopted during the original event. Memory trace was recovered in a shorter time if the posture at the time of retrieval was congruent with the posture at the time of encoding (Dijkstra et al., 2007). Thus, reactivating the same physical state adopted during the encoding phase may facilitate the recollection of the event itself.

Using the same logic, Casasanto and Dijkstra (2010) showed that the memory of autobiographical events also interacts dynamically with simple actions at the time of recollection. These results led the authors to conclude that there is a direct and causal relationship between our

actions and the accessibility of certain autobiographical events in memory (Casasanto & Dijkstra, 2010). In a processual view and terminology, body posture and body movements are dynamic constituents of a complex process of interactions that we call "a memory".

Findings confirming this dynamic interaction come from a variety of research areas, including gestures, eye movements and the expression of emotions (Ianì et al., 2018; Johansson & Johansson, 2014; Wilkes et al., 2017). Recently, similar effects have been observed in tasks involving memory of simple objects. In a study by Dutriaux and Gyselinck (2016), participants were asked to memorize a series of manipulable and non-manipulable objects. When, at recall, they were asked to hold their hands and arms behind their back (a posture that impairs the motor patterns required to interact with manipulable objects), a selective decrease in memory performance was found for manipulable objects, but not for non-manipulable objects (see also Dutriaux et al., 2019; Limata et al., 2023).

The fact that the body plays a causal role in "offline" cognitive processes such as memory, i.e. processes that are detached from the real sensory inputs in the environment (Wilson, 2002), contrasts with the presumed independence of some "*thought nuclei*", the reified concepts deriving from verbal labels. Memory is therefore not a passive re-collection of specific memory information that is neatly stored somewhere in the mind, but a constructive and interactive process. Memories are active "here-and-now" constructions, in the form of extended processes involving multiple components. Thus, current evidence suggests that memory processes are distributed throughout the nervous system rather than being a kind of (isolated and localized) storage (Drury & Tudor, 2023). The action system is not a "subordinate" and independent system, but an integral part of the memory system.

Let us take as example now the relationship between the action system and perception. In the field of action perception, the observer's posture and movements interact with the perception and processing of a given stimulus. While, under normal circumstances, the participants are able to infer

the weight of a box simply by observing lifting movements, the same does not hold when the participants are engaged in a secondary motor task, and thus with sensorimotor resources not fully available for processing the observed actions (Hamilton et al., 2004). This shows that observers use their body to process the perceived stimulus in a way that is at least partially constitutive of the cognitive process itself (see also Ianì et al., 2021). Here too, cognition (in terms of judgements) and action are involved in a way that is inherently bidirectional and dynamic.

The same reasoning can be applied again to the relationship between perception and memory. In this context, it has been emphasised that there is a natural and often automatic and implicit propensity to attribute meaning to experiences (Mazzoni & Scoboria, 2007). One of the reasons why it is difficult to draw a clear dividing line between these two components (perception and memory) is that the way we attribute meaning is closely linked to what we have experienced in the past (i.e. what we consciously or unconsciously remember). And the way we remember is inextricably linked to the psychological, physical and contextual factors of the present. An example of this constant and reciprocal relationship is what happens in the field of action observation. Several authors have argued that when we perceive the actions of other conspecifics, we build specific internal representations of the observed motor programs, a kind of "mental simulation" that allows us to predict and anticipate what we observe (e.g., Ianì et al., 2020; 2024). The crucial point is that previous experiences and thus memories are dynamic constituents of this process: the perception of others' actions and the corresponding internal simulations are modulated by the observer's familiarity and previous experiences (Casile & Giese, 2006). From a neurocognitive perspective, it has also been shown that the "mirror" activations resulting from the observation of an action vary in strength depending on the observer's degree of familiarity with the observed action (Calvo-Merino et al., 2005). These data suggest that the effectiveness by which we perceive actions is intrinsic coupled with cognitive processes at stake in remembering previous experiences (see also Teufel & Nanay, 2016). In this sense, our memory of previous experiences shapes our

ongoing perception in a way that makes it impossible to separate the two components. Perception and memory are not two isolated substances. They are interrelated processes involved in the active constructions here-and-now of what we experience and what we call “percepts”, “sensations”, and “feelings”. What we call separate components (in this example, memory and perception) are dynamic components whose interaction results in the emergence of a property such as the ability to perceive or remember.

The effects of reification can even be observed in some categorizations and dichotomies within a given cognitive function (for reification implied in memory store approach see e.g., Macken & Jones, 2003). For example, the declarative and procedural memory systems have been extensively studied in humans, and evidence of double dissociations has shown that the two systems can function independently (e.g., Eichenbaum & Cohen, 2001; patients may show impairment in explicit memory but not in procedural memory and vice versa, e.g., Klooster et al., 2015). The potential independence between procedural and declarative information is certainly important. However, to confirm the independence, it is sufficient to find a case in which the two systems function in parallel without interfering with each other. This tells us little about what happens under normal and ecological conditions. Indeed, in light of some experimental data, the concepts of declarative and procedural memory appear to have more subtle boundaries in some cases. In two recent studies, explicit and implicit memory of the position of letters on the QWERTY keyboard as well as the mechanisms involved were investigated (Snyder et al., 2014; Ianì et al., 2024). Explicit memory for the position of the letters was impaired when participants were engaged in a secondary task requiring hands/arms movements. Specifically, taxing participants’ sensorimotor resources led to a decrease in explicit memory performance when the secondary task required hands/arms movements (hands/arms tapping) compared to the task requiring legs/feet movements (control condition). That is, performance on the explicit task is impaired when participants are prevented

from simulating their procedural knowledge, suggesting that these two processes constitute an interacting system that leads to an emergent property of "memory".

The idea that available procedural resources may be involved in the recovery of declarative mnemonic traces is a core idea underlying many approaches, at least in the domain of embodied memory (Ianì, 2019). Therefore, a processual approach to such functions would be better than a reification-oriented approach that treats these functions as separate and isolated realities. Such data are also relevant to the literature on enactivism, which is best read through a "know-how" lens rather than a "know-that" lens (Drury & Tudor, 2023). In this sense, procedural knowledge appears to be pervasive and inseparable from declarative knowledge.

There is also other data showing that two ideally separate cognitive functions can be considered as one and the same phenomenon. Recently, imagining future events and remembering past events have been considered to be "fundamentally the same process", as acting on the same information, governed on the same rules of operation and subserved by the same brain systems (Addis, 2020; p.233; see also Schacter & Addis, 2007). Paradoxically, these data are surprising if one starts from the implicit assumption that these entities are independent, stable and isolable things (i.e. two substances).

Beyond the specific examples, these experimental results defy a substantialist and reificationist interpretation and instead support a processual interpretation that rejects "essentialist assumptions", i.e. these functions as rigidly separate and independent modules or "things" with specific and inherent properties. In other words, what emerges is a vision of human cognition as a highly active, dynamic and flexible system. And as an active, dynamic and flexible system that is easily prone to errors. In this view, the literature on false memories seems to suggest that they are the result of adaptative and flexible cognitive processes (Schacter et al., 2011). Memory is constantly changing and reconstructing (and then prone to false memories), because what we call memory is a process inextricably associated with perception, action and numerous other cognitive

systems that do not stop working between encoding and retrieval. Strongly trivializing, one could say that false memories become cognitive phenomena "in need of explanation" if one starts from the assumption that there is a specific, in some sense independent and isolated cognitive system dedicated to remembering, whose main goal is to recall events in such a way that they correspond to reality. If this assumption is questioned even a little, the problem tends to disappear[6].

Toward a Pluralistic Approach: Same Label, Different Cognitive Strategies

The question of how to classify cognitive processes has deep historical roots in both philosophy and psychology. As we have already seen, a classical way of dealing with this problem is to define different cognitive entities on the basis of their function. Indeed, cognitive "entities" are often understood as *cognitive functions/capacities*. For example, "episodic memory" is defined as the cognitive process that makes it possible to retrieve a particular episode, "action prediction" as the cognitive process that makes it possible to predict the final state of an observed action, and so on. The same principle is applied in defining neural ontologies, trying to link each area or network of areas to a specific function or set of functions (for a discussion se McCaffrey & Wright, 2022).

The aim of this section is to show that we cannot define ontologies via functional roles, as the same function can be achieved using (very) different processes. Exactly how the word "journey" refers to an enormous variety of different experiences but it "still seem to correspond to unitary, well-integrated and holistic concept" (Schmid, 1998; p.5), the label "episodic memory" potentially refer to an enormous variety of cognitive processes. A main point that has emerged in cognitive science research over the last decade, in contrast to a "substance" and unitary view, is indeed what we might call a "pluralistic" or "integrated" view of cognition. This view is based on the idea that a given cognitive function (e.g., the retrieval of a memory, the understanding of an observed action)

[6] For reasons of space, I will not extend the discussion to other cognitive domains, but for analogous problems with the construct of 'attention' see e.g., Anderson (2011), who has highlighted the tendency of researchers to reify the concept of attention and create circular explanations for their empirical findings. Similarly, Hommel and colleagues (2019) provocatively claimed that "no one knows what attention is" (p.2288) and Anderson (2011) claimed "there is no such thing as attention" (p.1).

can be carried out following different (cognitive) strategies. Notwithstanding some epistemological peculiarities, both the embodied/enactive cognition framework and the CDS framework mentioned before refer to a notion of cognitive functioning as centred on the integration of multiple strategies of information acquisition and thus on the interaction between different knowledge systems (e.g., sensorimotor, body-mechanics, and semantic). This means that different levels of cognitive complexity or different cognitive strategies can coexist to solve a particular problem. In highlighting the reification process involved in considering phonological loop and other memory stores, Macken and Jones (2003) claimed that

> "in principle, there is a vast number of possible ways in which participants may choose to retain information. If the material allows it, syntactic or semantic transitions may be imposed on the memory material, failing which speech-based transitions may be utilized, or any other skill that the participant possesses that may be co-opted in order to meet the demands of the task. […] We consider models of short-term memory to constitute a reification of the characteristics of performance on particular types of task into bespoke stores and processes whose function it is to perform those tasks […] on the evidence presented here, we argue that such memory stores do not exist" (p.1286).

Further, there are some memories that immediately pop up in mind and other that require cognitive effort to be fully accessible. For instance, the cognitive effort required to solve a given memory task is critical for the involvement of motor strategies (Ianì et al. 2017). In other words, "memory is the storage of changes in processing modes, and there are many kinds of such modes" (Bickhard, 2005; p.4)[7]. Thus, cognitive activities are "soft-assembled" on the spot (Thelen, 2005), based on

[7] It is noteworthy how this point and the idea of cognitive phenomena as "patterns emerging from non-decomposable and non-isolable complex processes" (Gernigon et al., 2023; p.1) might also account for reproducibility issues in some areas of cognitive science.

dynamical interactions between the person (the person's bio-dynamics, the person's history, etc…) and the current context of the activity (see Spencer et al. 2011).

To better understand this pluralistic view, let us again take as an example the literature on the observation of objects, which more than others seems to suggest the need for an integrated and pluralistic approach. Several behavioural studies, frequently cited in the embodied literature, seem to emphasize an automatic motor activation and motor feature processing while viewing manipulable objects, a neurocognitive process responsible for correctly manipulating and interacting with objects (e.g., Tucker & Ellis, 1998). However, developments in cognitive neuroscience increasingly highlight how the same functions can arise as a result of specifically human capacities of technical reasoning, understood here as a form of non-verbal knowledge of the mechanical principles that regulate the physical world (Osiurak et al., 2020).

The idea is that semantic knowledge, while not representing a *sine qua non* condition for their use, can dynamically intervene in the mechanisms through which tools are perceived, recognized and used (Federico et al., 2021). Otherwise put, the literature has emphasised that during object observation or interaction, in addition to a kind of internal "motor resonance" of the motor patterns necessary to correctly use a particular object (Tucker & Ellis, 1998), also a kind of "functional knowledge" of the tool plays a crucial role in guide our interactions. The latter is a kind of "technical thinking" that is able to process the specific function of the object and the mechanical principles that govern its operation (Osiurak et al., 2021, Reynaud et al., 2016; Reynaud et al., 2019).

Therefore, this perspective emphasizes the interaction between distinct forms of knowledge while sustaining the same cognitive function, and aims to restore an image of human cognitive architecture that favors dynamic and flexible information processing: the same cognitive function, different and integrated cognitive strategies.

Similarly, different sorts of inferential mechanisms can be at stake during action observation. It is well documented how after viewing a video or just an image representing an action (e.g., eating a hamburger), we recognize the forward states of the seen action faster than the backward states and, at least in some cases, to believe to have seen the natural continuation of the action (e.g., Chen et al., 2021). These effects are usually supposed to be due to the mental simulation triggered by action observation, i.e. a representation of the forward states of the action, generally the goal of the actor's intention. Again, how participants construct such internal representation can be the result of different cognitive strategies. On the one hand, there is a kind of "motor resonance" (Uithol et al., 2011) by which the observed action resonates in the observer's motor system by using the intrinsic "configural relationship between body parts" of the observed action ("how" the action is performed; Thompson et al., 2019) and without the need for semantic inferential processing. On the other, there is also a "goal identification" strategy by which we can understand the goal of others' actions ("why" an action is performed) via a conceptual mechanism, that is a "mechanical reasoning" about the object in order to infer the goal (see Osiurak et al., 2021). Further, recent experimental data suggest that it is possible to trigger one strategy or the other by manipulating participants' attentional focus (Ianì et al., 2024).

Such data should caution us against the risk of exacerbating a reification of our theoretical constructs if we do not assume a pluralistic view (see also Kirschner, 2006). In other words, depending on the specific characteristics of the contingent interaction between an agent and environment, several strategies can be pursued to achieve the same outcome.

Conclusion

In this paper, I have first discussed what reification is and then attempted to outline the origins of this psychological phenomenon, by examining the linguistic practice of hypostatization and the well-documented effects of verbal labelling on the ability and propensity to categorize. Cognitive scientists and psychologists when they try to determine what mental functions exist and to describe the functioning of the cognitive

system, they are ultimately engaging in a cognitive process that is subject to all the biases we know from the (same) literature, such as the effects of language on perception and categorization. The verbal description of our cognitive functioning creates delineations and boundaries where they do not actually exist. I concluded, by exploring some theoretical approaches to cognition as well as some paradigmatic experimental results, that we cannot draw clear boundaries between reified constructs. In this debate, both embodied/enactive, interactionist and dynamic systems theories have made a strong innovative contribution by "putting together" elements that were previously considered separate. According to the so-called "4Ecognition" approach, cognition is indeed embodied, enacted, embedded in, and extended across environments (Newen et al., 2018).

This view implies that different elements of cognition need to be studied considering their intrinsic interconnections (Richardson et al., 2008), and their dynamical and processual nature. Failure to consider these dimensions/connections would lead to a partial understanding of the whole phenomenon. Further, since cognitive psychology knowledge is strongly and implicitly influenced by the linguistic forms we use to describe cognitive functioning (increasing the tendency to categorize and to study cognitive functions as separate substances), this perspective also implies the need to formulate and argue hypotheses and communicate results, avoiding the use of nominalizations and the coupled substance-view. Cognitive science has long since abandoned *objectivism*, the idea that knowledge is independent of the human mind (for a discussion, see, Johnson, 1995, Raskin, 2002). Cognitive science, however, has seldom applied this perspective to itself, in order to highlight how much its knowledge depends on the practices that researchers use in their work, especially the linguistic forms they employ.

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