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A Radical Embodied Approach to Lower Palaeolithic Spear-making

Duilio Garofoli

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It has been argued that spear manufacture at Schöningen around 400 kya required abstract thought and in-depth planning of a kind associated only with fully modern humans. The argument, however, lacks detailed analysis of these cognitive capabilities. In this paper I shall provide such an analysis for the production of spears and show that no qualitatively modern cognitive advancement is required to realize this technology. Situated strategies grounded in re-enacting perceptual simulations are sufficient to obviate the need for any modern form of abstraction in explaining the evidence. This embodied perspective is further radicalized in favor of direct perception, enactivism, and intuitive artifact interaction in order to eliminate any explanatory role for mentalistic plans in both the invention and social transmission of the spear technology. A set of radical embodied cognitive abilities is also sufficient to account for other Acheulean tools, obviating any grounds for qualitative advances in cognition. The enactive integration of stone tools in the perceptual system of *Homo heidelbergensis*, coupled with an increase of information processing capacity, are quite sufficient quantitative augmentations to the capabilities of earlier hominids. The explanations advanced here are nonetheless consistent with a set of classic and innovative theories in cognitive archaeology.

Keywords: cognitive archaeology, embodiment, Schöningen spears

During the middle 1990s a set of incredibly well preserved wooden spears were found at Schöningen, Lower Saxony, Germany (Thieme, 1996, 1997, 1999). Dated at ca 320 kya, in the Lower Palaeolithic (Jöris and Baales, 2003; Urban, Sierralta, and Frechen, 2011), these spears provide the earliest reliable evidence of hunting weapons. Prior to this discovery, evidence for hunting weapons within a similar

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chronological range (ca 400-250 kya) was represented by a lance tip found at the English site of Clacton on Sea (Oakley, Andrews, Keeley, and Clark, 1977), a poorly preserved wooden stick at the site of Bad Cannstatt, Stuttgart, Germany (Thieme, 2005) and some fragments of wooden objects at Bilzingsleben, Germany (Mania and Mania, 2005). Wooden items normally decay, and therefore their conservation happens only when subject to very specific conditions. These rare events of preservation provide invaluable insights into the behavioral and social complexity of these archaic populations, which might actually be underestimated from the analysis of the stone tool record.

The Schöningen site is an open mine and the spears were found about ten meters below the present ground surface. The location is thought to be a lake shore and it was characterized by a swampy environment, rich in vegetation. The spears were embedded in a muck composed by wet sediments, possibly of a delta plain (Lang et al., 2012), with decay impeded by lack of oxygen in the soil.

The spears were discovered in the context of a camp, in association with a set of artifacts and traces of activities suggestive of a complex social organization at this location (Thieme, 2005). The makers of the spears are generally ascribed to the *Homo heidelbergensis* taxon (Coolidge and Wynn, 2009, p. 151), given the overlap between the chronological distribution of this species and the dating of the artifacts (Street, Terberger, and Orschiedt, 2006). Although sharing a robust facial anatomy with the more primitive *Homo erectus* taxon, *Homo heidelbergensis* shows derived features that are typical of later hominids. Focusing on cranial anatomy, these features include frontal and occipital proportions, parietal convexity, arching of the temporal squama, orientation of the nasal aperture, anatomy of the underside of the skull, and an average brain capacity of ca 1200 cc (Rightmire, 2007). A set of flint-made stone artifacts has been found in the Schöningen site, including retouched scrapers and some points, which were produced elsewhere and then transported to this location where the hominids reworked them. There was evidence of four hearths (but see Stahlschmidt et al. [in press], for a counterargument), which are all located in the Western part of the camp, suggesting a spatial organization of activities within a social space.

Evidence of butchering large mammals was present in several earlier sites, but an association with weapons would be needed to prove the effective involvement of hunting strategies. In fact, these earlier butchered remains may have resulted from scavenging activities or opportunistic hunting (e.g., animals naturally entrapped or injured). However, the Schöningen spears were found in association with the remains of twenty horses, which were killed and butchered in loco. Furthermore, the spears appeared to resemble modern javelins with a centre of gravity designed for throwing (Tattersall, 2006, p. 174). Thieme (2005) initially explained this body of evidence as a result of a single event involving the interception of a whole herd of horses. The hominids at Schöningen would have ambushed the herd with throwing spears and butchered all the animals. However, new data

suggest that the horses were associated with different hunting/butchering events (Rivals et al., in press) and that the bones accumulated in the same location over time. Although weakening the idea that local populations had evolved coordinated strategies for mass killing, this evidence is sufficient to prove that *Homo heidelbergensis* populations were consistently relying on big-game hunting. In sum, the evidence from Schöningen was suggestive of cultural and technological sophistication in these pre-modern human populations, thus overturning the orthodoxy that these hominids were limited to basic subsistence strategies, simple social organization, and a relatively static material culture, mostly represented by the realization of bifacial stone-tools (Ambrose, 2001; see Lycett and Gowlett, 2008 for a review).

Before the discovery of the spears, the cognitive archaeology of the Lower Palaeolithic material culture broadly focused on two aspects. Some scholars attempted to draw inferences from the features of the stone tools to the properties of language (e.g., Holloway, 1969). Such an approach, however, was criticized because the cognitive properties required to produce stone tools do not necessarily entail the presence of similar abilities in the language domain. For example, the control of sequential operations required in stone-tool knapping does not warrant the existence of an analogous mechanism in the control of sequential morphemes during speech (see Barnard, 2010a for a related analysis).

Other scholars adopted a safer epistemology, focusing on spatial cognition, as evidenced by the emergence of progressively more symmetric stone tools in the record (e.g., Wynn, 1989). In the case of *Homo heidelbergensis*, increased symmetry differentiated the roughly shaped bifacials of the early Acheulean period from the more coherent ones of the late Acheulean. Such evidence resulted in alternative explanations about the minimal cognitive requirements necessary to produce symmetric artifacts (see Wynn, 2002 and the related commentary). However, Wynn concluded that symmetric stone tools support the existence of potential cognitive enhancements that apply only to an isolated aspect of the mind, specifically, spatial cognition. In consequence, *Homo heidelbergensis* was still to be considered as cognitively archaic in many respects, since a wider analysis of their material culture did not support equivalence with modern humans.

Nevertheless, the Schöningen artifacts led some scholars to reconsider this initial conservative explanation. These artifacts were interpreted as evidence that *Homo heidelbergensis* was capable of in-depth action planning (Dennell, 1997) and foresight (Thieme, 1997). Such considerations led to the argument that the spear-makers had mastered sophisticated operational chains of actions, which required some degree of abstract reasoning, complemented by verbal communication (Mania and Mania, 2005; Thieme, 2005, p. 129). The combination of abstract reasoning, complex planning and language led scholars to conclude that *Homo heidelbergensis* had some intellectual capabilities that were previously considered as typical only of modern humans.¹ These cognitive properties represented advancements that

¹This statement will be henceforth referred to as “the initial assumption.”

extended far beyond the visuo-spatial domain, as hypothesized by Wynn (2002). In the cognitive archaeology debate, some scholars (d’Errico and Stringer, 2011; Zilhao, 2011) have recently embraced an extreme form of this argument, by contending that the bases of “modern cognition” have been present in human populations from 500 kya. However, the reasons why abstract concepts and language ought to be considered as necessary to produce these new technologies were not specified, and the core arguments are based on a set of a priori assumptions.

Aims of the Paper

I will argue that the production of the Schöningen spears required no qualitative enhancement of pre-existing cognitive capabilities such as the emergence of abstract cognition, in-depth planning, or linguistic meta-representations. In contrast, I aim to show that a set of embodied and situated strategies, grounded in perception, is sufficient to explain the spear-making process. Firstly, I shall adopt a conservative embodied cognitive approach, based upon the use of re-enacted simulations/perceptual concepts (e.g., Barsalou, 1999; Prinz, 2002), to question the presupposition that any form of abstraction involved in the spear-making process necessarily requires a qualitative leap towards a modern cognitive architecture. I shall then consider in-depth action planning/foresight by focusing on the notion of internally mentalized plans as opposed to an enactive conception of action organization. A radical embodied cognitive approach will be adopted to show that no mental representations must be a priori applied to the spear-making process. It will be argued that this body of situated abilities is also shared by Acheulean tool-making and therefore lies within the capabilities of more primitive human populations. The current analysis will thus seek to demonstrate that the cognitive capabilities postulated by the initial assumption (Thieme, 2005) are either non-necessary or non-modern. At least for the manufacture and cultural transmission of these spears, the most parsimonious conclusion is a requirement only for a quantitative advancement in mental capabilities over earlier hominids.

A Closer Look at the Schöningen Spears

The two-meter long Schöningen spears were produced using stone tools to work selected material from small spruce or pine trees. Haidle (2009, p. 68) argued that the process of manufacture involved an extended chain:

in the use of a tool (e.g., hammerstone) to produce a tool (knap a stone tool) to produce a tool (carve the wooden spear) to manipulate an object (hunt an animal) to satisfy a basic need (hunger).

This exposes the distance (Haidle, 2012) between a problem (satisfaction of hunger) and its solution (the sequence of behavioral operations that leads to succeed in

the hunting task). Haidle further analyzed the problem-solution distance with reference to the experimental evidence proposed by Veil (1991) as a plausible model accounting for the processes required in making a spear. The method of coding perception and action sequences in cognigrams (Haidle, 2009), namely, analytical extensions of the *chaînes opératoires* approach (e.g., Pélégriin, Karlin, and Bodu, 1988; Schlanger, 1994), was applied to the problem-solution distance. Specific operations were nested in the whole sequence as a series of sub-routines (see Haidle, 2010, 2012; Lombard and Haidle, 2012 for additional examples). Each of the elements nested in the sequence could be considered as a relative problem that requires a specific solution in order to advance to the subsequent step in the longer problem chain (i.e., making a spear to kill the prey). Table 1 shows the basic set of operations required for the spear-making process at Schöningen, according to Haidle (2009).

Table 1
Basic Chain of Subproblems Implied in Hunting a Prey with a Spear (Haidle, 2009)

Problem type	Problem definition
Basic need	hunger
Subproblem 1	hunt prey
Subproblem 2	need of spear (tool 1)
Subproblem 3A	need of handaxe to cut down tree (tool 2): quality A
Subproblem 3B	need of handaxe to cut down tree (tool 2): quality B
Subproblem 4	need of flake tool (tool 3) to work wood
Subproblem 5	need of hard hammerstone (tool 4) to produce tool 3 and work on tool 2
Subproblem 6	need of a soft hammerstone (tool 5) for retouch of tool 2

The sequence begins with the basic need of satisfying hunger, the origin for the problem of hunting prey (subproblem 1) using a spear (subproblem 2). The following subproblems show the operations required to chop off part of a tree (subproblem 3A–B) and to work it (subproblem 4). The operations are carried out using different kinds of stone tools, which in turn require other stone tools for their manufacture (subproblems 5–6).

An intricate network of raw material procurement, tool production, and item transportation could have been carried out over several days. According to Haidle (*ibidem*, p. 72), it seems quite implausible that a pre-modern species like *Homo heidelbergensis* would have approached spear-making by keeping in mind all the intermediate goals of the whole plan, repeatedly calling to mind this cognitively demanding plan every time they needed to hunt for food. More likely, stone tools could have been made for other tasks as well, rather than specifically brought into being for spear manufacture. In this way, they could have been

produced and used as modular units, providing hominids with independent solutions applicable to a range of potential problems (Haidle and Conard, 2011).

Haidle's analysis is relevant for revealing the operational sequences that underlie behavioral practices reconstructed from the archaeological record. However, mapping properties of behavior to properties of cognitive systems requires a different form of explanation that needs to be separately specified in cognitive archaeology. This aspect becomes particularly important when considering the idea that Haidle's operational chain offers a "neutral" description of the spear-making process, a description that is not situated in any specific historical context and that is applicable to all contexts. Cognitive explanations are in fact sensitive to the historical development of a technology. The operational chain might indeed refer to a long-term instantiated spear-making practice, which is performed by means of expert cognitive strategies. In contrast, a very different body of cognitive explanations might emerge if we consider the same operational chain as underpinning the invention of a new technology. I will focus specifically on reconstructing the cognitive requirements for this latter situation of invention.

The Many Faces of "Abstraction"

Key questions need to be addressed before we can draw any conclusions concerning a putative involvement of complex abstract thinking in these archaic populations' invention and use of spears. What do we mean by abstraction? And why and how might a given form of abstraction be involved?

Lawrence Barsalou (2003a, 2005) suggested that the concept of abstraction can be interpreted according to six different senses:

Sense 1. Abstraction as categorical knowledge: the cognitive ability to create general conceptual categories from classes of instances that are met in experience.

Sense 2. Abstraction as the behavioral ability to generalize across instances: the behavioral ability to produce abstractions of the first kind. Namely, the fact that people can summarize the properties of one or more category members behaviorally.

Sense 3. Abstraction as summary representation: the idea, according to some theories, that behavioral abstractions are performed at the cognitive level by reading out an underlying summary representation, which can assume multiple forms (e.g., a declarative rule or a statistical prototype).

Sense 4. Abstraction as schematic representation: the idea that summary representations are in fact schematic, for they can abstract critical properties while discarding irrelevant ones.

Sense 5. Abstraction as flexible representation: the fact that summary representations can be applied flexibly to a wide variety of tasks, such as categorization, inference, language comprehension, reasoning, etc. According to this sense, increasing abstractness raises the flexibility of a representation.

Sense 6. Abstraction as abstract concepts: abstraction can refer to the degree of concreteness that characterizes a concept. When concepts become detached from physical entities and associated with mental events, they are considered to be abstract.

The six senses show that abstraction is an ambiguous concept unless defined clearly. Hence, the drawing of inferences about cognitive modernity is unwarranted unless we are clear about what we mean by the term. For example, abstraction as categorization (sense 1) does not necessarily lead to the production of abstract concepts (sense 6). The concept of DOG, according to a classic paradigm (Machery, 2009, sec. 4.2), could be a prototype derived from superimposing entities whose properties show sufficient statistical similarity. This operation could simply lead to the formation of a concrete concept. In contrast, the concepts of RESPECT, DEMOCRACY, or JUSTICE are clearly abstract in the sixth of Barsalou's senses. These two senses are not necessarily associated. It is possible that primitive mental systems can work with concrete abstractions, but no more than that. At the same time, it is also possible that some variants of abstraction are uniquely confined to a modern human mental architecture. I assume that three of the six senses of abstraction are relevant to the current analysis about the minimal cognitive requirements to produce the Schöninggen spears, namely 1, 5 and 6. While these senses describe abstraction in terms of a series of cognitive abilities, senses 3–4 concern instead more foundational aspects about the nature of mental representations and their role in the process of abstraction. In this way, these senses are orthogonal to the discussion. In the next section I will attempt to demonstrate that those definitions of abstraction that *prima facie* seem to require a modern cognitive architecture are not necessarily involved in the spear-making process. In contrast, I will show that the senses of abstraction that most likely apply to the Schöninggen spears are not uniquely modern.

Why Abstract? How Abstract?

Traditional theories in cognitive science argue that conceptual knowledge inhabits a modular semantic system, which stands as separate from modality-specific systems for perception, action and emotion, as well as from episodic memory (e.g., Fodor, 1975; Pylyshyn, 1984; Tulving, 1972). Concepts are represented by transducing modal states into amodal representations, which could take the form of a list of features or a semantic network. Amodal concepts thus instantiate the fundamental units that are manipulated during cognitive operations.

In contrast, an important body of theory (Barsalou, 1999, 2012; Barsalou, Solomon, and Wu, 1999; Prinz, 2002) asserts that human concepts are to be considered as perceptual symbols, namely, representations that are grounded in specific sensorimotor codes. Perceptual symbol systems are based on a natively constrained neural architecture, which combines modality-specific neurons with associative areas of the brain. Firstly, different features of perceptual experience activate different neural detectors within modality-specific systems. Considering the case of vision, for example, neural feature detectors situated in the visual system respond to particular features of the percept. Secondly, conjunctive neurons in associative areas (Damasio, 1989; Damasio and Damasio, 1994) enable the conjoint of perceptual information about objects/events derived from the various neural feature detectors. These conjunctive neurons increasingly integrate information across modalities, thus producing multi-modal rather than amodal representations. Categorization and use of concepts in cognitive processes is conceived as a form of simulation of that category, which follows from an actual process of neurophysiological re-enactment (Barsalou, Simmons, Barbey, and Wilson, 2003). In this way, conjunctive neurons can partially re-activate neural detectors that were originally responding to perceptual features of the environment. This process of simulation/re-enactment can be consciously performed, like in the case of visual imagery (Collins, 2013, chapter 4) and imagistic reasoning (Kosslyn, 1994). In these cases, simulations consist of partly re-constructing the phenomenology of an object/event in the absence of sensory input. On the other hand, simulations could also be unconscious, as it happens for instance in preconscious processing and automated skills (Barsalou, 1999, p. 583).

The idea that situated concepts play a major role in human conceptualization has been subject to several critiques, which in turn generated responses (see Barsalou, 1999 and the associated commentary). Most importantly, it has been argued that situated concepts are best suited to explain only highly imageable, concrete concepts. Their role in the representation of abstract concepts (e.g., DEMOCRACY) is more contentious. Dove (2009), after examining arguments for and against perceptual concepts, has concluded that the most plausible explanation assumes representational pluralism. From this perspective, perceptual symbols can coexist with amodal representations, so that abstract concepts can be represented by the classic amodal theories (definitions, prototypes, exemplars, theories), while concrete, highly-imageable entities can be represented in the form of perceptual tokens. A different proposal advances linguistic forms instead of amodal concepts as the means to represent abstract concepts (Barsalou, Santos, Simmons, and Wilson, 2008). The latter are to be considered as networks of labels, which are semantically connected to perceptual representations by convention and cultural scaffolding. This theory advocates a combination of language and sensorimotor simulations (LASS). If representational pluralism or LASS are true, then we can assume that modern humans rely on different representational substrates that allow them to

flexibly engage with everyday tasks. Most importantly, if abstract concepts require amodal structures or language in order to be produced, any involvement of this sense of abstraction in producing artifacts might reasonably constrain the presence of a modern cognitive architecture, as supposed by the initial assumption (Thieme, 2005).²

The crucial aspect for the present discussion about the Schöningen spears is that representational pluralism or LASS do not need to apply with *Homo heidelbergensis* spear-makers. Indeed, no form of abstract conceptualization (sense 6) seems to be present in the spear-making process to require either amodal structures or linguistic scaffolding. On the contrary, the whole set of behavioral operations in Table 1 seems to be more parsimoniously explained by referring to perceptual simulations and image-based thinking.

How to Simulate a Simple Spear

A set of thought experiments can best illustrate the key aspects of my argument. The overall logic involves imagining the invention of a spear by means of abstract concepts and then contrasting this approach with a conservative embodied perspective based on perceptual simulations of concrete object/events. Let us consider how a hominid, armed with tools, approaches the problem of satisfying hunger by hunting a horse. I assume, as Haidle did, that *Homo heidelbergensis* could have relied on stone tools as modular units that can be used in a range of tasks. According to Table 1, hunting a prey entails “need a spear” as a sub-problem. However, if we consider the spear-making process as a practice to be invented and established, then the concept of spear must first itself be conceived. In this way, the hominid explores his habitat with pre-existing mental and physical resources, searching for a solution to the problem. The spear-making process begins when the hominid notices a pine or spruce shaft. At this point, abstract concepts could be used to support and justify each potential cognitive operation that aims to explain the underlying behavioral sequence. We might assume, for instance, that the hominid compares the perceived shaft to the abstract concept of POINT or to the composite one of POINTED OBJECT. The hominid “knows” that a POINT is necessary to kill the animal by THRUSTING and therefore deduces that a shaft has the right properties to be made into a stabbing tool. Further sub-problems related to using stone tools for cutting the trunk and carving out the spear could clearly be tackled with the same reference to abstract conceptualization and reasoning.

²The involvement of linguistically scaffolded abstract concepts plausibly constrains the existence of a modern cognitive architecture in Barnard’s (2010b) conception. In contrast, amodal concepts lack implementation in this theory of cognitive architecture and therefore their connection to modern cognition is assumed as a logical possibility, which might be thought to motivate the initial assumption on the Schöningen spears. The possibility that humans could have evolved an entirely different representational system is discussed by Barsalou (1999, p. 606). Whether this hypothesis is sound or not, the current analysis flanks the problem by rejecting any necessary involvement of amodal or linguistically scaffolded abstract concepts in spear-making.

However, despite this logical possibility, I contend that no form of abstract concept is necessary to explain the spear-making process. Each of the behavioral components of the chain under consideration is highly imageable/concrete and therefore within the scope of the situated approach introduced earlier. For example, in the context of a tree shaft, it is not necessary to postulate the existence of a concept of POINTED OBJECT in order to produce a spear. These hominids would have been repeatedly interacting with a wide range of naturally occurring forms or those modified by conspecifics. Such interactions could have led these pre-modern humans to be well acquainted with specific recurring properties, such as for example the fact that some of the objects were indeed pointed and that sharp tips can pierce the skin. Furthermore, explorative actions with stone tools might have revealed that scraping some particular branches and pieces of wood in a specific way produces sharp points. In this way, the concept of SHARP POINTED STICK could emerge through the practical engagement with these objects and be represented as a form of situated action.

Once such situated concepts are in place, an appropriate wooden shaft found in the environment could lead the hominid to re-enact perceptual simulations of known pointed objects. These re-enacted simulations could allow the hominid to imagine a weapon inside the shaft as well as the operations needed to carve the weapon out from the shaft. The same logic also applies to the rest of the sub-problems shown in Table 1. In particular, referring to subproblem 3A, “need of handaxe to cut down tree,” sensorimotor simulations could readily reveal the properties of suited stone tools and support the selection of appropriate actions. The same would hold for subproblem 4, “need of flake tool to work wood.” Furthermore, action control could be carried out by contrasting the simulated weapon with the specific properties of the actual tree in view at the time. In sum, by grounding in perception the operations underlying the invention of a spear it is no longer necessary to refer to abstractions in Barsalou’s sense 6.

Objections and Replies

Skeptics might argue that this position does not rule out abstraction in sense 1 or 5. Sense 1 in Barsalou’s list, namely categorization, might be used to argue that the perceptual representations underlying the spear-making process are nevertheless “abstracted” from experience. However, it is unclear how this point could be used to argue that sense 1 of abstraction constrains the existence of uniquely modern cognitive capabilities. To defend a similar position requires the assumption that conceptualization and the cognitive use of knowledge emerge with *Homo heidelbergensis* and represent the original roots of a modern-like cognition. While empirical evidence indicates that monkeys and apes are capable of acquiring concepts (e.g., Vonk, Jett, Mosteller, and Galvan, 2013), our skeptic faces also theoretical problems. Both Mithen (1998) and Haidle (2009), for example, compared

spear-making to the behavior of chimpanzees out hunting bushbabies (Pruetz and Bertolani, 2007). If the ability to create simulators itself is the subject of criticism, then it is unclear how a chimpanzee could keep a problem in its working memory (i.e., hunting the bushbaby) while attempting to solve a subproblem routine (i.e., finding an appropriate branch to stab the prey into its nest). The problem is compounded when applied to early forms of tool-making. Absence of abstraction in sense 1 therefore leaves open the issue of how to explain offline representations held in memory. More widely, it posits the problem of justifying the use of conceptual knowledge in non-human animals (Barsalou, 1999, pp. 606–607).

Even if the point about categorization were to be conceded, one might argue that the Schöningen spears still represent a leap towards modern human abstraction in Barsalou's sense 5, namely flexibility. According to this criticism, the spear-making process would somehow demonstrate that simulations can be performed beyond the isolated context of spear manufacturing and used in a rich gamut of cognitive activities. In contrast, more archaic hominids, as well as non-human animals, could have relied only on context-bound forms of situated conceptualization. In these archaic mental systems, perceptual simulations would be strictly bound to particular situations and therefore capable of representing only specific instances of events/objects.

The most problematic aspect of this explanation is that the spear-making process could also be based on context-bound conceptualization. Even though a certain degree of flexibility might be present in using the concept of SHARP POINTED STICK in the same material domain, this does not entail that such a simulator could be flexibly adopted in a different range of situations, transformed into an ad hoc category (Barsalou, 2003b), or could be applied to producing new weapons and technologies. For example, *Homo heidelbergensis*' cognitive system could have lacked the flexibility to turn a spear into a bow and arrow technology (Lombard and Haidle, 2012) or into a pole to support a stilt house. An analysis of these hominids' material culture, given the culture's relative stability in time, *prima facie* does not support a strong case for this type of cognitive flexibility (Wynn, 2002).

Raising the Ante: Throwing Spears

The arguments so far might hold for spears as thrusting weapons, whose use involves physical contact with the prey. The spears from Schöningen appear to be balanced for throwing, much like modern javelins (Thieme, 2005, p. 125). Several researchers have questioned whether the spears were actually thrown, and have provided different arguments (d'Errico and Stringer, 2011, pp. 1063–1064), including whether the anatomy of the upper limbs was sufficiently developed for throwing (Churchill and Rhodes, 2009); whether such spears could actually bring down big game if thrown from a distance (R.G. Klein, 2009, p. 404; Wynn and Coolidge, 2012, p. 50); and whether the spears were possibly too heavy or large for

throwing (Shea, 2006; but see Rieder, 2003 for a counterargument). However, if the spears were thrown, there is a further challenge for any situated cognitive approach. For example, Zilhao (2011, p. 118) assumes that in order to produce and use long-range hunting weapons, their makers must have “mastered the laws of ballistics before Neanderthals.” Against this background, it is worth examining whether the use of spears as projectiles would reintroduce the need for abstract concepts in the process of manufacture.

Coolidge and Wynn (2009, p. 167) have argued that *Homo heidelbergensis* must have been capable of understanding properties of Euclidean space in order to organize their actions. However, this was limited to some form of intuitive understanding without a formal grasp of, for example, spatial coordinates. An expert cognition, repetition-based approach (Wynn and Coolidge, 2004) is quite sufficient without requiring reference to Euclidean space.

The innovation of throwing weapons could plausibly have developed out of prior use of stabbing weapons in a hunting context. Thrusting weapons could have been let go in the course of a thrust, in order to minimize the risk of injury in big game hunting. On the other hand, this practice could have also capitalized on pre-existing habits of throwing manuports, for example, to keep predators like hyenas at bay. From these practices, *Homo heidelbergensis* populations could have gradually discovered the proper features a weapon ought to have to act as a projectile. Then, they could have learned to produce spears with “throwing” properties, by learning how to control specific technical processes (e.g., tree choice, carving procedure). At the cognitive level, this learning could well have been accomplished by comparing perceptual instances of some spears with situated simulations of the technical procedures required to produce them. No abstract representational form, like INCLINATION, ATTRITION, CENTER OF WEIGHT, needs to be a priori cognized in order to produce a correct balancing of the spear. If these components are excluded, however, the principles of ballistics mentioned by Zilhao (2011) can be considered as simple practical laws that are acquired by combining action dynamics with situated representations.

A Radical Reinterpretation

The conservative embodied view presented earlier can still be subject to a mentalistic conception. This considers the behavioral sequence of operations reported by Haidle (2009) as reflecting the presence of a cognitive plan, which addresses each sub-goal and sub-routine in terms of input-output. In this way, skeptics might concede that abstract cognition is not necessary for manufacturing spears. However, they could still claim that realizing a spear involves modern “in depth-planning,” which takes the form of a series of inferences advanced from a set of mental representations, though grounded in perception. In-depth planning would prove a qualitative overlap in cognitive functions between *Homo*

heidelbergensis and modern humans, as postulated by the initial assumption (Thieme, 2005). The aim of the current and the following section will be to provide a radical embodied counterargument to this objection. This alternative view will be developed by combining ecological principles of perception and intuitive interaction theory.

According to James Gibson's (1979) ecological approach, perception does not require the a priori use of concepts in order to make sense of the world. In visual perception, our brain does not process the stimulus registered on the retina by adding information concerning native or acquired categories. Rather, information is already present in the structure of the environment itself. Most crucially, perception is radically embodied, in that meaning of the world emerges directly in the interaction between agents and their environment. Since agents have certain body features, elements of the world are directly perceived as a set of affordances for action (e.g., Chemero, 2003, 2009, chapter 7). For example, a surface does not appear as climbable for the fact that it is inferentially judged as flat. Rather, when the agent navigates the environment, the surface presents some invariant properties that allow the agent to directly perceive it as climbable.

Intuitive interaction is a research program developed in the context of product design with the aim of simplifying human-artifact interactions and minimizing users' cognitive load (Blackler, 2008; Blackler, Popovic, and Mahar, 2010). Intuition is defined as a direct/non-inferential process of knowledge acquisition based on past experience (e.g. Bastick, 2003; G. Klein, 1998; Volz and von Cramon, 2006). Empirical studies in this field have shown that the key for reducing complexity lies in exploiting users' previous experience with similar artifact interfaces or real life situations (Brandenburg and Sachse, 2012; Pearson and van Schaik, 2003; Rettig, 1991; Thomas and van Leeuwen, 1999). For example, consistency with the operations usually performed in a real office environment has represented a guiding principle to develop human-computer interfaces during the last decades (e.g., see Smith, Irby, Kimball, and Verplank, 1982, about the revolutionary Xerox Star Interface, which first implemented the "you get what you see" principles). Familiar actions like moving a book from a shelf to a desk have been exploited to design interfaces that simulate the transferring of a folder onto a virtual desktop. Users understand the artifacts' rules of functioning by actively engaging with them in their living contexts. Intuitive understanding happens when features of new artifacts trigger analogous features and rules of functioning of familiar artifacts from long-term memory (Bowers, Regehr, Balthazard, and Parker, 1990; Kolodner, 1993; Richman, Gobet, Staszewski, and Simon, 1996, p. 180). Such an intuitive connection is fast, efficient, and mostly unconscious (Bowers, 1984; Dijksterhuis and Nordgren, 2006), for the user has the feeling of knowing how the artifact works without a clear awareness of how he reached such an understanding (Horr, Braun, and Volz, 2014).

The importance of intuition in designing human–artifact interfaces is represented by the fact that this cognitive process reduces the involvement of knowledge-based approaches to understanding artifacts (Rasmussen, 1990). If users can exploit their past experience in a fast, efficient, and quasi-automatic fashion, then they would need to employ theoretical knowledge about how artifacts work (Naumann et al., 2007). Increasing the intuitive aspects of human–artifact interfaces therefore leads to a better usability of the products.

Interestingly, intuitive interaction theory is positively oriented towards embodied cognition and ecological psychology (Blackler, 2008, pp. 21–23, 89–94). Past experience in user–artifact interaction is indeed conceived as the learning of affordances that are “virtually” built within the cultural context where agents and artifacts are situated (Norman, 1988). In the current paper, intuition will be used as a cognitive process to bridge ecological and enactive principles of perception, action, and memory, with the aim of ruling out mental plans from the spear-making process.

Intuitive Resonance

Homo heidelbergensis spear-makers developed in a cultural milieu that allowed them to interact with stone artifacts as problem-solving tools. Likewise, evidence of wooden objects from Lower Paleolithic sites besides Schöningen (see the Introduction), though quite limited, supports the idea that these hominids were also familiar with the properties of wood and plausibly with the interaction between wooden objects and stone tools. As a result of such a long-term material engagement (Malafouris, 2004, 2013), these artifacts become deeply embodied in the hominids’ perceptual systems, capable of perceiving new affordances for action in the world. The perceptual system thus becomes extended by memory (Gibson, 1979, p. 279), since affordances for action are memorized as variations of sensorimotor features of objects in relation to embodied activity (Noë, 2004, p. 105; O’Regan and Noë, 2001).

Simply looking at a tree can trigger affordances for action that have been acquired from potentially extensive past experience of, for example, other similar shaped branches and how they are joined to a trunk. Past experience of multimodal sensorimotor contingencies may also resonate with particular perceived features of the tree by means of a deep intuitive sense of similarity and association. Intuition leads therefore to an automatic understanding of the affordances of the constituent parts of a tree. In this way, hominids could directly perceive the possibility of carving a spear out of a tree branch and trunk. This “spear-derivability” affordance is apparent when other affordances like “ability-to-be-chopped-off” and “bark-reduction” are also perceived. As the sequence of actions involved in manufacturing a spear gradually unfold, so the “hunting an animal affordance” would become increasingly evident to the maker or to others in their band who might be observing that process.

Furthermore, subproblem 1, namely hunting an animal, is kept coupled to the agent–artifact system by the progressive chain of actions leading to the emergence of a thrusting weapon. The refinement of the pointed tip affords killing by thrusting, which in turn complements being killed by thrusting. In sum, every aspect of the process is coupled within the dynamics of action and perception underlying the spear-making process.

Unlike the conservative embodied model discussed above, the radical reinterpretation does not involve that mental representations are compared with percepts in order to draw inferences and accordingly organize actions. The spear-making artisans did not need keep in mind subproblem 1 “hunt prey” and subproblem 2 “need of spear” as a sort of conceptual premise according to which he organized action. With respect to any putative involvement of conceptual knowledge, there is a direct parallel with the discussion provided earlier about the non-necessity of abstract concepts and the sufficiency of sensorimotor simulations of concrete objects/events. However, in the current radical embodied version, concepts and memories *resonate* with affordances by means of intuition and are not used a priori to discover meaning of an aspect of reality. Conceptual representations can in fact be enacted from memory while perceiving affordances, letting the plan emerge and take form while perceiving relevant aspects of the world.

Intersubjective Spear-making

It could be pointed out that the spear technology was not systematically reinvented by *Homo heidelbergensis* every time they needed it, but transmitted from experts to novices across generations. At the same time, there are reasons to believe that such a transmission was grounded in active teaching–learning mechanisms. Indeed, the complexity of the tasks involved in the production of Acheulean artifacts, such as symmetrically coherent handaxes (Wynn, 2002), dissuades one from thinking that the spear-makers relied on learning strategies based on imitation/emulation (Morgan et al., in press). If these were the only existing mechanisms, coherent handaxes, for example, should appear only very rarely in the record, surrounded by a great amount of failed imitative attempts and incomplete tools. This would make difficult to explain cases such as the high standardization of bifacial forms appearing in African sites from ca 700 kya (Pélégryn, 2009; Roche, 2005), unless one implausibly assumes that these artifacts were produced only by few gifted individuals.

The active transmission of the spear-making process could have happened through the construction of an internal model of a spear. Expert spear-makers could have shared this mental template with novices by adopting language-based meta-representations, which allow one to represent the mental states of the other individuals “as such” (i.e., I know what you believe, wish, or think). In this way, social transmission of expertise could be argued to reintroduce the costly cognitive strategies eliminated from the individual dimension within the previous discussion.

However, according to a radical embodied argument (Hutto and Sánchez-García, *in press*), such a mentalistic approach does not represent the actual way learners acquire practical expertise from their teachers. Evidence from the musical domain allows us to understand the main aspects of the radical embodied principles of skill transmission and acquisition. Laroche and Kaddouch (2014) have recently discussed the case of enactive learning of piano playing abilities through four-hand improvisation. In this situation, a teacher sits at the left part of the piano, which represents low notes, while a young learner sits at the right side, corresponding to high notes. Four-hand improvisation is not based on representing and sharing an internal melody, made of theoretical relations among the notes. On the contrary, the two players create an intersubjective system, where the activity of the one influences and shapes the activity of the other (De Jaegher, 2009; Fuchs and De Jaegher, 2009). Mutual understanding emerges from interactive modulations of individual actions, a process also known as “participatory sense-making” (De Jaegher and Di Paolo, 2007). The novice begins to play notes by relying on her prior experience. The teacher enters in resonance with these basic patterns and gradually alters his playing in order to drive the learner towards a new pattern. In this way, the melody played by the teacher provides the affordances for action that the novice learns to exploit with experience. At the same time, the teacher can perceive when the novice hesitates in adapting to the new patterns and regulates his actions to help facilitate the learning process.

The principles of participatory sense-making introduced above apply also to the transmission of the spear technology. Let us consider the case of a single hominid that invents a spear by means of intuitive resonance with a tree shaft (see above). The other band members can exploit this situation by adopting a hybrid learning strategy articulated in two steps (Sterelny, 2011, chapter 2). First, they can indirectly analyze wooden flakes and debris left back by the expert’s crafting activity. Such an explorative ability allows them to become familiar with some preliminary aspects of the technique and to acquire a basis of individual experience. Second, and most importantly, they can directly refer to the expert as a model for knowledge acquisition. In this way, the expert and the apprentice form an intersubjective system, similar to the one described for piano improvisation.

The spear-making technique is acquired by the novice as a result of a mutual engagement with an expert practitioner. The actions adopted by the expert to craft a spear with handaxes directly represent what is needed to be done. The novice attempts to reproduce these patterns with his own tools by directly comparing his performance with that of the expert. This, in turn, modulates the activity of the novice, leading him to discover how to solve problems with the carving process. Intentionality is directly perceived by both agents as an embodied action directed toward the tool-agent complex (see Garofoli, *in press*, for a similar account). No mentalistic abilities are necessary to realize this intersubjective system. In particular, language need not be used to represent and share an ideal model. A large part of

this system can be realized in a non-linguistic way, while vocalizations can be initially used as epistemic tools to support the meaning of embodied actions (Stout, 2002, p. 719). For example, vocal emphasis can be used by the expert to mark the correct copying of a technique by the apprentice, or to draw his attention on a mistake. This seems to be the case also in some contemporary ethnographic contexts of apprenticeship like blacksmithing (Keller and Keller, 1996; Wynn and Coolidge, 2004). Primitive vocalizations can gradually become indexical of particular actions or events (Brown, Collins, and Duguid, 1989) and scaffold the emergence of abilities like abstract concepts or meta-representations in the long term. Situated apprenticeship thus represents a necessary condition for the emergence of abstractions and not the other way around.

Drawing from Sperber (2000), Sterelny (2011, chapter 6) argues that humans did evolve specific meta-representational abilities that allowed teachers and learners to coordinate actions according to a “mentally shared” plan. However, these mentalistic strategies may be relevant for apprenticeship only in quite recent cultural contexts (Wynn and Coolidge, 2012, p. 70). By embracing an argument from phenomenology (de Bruin and de Haan, 2012), enactivists claim that social understanding grounded in mentalistic abilities like theory of mind is in fact not primary even in contemporary societies, where perception of social affordances, augmented by contextual knowledge and narratives, plays the main role (Gallagher, 2008; Gallagher and Hutto, 2008; Garofoli, in press). Furthermore, the emerging radical embodied approach to Dreyfusian pedagogy (Dreyfus, 2012; Hutto and Sánchez-García, in press) argues for abandoning shared abstractions when developing training strategies for novices. Evidence from sport science shows indeed that the adoption of shared abstractions impairs task acquisition and performance (Beilock, 2008; Davids, Araújo, Hristovski, Passos, and Chow, 2012), since the use of explicit cognitive strategies interferes with the embodied realization of a task, a phenomenon known as “choking” (Beilock, 2011). In sum, the multiple sources of argument introduced above show there is a paradox in assuming that mentalistic strategies, considered secondary in modern contexts, were necessary to the transmission of Lower Paleolithic spears.

Discussion

The results of the current analysis show that intuitive resonance is sufficient to explain the spear-making process at Schöningen. This radical embodied cognitive process eliminates the involvement of presumed modern human-like abilities, namely abstract thinking and in-depth action planning. Further, intuitive resonance is considered to be similarly involved in producing both Acheulean tools and the Schöningen spears. Indeed, direct perception of affordances for action, augmented by previous experience, can explain the production of these artifacts. Besides this similarity in the general cognitive requirements, affinity between these

two technologies also exists at a more specific level. Indeed, some affordances for action seem to be invariant between the two considered practices. For example, stone reduction and bark reduction could be grounded on the perception of analogous affordances for “reducing a core.”

This conception is consistent with some of the more skeptical views about the Schönningen spears. R.G. Klein (2009), for example, argues that the cognitive complexity of the spear-making process equals that of stone-tool making, since wooden spears and stone tools still imply the presence of one tool to produce another, a conception also within the idea of modular culture (Haidle and Conard, 2011). In consequence, fabricating stone tools entails the same level of “foresight and control” (R.G. Klein, 2009, p. 407) required to manufacture simple spears. More specifically, the two technologies tap into the same set of cognitive and neural processes, purposed to the control of reiterated operations (Ambrose, 2010). From the radical embodied approach, these proposals have merit in that they emphasize the qualitative stability in the behavioral and cognitive processes underlying spear-making, which can be seen as the emergence of new affordances for artifact-making in both stones and tree trunks. However, the skeptics underestimate the quantitative augmentation that a perceptual system must have to start to detect the affordances necessary to produce spears. In fact, perceiving affordances for cutting in a stone tool and affordances for imposing edges and rough symmetry to the same object might be easier than directly perceiving a spear into a tree. Expertise in Acheulean tool-making can be based upon becoming attuned to the properties of cores and hammers by actively manipulating them (Bingham, Schmidt, and Rosenblum, 1989; Nonaka, Bril, and Rein, 2010; Reed, 1996; Zhu and Bingham, 2008). However, in the case of spear-making, the perceptual system apparently needs a larger amount of information. Indeed, the learning stage for creating a spear implies a set of different stone tools, namely handaxes for chopping off trunks and scrapers for removing bark and working out the wood to be integrated within the perceptual system (Table 1).³ Such an integration requires acquiring expertise with multiple stone tools and at the same time using these tools to explore the properties of wooden objects. In addition, properties of animals and affordances of objects necessary to hunt them need to be included within the creative process. A system capable of this integration might therefore need higher capacity than that possessed by *Homo erectus*: simply able to pick up cutting affordances and to impose a rough symmetry to stone tools (Wynn, 2002).⁴ Such a position is consistent with the view that the same mental architecture, common to both *Homo erectus* and *Homo*

³See Nonaka et al. 2010, pp. 164–165 (and references therein) for a review of the necessary learning conditions that lead to the emergence of novel technologies and behaviors.

⁴In this paper the notion of cognitive capacity refers to a specific property of mental architecture, namely to the quantity of information that subsystems can carry and reciprocally exchange (Buschman, Siegel, Roy, and Miller, 2011; Halford, Cowan, and Andrews, 2007).

heidelbergensis, increased the amount of information processed by its component subsystems, without any alteration to the architecture's qualitative structure.

Reasons for preferring the radical embodied explanation to mentalistic proposals are to be found in two different lines of argument. Firstly, an approach based on intuitive resonance allows one to avoid the "representational fallacy" that plagues mentalistic theories (Malafouris, 2013, p. 253). There is indeed logical circularity in assuming that a representation of a spear exists in the mind of the artisan prior to its empirical instantiation. A way out from this paradox lies in assuming that abstract conceptualizations and internal plans emerge as a result of natural selection acting on innately specified neural substrates and cognitive functions. However, this solution leaves room for anthropocentric (Knappett and Malafouris, 2008) and deterministic (Tallis, 2011) problems. In contrast, according to the radical embodied proposal, the concept of SIMPLE SPEAR emerges from material engagement with tree shafts and stone tools. In the long term, this concept scaffolds the production of more sophisticated technologies like hafted weapons (e.g., Mazza et al., 2006).

A second motivation in support of the radical embodied proposal lies at the level of plausibility selection. Indeed, if radical embodied cognitive science is sufficient to explain the spear-making process, then the involvement of abstract concepts, for example, becomes disconnected from the archaeological record and is reduced to the status of a logical possibility. Considering logical possibilities as relevant theories openly violates the strict standard of parsimony required in cognitive archaeology (Wynn and Coolidge, 2009). Garofoli and Haidle (2014) recently argued that logical possibilities could escape from their unconstrained status only by adding ad hoc hypotheses, which dramatically reduce their plausibility as theories. In consequence, keeping abstract concepts and in-depth plans as candidate explanations, despite their unconstrained status, implies that we are assuming them as ad hoc theories. There is no reason to accept this kind of explanation when there are easier, empirically grounded ones. However, Garofoli and Haidle (2014) also added that analyses of single and isolated practices are insufficient to draw inferences about the overall properties of extinct minds. To this end, it is crucial to place the explanations provided for single technologies in the context of a wider repertoire of behavioral practices that represent the cultural capacity of one species (Haidle and Conard, 2011). Referring to *Homo heidelbergensis* at Schönningen, radical embodied cognitive science thus needs to explain also the organizational patterns that lead to ambush hunting, as well as to the production of a bipointed wooden tool interpreted as a spit (Thieme, 2005). Likewise, evidence of human-made shelters associated with this species needs to be carefully examined (Gamble, 1999, chapter 4). If any aspect of *Homo heidelbergensis*' cultural capacity would necessarily require using high-level mentalistic strategies, then it would be possible to expect that these same strategies have been also employed for producing the spears. Such a condition would threaten the plausibility of the radical embodied explanation here provided.

Conclusions

Overall, evidence at the Schöningenen site has been interpreted as proof of the involvement of intellectual capabilities previously ascribed to modern humans only. In this paper, I have attempted to demonstrate that the production and cultural transmission of wooden spears does not necessarily imply any qualitative advancement that overlaps with modern human cognition. A radical embodied approach has been specified to show that more primitive abilities could have played a pivotal role in the production of this new technology. I have therefore emphasized a role of Gibsonian smart perception in the production of this technology, which eliminates and replaces the need for abstract conceptualization and mentalistic planning from the cognitive requirements underlying the spear-making process. The radical embodied approach is valid insofar as we consider this practice in isolation. Additional analyses about other behavioral practices associated with *Homo heidelbergensis* are required to further validate the current proposal.

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Is That Me? Sense of Agency as a Function of Intra-psychic Conflict

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The sense of agency is based on several cognitive processes, including the perception of a lawful correspondence between *action intentions* and *action outcomes*. We hypothesize that this sense is also modulated by intra-psychic conflict, such that urges (e.g., to smoke) conflicting with current goals (e.g., to not smoke) tend to be perceived as foreign to the self, as captured by the “monkey on one’s back” metaphor describing aspects of addiction. Accordingly, in two classic *response interference* paradigms, participants perceived the activation of plans as less associated with the self when the plans conflicted with intended action than when the same plans led to no such interference. Intra-psychic conflict influenced the sense of agency in a dynamic and contextualized fashion. In both paradigms, response interference was associated with weakened perceptions of control and stronger perceptions of competition. These findings illuminate aspects of self-control, volition, and the cognitive construction of the self.

Keywords: sense of agency, authorship processing, cognitive conflict

Traditional psychophysics has focused on the correspondence between subjective experience and the stimuli of an external, objective world. Less attention has been given to the correspondence among modes of cognitive processing in the brain and their subjective effects. Intimately related to the notion of “Dasein” is

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the sense of existing as an entity/agent, both in the world and in the mind. This sense of agency is based on several cognitive processes, including the perception of a lawful correspondence between action intentions and action outcomes (Wegner, 2003). For example, if one intends to extend one's arm and then the arm happens to extend, one is likely to believe that the movement was willed by the self (Berti and Pia, 2006; Frith, Blakemore, and Wolpert, 2000; Pacherie, 2008; Prinz, 2003). Similarly, in the mental world, if one intends to imagine the shape of a triangle and then happens to experience triangle-like imagery, one is likely to believe that the imagery was willed by the self, even when, in actuality, the percept may have been caused by an experimental manipulation, as in the classic Perky effect (Perky, 1910). (In the Perky effect, experimental subjects are fooled into believing that they are imagining an image that is actually presented physically on a screen.) When intentions and outcomes mismatch, as in action slips and spoonerisms (Botvinick and Bylsma, 2005; Heckhausen and Beckmann, 1990), people are less likely to perceive actions as originating from the self (Wegner, 2002), leading to the cognition, "I didn't intend to do that" or "That thought/action came out of the blue," meaning "not from me."

It seems that similar self-versus-other attributions are found in motivational, intra-psychoic conflicts as well (cf., Livnat and Pippenger, 2006), as captured by the "monkey on one's back" metaphor that is often used to describe the tendencies associated with aspects of addiction. Most exemplary, in Freud's (1938) classic framework of the *id*, *ego*, and *superego*, primitive animalistic urges (e.g., libidinal urges from the *id*) stem from something that is perceived to be distinct from the self (i.e., distinct from the *ego*). Apart from these speculations and theoretical approaches, there is little empirical evidence to illuminate the relationship between the sense of agency and intra-psychoic conflict.

To this end, we hypothesize that intra-psychoic conflict influences the sense of agency, such that urges conflicting with goals tend to be perceived as foreign to the self. More specifically, building in part on findings in the addiction literature (Baker, Piper, McCarthy, Majeskie, and Fiore, 2004; Loewenstein, 1996), we hypothesize that the urge to engage in an activity (e.g., smoking) that is incompatible with intentions (e.g., to be healthy) should lead to conscious conflict and such self-versus-not-self attributions (Pacherie, 2008). These intra-psychoic, conscious conflicts (Morsella, 2005) stem from incompatible skeletomotor intentions, such as when one suppresses dropping a hot dish of food, suppresses eating behaviors (as in dieting), suppresses emotions, or holds one's breath while underwater (Morsella, Krieger, and Bargh, 2009). To the benefit of the experimenter, research has revealed that such conscious conflicts can also stem from less "hot" (Metcalfe and Mischel, 1999) conflicts, such as those elicited by laboratory response-interference paradigms (Morsella, Gray, Krieger, and Bargh, 2009).

In accord with recent views (Gazzaley and D'Esposito, 2007; van Veen and Carter, 2006), we believe that unraveling the nature of the subjective effects associated

with response conflict in interference tasks such as the Stroop paradigm is essential for understanding the dynamics of the “hot” response conflicts (Metcalf and Mischel, 1999) of everyday life, such as those involving self-control and motivational conflict (Baker et al., 2004; see review in Morsella, Berger, and Krieger, 2011).

In the classic Stroop interference paradigm (Stroop, 1935), for example, participants are instructed to name the colors in which words are written. When the word and color are incongruous (e.g., RED presented in blue), response conflict leads to increased error rates, response times (RTs), and self-reported “urges to make a mistake” (henceforth, “urges to err”; Morsella, Gray et al., 2009). Moderate interference is also found with non-color, control words (e.g., HOUSE presented in blue). When the color and word are congruous (e.g., RED presented in red), or the color is presented on a neutral stimulus (e.g., a series of x’s as in “XXXX”), there is little or no interference (see review in MacLeod and MacDonald, 2000) or urges to err (Morsella, Gray et al., 2009).

Only recently have researchers begun to look at the subjective and metacognitive aspects (e.g., urges to err) of interference tasks (Morsella, Wilson et al., 2009). Data suggest that these trial-by-trial subjective effects are not due to participants observing their own behavioral RTs. For example, these subjective effects are still robust in a Stroop-like interference paradigm (Morsella, Wilson et al., 2009) in which participants are instructed to withhold responding to the target stimulus for over a second, which eradicates RT effects (Eriksen and Schultz, 1979). Moreover, the effects are present when participants sustain incompatible intentions (e.g., to point left *and* right) in a motionless state in which no response is required or emitted (Morsella, Gray et al., 2009). In addition, though post-error corrections in interference paradigms involve improved performance (e.g., faster RTs) on trials following a trial involving response interference (e.g., an incongruent trial), reported urges to err actually increase in such a trial, which has been explained as a difference between implicit measures of performance (e.g., RT) and explicit measures (e.g., self-reports about task difficulty; Etkin, Prater, Hoefl, Menon, and Schatzberg, 2010). This research suggests that the explicit (conscious) system can be affected in the opposite manner of the implicit, unconscious, behavioral system, and that urge ratings are not based on observations of one’s RTs.

Nevertheless, and despite research showing that urges arise even when RT effects are eradicated by having participants delay responses (Morsella, Wilson et al., 2009), at this stage of understanding, it is difficult, if not impossible, to remove all influence of processing speed, processing fluency, or a general sense of effort (or a combination thereof) on the judgments made by participants (Winkielman, Schwarz, Fazendeiro, and Reber, 2003). Processing speed is introspectable even when behavioral responses are suppressed. More generally, as with other introspective measures, it is challenging to verify what participants are introspecting at the moment that they are making their judgment. Self-reports are far from infallible, even if they occur just seconds after the relevant conscious experience (Block, 2007).

In examining the trial-by-trial subjective aspects of participants' responses in interference paradigms, Morsella, Wilson et al. (2009) concluded that, when there is response conflict (e.g., the Stroop incongruent condition), urges to err tend to be strong; when response interference is low or absent (e.g., the congruent condition), self-reported urges to err tend to be weak. That urges to err are weak for the congruent condition of the Stroop task is interesting because it is known from behavioral and psychophysiological data that participants often do read the stimulus word inadvertently in this condition: "The experimenter (perhaps the participant as well) cannot discriminate which dimension gave rise to the response on a given congruent trial" (see review in MacLeod and MacDonald, 2000, p. 386). Urges to err for the congruent condition are comparable to those of the neutral condition of the Stroop task, in which the color is presented on an illegible letter string (Morsella, Wilson et al., 2009). This intriguing finding has been explained as an instance of *synchrony-blindness*, in which one is unaware that two distinct cognitive operations are activated when the operations lead to the same action plan (Molapour, Berger, and Morsella, 2011). The notion of synchrony-blindness is consistent with the more general view that one is conscious only of the outputs of processes, not of the processes themselves (Fodor, 1983; Lashley, 1951). Synchrony-blindness seems to be featured also in the congruent conditions of countermanding tasks such as the anti-saccade task (Curtis and D'Esposito, 2009).

As this initial research suggests, notable changes in consciousness accompany responses in interference paradigms, rendering the responses in these paradigms qualitatively different from everyday actions (e.g., flicking a switch). Yet, as mentioned above, less has been revealed and documented about the subjective, agency-related aspects of these tasks than about their behavioral and neural aspects. Stemming from research unrelated to the phenomena at hand, one framework (Morsella, 2005) proposes that, of the many forms of integration or binding in the brain, the kinds of subjective and metacognitive effects associated with the sense of agency are most intimately related to one form of binding, namely, *efference-efference* binding. From this standpoint (Morsella and Bargh, 2011), consciousness and other high-level metacognitive processes play a smaller role in the binding of perceptual features within or between modalities. This *efference* binding can occur unconsciously, as in perceptual feature binding (e.g., the binding of object shape to color) and intersensory illusions (e.g., the ventriloquism effect). As well, the binding between perceptual and action codes (*efference* binding; Haggard, Aschersleben, Gehrke, and Prinz, 2002) can occur unconsciously, as when a subliminal stimulus elicits a button press or when one reflexively withdraws one's hand from a painful stimulus or when one reflexively inhales. Thus, consciousness, the sense of agency, and other, high-level metacognitive components (e.g., sense of competition) are most intimately-related to *efference-efference* binding (defined below).

Efference–efference binding occurs when two streams of efference binding are trying to influence skeletomotor action at the same time. It is important to note that the conscious conflicts associated with this form of binding are intimately related to action selection in the skeletal muscle output system (Morsella, 2005). Conflicts involving non-skeletal muscle effectors (e.g., smooth muscle conflict) do not lead to any subjective effects (Morsella, Gray et al. 2009), and conflicts occurring before the action selection stage of processing (e.g., intersensory conflicts) do not lead to any kind of subjective strife. The pattern of observations is consistent with the view that consciousness integrates high-level outputs for a form of action control, one operating at a higher level than motor control, which is largely unconscious (Morsella and Bargh, 2011).

It has been proposed that, because it is required for integrating two conflicting streams of efference binding, efference–efference binding results in integrated actions such as holding one’s breath, carrying a hot dish of food, performing the Stroop task, suppressing socially-inappropriate behavior, or thus modulating another action plan (Morsella and Bargh, 2011). Yet, to date, there is no evidence that a conflicting efference stream is perceived as a “monkey on one’s back” and perceived as foreign to the self.

In interference tasks, are self-versus-not-self attributions ephemeral and nebulous, or systematic and reliable? In light of these questions, our goal was to demonstrate for the first time that urges conflicting with one’s intended action goals (an instance of efference–efference binding) tend to be perceived as foreign to the self. To this end, in a series of studies, we had participants introspect self-relevant aspects of subjective experience (*perceptions of action authorship* [Wegner, 2003], *control, and competition*) on a trial-by-trial basis while performing classic response interference paradigms.

Study 1

Hypothesis and prediction. We hypothesized that, when an action plan is activated and counters one’s action goal, that action plan is perceived as less due to the self than when the concurrently activated action plan does not interfere with one’s action goal. In the control and incongruent conditions of the Stroop task, word reading leads to an action plan that counters the participants’ goal of naming the color (henceforth, “color-naming”). Hence, we predicted that, in these two conditions of the classic Stroop task, urges to read are less attributed to the self than in the congruent condition, when word-reading does not interfere with, and may actually facilitate, performance on the task (MacLeod and MacDonald, 2000). In our paradigm, participants were asked after each Stroop trial, “How strongly do you feel that the urge to read the word was due to your ‘self’?” For brevity, we refer to this as our “reading due to self” dependent measure. We chose the Stroop task because it innocuously captures aspects of the “monkey on one’s back” phenomenon, and much is already known about its cognitive, subjective, and neural components.

Extensive piloting revealed that, when presenting this question alone (Pilot Study 1, $n = 17$), and when not including additional clarifications about what was meant in the question by the term “self” (Pilot Study 2, $n = 8$), different participants tended to interpret this question about the self to mean quite different things. For example, piloting revealed that participants often construed “self” as meaning the physical body or organism. As one would expect, this misinterpretation of our question did not lead to informative effects about our experimental manipulation: the Stroop condition did not influence attributions of word reading to the self ($p > .10$). Similar, ambiguous effects were obtained in Pilot Study 3 ($n = 18$), in which the following question was presented alone: “How strongly do you feel that the urge to read the word was due to your ‘self’?” As explained below, for Pilot Studies 1 and 3, after each trial, participants were also asked the following two questions in the following order: “How much personal control did you feel when responding?” (on a 1-to-8 scale in which 1 signified “no control” and 8 signified “absolute control”) and “How strong was the thought of a competing response?” (on a 1-to-8 scale in which 1 signified “not strong at all” and 8 signified “very strong”).

From piloting we learned that, to remedy these shortcomings, participants need to be presented with a statement (presented below) that explains the difference between the physical self and psychological self. In addition, we learned that, to be understood in the intended manner, the “reading due to self” question could not be presented alone and benefited from being presented along with the question above about color-naming and the self (i.e., “color-naming due to self” question). As evident in previous studies (Morsella, Wilson et al., 2009), questions about subjective experience are answered differently in different contexts and introspecting about one subjective dimension of interest influences judgments based on other dimensions. From this extensive piloting, we became confident that, by clarifying what we mean by “self” and by presenting a comparison question about color-naming, participants would interpret our critical question as we intended.

Method

Participants. San Francisco State University undergraduate students ($n = 32$) participated for class credit. These students were enrolled in psychology courses. The involvement of human participants in our project was approved by the Institutional Review Board at San Francisco State University.

Procedure. Participants were run individually. The session consisted of a block of trials in which participants responded to Stroop stimuli vocally. Each block consisted of 24 Stroop trials having eight congruent (e.g., RED written in red), eight incongruent (e.g., RED in blue), and eight control (e.g., HOUSE in green) stimuli presented in random order. No neutral stimuli (e.g., XXXX in pink) were presented because our “reading due to self” question could not be asked about such stimuli. The eight colors used were correctly identified by all participants. Participants

were instructed, "In this task, you must respond to the words presented on the screen by naming aloud the colors in which the words are written as fast and as accurately as possible. For example, if the word FLOWER is presented in blue, you must utter the color name 'blue.' The microphone will record your response and measure your response time." Vocal responses were detected by microphone (Model 33-3014; Radio Shack; Fort Worth, TX) connected to a PsyScope button box (Response Box; ioLab Systems; UK). Piloting revealed that, for participants to understand that our question was not about the physical self, the experimenter had to explain the nature of the psychological self. Hence, in our experiment, participants were presented with the following statement about the "self."

There are things that occur in the mind which feel like they come from one's psychological self, and things that feel like they do not come so much from one's psychological self. In psychology, researchers often differentiate between "the bodily self" and "the psychological self." In this study, we are examining the nature of the psychological self.

For this and the following experiments, stimuli were always presented in random order on a white background of a 43 cm Apple iMac computer monitor with a viewing distance of approximately 50.8 cm, and stimulus presentation was controlled by PsyScope software (Cohen, MacWhinney, Flatt, and Provost, 1993). A sample trial proceeded as follows. A blank screen was shown for 700 ms. It was followed by a randomly selected Stroop stimulus (48-point Helvetica), remaining onscreen until a vocal response was detected by microphone. After the response, participants were asked via computer screen, "How strongly do you feel that the urge to read the word was due to your 'self?'," which they rated on an eight-point scale, in which 1 signified "not at all due to self" and 8 signified "absolutely due to self." After inputting their rating and pressing the return key, participants were asked, "How strongly do you feel that the urge to name the color was due to your 'self?'," which they rated using the scale for the first question. This input terminated the trial. The order of presentation of the two questions was counter-balanced across participants.

Results

Primary results. As illustrated in Figure 1, the Stroop condition produced the predicted systematic effects on the measure "reading due to self," $F(2, 62) = 10.856, p < .0001 (\eta_p^2 = .26)$, in which these attributions were lowest for the incongruent condition ($M = 5.51, SEM = .30$), followed by the control ($M = 5.61, SEM = .28$) and congruent conditions ($M = 6.33, SEM = .30$). Planned comparisons revealed that all differences between conditions were significant ($ps < .01$), except for that between incongruent and control conditions ($p = .53$). Omitted responses and typing errors resulted in the loss of eight (1.0%) of 768 "reading due to self" ratings.

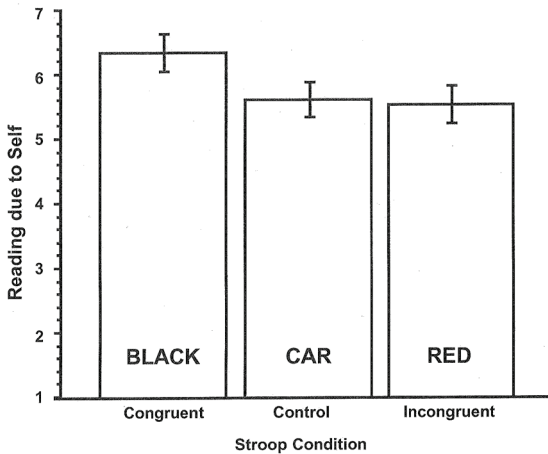


Figure 1: Mean attributions of word-reading urges being due to “the self” as a function of Stroop condition. Error bars indicate SEMs.

Reaction time analysis. As in Morsella, Gray et al. (2009), Stroop-task RTs below 200 ms and above 2.5 s were excluded from analysis, resulting in the data loss of 82 (10.6%) out of 768 trials. We replicated the Stroop RT effect: ANOVA analyses revealed that the Stroop condition had systematic effects on RTs, $F(2, 62) = 41.171$, $p < .0001$. Mean RTs were greatest for the incongruent ($M = 1289.96$, $SEM = 51.47$), followed by control ($M = 1166.67$, $SEM = 55.72$) and congruent conditions ($M = 1019.86$, $SEM = 48.28$). Planned comparisons revealed that all differences between conditions were significant ($ps < .01$).

Correlational analysis. Only five of the 32 participants had significant within-person correlations ($r_s > .4$ or $< -.4$, $ps < .05$) between RT and “reading due to self” ratings. We used Fisher zr to estimate the population correlation between RT and the ratings (based on 24 trials), and it was nonsignificant ($r = -.05$, $p > .05$). These findings suggest that participants may not have based their “reading due to self” judgment on observing their own RTs. Regarding the “color-naming due to self” ratings, ten of the 32 participants had significant within-person correlations ($r_s \leq -.42$, $ps < .05$) between the rating and RT. We used Fisher zr to estimate the population correlation between RT and the ratings (based on 24 trials), and it was nonsignificant ($r = -.25$, $p > .05$).

Supplementary analysis. The “color-naming due to self” question led to an unanticipated and intriguing pattern of results, mirroring that of the “reading due to self ratings,” in which these attributions were lowest for the incongruent condition ($M = 5.15$, $SEM = .30$), followed by the control ($M = 5.56$, $SEM = .28$) and congruent conditions ($M = 6.36$, $SEM = .31$), $F(2, 62) = 14.498$, $p < .0001$ ($\eta_p^2 = .33$). Fisher’s PLSD revealed that only the contrast between the congruent and incongruent conditions was significant, $p < .05$. (Each contrast is significant when

analyzing the data using the same, planned analysis that was used for the “reading due to self” ratings, $p_s < .05$.) Omitted responses and typing errors resulted in the loss of 39 (5.1%) of 768 “reading due to self” ratings.

Discussion. As predicted, urges to read were less attributed to the self in the incongruent and control conditions of the Stroop task than in the congruent condition, the only condition in which the automatic action plan of reading does not interfere with performance. At this stage of understanding, it remains unclear why the same pattern of judgments was found for the “color-naming due to self” question. Warranting further investigation and beyond the purview of the present project, which focuses on the strong, automatic actions associated with the task (i.e., the automatic word-reading plan), this finding may reveal additional information about the ways in which participants introspect about, and conceptualize, the process of color-naming, the non-dominant, target action plan (see General Discussion).

Less interestingly, perhaps participants were simply re-inputting the rating that they had inputted for the first question that happened to be presented, or they adopted a strategy in which, when confronted with the incongruent condition, lower ratings were always inputted for the incongruent condition, regardless of the question at hand. To evaluate this uninteresting hypothesis and also learn more about the kinds of agency-related attributions that participants are making as a function of Stroop condition, we re-analyzed the data from the pilot studies (Pilot Studies 1 and 3, $n = 35$) that included two questions about the sense of agency (“How much personal control did you feel when responding?” and “How strong was the thought of a competing response?”), questions that should lead to an opposite patterns of results.

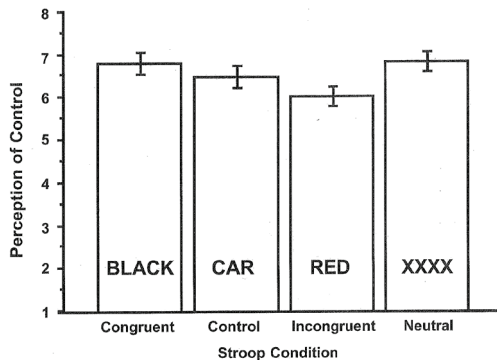


Figure 2: Mean perceptions of control in a vocal version of the Stroop task. Error bars indicate SEMs.

Regarding “perception of control,” as revealed in Figure 2, Stroop condition led to systematic effects, $F(3, 102) = 18.034$, $p < .0001$ ($\eta_p^2 = .35$), in which perception of control was greatest for the neutral ($M = 6.81$, $SEM = .25$) and congruent ($M = 6.80$,

SEM = .25), followed by control ($M = 6.48$, $SEM = .25$) and incongruent conditions ($M = 6.00$, $SEM = .24$). Planned comparisons revealed that all the differences between conditions were significant ($ps < .05$), except for the differences between congruent and control conditions ($p = .05$), and neutral and congruent conditions ($p = .94$).

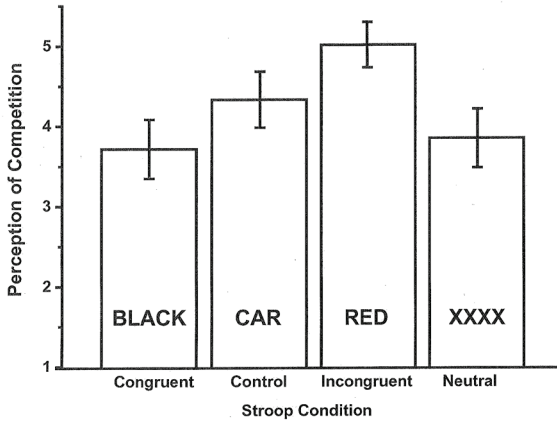


Figure 3: Mean perceptions of competition in a vocal version of the Stroop task. Error bars indicate SEMs.

As illustrated in Figure 3, the opposite pattern of results was obtained from the “perception of competition” question, $F(3, 102) = 18.648$, $p < .0001$ ($\eta_p^2 = .35$), in which perception of competition was greatest for the incongruent condition ($M = 5.02$, $SEM = .28$), followed by the control ($M = 4.34$, $SEM = .34$), neutral ($M = 3.85$, $SEM = .37$) and congruent conditions ($M = 3.72$, $SEM = .36$). Planned comparisons revealed that all the differences between conditions were significant ($ps < .05$), except for the difference between congruent and neutral conditions ($p = .38$). Together, these data replicate in a different context the findings regarding perceptions of control and competition found in Morsella, Wilson et al. (2009). More importantly for present purposes, these data suggest that our primary finding regarding “reading due to self” occurred within a task in which introspections about subjective dimensions associated with agency (e.g., perceptions of control and competition) can be made accurately and reliably. In short, it seems that the judgments obtained in Study 1 co-occur with subjective experiences that one would associate with the sense of agency. In addition, these additional data cast doubt on the alternative hypothesis that our primary finding stemmed, not from participants accurately introspecting about how strongly they felt the urge to read to be attributed to their psychological self, but from participants always reporting lower scores for the incongruent condition, regardless of the question at hand. Data regarding perceptions of control and competition reveal that participants

are capable of responding differentially to questions about subjective aspects of responding that are inversely-related, and suggest that, at a minimum, the unexpected “color naming due to self” finding requires further exploration. Regarding our primary “reading due to self” effect, a more convincing argument about the sense of agency and cognitive interference would be made if it were replicated in a different kind of interference paradigm.

Study 2

In addition to attempting to replicate the primary finding of Study 1 in a different paradigm, in Study 2 we also examined the hypothesis that these self-versus-not-self attributions are malleable and context-dependent: a plan that is intended in one context may be perceived as foreign to the self in another context (e.g., when it is incompatible with current goals). One limitation of using the Stroop task to examine this additional hypothesis is that the interference elicited by the task involves plans that are qualitatively distinct (object-naming versus word-reading) and that possess different “strengths”: the color-naming plan is weaker than the automatic, word reading plan (Cohen, Dunbar, and McClelland, 1990; MacLeod and MacDonald, 2000). Hence, to examine our hypothesis, we used a Stroop-like task without these limitations. In the MacLeod and Dunbar (1988) task, participants are trained to name nonsense shapes using color names. For instance, the participant is instructed to name a six-sided polygon as “orange.” Following training, participants are instructed to name the colors in which the shapes happen to be presented. On congruent trials, the shape name and color are congruent (e.g., the shape “orange” is presented in orange). On incongruent trials, the shape name and color name are different. For example, the same six-sided polygon will appear in blue and the participant must respond “blue,” leading to interference (e.g., increased RTs). In a second phase, participants are instructed to name the shapes and disregard the colors in which the shapes are presented. In the incongruent condition, newly acquired shape-naming plans interfere with color-naming plans (MacLeod and MacDonald, 2000).

Unlike the Stroop paradigm, which examines interference from undesired word-reading plans (Cohen et al., 1990), in this paradigm one can measure within a single session the subjective interference effects of each stimulus-related plan, because the plan that is task-irrelevant in one phase (e.g., shape naming) of the session is task-relevant in the other, and vice versa. Moreover, the paradigm is purer than the Stroop in that intended and interfering plans involve the same kind of action (naming). Together, these advantages allow one to draw better conclusions (cf., MacLeod and MacDonald, 2000).

Hypothesis and prediction. We predicted that, during the shape-naming phase, participants would perceive the activation of color-naming plans as less associated with the self in incongruent than in congruent conditions. Our second prediction

was that, in the color-naming phase, participants would perceive the activation of shape-naming plans as less associated with the self in incongruent than in congruent conditions. Last, we predicted that perceptions of control would be greater for congruent than incongruent conditions and that perceptions of competition would be greater for incongruent than congruent conditions.

Method

Participants. San Francisco State University undergraduates ($n = 85$) participated for class credit. As with Study 1, these students were enrolled in psychology courses. The involvement of human participants in our project was approved by the Institutional Review Board at San Francisco State University.

Procedure. Procedures followed those of MacLeod and Dunbar (Experiment 1; 1988). Stimuli were presented by computer screen in the same manner as in Study 1. After assessing that participants could identify the colors blue, green, orange, and pink, the session began with a shape-familiarization phase in which participants learned to name shapes by the designations “blue,” “green,” “orange,” and “pink” (Figure 4). Each shape appeared with its corresponding name twice. Thereafter, participants performed a training session in which they had to name each shape aloud. As in Study 1, vocal responses were detected by microphone.

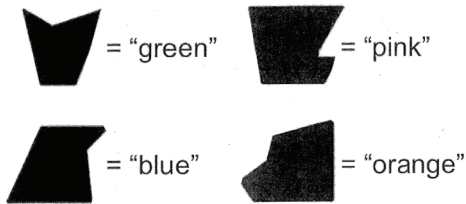


Figure 4: Shape names for the visual stimuli based on MacLeod and Dunbar (1988).

MacLeod and Dunbar (1988) provided participants ($n = 22$) with 16, 192, 288, or 576 trials of shape-naming training. To examine the sense of agency, it was unnecessary and unfeasible to administer four different degrees of training. Because having participants perform just one of the four training regimens might yield subjective effects that are unique to that regimen, and because administering only a representative regimen (e.g., the average of 268 trials) would not permit us to compare our RT data with those of MacLeod and Dunbar (1988), we decided to administer the two most extreme training regimens (16 trials [participants = 45] or 576 trials [participants = 40]) to get a representative sample of the variable degree of training. Varying the *degree of training* also allowed us to examine whether

introspections could be influenced by degree of training or by its effects on RT. Again, it is difficult to eradicate the influence of processing fluency or speed on subjective judgments (Winkielman et al., 2003): introspective judgments could be based, not on conflict, but on the observation of the speed of the overt response or internal processing. Thus, the two regimens also allowed us to explore further the relationship between RT and judgments.

Following training, participants performed the *color-naming phase*, in which they had to name as quickly as possible the colors in which the shapes were presented. Of the 72 trials, 24 trials were incongruent, 24 were congruent, and 24 were control (a square patch of blue). In the incongruent condition, each color was presented on each shape twice. In the control condition, each patch of color appeared six times. In the congruent condition, each color appeared with the congruent shape six times. Following each trial, participants were asked three questions in the following order: "How much personal control did you feel when responding?," "How strong was the thought of a competing response?," and "How strongly do you feel that the urge to shape-name was due to your 'self?'" Participants rated introspections on a 1–8 scale, in which 1 signified "no control" for the first question, "not strong at all" for the second question, and "not at all due to self," for the third question, and 8 signified "absolute control," "very strong," and "absolutely due to self," respectively. The subsequent, *shape-naming phase* was identical except that participants named aloud the name of the shape, and control stimuli were the shapes presented in black. For both phases, control stimuli were included only because we wanted to follow the procedures of MacLeod and Dunbar (1988) as closely as possible. It is difficult to appreciate whether control stimuli are informative regarding our subjective measures. For this phase, the third question read, "How strongly do you feel that the urge to name the color was due to your 'self?'"

Results

The data from one participant were excluded from analysis because the participant did not follow instructions. We collapsed the introspective data from both degrees of training, because both regimens provided similar results. Because our primary focus was the shape-naming phase (where interference is presumably strongest), we present those results first.

Shape-Naming Phase

Typing errors resulted in the loss of 275 (1.5%) of 18,144 ratings. Participants perceived the urge to color-name as less due to the self during the incongruent than congruent conditions, $F(2, 166) = 3.843$, $p < .05$ ($\eta_p^2 = 0.04$). [Table 1]. Planned comparisons revealed that all means are significantly different from

Table 1
Mean Introspective Report as a Function of Task and Condition

Shape-Naming Task	Congruent	Incongruent	Control
Color-naming plan due to self	5.54 (.23)	5.31 (.20)	5.31 (.23)
Personal control	6.75 (.20)	6.06 (.17)	6.57 (.17)
Perceptions of competition	2.43 (.19)	3.87 (.18)	2.99 (.20)
Response times	1176.07 (52.61)	1360.94 (55.54)	1264.75 (53.20)
Color-Naming Task	Congruent	Incongruent	Control
Shape-naming plan due to self	5.66 (.25)	5.47 (.24)	5.81 (.26)
Personal control	7.13 (.17)	6.84 (.16)	7.28 (.17)
Perceptions of competition	2.46 (.21)	3.21 (.23)	2.27 (.22)
Response times	1190.35 (46.50)	1341.12 (58.36)	1253.55 (50.63)

Note: SEMs in parenthesis.

each other ($p_{\text{paired}} < .05$), except those of incongruent and control ($p_{\text{paired}} = .091$). Participants reported stronger perceptions of personal control for congruent than incongruent conditions, $F(2, 166) = 22.121$, $p < .01$ ($\eta_p^2 = .21$), with all means being significantly different from each other, except for those of congruent and control ($p_{\text{paired}} > .05$). Stronger perceptions of competition were reported for the incongruent than congruent conditions, $F(2, 166) = 59.688$, $p < .01$ ($\eta_p^2 = .42$), with all means being significantly different from each other ($p_{\text{paired}} < .05$).

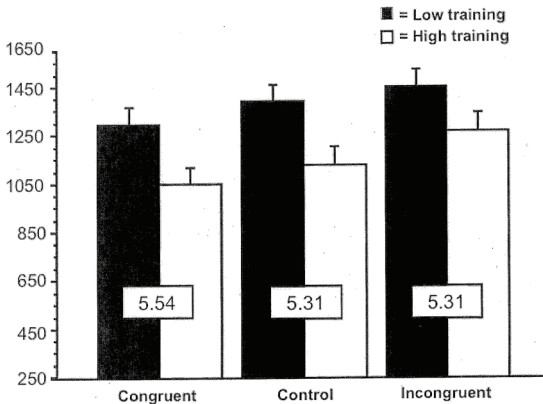


Figure 5: Mean response time (ms) as a function of degree of training and condition. Error bars indicate SEMs. Presented in the graph are the mean responses to the question, “How strongly do you feel that the urge to name the color was due to your ‘self?’” (1 signified “not at all due to self” and 8 signified “absolutely due to self”) for each Stroop-like condition.

It is important to note that, though RT was not the focus of this study, we did replicate the RT effects of MacLeod and Dunbar (1988). Based on previous research (Morsella, Gray et al., 2009; Morsella, Wilson et al., 2009; van Veen et al., 2001; Woodworth and Schlosberg, 1954), we excluded from analysis RTs below 200 ms and above 3.5 s, resulting in the loss of 1,103 (18%) out of 6,048 trials. (Importantly, the same pattern of results is obtained with the unconventional window of 200 ms to 6 s, with only 6% data loss.) As illustrated in Figure 5, there was a main effect of condition (congruent, control, and incongruent), $F(2, 164) = 24.777, p < .0001 (\eta_p^2 = .23)$ and training, in which highly trained participants (training trials = 576) were faster than those less trained (training trials = 16), $F(1, 82) = 5.357, p < .05 (\eta_p^2 = .06)$. There was no interaction between the interference condition and degree of training ($p = .30$). In a by-subject analysis, RTs did not correlate with perceptions of action authorship, control, or competition ($ps_{\text{paired}} > .05$).

Color-Naming Phase

Typing errors resulted in the loss of 164 (0.9%) of 18,144 ratings. Participants perceived the urge to shape-name as less due to the self during the incongruent than congruent conditions, $F(2, 166) = 8.534, p < .01 (\eta_p^2 = .09)$, with all the means being significantly different from each other ($ps_{\text{paired}} < .05$), except those of congruent and control, which were marginally non-significant ($ps_{\text{paired}} = .053$). Participants reported stronger perceptions of personal control for congruent than incongruent conditions, $F(2, 166) = 17.716, p < .01 (\eta_p^2 = .18)$, with all means differing from each other significantly ($ps < .05$). Stronger perceptions of competition were reported for incongruent than congruent conditions, $F(2, 166) = 35.728, p < .01 (\eta_p^2 = .30)$, with all means differing significantly from each other ($ps_{\text{paired}} < .05$).

Reaction time trimming resulted in the loss of 1,410 (23%) out of 6,048 trials. (The same pattern of results is obtained with data spanning from 200 ms to 6 s, with only 9% data loss.) There was a main effect of condition, $F(2, 164) = 15.148, p < .01 (\eta_p^2 = .16)$, and a trend in which highly trained participants were faster than less trained participants, $F(1, 82) = 2.925, p = .09 (\eta_p^2 = .03)$, but no interaction between condition and degree of training ($p = .78$). In a by-subject analysis, RTs did not correlate with any of the ratings ($ps > .05$).

Discussion. Conflict influenced the sense of agency and action-plan authorship in a dynamic and contextualized fashion. As predicted, in the shape-naming phase, participants perceived the urge to color-name as less due to the self during the incongruent than congruent conditions, and, in the color-naming phase, participants perceived the urge to shape-name as less due to the self during the incongruent than congruent conditions. In this study, we demonstrated that the activation of action plans countering current goals is perceived to be less associated with the self than the activation of plans that happen to be compatible with current goals, regardless of the nature of the plan (e.g., color-naming versus shape-naming).

In addition, perceptions of personal control were stronger for congruent than incongruent conditions, and perceptions of competition were greater for incongruent than congruent conditions. Although the focus of this study was not on the complex relationship between RT and judgments, it seems that introspections could not be predicted by knowledge of RT data alone. As in previous studies (Morsella, Wilson et al., 2009), conflict may affect behavior and high-level, conscious metacognitive phenomena in parallel.

General Discussion

As captured by the metaphor “a monkey on one’s back,” we demonstrated for the first time that when an action plan is activated and counters one’s action goal, that action plan is seen as less due to the self than when the concurrently activated action plan does not interfere (or facilitates) one’s action goal. In Study 1, urges to read during the Stroop task were less attributed to the self in the incongruent and control conditions of the task than in the congruent condition, the only condition in which the concurrently-activated action plan (word-reading) does not interfere with, and may even facilitate, performance (MacLeod and MacDonald, 2000). This is the first demonstration of such attributions during an interference task. Corroborating our primary finding, perceptions of personal control were stronger for congruent than for incongruent conditions, and perceptions of competition were greater for incongruent than congruent conditions, as found in previous research (Morsella, Wilson et al., 2009). Replicating previous findings (Morsella, Gray et al., 2009; Morsella, Wilson et al., 2009), correlational analyses suggest that participants did not base their judgments only on observing their RTs. It is striking that participants were capable of introspecting such high-level aspects of a cognitive process as fleeting as color-naming, an act lasting less than one second. Although it is known that participants cannot introspect their own RTs at this time scale (Libet, 2004; but see recent evidence to the contrary: Corallo, Sackur, Dehaene, and Sigman, 2008), it cannot be completely ruled out that they were basing their judgments on RTs (see discussion above).

Study 2 replicated the pattern of results found in Study 1 in a different interference paradigm, thereby allaying some of the concerns about the validity of the primary results of Study 1. In Study 2, we demonstrated for the first time that these effects are contextualized and dynamic: in the shape-naming phase, participants perceived the urge to color-name as less due to the self during the incongruent than congruent conditions, and, in the color-naming phase, participants perceived the urge to shape-name as less due to the self during the incongruent than congruent conditions. As in Study 1, perceptions of personal control were stronger for congruent than for incongruent conditions, and perceptions of competition were greater for incongruent than for congruent conditions. Again, although the focus of this study was not on the complex relationship between RT and judgments, it seems that introspections could not be predicted by knowledge of RT data alone.

One unexpected finding that will require further investigation is the pattern of judgments found for the “color-naming due to self” question in Study 1. Beyond the purview of Study 1, which focused on the automatic aspect of the Stroop task (i.e., the automatic word-reading plan), this finding may reveal the ways in which participants introspect about and conceptualize the process of color-naming, the target action plan. Data from our perceptions of control and competition questions imply that, for the color-naming question, participants were not simply re-inputting the rating that they had input for the first question, and were not adopting a strategy in which, when confronted with the incongruent condition, lower ratings were always inputted for the incongruent condition, regardless of the question at hand. Was “color-naming due to the self” more for the congruent condition than for the incongruent and control conditions because the correct action plan was perceived to be stronger? Was this, in turn, because participants were incapable of detecting any interference in this condition, perhaps due to a phenomenon such as synchrony-blindness? Because of such interesting possibilities, this unpredicted pattern of results demands further contemplation and exploration.

Another limitation of the current project is that our sample was restricted to university students. These participants are familiar with laboratory studies and such familiarity may influence performance. Participants’ reliable judgments could have been based, not on their experience of conflict, but on their folk beliefs about intra-psychic conflict, the sense of agency, and/or how to comport oneself in a psychological experiment. For example, perhaps participants based their ratings on heuristics such as, “if the Stroop trial is incongruent, then I will report 6 as the rating.” This alternative hypothesis has been addressed before (see Morsella, Wilson et al., 2009). Although this cannot be fully ruled out by the present studies, this alternative hypothesis seems unlikely given that participants’ ratings tended to vary across trials within each condition. For instance, for incongruent Stroop trials, the first 8 “word-reading due to self” ratings from a participant selected at random from Study 1 were 4, 4, 3, 4, 3, 6, 6, and 7. Of course, it may well be that participants were using a more sophisticated and nuanced heuristic when engendering our primary results. An additional limitation of the current project is that it did not take into account the potential effects of the variables of sex and age on the attributions of agency associated with conflict. Future investigations on cognitive conflict and the sense of agency, involving different kinds of population samples, will certainly be needed to qualify the kinds of conclusions that can be drawn from this present, initial project. We emphasize that this is an initial, and not a conclusive, project on the sense of agency and conflict.

Apart from these considerations, a limitation of this approach is that judgments may simply be based on task difficulty, with the efference–efference binding of incongruent conditions being more difficult than the kinds of bindings (e.g., efference binding) required in the other conditions. Data suggest that efference–efference is qualitatively distinct from the other forms of binding.

For example, in a neuroimaging study, van Veen et al. (2001) demonstrated that, though both response interference (when targets and distracters are associated with a different response, as in the Stroop incongruent condition) and perceptual interference (when distracters and targets look different but are associated with the same response) are associated with differences in performance, only the former (involving efference–efference binding) activates the anterior cingulate cortex, a brain region located on the medial surface of the frontal lobe that is interconnected with many motor areas and is believed to be involved in both conflict detection and willed processing (Botvinick, Braver, Carter, Barch, and Cohen, 2001; Brown and Braver, 2005; Crick, 1995; Mayr, 2004). Consistent with the idea that the conflict among plans is what is primarily driving our sense of agency effects, it has been shown that, independent of suppression or other forms of interference (e.g., perceptual interference), and on the basis of a priori theoretical predictions (Morsella, 2005), merely sustaining incompatible intentions (e.g., to point left *and* right) leads to subjective, metacognitive effects that are greater than those associated with sustaining compatible intentions (e.g., to point left *and* utter a word; Gray, Bargh, and Morsella, 2013; Morsella, Gray et al., 2009). This datum demonstrates that introspections about agency in a cognitive task are due not simply to self-observations of RT.

In conclusion, we hope that these initial findings about the liaison between intra-psychoic conflict and the sense of agency (including perceptions authorship, control, and competition) will provide a foundation for a deeper understanding of the cognitive construction of the self, a mental content that is intimately related to Dasein. In addition, we hope that such an experimentally-based approach will one day illuminate the nature of “hotter” conflicts involving self-control and disorders of agency.

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Forms of Momentum Across Time: Behavioral and Psychological

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The behavior of an organism often exhibits biases consistent with an anticipation of future behavior. One such type of bias results in momentum-like effects in which past behavior is extrapolated or continued into the future, and examples include behavioral momentum and psychological momentum. Similarities and differences between behavioral momentum and psychological momentum are considered. It is suggested that (a) behavioral momentum and psychological momentum are closely related and reflect similar or overlapping mechanisms despite differences in experimental methodologies and nomenclatures, (b) behavioral momentum and psychological momentum reflect dynamic representation, (c) dynamic representation can operate across several different time-scales, and (d) behavioral momentum and psychological momentum might be related (via processes involved in dynamic representation) to other types of momentum-like effects.

Keywords: behavioral momentum, psychological momentum, temporal representation

The cognitive representation of the current action of a stimulus or the current behavior of an organism is often continued (extrapolated) forward in ways that reflect the anticipated subsequent action or behavior of that stimulus or organism. This continuation is found with different types of stimuli, and it is often described as or attributed to a momentum-like effect. Some types of momentum-like effects operate on a brief time-scale and appear primarily spatial, and examples include representational momentum (e.g., Freyd and Finke, 1984), operational momentum (e.g., McCrink, Dehaene, and Dehaene-Lambertz, 2007), and attentional momentum (e.g., Pratt, Spalek, and Bradshaw, 1999). Other types of momentum-like effects operate on a longer time-scale and appear primarily temporal, and examples include behavioral momentum (e.g., Nevin, Mandell, and Atak, 1983) and psychological momentum (e.g., Vallerand, Colavecchio, and Pelletier, 1988).

The shorter time-scale and more spatial momentum-like effects were reviewed in Hubbard (2014), and the longer time-scale and more temporal momentum-like effects of behavioral momentum and psychological momentum are reviewed in this paper. One purpose here is to examine similarities and differences of behavioral momentum and psychological momentum and to consider whether these two effects might reflect similar or overlapping mechanisms. A second purpose is to consider whether behavioral momentum and psychological momentum are consistent with the notion of dynamic representation.

Although behavioral momentum and psychological momentum are considered in more detail below, it would be helpful to begin with a brief description of each of these two momentum-like effects. Behavioral momentum and psychological momentum are each based on an analogy with physical momentum. Physical momentum is the product of velocity and mass, and as specified by Newton's laws, an object in motion continues in motion at the same velocity and in the same direction until acted upon by some other force. Behavioral momentum is a tendency for learned behaviors to continue until acted upon by some opposing force (e.g., extinction, satiation); more specifically, behavioral momentum involves resistance to change of a learned behavior in which response rate is analogous to velocity and that behavior's resistance to change is analogous to mass. Similarly, psychological momentum is a tendency to believe that a subsequent behavior is more likely to be consistent with previous behavior; more specifically, psychological momentum involves perception of whether success or failure (e.g., winning or losing a game, respectively) is more or less easily achieved as a function of recent success or failure. Behavioral momentum has been most often studied with laboratory animals (mostly pigeons) or behavior analysis of humans (mostly individuals with developmental or learning disorders) in clinical or applied settings, whereas psychological momentum has been most often studied with verbal reports regarding observation of or participation in human sport competition.

One conclusion that will be reached is that behavioral momentum and psychological momentum reflect similar or overlapping mechanisms. These mechanisms are not tied to a literal physical momentum, but instead reflect a more abstract notion of change in which temporal information is an intrinsic and necessary component of the representation of an action or behavior (cf. the mechanism of representational momentum in Finke, Freyd, and Shyi, 1986; Freyd, 1987). Along these lines, whether the term "behavioral momentum" or "psychological momentum" is used often appears to depend on whether the data involve observable behavior or verbal reports of subjective experience. A second conclusion that will be reached is that behavioral momentum and psychological momentum involve dynamic representation, and views of dynamic representation that arise from consideration of other momentum-like effects should be expanded to include the longer time-scales of behavioral momentum and psychological momentum. Parts I and II review research on behavioral momentum and psychological momentum, respectively, and use the same general framework

(involving characteristics of the target, context, and observer) as Hubbard's (2014) discussion of spatial momentum-like effects.¹ Part III compares properties of behavioral momentum and properties of psychological momentum and considers whether these momentum-like effects involve similar mechanisms and are consistent with characteristics of dynamic representation. Part IV provides some brief conclusions.

Part I: Behavioral Momentum

Just as a physical body continues in motion until acted upon by an outside force, ongoing behavior maintained by constant conditions of reinforcement continues at a steady rate until acted upon by an external variable (Nevin et al., 1983). Baseline response rate under constant conditions is considered equivalent to initial velocity, and resistance of behavior to change is considered equivalent to mass (Nevin, 1988, 2012); therefore, behavioral momentum is the product of response rate (analogous to velocity) and resistance to change (analogous to mass). More specifically, response–reinforcer (operant) relationships correspond to velocity, and stimulus–reinforcer (Pavlovian) relationships correspond to mass (Nevin, 1992). In general, higher reinforcement rates or magnitudes produce more persistent behavior. Behavioral momentum has its roots in the study of learning, and studies of behavioral momentum typically use the methodologies, statistical techniques, and language of learning theory. A complete review of this literature is beyond the scope of this article (for reviews, see Dube, Ahearn, Lionello-DeNolf, and McIlvane, 2009; Nevin and Grace, 2000; Nevin and Shahan, 2011), but a selective review of behavioral momentum that focuses on primary findings and highlights similarities to psychological momentum is presented.

Target

In studies of behavioral momentum, the term “target” usually refers to a specific behavior of an organism rather than to a stimulus external to the organism (cf. use

¹Spatial forms of momentum-like effects include representational momentum, operational momentum, and attentional momentum (for review, see Hubbard, 2014). Although an understanding of these spatial forms of momentum-like effects is not necessary for the consideration of temporal forms of momentum-like effects (i.e., of behavioral momentum and psychological momentum) in this paper, such an understanding might be helpful. In brief, representational momentum involves displacement of the judged position of a moving target in the direction of anticipated motion (e.g., if a target is moving from left to right and then vanishes, observers indicate the final position of the target is slightly to the right of the actual final position). Operational momentum involves overestimation of sums in addition and underestimation of differences in subtraction (i.e., the response is further along the number line in the direction of motion than is the actual sum or difference). Attentional momentum suggests a change in the direction of movement of attention across space must first overcome momentum in the current direction of movement (e.g., more time is required to detect a target not in the current direction of movement of attention than to detect a target further along in the current direction of movement of attention).

of the term “target” in studies of representational momentum). Characteristics of the target considered here include (a) extinction, (b) the partial reinforcement extinction effect, and (c) resurgence.

Extinction. Extinction of a behavior and behavioral momentum of that behavior are inversely related. Nevin and Shahan (2011) noted that extinction disrupts responding to the target because in extinction the (a) contingency between responses and reinforcers is suspended, (b) reinforcement previously contingent upon behavior is withheld and responding declines due to generalization decrement, and (c) effects of contingency suspension and generalization decrement increase with the passage of time. Withdrawing reinforcement results in a decrease in the likelihood of a learned response (i.e., a decrease in velocity), thus resulting in a decrease in behavioral momentum. The standard view in learning theory is that resistance to extinction is a decreasing function of reinforcer rate, that is, resistance to extinction is greater with lower rates of reinforcement than with higher rates of reinforcement (see discussion of the partial reinforcement extinction effect below). However, Nevin (2012) suggests this standard view is incorrect, and that (a) resistance to extinction is an increasing function of reinforcer rate consistent with behavioral momentum (see also Nevin and Grace, 2005), and (b) the notion of behavioral momentum can account for resistance to extinction in single schedules and in multiple schedules. Relatedly, Grace, McLean, and Nevin (2003) reported that resistance to change in extinction in a response-independent reinforcement condition was consistent with behavioral momentum (see also Grace, Arantes, and Berg, 2012).

Podlesnik and Shahan (2008, 2009) examined whether reinforcement rate influenced relapse of a previously extinguished operant behavior. Pigeons on multiple variable interval schedules were provided with response-contingent food reinforcement. Additional non-contingent food reinforcement was delivered during one of the schedules. Consistent with Nevin, Tota, Torquato, and Shull (1990), baseline responses were lower and resistance to extinction was higher if additional response-independent reinforcement was presented. Following extinction, responding produced by reinstatement, resurgence, or renewal of the previously extinguished response was larger in the presence of the stimulus associated with a higher combined rate of contingent plus noncontingent reinforcement. Nevin et al. interpreted these patterns as consistent with behavioral momentum (see also Nevin and Grace, 2000), as additional reinforcement would have the effect of increasing behavioral mass (and thus increasing behavioral momentum). Podlesnik and Shahan (2009, 2010) suggested that resistance to extinction is greater in the presence of stimuli associated with a higher rate and magnitude of reinforcement. Similarly, relapse was a function of reinforcement rate, and Podlesnik and Shahan suggested an augmented version of behavioral momentum theory (including baseline reinforcement rate on relapse of responding following extinction) could account for effects of different reinforcement conditions on resistance to extinction and relapse.

Podlesnik, Bai, and Elliffe (2012) found that reinforcing an alternative response within the same context as a target response decreased the occurrence but increased the persistence of the target response (cf. Mace, McComas, Mauro, Progar, Taylor, Ervin, and Zangrillo, 2010). The increased persistence (i.e., decreased extinction) is consistent with behavioral momentum, as the alternative reinforcement (see below) should enhance the relationship between the target and the context (i.e., increase behavioral mass of the target response). Podlesnik et al. suggested one way this persistence can be decreased (i.e., extinction increased) is by training the alternative response in a different context prior to training the alternative response in the same context as the (unreinforced) target response. Podlesnik and Fleet (2014) examined whether manipulations of the stimulus–reinforcer relationship (i.e., behavioral mass) influenced resistance to change, and when additional stimuli were presented in one component of a multiple schedule, resistance to extinction decreased as stimulus duration increased. Podlesnik and Fleet suggested this was not entirely consistent with behavioral momentum theory, leading them to conclude that factors in addition to the stimulus–reinforcer relationship influenced resistance to change. A similar conclusion was reached by Arantes, Berg, Le, and Grace (2012), who noted that behavioral momentum theory did not predict that variable responding would be preferred to fixed (repetitive) responding in their (pigeon) data.

Partial reinforcement extinction effect. A key claim of behavioral momentum theory is that resistance to a change in behavior is stronger if reinforcement rate is higher than if reinforcement rate is lower (e.g., Nevin, 1988; Nevin and Grace, 2000; Nevin and Shahan, 2011). However, this claim initially appears inconsistent with the standard view noted earlier that responding extinguishes more quickly after learning under a continuous reinforcement schedule (more total reinforcement) than after learning under a partial reinforcement schedule (less total reinforcement). This latter finding has been referred to as the *partial reinforcement extinction effect*, and Nevin (1988, 2012) discussed the relationship between the partial reinforcement extinction effect and behavioral momentum in detail. Nevin (1988) presented pigeons with two schedules. Either the left key or the right key was illuminated on each trial. Left key pecks resulted in delivery of food on every trial (i.e., continuous reinforcement), whereas right key pecks resulted in delivery of food on a variable interval schedule (i.e., partial reinforcement; described in Nevin, 1992, as delivering food on 25% of trials). Responding extinguished more slowly for the right key than for the left key, and this is consistent with the partial reinforcement extinction effect. However, if prefeeding or food presentation during an intertrial interval occurred, responding extinguished more slowly for the left key (i.e., continuous reinforcement), and this is consistent with behavioral momentum.

Nevin (1988) suggested that the apparent inconsistency of the partial reinforcement extinction effect and behavioral momentum arises because most free-operant extinction data are reported as response totals, and this confounds the initial levels of responding with the rate at which responding decreases over the course of extinction

(i.e., the partial reinforcement extinction effect does not take into account the velocity of behavior prior to introduction of a response disruptor). Indeed, Nevin's reanalysis of previous data suggested the slope of extinction was shallower after extended training under a continuous reinforcement schedule (as predicted by behavioral momentum theory). Nevin (1988) also ruled out the alternatives that (a) resistance to extinction is a counterinstance to the general relationship between resistance-to-change and rate of reinforcement, (b) the relationship between resistance-to-change and rate of reinforcement is non-monotonic, and (c) outcomes of resistance-to-change research depend upon whether comparisons involve within-subject designs or multiple schedules. Nevin and Grace (2000) suggested continuous reinforcement results in greater behavioral mass (and thus greater behavioral momentum) than does partial reinforcement; given this, greater persistence of responding in the left-key condition (after reanalysis) in Nevin (1988) might reflect greater behavioral momentum in training with a continuous reinforcement schedule than in training with a partial reinforcement schedule.

Resurgence. Resurgence is the reappearance of a previously extinguished behavior when an alternative behavior reinforced during extinction is also extinguished (e.g., see Cleland, Foster, and Temple, 2000; Mace et al., 2010). Shahan and Sweeney (2011) suggested resurgence can be understood as an extension of how extinction is characterized by behavioral momentum theory, which is that decreases in responding during extinction result from disruptive influences that terminate the contingency between responding and reinforcer. This is not unique to behavioral momentum theory, but behavioral momentum theory does explicitly predict resurgence given the existence of alternative reinforcement (see below). Shahan and Sweeney pointed out that an additional source of reinforcement increases the strength of target behavior (i.e., increases behavioral mass), and consistent with this, Sweeney and Shahan (2013a) found that increased exposure to extinction reduced resurgence. Podlesnik and Shahan (2009, 2010; see also Podlesnik and Kelley, 2014) suggested resurgence occurs if changes in context produced a decrease in disruption associated with extinction (i.e., if there is a decrease in the external force that is reducing momentum [e.g., similar to a decrease in friction, see Nevin, 1988]), and combined with Shahan and Sweeney's observation, it appears that responding can be strengthened while undergoing extinction if an alternative source of reinforcement is introduced (cf. Nevin et al., 1990). Relatedly, the idea that extinction serves as a disruptor suggests extinction might be a type of "behavioral friction" (see Nevin, 1988, cf. representational friction in Hubbard, 1995, 1998), and if this friction is increased or decreased, behavioral momentum is decreased or increased, respectively.

Context

Given that most of the studies on behavioral momentum involve laboratory studies of animal behavior or applied behavioral interventions in humans, it is

not surprising that many studies focus on the context of the behavior of interest. Characteristics of the context considered here include (a) reinforcement schedule, (b) whether a previously completed task typically exhibited a high or low level of compliance, (c) reinforcer quality, and (d) the presence of alternative reinforcement.

Reinforcement schedule. Much of the research in behavioral momentum literature involved presentation of multiple reinforcement schedules. Nevin et al. (1983) conditioned pigeons to peck when a green key or a red key was illuminated, and reinforcement for each key was on a different variable interval schedule; the schedule with shorter intervals was always associated with the red key. Food was presented during a subsequent dark-key period, and extinction sessions with illuminated keys were then presented. Responding during dark-key periods declined; decreases were greater for the green-key than for the red-key, and this difference increased with larger differences between green-key and red-key reinforcement rates. A similar pattern occurred during extinction. Estimated ratios of behavioral masses in the green-key and red-key conditions were calculated and increased with increases in the ratio of baseline reinforcement rates. Dark-key periods and extinction each resulted in an apparent decrease in behavioral mass; however, the two methods resulted in differing estimates of the decrease. In dark key periods, the relationship between the ratio of behavioral masses and the ratio of reinforcement rates was a power function with an exponent of approximately 0.7, but in extinction, the relationship between the ratio of behavioral masses and the ratio of reinforcement rates was less clearly related to reinforcement rate ratios (cf. Nevin, 1988).

Cohen, Riley, and Weigle (1993) reported resistance to change was related to reinforcement rate for multiple schedules but not for simple schedules (see also Nevin, 2012). Cohen (1998) noted that stimulus-reinforcer relationships varied between simple schedules and multiple schedules. Given that behavioral momentum theory emphasizes the role of stimulus-reinforcer relationships (Nevin, 1992, 2012; Nevin et al., 1990), such differences could limit the range of applicability of the notion of behavioral momentum. Cohen (1998) measured resistance to change by prefeeding and by extinction for behaviors learned under different variable interval schedules (see also Cohen et al., 1993), and he varied whether these schedules were implemented successively, on alternating days, or as multiple schedules within the same session. The results suggested different reinforcement rates must be compared within the same session or in alternating sessions in order to produce data consistent with behavioral momentum (cf. effects of latency from prior compliance with high probability requests to low probability requests, Mace, Hock, Lalli, West, Belfiore, Pinter, and Brown, 1988). Also, behavioral momentum might be much longer lasting with simple schedules (e.g., Nevin, 1996). Interestingly, the apparently stronger effect of behavioral momentum with multiple schedules (cf. Podlesnik, Thrailkill, and Shahan, 2012) appears consistent with the larger representational momentum that is observed with divided attention than with selective attention (cf. Hayes and Freyd, 2002).

A consistent finding within behavioral momentum literature (e.g., Nevin and Grace, 2005; Nevin et al., 1983; Podlesnik, Bai, and Elliffe, 2012; Podlesnik and

Shahan, 2009, 2010; Podlesnik, Thrailkill, and Shahan, 2012; Sweeney and Shahan, 2013b) is that learning under a schedule that provides more reinforcement per unit of time is more resistant to change than is learning under a schedule that provides less reinforcement per unit of time. This pattern occurs regardless of baseline response rates (Nevin, 1992), and so is consistent with the idea that baseline responding (initial mass) might be independent of response rate (initial velocity). Indeed, just as physical velocity and physical mass are conceptually independent in Newtonian physics, Nevin (1992) argued that steady-state response rate (i.e., behavioral velocity) and resistance to change (i.e., behavioral mass) are conceptually independent. Nevin (1992) examined parameters regarding resistance to change, and as noted earlier, he concluded that response rate depends upon response–reinforcer (operant) contingencies and resistance to change depends upon stimulus–reinforcer (Pavlovian) contingencies (see also Podlesnik and Shahan, 2008). Relatedly, Cohen (1998) observed that experiments reporting evidence consistent or inconsistent with behavioral momentum generally involved learning schedules with higher or lower reinforcement rates, respectively. Thus, behavioral momentum for a newly-learned behavior might be relatively weak or fragile, and so more easily disrupted or masked by other variables or by variance.

Effects of behavioral momentum can last for days, weeks, or perhaps longer. Consistent with the idea of longer time-scales, behavioral momentum has been suggested to provide a useful framework with which to explain some historical events. Nevin (1996) analyzed the occurrence of interstate wars from 1495 to 1990; he found that the proportion of wars initiated by a given nation increased with successive wins and decreased with successive losses, and that the latency to initiate a war was shorter after a win than after a loss. Pulido and López (2010) examined strategies of Admiral Bill Halsey in the Battle of Leyte Gulf and of General Maurice Gamelin in the Battle of France (both during World War II), and they suggested that consequences of previous military experiences shaped the subsequent strategies and military outcomes. More specifically, positive outcomes of a specific strategy lead to a type of momentum in which that strategy will continue to be used, even if changes in circumstances suggest a different strategy might be more optimal or appropriate (but even so, continuation of a specific strategy given previous positive outcomes for that strategy is not unique to theories involving behavioral momentum). Along these lines, behavioral momentum in war appears similar to psychological momentum in competitive sport (cf., perception of a hot-hand effect discussed in Part II). More broadly, such a characterization suggests behavioral momentum might also offer a potential account of mechanization of thought and the *Einstellung* effect (e.g., see Luchins and Luchins, 1959).

Compliance on previous tasks. One way in which context influences behavioral momentum is if a preceding task involves a high probability of response or compliance or a low probability of response or compliance. Ardoin, Martens, and Wolfe (1999) presented second-grade students with requests that were more likely to result in compliance (i.e., high probability requests) followed by requests that were less likely to result in compliance (i.e., low probability requests). Presentation of a high

probability request prior to presentation of a low probability request increased the probability of compliance with the low probability request (see also Ducharme and Worling, 1994). Belfiore, Lee, Scheeler, and Klein (2002) presented developmentally delayed ten-year old children with ten multi-digit multiplication problems to be solved (which had a low probability of compliance). Multi-digit problems (a) were preceded by three single-digit multiplication problems to be solved (which had a high probability of compliance) or (b) contained five problems that were crossed out (i.e., did not have to be solved and could have functioned as negative reinforcement). Both interventions similarly decreased latency to begin the next problem (see also Lee, Belfiore, Scheeler, Hua, and Smith, 2004). Belfiore et al. suggested behavioral momentum established by previous high probability compliance tasks might be more effective in changing subsequent behavior than would focusing on consequences of non-compliant behavior.

Vostal and Lee (2011) reported that reading an easy paragraph (a high probability of compliance) led to decreases in latency to begin reading a difficult paragraph (a low probability of compliance) and to more accurate pronunciation of the first ten words of the difficult paragraph in adolescents. Burns, Ardoin, Parker, Hodgson, Klingbeil, and Scholin (2009) placed easier words at the beginning of a reading list or interspersed easy words throughout the list, and fourth-grade children who received the easy words at the beginning of the list (a high compliance condition) read more total words than did students who received easy words interspersed throughout the list. Kelly and Holloway (2015) used compliance with high probability requests as a tool to improve verbal fluency of low probability tasks in children (three to 4 years old) with autism spectrum disorder. Lee, Belfiore, Ferko, Hua, Carranza, and Hildebrand (2006) reported the latency from completion of a high probability response to initiation of a subsequent low probability response was shorter than the latency from completion of a low probability response to initiation of a subsequent high probability response in normally developing six year olds and in learning disabled fifth graders (see also Wehby and Hollahan, 2000). Belfiore, Basile, and Lee (2008) reported compliance with prior high probability requests increased compliance with subsequent low probability requests in a seven-year old with moderate retardation and Down syndrome.

Reinforcer quality. Mace, Mauro, Boyajian, and Eckert (1997) noted that reinforcers in Mace et al. (1988) involved verbal praise, and Mace et al. (1997) hypothesized that compliance with a subsequent low probability request might be enhanced if reinforcer quality for previous high probability requests was increased. In experiments with developmentally disabled adolescents, Mace et al. (1997) presented food (a higher quality reinforcer) or verbal praise (a lower quality reinforcer) following compliance with high probability requests, and compliance on a subsequent low probability request was enhanced if higher quality reinforcers had been previously presented. If multiple low probability requests were given after compliance with high probability requests, then probability of compliance declined as the number of low probability requests increased, and resistance to change across low probability requests was greater

if a higher quality reinforcer had been previously presented. However, it is not clear whether the decline in compliance reflected the number of requests or the time elapsed since high probability requests ended, as Mace et al. (1988) reported compliance on a low probability request decreased if latency since compliance with high probability requests increased (cf. temporal separation in Cohen, 1998). Also, Mace et al. (1997) trained rats on multiple variable interval schedules in which sucrose (a higher quality reinforcer) or citric acid (a lower quality reinforcer) was presented, and they found that subsequent resistance to extinction was greater after presentation of a higher quality reinforcer.

Alternative reinforcement. A consistent finding within behavioral momentum literature is that increases in reinforcement that are not related to responding nonetheless increase resistance to extinction (e.g., Nevin et al., 1990; Podlesnik and Shahan, 2009, 2010). Nevin et al. (1990) reinforced a target response at different rates in different schedules, and additional reinforcers were presented noncontingently or contingent upon a different (alternative) concurrent response. Adding response-independent food (i.e., extra reinforcement) to a variable interval schedule decreased the rate of responding to the stimulus and increased resistance of the target response to change (i.e., to extinction). Such additional food (reinforcement) could be considered as increasing behavioral mass (and thus increasing behavioral momentum). Consistent with this, Mace et al. (2010) reported that problem behaviors in children with developmental disorders decreased more rapidly and to a lower level if treatment included differential reinforcement of alternative behavior (see also Podlesnik, Bai, and Elliffe, 2012). However, although differential reinforcement of desirable behaviors generally decreases rates of problem behaviors, it also increases resistance to extinction of those problem behaviors (cf. Ahearn, Clark, Gardenier, Chung, and Dube, 2003; Dube et al., 2009). Additionally, effectiveness of alternative reinforcement is enhanced if the alternative response is trained in a separate context before being combined with the target context (Podlesnik, Bai, and Elliffe, 2012).

Observer

Given the origin of behavioral momentum theory in learning literature, there has been relatively little investigation of the effects of the observer (e.g., individual differences) on behavioral momentum.² Characteristics of the observer considered here include (a) attention and (b) psychopathology.

Attention. Dube, McIlvane, Mazzitelli, and McNamara (2003; see also Dube and McIlvane, 2001) had mentally-challenged participants complete discrimination

²In discussion of behavioral momentum and psychological momentum, the term “target” refers to a specific behavior that is exhibited by an organism. Presumably an organism that exhibited a target behavior could in many instances observe itself exhibiting that behavior, and so the term “observer” can refer either to an organism that exhibits the target behavior or to an organism that does not exhibit the target behavior.

tasks involving selective attention, and the reinforcer was snack food. Participants who received higher rates of reinforcement exhibited larger behavioral momentum. Podlesnik, Thrailkill, and Shahan (2012) presented pigeons with center key stimuli consisting of lines that varied in color (blue, green) and in orientation (horizontal, vertical). After the stimulus vanished, side keys presented each of the two colors or each of the two orientations. Choosing the side key corresponding to the color or orientation that appeared in the preceding stimulus resulted in food presentation on a predetermined schedule. As the initial stimulus always included a color and an orientation, and it was not possible to know in advance which dimension would need to be remembered, Podlesnik et al. considered this task to involve divided attention. Pigeons that received a higher rate of reinforcement exhibited greater resistance to disruption due to pre-session feeding or to extinction, and this is consistent with behavioral momentum. Given the existence of behavioral momentum with selective or divided attention, it could be informative to examine resistance to disruption in divided attention relative to resistance to disruption in selective attention (e.g., representational momentum literature would predict an increase in behavioral momentum with divided attention). Also, Nevin, Davison, and Shahan (2005) proposed a theory of attention based on reinforcement rate, which they suggested paralleled behavioral momentum theory.

Psychopathology. Behavioral momentum theory has been used in treatment of problem behaviors (and in establishing new desirable behaviors) in humans diagnosed with developmental or learning disorders. Mace, Lalli, Shea, Lalli, West, Roberts, and Nevin (1990) examined behavioral momentum in mentally-challenged adults in a group home; responding involved sorting different types of dinnerware, and the distractor was a video. As predicted by behavioral momentum theory, responding accompanied by a higher rate of reinforcement was more resistant to disruption (see also Mace et al., 2010). Mace et al. (1988; see also Mace and Belfiore, 1990) found that presenting a mentally-challenged patient with requests that had a high probability of being obeyed established a momentum of compliance that increased the probability the patient would obey a subsequent request that previously had a low probability of being obeyed. Ahearn et al. (2003) reported that three children (aged four to 9) diagnosed with autism spectrum disorder and who displayed vocal or manual stereotypy exhibited more resistance to change following access to preferred stimuli. As discussed by Dube et al. (2009), even though stereotypies decreased during noncontingent reinforcement, stereotypies were more difficult to extinguish after noncontingent reinforcement was withdrawn; this is consistent with behavioral momentum but not consistent with a partial reinforcement extinction effect.

Many studies of behavioral momentum involving psychopathology sought to improve academic performance in children diagnosed with developmental or learning disorders (e.g., Belfiore, Lee, Vargas, and Skinner, 1997; Belfiore et al., 2002, 2008; Burns et al., 2009; Kelly and Holloway, 2015; Lee et al., 2004, 2006; Vostal and Lee, 2011; Wehby and Hollahan, 2000), and these studies usually

found that behavioral momentum induced by successful completion of a task with a high probability of compliance improved performance on academic tasks that had an initially low probability of compliance (see also Lee, 2006). Relatedly, Parry-Cruwys, Neal, Ahearn, Wheeler, Premchander, Loeb, and Dube (2011) reinforced developmentally delayed children (four to 13 years old) for completing regularly scheduled academic or leisure tasks, and consistent with behavioral momentum theory, behavior with a higher reinforcement rate was more resistant to disruption. Strand (2000) suggested behavioral momentum provides a useful perspective on child conduct disorder, and Romano and Roll (2000) suggested techniques to increase behavioral momentum are useful in increasing compliance behaviors in youth with developmental disorders. Pritchard, Hoerger, Mace, Penney, and Harris (2014) suggested animal models of relapse based on behavioral momentum (e.g., Podlesnik and Shahan, 2009, 2010) can serve as models of treatment relapse in humans.

Part II: Psychological Momentum

Psychological momentum has been conceptualized as a power or force that changes interpersonal perceptions and influences mental or physical performance (Iso-Ahola and Mobily, 1980), as a bidirectional concept that affects the probability of winning or losing as a function of the outcome of the preceding event (Adler, 1981), and most recently as a psychological phenomenon that mediates or moderates performance (Iso-Ahola and Dotson, 2014, 2015). More specifically, the notion of positive psychological momentum suggests that current success or victory increases the likelihood of subsequent success or victory, whereas the notion of negative psychological momentum suggests that current failure or defeat increases the likelihood of subsequent failure or defeat (but see Cornelius, Silva, Conroy, and Petersen, 1997). Although many researchers accept these characterizations, there have been calls for a redefinition of psychological momentum that is based on a closer study of the relevant phenomenology (e.g., Crust and Nesti, 2006). Several theories of psychological momentum have been proposed (e.g., Cornelius et al. 1997; Iso-Ahola and Dotson, 2014; Markman and Guenther, 2007; Taylor and Demick, 1994; Vallerand et al., 1988); a complete review of this literature is beyond the scope of this article, but a selective review of psychological momentum that focuses on primary findings and highlights similarities to behavioral momentum is presented.

Target

As in studies of behavioral momentum, the target in studies of psychological momentum is a specific behavior of an organism (and in studies of psychological momentum, the organism is usually human). Characteristics of the target considered here include (a) valence, (b) direction, (c) duration, (d) mass, (e) task, and (f) prior probability.

Valence. Psychological momentum can be described as positive or as negative. Even so, in positive psychological momentum and in negative psychological momentum, the direction of momentum always involves forward extrapolation in the current direction of motion (toward success or failure, respectively); therefore, distinguishing between positive psychological momentum and negative psychological momentum does not make psychological momentum inconsistent with other types of momentum-like effects that do not involve such a distinction. Silva, Hardy, and Crace (1988) considered the possibility of behaviors in the direction opposite to psychological momentum. In *positive inhibition*, success increases the probability of subsequent failure (e.g., a team that is leading grows complacent and loses), and in *negative facilitation*, failure increases the probability of subsequent success (e.g., a team that is trailing becomes “fired up” and more motivated to succeed). Silva et al. reported that positive psychological momentum and negative psychological momentum occurred more often than did positive inhibition and negative facilitation, and so behavior consistent with behavioral momentum occurred more often than did behavior inconsistent with behavioral momentum. Stanimirovic and Hanrahan (2004) reported performance did not improve with increases in positive psychological momentum, but performance did improve with increases in negative psychological momentum (i.e., negative facilitation, cf. Perreault, Vallerand, Montgomery, and Provencher, 1998).

Direction. Gernigon, Briki, and Eykens (2010) examined how changes in apparent direction influenced psychological momentum. Participants were regional level table-tennis players asked to empathize with a player in a video of an important competitive table-tennis match. Over the course of the video, the score gap increased or decreased. Variations in cognitive anxiety and in somatic anxiety reported by participants were suggested to reflect psychological momentum such that linear increases in positive psychological momentum occurred if the video suggested moving from likely defeat to likely victory, but nonlinear increases in negative psychological momentum occurred if the video suggested moving from likely victory to likely defeat. Gernigon et al. also reported psychological momentum was stronger with a negative direction of motion than with a positive direction of motion (cf. Stanimirovic and Hanrahan, 2004). Similarly, ratings of mastery-avoidance goals (which focus on avoiding mistakes) exhibited a nonlinear decrease as likelihood of victory increased and a nonlinear increase as likelihood of defeat increased, a pattern that Gernigon et al. interpreted as consistent with negative hysteresis (see also Briki, Doron, Markman, den Hartigh, and Gernigon, 2014). Gernigon et al. suggested their data illustrated the dynamic nature of psychological momentum (see Part III). However, the ways in which cognitive anxiety, somatic anxiety, and mastery-avoidance goals are related to psychological momentum are not clear.

Duration. Hunt, Rietschel, Hatfield and Iso-Ahola (2013) found that winners of a shooting competition reported greater confidence than did losers, and this difference increased with increases in the duration of success. Iso-Ahola and Dotson

(2014) suggested enhanced success or even neutral performance can maintain psychological momentum, but that psychological momentum can be terminated by (a) interrupting performance (e.g., a time-out in a basketball game; Mace, Lalli, Shea, and Nevin, 1992), and (b) an individual's unsuccessful performance or an opponent's successful performance (e.g., falling behind in a virtual cycling contest; Briki, den Hartigh, Markman, and Gernigon, 2014). Hamberger and Iso-Ahola (2004) suggested psychological momentum is relatively short-lived, but that the longer a person can maintain positive psychological momentum, the more likely success, or victory, become. Consistent with this, single or isolated successes within a longer contest might not be sufficient to produce a perception of psychological momentum unless such instances are particularly intense (Iso-Ahola and Dotson, 2014). Although psychological momentum is usually considered as occurring within a single performance (e.g., an individual game), psychological momentum has been suggested to also occur across performances (e.g., multiple games in a tournament), but this suggestion has not yet been empirically examined. Interestingly, an extension across multiple performances is consistent with the notion that psychological momentum emphasizes continuation across time rather than across space (see Hubbard, in press).

Mass. Markman and Guenther (2007) posited that psychological momentum is sensitive to naïve physics beliefs, and they focused on naïve physics beliefs regarding mass. In one experiment, participants read a description of a basketball game in which one team, East Midland, defeated a team that was or was not a major rival. Just as increases in the size of a physical object leads to perception of greater mass, Markman and Guenther found a goal that is perceived as more important or valuable connotes a greater mass. Thus, the presence of a major rivalry was predicted to increase the behavioral mass of East Midland's victory, and consistent with this, participants predicted a greater likelihood that East Midland would win their next game if the team East Midland defeated was a major rival. Interestingly, naïve physics beliefs regarding mass influence other momentum-like effects (e.g., beliefs regarding impetus influence representational momentum, e.g., Hubbard, 2013; Hubbard and Ruppel, 2002; Kozhevnikov and Hegarty, 2001). Nevin (1988) pointed out that an absolute scale for behavioral mass cannot exist (in part because the units in which behavioral mass is specified vary across situations and experiments), and he suggested behavioral mass reflected differences between conditions rather than absolute values. A similar caveat should also apply to psychological mass (e.g., in Markman and Guenther's experiment, the increase in behavioral mass if a major rival was defeated was due to the greater importance of defeating a major rival than of defeating a non-rival).

Task. The majority of studies on psychological momentum involved athletic performance or competition. However, Markman and Guenther (2007) proposed psychological momentum should occur in domains other than sport (see also Iso-Ahola and Dotson, 2014). In one of Markman and Guenther's experiments, par-

ticipants read about an individual, Jane, attempting to complete two tasks (cleaning an apartment, writing a paper) by a self-imposed deadline. In one version, Jane was described as making steady progress on the first task, and in another version, Jane was described as experiencing momentum while completing the first task. Participants who read the latter version judged Jane had more momentum going into the second task and was more likely to complete the second task by the deadline. Also, participants indicated Jane would have more difficulty finishing the second task after an interruption at the end of the first task if momentum had been experienced in the first task. Markman and Guenther conjectured that psychological momentum might be perceived as hard to lose once it is gained but harder to regain once it is lost. Interestingly, tasks used by Markman and Guenther seem similar to domestic and academic tasks in studies of behavioral momentum (e.g., Belfiore et al., 2002; Dube et al., 2009; Lee et al., 2004; Mace et al., 1990), and this suggests a possible connection between behavioral momentum and psychological momentum. Consistent with this latter point, athletic performance and competition have been used as stimuli in studies of behavioral momentum (e.g., Roane, 2011).

Prior probability. One of the clearest examples of psychological momentum is belief in the “hot hand” in basketball. If a player has made several baskets in a row, he or she is considered to have a “hot hand,” and the generally accepted strategy is that a player with a hot hand should continue taking shots. Gilovich, Vallone, and Tversky (1985) compared subjective perception of randomness in basketball shooting with actual performance data. Existence of a hot hand effect was not supported statistically, and examples of a perceived hot hand were not significantly different from scoring streaks predicted by a binomial model with a constant hit rate (i.e., that assumed no dependency between previous success and subsequent success). Vergin (2000) reported that winning streaks over a full season of play by major league baseball teams and by national basketball association teams did not differ from what would be expected if the outcome of a given game was independent of the outcome of the previous game, and he suggested that undue importance was placed on momentum as a causal factor in determining the outcomes of games. Similarly, O’Donoghue and Brown (2009) reported the distribution of service points in elite men’s tennis did not differ from chance. The lack of statistical significance of streaks led Gilovich et al. (p. 313) to suggest that psychological momentum is a “powerful and widely shared cognitive illusion” (cf. Roediger’s, 1996, suggestion that representational momentum is a memory illusion).

The claims of Gilovich et al. (1985) and others that the hot hand effect does not exist have been challenged. In a detailed review, Bar-Eli, Avugos, and Raab (2006) reported the majority of empirical evidence does not support the existence of a hot hand effect, but the potential existence of a hot hand effect could not be ruled out. Wardrop (1995) reanalyzed the data of Gilovich et al. and suggested that collapsing data over individual players could lead to perception of a hot hand effect. Iso-Ahola and Dotson (2014) contended the hot hand effect exists but is difficult

to detect because it is relatively infrequent. Most investigations of the hot hand effect have involved team sports such as basketball and baseball, and Iso-Ahola and Dotson suggested hot hand effects might be more frequent in individual sports (e.g., billiards, tennis; Bar-Eli et al., 2006) than in team sports, if opponents were less able to employ countermeasures (e.g., volleyball; Raab, Gula, and Gigerenzer, 2012), or if performance trials were uniform (e.g., bowling; Yaari and David, 2012). Although investigations of the hot hand effect have generally focused on athletic or sport performance, Iso-Ahola and Dotson point out that nonathletic versions of a hot hand effect have been reported in gambling (e.g., Arkes, 2011) and financial decision-making (e.g., Hendricks, Patel, and Zeckhauser, 1993). They consider psychological momentum to be a psychological force rather than a statistical effect, and in the case of the hot hand effect, Iso-Ahola and Dotson propose psychological momentum mediates or moderates rather than causes future success (see also Avugos and Bar-Eli, 2015; Iso-Ahola and Dotson, 2015).

Context

Given that many studies of psychological momentum do not involve the level of laboratory or environmental control found in studies involving behavioral momentum, characteristics of the context are not emphasized as much in studies of psychological momentum as in studies of behavioral momentum. Characteristics of the context considered here include (a) cohesion, (b) configuration, and (c) preceding performance.

Cohesion. Adler (1981) suggested increased cohesion creates a climate more favorable for perception of psychological momentum. To examine this, Eisler and Spink (1998) presented volleyball players at a high school level tournament with written scenarios in which their team and their opponent were tied at 13 in the third game of a best-of-three series. Team members also filled out questionnaires assessing team cohesion. Teams with overall higher cohesion generally perceived greater (positive) psychological momentum than did teams with neutral or low cohesion. The extent to which negative psychological momentum might be influenced by cohesion is not yet clear. Relatedly, Stanimirovic and Hanrahan (2004) examined team-efficacy (i.e., belief in team members' ability to perform) in volleyball players, and they reported that successes and failures led to increases and decreases, respectively, in team-efficacy. It could be predicted that increases in team-efficacy might result in larger or more frequent episodes of positive psychological momentum (perhaps related to cohesion), but such an hypothesis has not been tested. Also, it is not clear how cohesion would affect a single individual in a non-team competition (e.g., men's tennis singles), although it could be hypothesized that the range of cohesion might be extended to include coaches, managers, or others involved with the individual.

Configuration. Vallerand et al. (1988) suggested psychological momentum is dependent upon context and not solely dependent upon individual events (e.g., "making

three steals in a row in basketball while you are winning by 30 does not greatly affect the PM [psychological momentum] perceived in the situation. However, three steals in a row to tie the score is a different situation” [p. 95]). Vallerand et al. reported more psychological momentum was attributed to a tennis player who came from behind by winning four games to tie the score at 5 than was attributed to that player if he and his opponent alternated wins in that set (see Eisler and Spink, 1998; and Miller and Weinberg, 1991, for similar findings in volleyball), and this suggests scoring streaks are associated with increased positive psychological momentum (i.e., perception of a hot hand effect). As noted by Eisler and Spink (1998), calling a time-out as a way to slow or disrupt an opponent’s momentum might be a useful strategy (e.g., Mace et al., 1992, reported the number of points scored by the opposition decreased following a time-out in basketball; however, Wanzek, Houlihan, and Homan, 2012, reported that calling a timeout did not reduce the velocity of a subsequent serve in volleyball). Eisler and Spink suggested psychological momentum was influenced by elapsed time: the longer the temporal interval in which the relevant event occurs, the weaker the psychological momentum (cf. Hamberger and Iso-Ahola, 2004). Consistent with this, Silva et al. (1988) suggested it might be easier to observe psychological momentum in “micro” events (e.g., points and rallies) than in “macro” events (e.g., games and sets).

Preceding performance. Although some studies reported that individuals who won the first game in billiards (Adams, 1995) or the first set in tennis or racquetball (Iso-Ahola and Blanchard, 1986; Iso-Ahola and Mobily, 1980; Silva et al., 1988; Weinberg, Richardson, and Jackson, 1981) were more likely to win the next game or set, other studies did not find such an effect (e.g., Ransom and Weinberg, 1985; Stanimirovic and Hanrahan, 2004). Silva, Cornelius, and Finch (1992) had participants compete in a novel task; although participants reported differences in psychological momentum as a function of whether feedback suggested victory or defeat, there were no differences in performance as a function of reported psychological momentum (cf. Kerick, Iso-Ahola, and Hatfield, 2000). Similarly, Miller and Weinberg (1991) reported that psychological momentum had minimal influence on performance. Perreault et al. (1998) had participants complete a (virtual) bicycle race (on an indoor stationary cycle) while simultaneously viewing a video reported to be of a real-time competitor. If the video suggested participants lost the lead, their reported psychological momentum decreased, and if the video suggested participants came from behind to tie, their reported psychological momentum increased (cf. Briki, den Hartigh, Markman, and Gernigon, 2014). Also, there was a trend for increases in performance (speed of pedaling) if a participant was falling behind (i.e., negative facilitation), and Perreault et al. suggested psychological momentum facilitates performance only if the task requires great effort.

Although preceding performance is often assumed to give rise to psychological momentum, Burke, Edwards, Weigand, and Weinberg (1997) reported that spectators of tennis or basketball matches exhibited surprisingly low agreement

(<25%) regarding the specific events that triggered or terminated psychological momentum (but see Burke, Burke, and Joyner, 1999). Jones and Harwood (2008) interviewed competitive soccer players, and those players identified triggers of psychological momentum involving opponent behaviors and their own confidence. If a player saw an opponent's negative body language or conflict with a teammate, that could give rise to positive psychological momentum, whereas if an opponent was playing well, that could give rise to negative psychological momentum. Also, a high level of confidence could give rise to or be an outcome of positive psychological momentum, whereas a low level of confidence could give rise to or be an outcome of negative psychological momentum. Along these lines, some theories suggest psychological momentum influences subsequent performance (Iso-Ahola and Dotson, 2014; Taylor and Demick, 1994; Vallerand et al., 1988), and this suggests a positive feedback loop (i.e., increases in positive [negative] psychological momentum increases [decreases] performance, which in turn increases positive [negative] psychological momentum). However, other theories (e.g., Cornelius et al., 1997) suggest psychological momentum is solely a consequence of preceding performance and is not a cause of future performance (cf. Miller and Weinberg, 1991; Silva et al., 1992).

Observer

Perhaps the most widely investigated class of variables in studies of psychological momentum involve characteristics of the observer. Characteristics of the observer considered here include (a) sex, (b) affect, (c) whether feedback is received, (d) self-efficacy, (e) ability, and (f) whether the observer has control of the action or outcome.

Sex. Iso-Ahola and Mobily (1980) reported greater positive psychological momentum for male players than for female players in racquetball, and Weinberg et al. (1981; see also Weinberg, Richardson, Jackson, and Yukelson, 1983) reported that in junior and professional tennis, males came from behind to win more often than did females. Silva et al. (1988) examined archival data from three seasons of a Division I collegiate men's tennis team and collegiate women's tennis team, and they found that reports of psychological momentum did not vary as a function of sex. Smission, Burke, Joyner, Munkasy, and Blom (2007) did not find a difference in the number of psychological momentum sequences reported by males or females viewing collegiate basketball games, nor was there a difference in the number of psychological momentum sequences reported in men's or women's games. Mace et al. (1992) had participants view videotapes of men's collegiate basketball games and count the reinforcers, adversities, and favorable responses to adversity. Favorable responses to adversity increased as the number of reinforcers during the preceding three minutes increased, and this appears consistent with behavioral momentum and with psychological momentum. Roane, Kelley, Trosclair, and Hauer (2004) attempted to replicate Mace et al.'s findings with participants who viewed videotapes of women's collegiate basketball games. Roane et al. found a lower overall

rate of reinforcement, and whether favorable responses to adversity were related to the amount of preceding reinforcement was not as clear.

Affect. Kerick et al. (2000) examined whether psychological momentum was related to subsequent performance or to changes in affective or electrophysiological responses. They provided false feedback to novice participants engaged in target shooting; additionally, questionnaires regarding affective responses and psychological momentum were administered, and EEG data were collected during performance. Reported (positive) psychological momentum was lower if participants received low feedback scores than if participants received neutral, high, or no feedback scores. Subsequent target shooting performance, affective responses, and left–right asymmetries in the EEG data (recorded from F3 and F4) were not influenced by feedback. Kerick et al. suggested psychological momentum was independent of affective, electrophysiological, and performance effects in novice participants performing a fine motor task. However, this suggestion is not consistent with the multidimensional model of psychological momentum proposed by Taylor and Demick (1994), in which psychological momentum is the output of a chain of processes including affective responding, and in which psychological momentum is associated with affective changes in the same direction as the valence of subsequent psychological momentum.³ The relationship of affect with psychological momentum is not yet clear and remains a topic for future research.

Feedback. Whether psychological momentum is positive or negative is a function of whether a person is succeeding (winning) or failing (losing), and so feedback regarding performance would appear to be a contributor to the belief in or experience of psychological momentum. Surprisingly, relatively few studies have examined the role of feedback in psychological momentum. In an early set of studies, Feather and colleagues (Feather, 1966, 1968; Feather and Saville, 1967) found a positive effect of feedback on psychological momentum, as participants were more successful in solving subsequent anagrams if they had experienced success in solving previous anagrams. In recent studies, and as noted earlier, feedback suggesting an unsuccessful performance decreased positive psychological momentum but had no impact on actual subsequent performance (Kerick et al., 2000), and feedback

³As noted earlier, psychological momentum can have positive or negative valence. The issue of valence makes the relationship of affect and momentum-like effects less straightforward. In general, it might appear that perception of positively-valenced psychological momentum would be more likely to involve positive affect, and perception of negatively-valenced psychological momentum would be more likely to involve negative affect. However, caveats and counterexamples can be hypothesized. It is also possible that an affective response might exhibit a momentum-like effect in the absence of psychological momentum, and such an effect might be consistent with an “affective momentum,” in which the intensity of felt emotional experience exhibits momentum-like effects. Indeed, to the extent that facial expression is linked to felt emotion (e.g., Strack, Martin, and Stepper, 1988), previous findings of representational momentum for facial expression (e.g., Yoshikawa and Sato, 2008) would be consistent with the existence of such an affective momentum.

suggesting a participant had lost or regained the lead in a cycling race decreased or increased, respectively, positive psychological momentum (Briki, den Hartigh, Markman, and Gernigon, 2014; Perrault et al. 1998). Iso-Ahola and Dotson (2014) claimed positive or neutral feedback can maintain positive psychological momentum and that attributions based on feedback and performance outcomes play an important role in creating and maintaining psychological momentum. Consistent with this, Iso-Ahola and Dotson also note that success reinforces an individual's perception of himself or herself as a capable performer and motivates for greater achievement, and that this could contribute to perceptions of momentum.

Self-efficacy. Shaw, Dzewaltowski, and McElroy (1992) proposed self-efficacy might account for laypersons' interpretations of psychological momentum. Self-efficacy involves a belief that one can successfully perform the behaviors necessary to achieve a desired outcome (Bandura, 1977, 1990). Individuals who experience success should experience an increase in self-efficacy, thus increasing their efforts if future performances appear to be falling short, and thereby increasing the probability of future success. Similarly, individuals who experience failure would experience a decrease in self-efficacy, thus decreasing their efforts if future performances appear to be falling short, and thereby increasing the probability of future failure (cf. effects of team-efficacy in Stanimirovic and Hanrahan, 2004). Shaw et al. paired male undergraduate participants with skilled confederates in a basketball free-throw shooting contest, and participants were randomly assigned to a success condition or a failure condition. After each set of ten shots by a participant and ten shots by the confederate, that participant filled out questionnaires assessing his own psychological momentum and his own self-efficacy. In the success condition, positive psychological momentum and self-efficacy each increased over time but were not significantly correlated. However, in the failure condition, (positive) psychological momentum and self-efficacy decreased over time and were significantly correlated. Shaw et al. concluded that psychological momentum and self-efficacy were different constructs and depended upon different antecedents.

Ability. A player or team that wins the first game or set might be more likely to win the second game or set (or the match) because of having more ability and not because of having psychological momentum. Studies of psychological momentum have attempted to control for differences in ability by creating a novel task (e.g., Silva et al., 1992), pairing experimental participants with a high-ability confederate and varying the confederate's performance (e.g., Shaw et al. 1992), providing false feedback (e.g., Kerick et al., 2000), or restricting the sample to elite performers (e.g., Ransom and Weinberg, 1985). Iso-Ahola and Blanchard (1986) reported racquetball players who won the first set rated themselves as more likely to win the second set and as having more ability than did players who lost the first set. Effects of reported psychological momentum appeared as large in expert players as in novice players, although differences in ability across expert players would presumably have been less than differences in ability across novice players. Gayton, Very,

and Hearn (1993) reported professional hockey teams in the Stanley Cup finals that outscored their opponent during the first period were more likely to win the game, and there would presumably be minimal differences in ability at this championship level. Consistent with this, Miller and Weinberg (1991) reported low-skill volleyball players predicted that psychological momentum would have larger effects on game outcome than did high-skill volleyball players (although perceived psychological momentum was actually unrelated to game outcome).

Control. The antecedents-consequences model of psychological momentum of Vallerand et al. (1988) suggests that whether individuals have control of the action or outcome is a key variable in determining whether psychological momentum is perceived. One implication of this is that spectators of athletic events, who have less control over the action, should perceive psychological momentum less strongly than do athletes, who have more control over the action (see also Burke et al., 1997); however, comparisons of psychological momentum simultaneously experienced by spectators and by athletes and for the same stimuli have not been reported, although Briki, Doron, Markman, den Hartigh, and Gernigon (2014) reported that virtual actors who imagined themselves playing table tennis reported lower psychological momentum than did participants who imagined themselves observing table tennis. Curiously, the relationship of psychological momentum to standard locus-of-control measures has not been reported, although Smission et al. (2007) did compare spectators' perceptions of psychological momentum in collegiate basketball games with those spectators' responses on the Belief in Personal Control Scale (Berrenberg, 1987). Smission et al. found that the number of psychological momentum sequences perceived and external control were negatively correlated; however, the number of psychological momentum sequences perceived did not significantly correlate with exaggerated internal control or with god-mediated control.

Part III: Comparison and Representation

Parts I and II reviewed findings on behavioral momentum and psychological momentum, respectively. Part III summarizes similarities and differences of behavioral momentum and psychological momentum, suggests behavioral momentum and psychological momentum fulfill the criteria for dynamic representation, compares properties of behavioral momentum and psychological momentum with properties of dynamic representation, suggests advantages of considering behavioral momentum and psychological momentum as based on or involving dynamic representation, and considers possible relationships of behavioral momentum and psychological momentum.

Similarities and Differences

Studies of behavioral momentum arose out of learning theory and behavior analysis and generally involve laboratory experiments with nonhuman animals

or behavioral modification in humans with developmental or learning disorders, whereas studies of psychological momentum arose out of social psychology and sports psychology and generally involve experiments with stimuli or settings from everyday life and normative human populations. Even so, a few studies of psychological momentum involving laboratory settings (e.g., Briki, den Hartigh, Markman, and Gernigon 2014; Kerick et al., 2000; Perreault et al., 1998), and a few studies of behavioral momentum involving everyday stimuli and settings (e.g., Mace et al. 1992; Pritchard et al., 2014; Roane, 2011), have been reported. However, differences in methodology and in nomenclature between domains typically considered in studies of behavioral momentum and domains typically considered in studies of psychological momentum can obscure potential similarities. Also, at least some potential differences might reflect the lack of investigation in a specific domain rather than an actual difference between behavioral momentum and psychological momentum (e.g., valence is important for psychological momentum but not yet investigated for behavioral momentum, and an influence of valence on behavioral momentum seems plausible, e.g., effects of valence and predispositions on approach/avoidance behaviors, Chen and Bargh, 1999). Given this, comparisons of behavioral momentum and psychological momentum have considerable heuristic value in generating new hypotheses and applications.

Numerous similarities of behavioral momentum and psychological momentum are apparent, and these are listed in Table 1. Behavioral momentum (e.g., Nevin, 1988) and psychological momentum (e.g., Mace et al., 1992) involve continuation of previously reinforced behaviors. Behavioral momentum in compliance (e.g., Mace et al., 1988), in which low probability events are more likely if success (compliance) is previously established, appears similar to psychological momentum in perception of a hot hand effect (e.g., Iso-Ahola and Dotson, 2014). Behavioral momentum (e.g., Nevin, 1988; Nevin and Grace, 2000) and psychological momentum (e.g., Markman and Guenther, 2007) are increased (i.e., less susceptible to disruption) if reinforcement rate is increased. Behavioral momentum (e.g., Nevin and Shahan, 2011) and psychological momentum (e.g., Eisler and Spink, 1998; Markman and Guenther, 2007) can be disrupted if the contingency between the response (i.e., the task) and the reinforcer is interrupted or delayed. Behavioral momentum (e.g., Mace et al., 1988; Parry-Cruwys et al., 2011) and psychological momentum (e.g., Markman and Guenther, 2007) can facilitate desired behaviors. Behavioral momentum (e.g., Pulido and López, 2010) and psychological momentum (e.g., Gilovich et al., 1985) can result in continued use of a previously successful strategy even if such a strategy is no longer optimal or appropriate. Behavioral momentum (e.g., Mace et al., 1992) and psychological momentum (e.g., Eisler and Spink, 1998) have been used to understand athletic performance. Behavioral momentum (e.g., Mace et al., 1997) and psychological momentum (e.g., Markman and Guenther, 2007) are increased with increases in reinforcer quality.

Table 1
Similarities of Behavioral Momentum and Psychological Momentum

Behavioral Momentum	Psychological Momentum
Involves continuation of previously reinforced behaviors (Nevin, 1988)	Involves continuation of previously reinforced behaviors (Mace et al., 1992)
Low probability behaviors are more likely if success was previously established (e.g., compliance, Mace et al., 1988)	Low probability behaviors are (perceived as) more likely if success was previously established (e.g., hot-hand effect, Iso-Ahola and Dotson, 1985)
Increased if reinforcement rate is increased (Nevin and Grace, 2000)	Increased if reinforcement rate is increased (Markman and Guenther, 2007)
Disrupted if contingency between response and reinforcer is disrupted (Nevin and Shahan, 2011)	Disrupted if the task is interrupted (Briki, Doron, Markman, den Hartigh, and Gernigon, 2014; Eisler and Spink, 1998; Markman and Guenther, 2007)
Can facilitate accomplishing desired behaviors (Mace et al., 1988; Parry-Cruwys et al., 2011)	Can facilitate accomplishing desired behaviors (Markman and Guenther, 2007)
Can result in continued use of a previously successful strategy even if that strategy is no longer optimal (Pulido and López, 2010)	Can result in continued use of a previously successful strategy even if that strategy is no longer optimal (Gilovich et al., 1985)
Has been applied to understanding athletic performance (Mace et al., 1992)	Has been applied to understanding athletic performance (Eisler and Spink, 1998; Gilovich et al., 1985)
Increased with increases in reinforcer quality (Mace et al., 1997)	Increased with increases in reinforcer quality (e.g., importance of the previous behavior, Markman and Guenther, 2007)
Appears to involve dynamic representation (Part III of this paper)	Appears to involve dynamic representation (Part III of this paper)

A potentially stronger argument regarding the similarity of behavioral momentum and psychological momentum can be made, however. The same environment-based interpretation of behavioral momentum is equally applicable to psychological momentum (i.e., the presence and strength of a momentum-like effect is determined by context-specific reinforcement for performance). Behavioral momentum and psychological momentum each reflect effects of environmental contingencies on the individual. Along these lines, negative facilitation parallels an increase in motivation to escape an aversive stimulus, and positive inhibition parallels a reinforcer losing its effectiveness as a result of satiation. The notion of a momentum-like effect that covaries with performance in a given context is applicable to overt processes (e.g., behavioral momentum) and to covert processes (e.g., psychological momentum). In this light, behavioral momentum and psychological

momentum are more than similar; they are virtually the same momentum-like effect, with the modifier “behavioral” applied when describing an observed behavior and the modifier “psychological” applied when describing a reported subjective experience. Of course, humans are capable of more diverse, subtle, and sophisticated behaviors and psychological states than are many nonhuman animals, and so subjective aspects of psychological momentum in humans need not necessarily be attributed to examples of behavioral momentum in nonhuman animals.

Criteria of Dynamic Representation

Behavioral momentum and psychological momentum involve expectations regarding upcoming action or behavior. These expectations are based on a momentum metaphor, and target actions or behaviors are represented (at least in part) as involving or reflecting forces (cf. representation of forces in Freyd, Pantzer, and Cheng, 1988; Leyton, 1989, 1992). This implies that representations of those actions or behaviors are dynamic or contain dynamic information (cf. Briki, den Hartigh, Markman, and Gernigon, 2014). Freyd (1987) suggested another momentum-like effect, representational momentum, involved dynamic representation, and given this, it is useful to consider whether Freyd’s notions of dynamic representation can be adapted or expanded to include behavioral momentum and psychological momentum. Although time-scale of change in dynamic representation in Freyd’s framework is much faster than time-scales of change in behavioral momentum and psychological momentum, it is not clear that a dynamic framework is necessarily tied to a specific time-scale or temporal range, and so the notion of dynamic representation can perhaps be expanded to include the longer time-scales of behavioral momentum and psychological momentum. Along these lines, a potential neural architecture of an anticipatory system capable of operating at multiple time-scales is discussed in Jordan (2013), and such a system is consistent with the hypothesis that different momentum-like effects reflect the same dynamic processes or systems.

Freyd (1987) suggested that if a mental representation was dynamic, then that representation intrinsically and necessarily represented time (i.e., included temporal information). For time to be an intrinsic aspect of the representation, temporal information must be directional (i.e., moving in only one direction) and continuous (i.e., between any two points in time, a third point can be identified).⁴ The directionality of behavioral momentum and psychological momentum is

⁴Although it can be debated whether time is continuous at scales other than those experienced in daily life (e.g., time might be discrete at the quantum level), time as experienced in daily life appears continuous. Analogously, space is experienced as Euclidean in daily life, even though space is considered to be curved and warped at the astronomical level or at the quantum level. In considering the importance of continuity of time and space for dynamic representation, the important point is whether time and space are perceived and experienced as continuous (and thus presumably represented as continuous) and not whether time and space are actually continuous.

demonstrated in that past experience influences future behavior but future behavior does not influence past experience. The continuity of behavioral momentum and psychological momentum is demonstrated in the existence of an apparently continuous range of time-scales (rather than just a few discrete time-scales) in which momentum-like effects occur (cf. Jordan, 2013, who proposed a “multi-scale effect control” that pre-specifies [i.e., predicts] perception and action at multiple time-scales). Also, time is clearly a necessary aspect of behavioral momentum and psychological momentum. If temporal information were not present, then all information would be represented as simultaneous (i.e., not temporally ordered), and this would eliminate critical information (e.g., conditioning [or attributions of causality] would not be possible, as information regarding conditioned and unconditioned stimuli and responses [or cause and effect more generally] could not be separated). Thus, behavioral momentum and psychological momentum fulfill Freyd’s criteria regarding intrinsic and necessary inclusion of temporal information.

Behavioral Momentum, Psychological Momentum, and Properties of Dynamic Representation

If behavioral momentum and psychological momentum involve dynamic representation, then these two momentum-like effects should exhibit properties similar to those attributed to dynamic representation. Freyd (1987) proposed several candidate properties for dynamic representation, and these are listed in Table 2. Two of Freyd’s proposed properties are based on the short time-scale of representational momentum, and these suggest that changes in dynamic representation occur very rapidly and increase over short retention intervals. However, if the point of being dynamic is that change occurs over time, then it does not seem necessary to require that such change occur within a specific time-scale. Thus, these two properties might be too narrowly defined (being based on a single form of momentum-like effect with a short time-scale). Even so, findings that psychological momentum is relatively short-lived (Hamberger and Iso-Ahola, 2004) and decreases with increases in the temporal interval in which it occurs (Eisler and Spink, 1998) are consistent with the decline of representational momentum after an early initial peak (Freyd and Johnson, 1987). It is unclear whether a third suggested property, that changes in dynamic representations are not due to guessing, applies to behavioral momentum and to psychological momentum. Whether nonhuman animals in experiments involving behavioral momentum could be said to guess is debatable, and accounts of psychological momentum in human experimental participants do not appear to suggest explicit guessing.

Behavioral momentum and psychological momentum appear consistent with the remaining properties of dynamic representation proposed by Freyd (1987).

Table 2
 Properties of Behavioral Momentum and Psychological Momentum Compared
 with Freyd's (1987) Suggested Properties of Dynamic Representation

Dynamic Representation	Behavioral Momentum	Psychological Momentum
Basic phenomenon (forward displacement or continuation)	Learned behaviors continue until acted upon by another force	Past success likely to lead to future success; past failure likely to lead to future failure
Depends upon coherent direction of motion	Disrupted if contingency between response and reinforcer is disrupted	Disrupted if the task is interrupted
Differs from guessing	?	?
Does not stem from sensory processes	Involves learned behavior	Involves learned behavior
Is impervious to practice or error feedback	?	Continued use of previously successful strategies even if no longer appropriate
A shift in memory for position (time)	Involves anticipated (future) behavior	Involves anticipated (future) behavior
Increases with increases in velocity	Increases with increases in reinforcement rate	Increases with increases in reinforcement rate
Occurs very rapidly	Occurs hours, days, weeks or more after learning	Occurs hours, days, weeks or more after learning
Increases over short retention intervals, then decreases	?	Stronger over (relatively) shorter temporal intervals
Attached to the represented object, not to an abstract frame of reference	?	?
Dimensions of change other than rigid transformations	Occurs for simple (key peck) and complex (reading) behaviors	Involves many different types of behavior

Note: Entries in **bold** indicate properties of behavioral momentum or psychological momentum that initially appear inconsistent with properties of dynamic representation (but see main text for discussion). A question mark indicates a lack of relevant data or other uncertainty.

One such property is that dynamic representation results in automatic extrapolation (displacement) of a target in the direction of motion. Behavioral momentum and psychological momentum each involve an increased likelihood of a continuation of the current behavior, and a continuation of behavior is analogous to an extrapolation of target motion. A related property is that the rate of change in dynamic representation increases with increases in the rate of change of the stimulus. Freyd phrased this in terms of target velocity; response rate is the behavioral equivalent of

velocity, and behavioral momentum (Nevin, 1988; Nevin et al., 1983) and psychological momentum (Mace et al., 1992; Roane et al., 2004) each increase with increases in response rate. Another property proposed by Freyd is that changes in dynamic representation are not due to sensory processes. The time-scales of behavioral momentum and of psychological momentum are much longer than the duration of sensory processes. More critically, behavioral momentum (Podlesnik and Shahan, 2009; Podlesnik, Thrailkill, and Shahan, 2012) and psychological momentum (Kerick et al., 2000; Shaw et al., 1992) are influenced by manipulations that affect learning, and this suggests these two momentum-like effects result from learning (and other cognitive processes) and not from sensory processes.

Another property proposed by Freyd (1987) is that changes in dynamic representation depend upon a coherent direction of motion (e.g., representational momentum only occurs if the target maintains a consistent and predictable direction of motion). Behavioral momentum is disrupted if the contingency between response and reinforcer (analogous to a consistent direction) is disrupted (Nevin et al., 1983; Nevin and Shahan, 2011), and psychological momentum is disrupted if a task is interrupted (Briki, Doron, Markman, den Hartigh, and Gernigon, 2014; Eisler and Spink, 1998; Markman and Guenther, 2007). A related property is that changes in dynamic representation are not limited to rigid transformations, but this property might just reflect the types of stimuli (dots, geometric shapes) and changes (location, shape, size, etc.) typically used in experiments on representational momentum. It is not clear what would constitute a rigid or non-rigid behavior in the current context, but behavioral momentum and psychological momentum each involve complex behaviors that change along multiple dimensions, and considering all of these possibilities as “rigid transformation” does not seem plausible. A final property suggested by Freyd is that changes in dynamic representation are impervious to practice or error feedback. Given that behavioral momentum and psychological momentum are based upon learning, this might appear inconsistent, but the claim of imperviousness of representational momentum to feedback is overstated.⁵ Even so, resistance to statistical interpretations of the hot-hand effect suggests psychological momentum might not be easily influenced by error feedback.

⁵Research subsequent to Freyd (1987) documented numerous ways that information provided to participants can influence representational momentum (for review, see Hubbard, 2005, 2014). Of relevance to the issue of error feedback are findings that participants who receive error feedback regarding their judgment of whether a subsequently presented probe is at the location at which a target vanished (Ruppel, Fleming, and Hubbard, 2009), or who believe a *same* response is less likely to be correct (Hubbard and Lange, 2010), are less likely to respond *same* to subsequent probes, although forward displacement per se is not influenced (i.e., height, but not skew, of the distribution of *same* responses as a function of probe location is influenced by error feedback). Also, participants who receive information regarding representational momentum (Courtney and Hubbard, 2008), or who receive advance cueing regarding final target location (Hubbard, Kumar, and Carp, 2009), exhibit smaller (but still statistically significant) forward displacement. These findings suggest representational momentum is not completely impervious to error feedback.

Advantages of Considering Behavioral Momentum and Psychological Momentum as Dynamic Representation

There are at least three potential advantages of considering behavioral momentum and psychological momentum as based on or involving dynamic representation. First, a more parsimonious understanding of momentum-like effects can be developed. Instead of positing multiple separate and unrelated momentum-like effects (and redundancies in mechanisms for their effects), a single more general mechanism that is able to anticipate future actions, behaviors, and outcomes at multiple time-scales is posited (for a similar argument involving other types of momentum-like effects, see Hubbard, 2014, in press; for an argument involving the importance of multiple time-scales of anticipation, see Jordan, 2013). Second, and relatedly, dynamic representation involves active processing and anticipation regarding likely actions, behaviors, and outcomes, and such an idea is in line with recent developments in forward modeling and in the study of links between perception and action. Third, and as discussed earlier, the idea of a more general dynamic representation that produces momentum-like effects leads to specific predictions that can be tested (e.g., processes suggested to rely on dynamic representation should exhibit properties consistent with dynamic representation, the effects of variables previously shown to influence one type of momentum-like effect provide hypotheses regarding the effects of those variables on other types of momentum-like effects, etc.), and regardless of the outcomes of such tests, the results of such experiments should shed considerable light on the understanding and application of momentum-like processes.

The Relationship of Behavioral Momentum and Psychological Momentum

Although the reviews of behavioral momentum and psychological momentum in Parts I and II, respectively, used broad categories involving characteristics of the target, context, and observer, the individual variables within each of those broad categories were different for behavioral momentum and for psychological momentum (e.g., characteristics of the target in behavioral momentum consisted of extinction, the partial reinforcement extinction effect, and resurgence; characteristics of the target in psychological momentum consisted of valence, direction, duration, mass, task, and prior probability). Similarly, variables within the broad categories for behavioral momentum and for psychological momentum differ from variables within the same broad categories for previously documented momentum-like spatial effects (see Hubbard, 2014). Differences regarding specific variables, and in determination of which variables might be analogous to other variables in other momentum-like effects, make it more challenging to consider the relationship between behavioral momentum and psychological momentum (and the relationships between these two temporal momentum-like effects to other types of [e.g., spatial]

momentum-like effects). Even so, the possibility that behavioral momentum and psychological momentum each involve dynamic representation is consistent with the possibility that there is at least some overlap in the structures or processes involved in the different momentum-like effects.⁶

There are several possible relationships of behavioral momentum and psychological momentum. One possibility is that behavioral momentum and psychological momentum are separate and unrelated processes. However, this possibility seems inconsistent with the many similarities of behavioral momentum and psychological momentum noted earlier, as well as inconsistent with the similarities of momentum-like effects more generally (see Hubbard, *in press*). A second possibility is that psychological momentum is a subset or special case of behavioral momentum or that behavioral momentum is a subset or special case of psychological momentum. The data do not yet suggest whether behavioral momentum or psychological momentum is the more inclusive (although it might be easier to reduce psychological momentum to behavioral momentum than to reduce behavioral momentum to psychological momentum). A third possibility, and as suggested earlier, is that behavioral momentum and psychological momentum reflect the same general phenomenon, with the modifier “behavioral” applied when describing an observed behavior and the modifier “psychological” applied when describing a reported subjective experience. Indeed, the historically separate notions of “behavioral momentum” and “psychological momentum” might be examples of construct proliferation, in which the same general phenomenon is given different names by different groups of researchers working within different paradigms.

Part IV: Conclusions

Behavioral momentum and psychological momentum each involve a continuation (extrapolation) of current behavior. Despite this, there has been relatively little comparison of these two momentum-like effects. Although behavioral momentum has usually been studied within the framework of learning theory and with nonhuman animals or with humans diagnosed with developmental or learning disorders, and psychological momentum has usually been studied within social psychology and sport psychology with normative human participants, there are significant

⁶Similarly, studies on behavioral momentum tend to focus on the connection between environmental contingencies and exhibited behaviors, whereas studies on psychological momentum tend to focus on the connection between reported states and a mental construct. This difference maps onto the distinction between functional approaches and cognitive approaches discussed by De Houwer (2011; De Houwer, Barnes-Holmes, and Moors, 2013), with research on behavioral momentum focusing more on function and research on psychological momentum focusing more on cognition. An attempt to find commonalities between behavioral momentum and psychological momentum such as those in Table 1 and in comparison of dynamic properties in Table 2 can be viewed as an attempt to bridge functional and cognitive approaches to momentum-like effects.

similarities of these two types of momentum-like effects (e.g., increases in reinforcer rate or quality increase momentum-like effects, subsequent low probability behaviors are considered more likely if success or compliance was previously established, etc.). The similarity of ideas from such different paradigms points to deeper principles regarding adaptiveness of behavior and cognition to environmental contingencies and regularities. Despite differences in methodology and nomenclature, behavioral momentum and psychological momentum appear to be closely related, and might even reflect the same general processes, albeit in different forms. This is consistent with Newton's theory (on which the momentum metaphor is based), which clearly demonstrates that phenomena that might initially appear very different (e.g., motions of Earth-bound objects and motions of celestial objects) can nonetheless be governed by the same laws and principles.

Behavioral momentum and psychological momentum exhibit many of the properties previously attributed to dynamic representation. However, consideration of other momentum-like effects involving dynamic representation has previously been limited to processes that occur at much shorter time-scales. The existence of behavioral momentum and of psychological momentum suggests that dynamic representation can occur at different time-scales and is not necessarily limited to very short time-scales. Indeed, the possibility of different time-scales underscores the importance of temporal information (regarding change or transformation associated with a given duration or range of time) in dynamic representation. This suggests not only a connection between behavioral momentum and psychological momentum, but also the possibility of deeper principles connecting behavioral momentum and psychological momentum with other types of momentum-like effects (e.g., see Hubbard, in press). Even if momentum-like effects do not influence future behavior directly, behavioral momentum and psychological momentum are useful as heuristics in predicting behavior. Furthermore, behavioral momentum and psychological momentum demonstrate important ways in which organisms are actively engaged with stimuli and not just passive recipients or observers; in behavioral momentum and in psychological momentum, this active engagement takes the form of anticipating actions and behaviors and is based on dynamic representation.

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Singular Thought: The Division of Explanatory Labor

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A tacit assumption in the literature devoted to singular thought is that singular thought constitutes a unitary phenomenon, and so a correct account of it must encompass all instances. In this essay, I argue against such a unitary account. The superficial feature of singularity might result from very different deep-level phenomena. Following Taylor (2010) and Crane (2013), I distinguish between the *referential fitness* and the *referential success* of a thought. I argue that facts responsible for referential fitness (e.g., mental files or individual concepts), as well as facts responsible for referential success (e.g., acquaintance conditions on referential success), are relevant in explaining the data pertaining to a theory of singular thought. What makes this approach particularly attractive is that there are good independent reasons to introduce both kinds of facts in theorizing about thought.

Keywords: singular thought, referential success, referential fitness

There is an intuitive — that is, pre-theoretical — distinction between two kinds of beliefs, intentions, desires and other propositional attitudes, or, in general, thoughts. My thought that *the person I am looking at right now is very smart* is very different from my thought that *the inventor of the wheel, whoever she or he was, was very smart*. In the former case the thought has a perceived directness and aboutness that is missing in the latter case, which is a purely descriptive thought. Roughly speaking, this is the distinction between singular and general thoughts, or *de re* thoughts vs. *de dicto* thoughts. It is very easy to get as many paradigmatic cases of each kind of thought as one likes: believing that *she* (pointing at a particular student in class) is *German* is very different from believing that *the first student who will speak tomorrow in class, whoever she or he is, is German*. Even if it turns out it is the same person I am talking “about,” the two thoughts exhibit a different sense of aboutness, and they connect in a very different way to the extra-linguistic reality. If this intuition is rejected then there is nothing to explain. However, in as much as there is a real distinction to be made here, some explanation is needed.

Once the distinction is accepted, it may be thought that its explanation should invoke linguistic phenomena, and not facts about thought. The distinction, it may be argued, concerns the way we express our thoughts, and so, it is about language. To this we should reply that, although it is true that we do use language to express both singular and general thoughts, the distinction per se does not concern language. The distinction should not be identified with the semantic distinction between referential terms and quantifier expressions. For instance, sentences containing quantifier expressions can be used to express both singular and general thoughts. My reasons for uttering the sentence, “Every student in my class speaks Spanish,” can be purely general (e.g., I have asked those in class who do not speak Spanish to raise their hand and no one did), or singular (e.g., I have only one student enrolled in my class, Maria, and I know she speaks Spanish). The same point could be made by looking at the different uses of definite descriptions. As Donnellan notes, when a description is used referentially, but not when it is used attributively, “the speaker presupposes of some *particular* someone or something that he or it fits the description” (1966, p. 288, italics in the original). The thought the speaker intends to convey is singular when the definite description is used referentially, but it is general when the same description is used attributively. Donnellan’s (1966) examples, which I will not repeat here, help make this point vividly.

Let us then consider the above data as indicative of a genuine phenomenon concerning thought, not reducible to semantic facts. It is useful at this point to give due weight to the act/object ambiguity that “thought” exhibits: a thought is, on the one hand, an *act* of thinking, and on the other, that which one thinks, that is, a *content*.¹ Much of the literature on singular thought is focused on the latter notion, that is, on characterizing the content of singular thought. Nevertheless, focusing on the act of thinking may prove to be insightful as well. In particular, it helps us notice the distinction between *successful* acts of thinking singularly, as opposed to *failed* acts of entertaining a singular thought. In turn, this distinction suggests that we should separate two general questions concerning the conditions for thinking singular thoughts. These questions could be formulated as follows:

- i. What are the conditions that have to be fulfilled in order to perform an act of thinking that purports to be about — or to refer to — one individual?²
- ii. What are the conditions that need to be fulfilled for an act of thinking that purports to be about one individual to succeed, i.e. to be about — or to refer to — that individual?

¹Sellars (1956) called it the “ing/ed” ambiguity. Grice (1957) identifies “utterance” as exhibiting the same ambiguity. Bach (1998) adds “building,” “shot,” “writing,” “inference,” “statement,” “thought,” “perception” to the list.

²Crane (2013) uses “purporting to refer,” which he borrows from Quine’s *Word and Object*, where Quine uses it in relation to singular terms. Crane comments that this is a metaphor, adding that “thought does not purport to refer to anything, it is the thinker that may purport to do so” (p. 140).

These questions have also been formulated in slightly different terms. Taylor (2010, p. 79) distinguishes “objective” from “objectual” representations, by which he means representations that are merely “referentially fit,” and need not be “referentially successful,” vs. representations that are “referentially successful.” Borrowing this terminology, we could reformulate the above question as follows:

- a. What does it take to have a representation that is referentially fit?
- b. What does it take to have a representation that is referentially successful?

Or we could use yet other terms:

1. What does it take to aim at an object in thought?
2. What does it take to hit the object you aim at in thought?

The formulation “to aim at an object in thought” belongs to Crane (2013, p. 141). If the metaphor of aiming in thought is useful then it seems to me the contrast that we want to draw is well suggested by using the metaphor of “hitting in thought” what one aims at.

This pair of questions, however one wants to express it, is methodologically important in as much as the questions allow us to classify theories of singular thought in two categories: which question do they address and how do they answer it. Although succeeding requires trying, a theory may focus on the conditions of success and not on the conditions that make an action a trial. On the other hand, a theory may focus on the conditions that need to be fulfilled in order to count as aiming at an object in thought (or aiming to entertain a thought about a particular object). Yet other theories may address both conditions of trial and conditions of success. However, as I argue in what follows, many theories focus primarily on only one of the two questions, and are well equipped to answer it. In consequence, the view of the nature of singular thought the theorist ends up with depends on which of the two questions she addresses.

One group of theories is built on the idea that the subject has to be referentially successful in order for the thought she entertains to be singular. Call such views *referential success approaches to singular thought* (or RS approaches, for short). The question these theories focus on is (ii). On an RS approach it is not sufficient that the subject purports to refer to an individual. The thought is genuinely singular only when everything goes well and reference in thought is successful. Naturally, RS theories require aiming at a particular object as well. However, on an RS approach it is not sufficient that there is an object the subject aims at. It is also necessary that the aiming results in a successful hit.

One might conceive of referential success as a claim about the truth-conditions of the bearer of the thought (e.g., an utterance of a natural language sentence, a sentence-token in the language of thought, or whatever vehicle of representation is deployed in thought). Thus, a singular thought would be a thought whose truth-conditions are object-dependent (as opposed to object-independent). If we use a standard framework for expressing truth-conditions that relies on possible

world semantics, the object-dependent thought is true depending on how things stand with the particular actual object, no matter which world of evaluation we consider. However, this approach fails: the natural language sentence (or its correspondent in the language of thought), “The actual president of France in 2013 is bald,” has object-dependent truth-conditions. Its truth-value depends on how things stand with the actual president of France in 2013. But the sentence might be used to express a purely general thought, about whoever is the actual occupant of the presidency in 2013. The perceived directness and immediacy, which are phenomenological characteristics of singular thought, are not present in that case. Actualized definite descriptions, among other expressions, are devices of rigid designation but not of direct reference. That is, they do not contribute to the proposition expressed the object they pick out. So the truth-conditions are object-dependent although the proposition is general.

Worries of this kind motivate the idea that the claim that a thought is singular is not a claim about truth-conditions, but one that is best represented in a framework of structured propositions (Boër and Lycan, 1986, pp. 125–126). In turn, introducing an object in the proposition expressed requires thinking *directly* about the object. Tyler Burge says that a *de re* thought is a thought “whose correct ascription places the believer in an appropriate nonconceptual, contextual relation to objects the belief is about” (1977, p. 346). That is, singular thought requires *direct reference*. However, others argue that, on the contrary, entertaining a singular proposition about an object does not require thinking nonconceptually about it. Kent Bach, for instance, writes:

Even *de re* thought about a current object of perception, which is direct as can be, is still mediated. In general, to think of an object in a *de re* way is to think of it via some means, but it is still to represent the object. (2010, p. 55)

In the same line, García-Carpintero (2010, p. 275 n. 4) argues that Burge’s view is implausible: if there is no conceptual material involved, there is no genuine thinking whatsoever. Conceptual or descriptive mediation of the thought is still involved in entertaining singular thoughts, García-Carpintero maintains. As Recanati (2010, p. 148) puts it, both in case of a singular thought and in case of a general thought, the thought involves a *mode of presentation* of the object to the subject. The difference is that a descriptive mode of presentation consists of a set of satisfaction conditions, such that the object presented is whichever uniquely satisfies those conditions. A non-descriptive mode of presentation puts the subject in a special relation to the object, one that is grounded in a causal relation between the object and the subject.

Usually, both those who argue for unmediated directness and those who defend singular thought as conceptually mediated agree that a special relation must obtain between episodes of thinking that aim at certain objects and the objects they aim at, for the thought to be singular (i.e., for the “hitting” condition to be fulfilled). Following Russell (1911, 1912), this relation is sometimes called *acquaintance*.

Russell used the term to refer to a kind of relation between subject and object that is not conceptually mediated and is direct in an absolute sense. Acquaintance is a privileged epistemic relation between subject and object, such that the subject cannot be mistaken about what she is acquainted with. For Russell, acquaintance excludes any conceptual representation of the object, and so it also excludes any misrepresentation of it.

Most contemporary theorists think of acquaintance in a much less restrictive way than Russell did. It would be more accurate to talk of extended acquaintance, as McKay (2012) suggests. Some theorists follow Russell in understanding acquaintance in epistemic — but much more moderate — terms. Gareth Evans argues that “in order to be thinking about an object or to make a judgment about an object . . . one must know which object it is that one is thinking about” (1982, p. 64). Other authors, including Bach (2004, 2010), Burge (1977), Kaplan (1969), Recanati (2010, 2012) and Salmon (2010), take a different view. They use “acquaintance” to refer to an appropriate causal relation between subject and object, which is required to ground reference in language and thought. This is characterized as being in “a representational connection” (Bach, 2010, p. 58), or in “a real connection” (Salmon, 2010, p. 68) to an object. Direct perception of an object is one kind of such a causal relation, but not the only one. Most acquaintance theorists accept that we can refer in thought to objects that we do not perceive directly. They admit of perception-based acquaintance relations (such as having memory of a perception of an object), as well as of communication-based acquaintance relations (for instance, having reference passed to one through communication involving direct referential terms).

Not all theories that take singular thought to amount to entertaining a singular proposition impose an acquaintance requirement. Hawthorne and Manley (2012, pp. 24–25) call “liberal” all positions that reject an acquaintance constraint on singular thought. One such position is that of semantic instrumentalism, according to which entertaining a singular proposition requires identifying an object by description, and then using a linguistic device (such as Kaplan’s [1970] “dthat” operator, or other descriptively introduced directly referential term) to directly refer to that individual. Thus, Kaplan argues that I can entertain a singular proposition about the first child to be born in the next century just by introducing in my vocabulary “Newman₁,” a name that refers directly to whoever will be the first child to be born in the next century.³

Let us stop and sum up. I have so far briefly mentioned a number of RS theories of singular thought, according to which entertaining a singular thought amounts to entertaining a singular (object-involving) content. These theories focus primarily on

³Kaplan later qualifies his view, reaching a more moderate position (see Kaplan, 1989, pp. 604–607).

question (ii), concerning the conditions for referential success. A different group of theories take question (i) to be the only relevant one for understanding the nature of singular thought. I call them referential fitness approaches to singular thought (RF approaches, for short). RF theorists typically argue that a thought may be singular even if it does not “hit” any object, that is, independently of whether reference in thought is secured or not. Such theories are in general uninterested in question (ii), concerning the conditions of referential success. Consequently, these theorists also disregard metaphysical questions concerning the existence of an individual the thought purports to be about.

Both Sainsbury (2005) and Crane (2013) argue that a singular thought is a thought with singular content, but that this does not require referential success. As Crane (2013, p. 140) puts it, “if we take the connotations of ‘purporting’ seriously, then a thought can be singular even if it fails to refer to just one object, so long as it has the cognitive role associated with thoughts that succeed in so referring.” For instance, I can have a singular thought about Vulcan (the alleged planet that the nineteenth century astronomer Le Verrier postulated and baptized, and which he thought explained certain perceived perturbations in the orbit of Mercury). Although the planet that Le Verrier postulated does not exist, on Crane’s and Sainsbury’s views I could entertain the singular thought that Vulcan has an elliptical orbit. I can never succeed in referring to Vulcan, but I can purport to refer to Vulcan because I have at my disposal the cognitive resources required to do so. In Sainsbury’s (2005) view, the proposition entertained does not contain an object, but an individual concept. A concept may belong to this category even if it has no referent. It is the causal history of the concept that makes it an individual concept, rather than a descriptive one, and which determines what it is a concept of. Singular thought is thought that is formed by deploying individual concepts. Consequently, Sainsbury (2005, p. 240) denies that acquaintance, or any similar condition on referential success, needs to obtain for entertaining a singular thought.

Another popular RF approach appeals to the concept of a “mental file,” or a “mental dossier” to account for singular thought. The concept of mental files dates back to Grice (1969) and Bach (1987), and has been recently developed by Jeshion (2002, 2004, 2010), Recanati (2010, 2012), and others. These theorists account for the singularity of thought in terms of the cognitive organization of thoughts, and independently of what content these thoughts have. Mental files are not constituents of thoughts (they are not Fregean senses), but rather, ways in which the information a subject possesses is organized (Szabó, 2000, p. 53 n. 11). Hawthorne and Manley observe that, “On such a view, it is natural to hold that what makes a thought singular is a matter of how the content is represented, as opposed to the nature of the content itself” (2012, p. 17). The singularity of thought is explained by the cognitive role that the thought plays in the agent’s mental organization. Cognition creates singular thoughts by creating mental files in which information related to a certain individual (real, imagined, or assumed to exist) is stored.

A thought is singular if it relies on the information contained in a particular mental file. It is “about” whatever individual the information in that mental file is about. As Jeshion notes,

Singular thought about an individual is structured in cognition as a type of mental file.... One thinks a singular thought by thinking *through* or *via* a mental file that one has about the particular object. By contrast, descriptive thoughts occur discretely in cognition. (2010, p. 129)

The Data for Singular Thought Revisited

In the previous section I briefly revisited various theories of singular thought with the purpose of drawing a general distinction between theories that require referential *success* for a thought to be singular (RS approaches) and theories that require only referential *fitness* (RF approaches). Notice that the distinction is not between theories that account for singular thought in terms of *content* vs. theories that account for singular thought in terms of cognitive aspects that relate to the *presentation of the content*, instead of the content itself. Sainsbury’s theory of singular thought, for instance, relies on individual concepts, so it is a content theory, but at the same time it is an RF theory of singular thought. Other content theories, such as the acquaintance theories mentioned, are RS theories. Therefore, the RS vs. RF distinction is orthogonal with respect to the content vs. presentation of the content distinction. Needless to say, the latter distinction is equally useful. But it is the distinction between RS vs. RF approaches that serves my purpose here. I aim to suggest that both RS and RF theories have a role to play in accounting for the phenomenon of singular thought. In this section I develop an argument to support my claim. In particular, I consider the data relevant to theories of singular thought, and argue that it is best explained by a combination of RS and RF accounts.

First of all, notice that an RF theory of singular thought is compatible with the claim that singular thoughts may involve referential success, in which case their content is singular. But RF theories typically allow for singular thoughts to be formed by deploying, for instance, mental files that contain purely descriptive information. It is this latter point that RS theorists find unacceptable. Bach, for instance, thinks that a theory of mental files cannot explain singular thought:

The file model can’t explain singular thought itself, because it serves equally as a model for adding new beliefs to old beliefs “about” an individual we know of only by description, such as the last emperor of China, or even “about” a nonexistent individual, such as Bigfoot. (2010, p. 57)

Indeed, an RF mental file theory of singular thought typically allows for singular thoughts that have purely descriptive content. But is that an incorrect prediction? I want to suggest that it is not. It is useful at this point to take a closer look at some of the data that theories of singular thought purport to account for.

Theorists generally coincide in using the term “singular thought” to refer to a certain surface-level phenomenon, and agree on the theoretical goal to pursue, which is that of accounting for this phenomenon. There is broad agreement on how to characterize the surface-level phenomenon in general terms: as episodes of thinking that intuitively exhibit a singularity, or are *about* a particular individual. The data are sometimes presented in terms of “having in mind” (Donnellan, 1966; Wettstein, 2010) or “thinking of” a particular individual (Kaplan, 1969). These phrases are meant to trigger the intuition of singularity, or aboutness, or maybe directness, of thought. There is also agreement over paradigmatic cases that exhibit these features. However, there is a great range of cases over which there is no agreement. For many cases it is not at all clear whether we should say that the thought is singular or not. Other cases only trigger a weak intuition of singularity. To illustrate this point I consider three kinds of cases that fall in this category.

1. *Reference by proxy*. Also known as deferred reference, this is reference to an object that is absent from the context of utterance by way of exploiting its relation to some salient object present in the context. Many such cases of reference by proxy — including some of the ones discussed below — are, arguably, not genuine cases of successful reference at all. But what is relevant to our purposes here is not the question of whether there is referential success (i.e., whether the subject entertains a singular proposition), but the question concerning the *data* about intuitions of singularity. Do cases of reference by proxy trigger intuitions of singularity? Some cases do not. Consider Donnellan’s scenario in which the detective, upon seeing the scene of Smith’s assassination, utters, “Smith’s murderer is insane.” The detective does not have any particular suspect in mind (Donnellan, 1966, p. 288), and does not use the description as a means of referring to anyone (Donnellan, 1968, p. 205). But even if the detective had the intention to refer by proxy to Smith’s actual murderer, he could not do so. There is widespread agreement in the literature that Donnellan is right in claiming that the detective is not in a position to entertain a singular thought about the murderer. Instead, the detective could only entertain a general thought, one about whoever killed Smith.

Other cases that are relevantly similar do trigger the intuition of singularity. I point at a nineteenth century photo of a bearded man who is totally unknown to me, and I utter, “He looks impressive.” Intuitively, I manage to entertain a singular thought about the man in the photo. So, reference by proxy allows for clear intuitions of singularity. In this respect there is a marked contrast between this case and the previous one.

However, there are many other cases that are difficult to classify. Suppose that I am contemplating the same photo of the bearded man, this time in the context of a discussion of the artistic merits of various unknown photographers. While looking at the photo I utter: “He is very experienced,” meaning that *the photographer* is very experienced. Do I entertain a singular thought about the unknown photographer now? It is not at all clear what we should say.

The fuzziness of the intuitions is mirrored at a theoretical level, as different theorists make, and defend, different predictions about such cases. Given that I have no idea who the photographer is, someone such as Evans (1982), who subscribes to an epistemic acquaintance requirement for singular thought, would deny that I could entertain a singular thought about the unknown photographer. Authors who are more liberal about the requirements for entertaining singular thoughts (e.g., Hawthorne and Manley, 2012; Sosa, 1970) allow for singular thoughts even when this kind of knowledge is lacking. After all, I clearly have a singular thought about the bearded man although I don't know who he is either. And I can very well say: "Whoever this man is, he looks impressive." A defender of the epistemic acquaintance view might reply that these cases are, after all, different. The photo allows us to identify the person in normal circumstances, but the authorship of the photo does not. But whatever we say about this particular case, many more difficult cases remain. What about a photo in which a person is showing her back to the camera? What if all I can see is her right hand? Or only her shadow? Or her fingerprint? Or a strand of hair? In which of these cases am I in a position to form a singular thought about that person?

It is tempting, when faced with difficulties of this kind, to bring oneself to a liberal frame of mind so as to admit that in *all* these cases the subject entertains a singular thought. But this temptation will be quickly abandoned, as it is easy to find cases for which not even the most liberal would assent to this conclusion. Is our liberal willing to accept that I can think a singular thought about the sixteenth person who touched the photo after it was produced, whoever she or he is? This seems too much to take. However, that person is causally related to the photo — although the causal effect on it may be imperceptible — and so, indirectly, to me. However, the same mechanism of reference by proxy could be deployed as in the case of the photographer. So it is not at all clear why we should say "yes" in one case and "no" in the other. The lesson to draw is that the data from such cases of reference by proxy are far from clear. Arguably, we only have a *weak* intuition of singularity for such cases, but not a strong one.

II. Specific uses of definite and indefinite descriptions. It is uncontroversial that I can grasp singular thoughts through communication, a paradigmatic example being communication that involves proper names (Kripke, 1980, pp. 91–93). In such cases the intuitions of singularity are fairly strong. Consider now the following case: my friend tells me a story about the adventures of her uncle, whom I have never met or seen. Furthermore, suppose she is not mentioning his name, or using any other referential expression that would guarantee the singularity of the content expressed. She only refers to him by using the description, "my uncle." Am I in a position to have a singular thought about my friend's uncle? Again, in as much as we consider the raw data from intuitions, there is no clear answer to this question. While we might be inclined towards singularity, the intuition is surely a weak one.

Consider a similar case, this time involving the use of an indefinite description. My friend tells me, "A policeman told me to turn left." She gives me no further information about the policeman she talked to. Do I have a singular thought about that policeman when I think that *he* must have been confused if he sent my friend in that direction? Ludlow and Neale (1991, pp. 180–181) classify such uses of indefinite descriptions as *specific*, as opposed to referential or attributive uses (Donnellan, 1966). The authors characterize them as cases in which only the speaker — but, crucially, not the addressee — is in a position to associate a particular individual to the description and think a singular thought about him or her. The specific use of an indefinite description does not allow for the communication of singular thoughts. That is, according to Ludlow and Neale (1991), I am not in a position to entertain singular thoughts about the policeman my friend talked to. However, this diagnosis may be resisted. The data are sufficiently unclear to allow for disagreement. One might insist that there is a causal chain that I can trace between the policeman and myself, and this causal chain is sufficient to allow me to think *of* that policeman in particular. However, the intuition of singularity in this case is definitely not a strong one.

III. *Reference to "non-existent objects."* Certain thoughts about non-existent individuals also exhibit intuitions of singularity. Consider again the proper name "Vulcan." We now know that the planet Le Verrier postulated does not exist, and so the name fails to refer. Should we say that Le Verrier expressed and entertained a singular thought when he assertively uttered, "Vulcan has an elliptical orbit"? We are not inclined to say that the thought is purely general, but neither is it clearly singular. I suggest we should admit that there is only a weak intuition of singularity in such cases.

A similar point could be made about failure of demonstrative reference, as opposed to reference by a proper name. Suppose I am under the impression that there is someone in the corner of the room and I assertively utter, "That man over there must be drunk." I do not succeed in referring to anything with my use of the demonstrative, because no object that I demonstrate is a man. But when I sincerely utter the sentence, I am under the impression of entertaining a singular thought, and I do have an intuition of singularity.

Reference to fictional characters (e.g., Sherlock Holmes) and mythological beings (e.g., Santa Claus), as well as reference to future individuals (e.g., thinking about the conference we are preparing for the next autumn) are further cases that exhibit weak intuitions of singularity. I am not claiming that all these cases need to receive a uniform treatment. I am only suggesting that, in as much as we consider the pristine data coming from competent speakers' judgments uncontaminated by theoretical considerations (assuming something of that sort is possible to have in the case of the phenomenon of singular thought), these cases do not provide strong, but only weak, intuitions of singularity.

Rethinking the Data

I do not think there is any simple solution to these difficulties concerning the precise identification of the data for theories of singular thought. Given that surface-level data should be gathered before proceeding to theoretical inquiry into the nature of the phenomenon, the prospects look rather grim.⁴ If the data reduce to a very limited range of paradigmatic cases for which the intuitions are solid, it might be that there is no interesting distinction to make between singular and general thought. However, it might be that the problem is simply that we have been trying to fit in the same mold all the cases discussed: cases for which the intuition is strong (paradigmatic examples of singular thought), and cases for which it is weak. I suggest distinguishing the cases that exhibit strong intuitions of singular thought (which usually involve immediate and direct perception of an object, memory of such a perception, communication with direct referential expressions, and maybe other cases as well) from cases for which the intuition that the thought is singular is much weaker (including many of the cases discussed in the previous section). Definitely the thoughts we have about objects we perceive directly provide stronger intuitions of singularity than those concerning the thoughts I might have about the author of the photo I am perceiving, or about my friend's uncle in the above scenario.

It may be replied that the distinction between weak and strong intuitions of singularity is too vague to be methodologically useful at all. Although it is indeed vague, the distinction is useful, as it allows us to think of the data in a novel and different manner. In particular, if we accept this distinction we are no longer compelled to consider as reliable data only those cases that are similar enough to paradigmatic cases of singularity (such as those involving direct perception). If the paradigmatic cases are taken to set the standard for singular thought, to which any case is implicitly compared in order to reach a verdict, then a great range of cases will simply not meet the standard. They will be difficult to judge, as they do not meet the standard of paradigmatic cases of general thought either. However, if we open the possibility of a class of cases that exhibit weak singularity, we can accommodate many of the difficult cases as a *sui generis* kind of data to be treated separately. At least some cases of reference by proxy, some cases of specific use of definite and indefinite descriptions, and some cases of reference to fictional characters or to future individuals exhibit an intuition of singularity, although a weak one. My thought is *about* this forthcoming conference, it is this forthcoming event

⁴Not everybody thinks the data could be identified in a theory-independent way. Jeshion writes: "Considering that we are dealing with such highly abstract and theoretically entrenched notions as singular and descriptive thought, the thought experiment could not possibly test for 'pre-theoretical' intuitions" (2010, p.112). While it is indeed difficult to separate theoretical from pre-theoretical language, it is not impossible to do so. Jeshion does not tell us why the data could not be described in a theory-independent way. In fact, I have indicated above some ways in which this is standardly done.

that I have in mind and not that other; it is *this* character and not *that* one that did so and so, etc.

How to Divide the Explanatory Labor

The distinction between weak and strong intuitions is a first step towards dealing with the problem of the fuzzy data. In this section I take the next step, and argue that the distinction introduced at the level of the data becomes relevant at the level of the theoretical explanation of the data. My suggestion is that the explanation of strong intuitions of singularity need not be the same as that of weak intuitions. Indeed, observe that the cases in which the intuition is strong tend to be cases that involve referential success. On the other hand, cases in which the intuition of singularity is weak tend to be cases that involve reference failure. An RS theory of singular thought — for instance, the variety of an acquaintance theory that turns out to be best suited for the job — readily explains strong intuitions of singularity, as these cases tend to be such that the acquaintance requirement is fulfilled. But the chances of an RS approach to explain weak intuitions are slim, as in such cases no object-involving proposition is entertained.⁵ For this reason, an RF theory of singular thought — for instance, a variety of Jeshion’s mental file theory — looks more promising with respect to these cases. For in all weak cases of singularity the subject does purport to think about an individual identified one way or another (e.g., as the sixteenth person to have touched the photo I am perceiving now).

I am aware that these general claims require more detailed argumentation and analysis of the data than the space of this essay allows for. For that reason, the considerations I advance here should be taken as having a tentative and programmatic character. However, the three kinds of cases I have discussed in the second section suggest that the methodological approach I propose has several merits. Let us revisit them briefly. Cases of “reference” to fictional and mythological entities, to “non-existent objects” (such as Vulcan) and to future individuals are all plausibly treated as involving referential failure. While this is not the only way to treat these cases, it is surely a tenable position. We do not manage to secure reference because there is nothing there to refer to. Therefore, an RS theory of singular thought cannot explain the weak intuition of singularity these cases exhibit. But an RF approach, on which, for instance, singular thought is thought through a mental file, does account for the weak intuition. The subject opens a mental file on the individual she thinks “about,” and uses it in cognition to organize the information she gathers concerning that individual. This explains the intuition of singularity of our thoughts about fictional characters (Jeshion, 2002, pp. 57, 67; 2004, pp. 608–612),

⁵This is true for most acquaintance theories, although not for all RS theories. I ignore here implausibly liberal proposals, such as Kaplan’s semantic instrumentalism, on which it is possible to entertain an object-involving proposition even in cases that exhibit very weak intuitions of singularity.

about future individuals (Jeshion, 2004, pp. 609–612), about non-existent individuals such as Vulcan (Jeshion, 2002, p. 58), or a child’s singular thoughts about her imaginary friends (Jeshion, 2010, p. 136).

The examples discussed involving communication with specific uses of definite or indefinite descriptions, as well as some of the cases of reference by proxy, also exhibit weak intuitions of singularity. Although in these cases there is an individual that the subject purports to think about, arguably, in some of them, she fails to entertain an object-involving proposition. The “representational connection” (Bach, 2010, p. 58) is arguably too distant or indirect for the subject to secure reference to the object. Thus, an acquaintance theorist may argue that I fail to refer in thought to the photographer, or the sixteenth person that touched the photo, because the acquaintance requirement is not fulfilled.⁶ Nevertheless, at least in some of these cases, I have suggested, there is a weak intuition of singularity. A mental file theory of singular thought promises to account for such acquaintanceless *de re* thoughts (Jeshion, 2010, pp. 126–127).

For the sake of clarity, let me emphasize that the dual approach to singular thought I propose disagrees with Jeshion’s proposal (and in general with any RF theory of singular thought) in as much as the latter aims at accounting for *all* intuitions of singularity exclusively in terms of facts about referential fitness (such as initiating mental files and thinking through mental files). While RF approaches do a good job of explaining weak intuitions of singularity, they fail to explain why some intuitions are stronger than others. The approach I propose manages to explain this. It is to be expected that a thought that is referentially fit *and* referentially successful generates a stronger intuition of singularity (as the content is object-involving) than a thought that is referentially fit but not referentially successful. In the latter case the intuition is weakened by the awareness of precisely those facts that account for referential failure: either that the “relational connection” to the object is too indirect or somehow inappropriate, or that there is no object whatsoever to refer to. In cases such as that of the photographer, we realize that the individual is too remotely connected to the subject, and this realization diminishes the strength of the intuition of singularity. In cases of non-existent referents (e.g., Santa Claus), the intuition is weak because we know there is no object the thought could be about, no object we could have in mind, etc.

Notice also that in cases of reference failure the intuition is weak only if we *realize* that there is no object to refer to. Introspectively, when purporting to demonstratively

⁶What conditions must the “representational connection” fulfill for referential success? It is the job of an RS theory to determine this. Similarly, it is part of the job description of an RF theory to tell us what cognitive mechanisms one must have and deploy in order to purport to refer. This way, an RF theory draws the line between weak singular thought and general thought. It may do this by introducing restrictions on the creation of mental files. Jeshion (2010), for instance, argues that an individual must be significant to the subject for the latter to initiate a mental file on that individual.

refer to the (inexistent) person in the corner of the room, I have a strong intuition of singularity as long as I am under the illusion that there is someone there. Similarly, the intuition of singularity of a believer in God is much stronger than the intuition of singularity of a non-believer. Both subjects have a mental file about God but they disagree over the content of their beliefs. Such cases introduce further complications in the account of weak and strong intuitions of singularity. The intuition is not always strong whenever the content is object-involving, and not always weak when the thought fails to refer. Awareness (or belief, whether true or false) of the existence or inexistence of the object the speaker purports to think about increases and, respectively, diminishes the strength of the intuition of singularity. The dual account of singular thought that I am suggesting provides the resources to account for these variations.

A third merit of the proposal I advance (apart from accounting for both weak and strong intuitions, as well as for the difference between them) is its theoretical economy. What makes the approach particularly attractive is that it does not require postulating new facts that are not otherwise theoretically motivated. There are good independent reasons to believe in both facts responsible for referential fitness (e.g., mental files, or individual concepts) and facts responsible for referential success (e.g., acquaintance conditions on referential success). For instance, the motivation for a theory of mental files is not primarily to explain singularity intuitions. Mental files are useful in accounting for our ability to track discourse referents (Recanati, 2012, pp. 172f; Szabó, 2000). And they are equally useful in offering a perspicuous psychological explanation of Frege puzzles, as they allow for a very fine-grained way of individuating singular thoughts (Hawthorne and Manley, 2012, p. 17).

Comparative Remarks

Let me end with a few comparative remarks about the historical antecedents of the present proposal. One classical approach that needs to be mentioned in this sense is Boër and Lycan (1986, pp. 125–134). The authors distinguish six different sorts of aboutness which they present in ascending order, from pure *de dicto* attitude to a strong sense of *de re* attitude. For grade 1 of aboutness (or *de dicto* aboutness) the believer's representation must contain a singular term (of any sort, including definite descriptions or quantifier expressions) that uniquely denotes one individual. For grade 2 of aboutness the requirement is that the expression in question must be rigid. For grade 3 the requirement includes, apart from rigidity, that there must be a causal "contact" between subject and object. Grade 4 requires direct reference. That is, it demands that the term must not pick out the object in virtue of uniquely satisfying a description, but in virtue of the causal chain that links the object to the subject. Grade 5 introduces an "epistemic intimacy requirement" on top of direct reference, which is fulfilled in cases of direct perception and also in cases of possessing (sufficient) descriptive information about the object. Grade 6 of aboutness requires knowledge by acquaintance in Russell's original sense.

This insightful and instructive analysis of the multiple sources of aboutness resembles to a certain extent the position I have developed above. However, Boër and Lycan refrain from concluding that the distinction between singular and general thought is a matter of degree. They write:

Is there, now, a single distinction between attitudes *de dicto* and attitudes *de re*? Or has that distinction shattered into fragments corresponding to our various grades of aboutness? [...] To mark the traditional distinction in a well-motivated way we must look for a natural break in the series of grades of aboutness. And such a break is there — between grades 3 and 4. We saw that despite the causal connection that obtains in a case of type three ... the mechanism of reference in that case involves descriptive material and role filling rather than the causal chain. Moreover, as we saw, a thought of grade 3 does not express a singular proposition ... involving the thought's denotatum as a constituent. (Boër and Lycan, 1986, p. 131, italics in the original)

Although Boër and Lycan admit that referential success is not required for grades of aboutness inferior to grade 4, when it comes to “the traditional distinction” between *de re* and *de dicto*, they draw a strict line between grades 3 and 4. In this respect their approach resembles the one I have proposed. However, Boër and Lycan do not introduce a distinction between weak and strong intuitions of singularity. Arguably, Boër and Lycan’s aboutness of grades 2 and 3 (and arguably some cases of grade 1) generate weak intuitions of singularity, while grade 4 and above (when the proposition entertained is object-involving) generate strong intuitions of singularity. If we interpret Boër and Lycan’s talk of grades of aboutness along these lines, their proposal is a version of the approach I have suggested. A second difference between their account and mine is that they treat all cases of aboutness from the perspective of the content of the thought, while I have emphasized that RF theories of singular thought might not make reference to the content of thoughts at all.

Another approach that bears important resemblances with the one proposed here is developed in Recanati (2012). Recanati draws a distinction between two kinds of singular thoughts: a thought-*vehicle* that is singular and a thought-*content* that is singular. He defends a mental file theory of singular thought, but combines it with an acquaintance requirement, as follows:

Opening a mental file is sufficient to entertain a singular thought only in the sense of thought-*vehicle*. It is not sufficient to entertain a singular thought in the sense of thought-*content*. What are the conditions on successfully thinking singular thought-*contents*? I have argued that singular thoughts are fundamentally non-descriptive: their object is determined relationally, not satisfactorily. (Recanati, 2012, p. 169, italics in the original)

Singular thought-vehicles are thoughts exercised from mental files, and are possible to instantiate even in cases in which an acquaintance relation is not instantiated (Recanati, 2012, pp. 155–158). But in as much as the content is concerned, Recanati (2010, 2012) advocates an acquaintance theory of singular thought: “One may think a singular thought-vehicle even if one does not expect to be acquainted, but

to think a singular thought-content one must at least expect acquaintance and be right in one's expectation" (2012, p. 170).

Recanati's distinction between singular thought-content and singular thought-vehicle resembles the distinction between a thought that is referentially fit and a thought that is referentially successful. However, it is not identical with it. The distinction I have introduced is not one between content vs. presentation of content, as Recanati's is. Instead, it is a distinction between the facts that account for referential fitness vs. the facts that account for referential success. Therefore, Recanati's approach cuts the material offered by the data from intuitions of singularity in a different way than I have done above.

A further difference between Recanati's proposal and the present one concerns the methodological role of the distinction. Recanati does not tell us how the distinction he introduces between the two kinds of singular thoughts relates to the data concerning intuitions of singularity. I have suggested that the distinction between RS and RF theories plays a significant role in accounting for the difference in the strength of intuitions of singularity.

The assumption that the phenomenon of singular thought is a natural kind is almost ubiquitous in the literature. The authors just discussed are among the few exceptions. If this assumption were correct, then an account of singular thought should encompass all instances in which the relevant features are manifest. In this essay I have argued that the thoughts that exhibit the superficial feature of singularity might not form a unitary category. Instead, intuitions of singularity are either strong or weak, to a recognizable degree. Second, I have argued that the two kinds of intuitions are the result of very different deep-level phenomena. My suggestion is that it is wrong to suppose that all intuitions of singularity have the same source, and are to be accounted for by appealing to the same kind of facts. Thus, it is a fruitful theoretical option to allow for both RF and RS theories to be part of the explanation of the phenomenon of singular thought.

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Critical Notices

Book Reviews

Book Notes

Waking, Dreaming, Being: Self and Consciousness in Neuroscience, Meditation, and Philosophy. Evan Thompson. New York: Columbia University Press, 2014, 496 pages, \$32.95 hardcover.

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Consciousness is like no other object of study. In fact, it is no object at all, but rather the precondition for anything to be taken as an object of attention or thought. This unique status makes it very unlikely that ordinary, one-dimensional, objectifying strategies of research may bring much light to the nature and origin of consciousness (at least if these strategies are used in isolation). Consciousness must be approached from within, at least as much as from without, from the midst of lived experience, at least as much as from an objective scientific vantage point. Consciousness must be apprehended from *where it is*, not only from where one hopes to contemplate it. Prioritizing this lived, embodied, approach to consciousness is the program of phenomenology, as Edmund Husserl and his lineage defined it. Articulating the lived domain of phenomenology with the scientific study of objective correlates of mental structures, and buttressing the study of one onto the study of the other, is the extended program of neurophenomenology as developed by Francisco Varela. Some philosophers of mind also advocated such a balanced attitude, by prescribing a triangulated approach to consciousness (Flanagan, 1993) or a “reflective monist” theory of consciousness (Velmans, 2009). But, unlike neurophenomenologists, they did so shyly since they fell short from prescribing an extensive methodology of first-person inquiry, and adopted a kind of non-committal metaphysical standpoint instead.

Evan Thompson makes full use of the neurophenomenological strategy, in his remarkable book *Waking, Dreaming, Being : Self and Consciousness in Neuroscience, Meditation, and Philosophy*, which will soon be considered a landmark and a tipping point in consciousness investigations. He systematically confronts data from cutting-edge neurocognitive science with various sources of knowledge about the corresponding lived experiences; and he carefully extracts from each one of these approaches the most relevant information to make sense of the other one. True, the best possible neurophenomenological methodology would include experimental control on both sides of the first-person/third-person divide, but even though this requirement is not fulfilled in some of the cases studied by Thompson, his intellectual mastery of the subject is such that he offers a convincing compensation for it.

Yet, Thompson’s most admirable achievement is probably not this one. It can rather be found in his thorough exploration of a host of so-called “altered states of consciousness,” from lucid dreaming to near-death experiences. It can also be found in Thompson’s masterly use of texts from the Indo-Tibetan civilizational area, which most valued the methodic culti-

vation of these states and the study of the corresponding experiences. This input from such sources as the *Upanishads* and the *Advaita Vedānta*, as well as *Yogacāra* and *Mādhyaṃika* Buddhism, is rich, accurate, scholarly, and immune from any temptation of syncretism. Thompson's book thus comes close to what I consider an ideal of consciousness studies: opening them to the full range of experiences that may occur in human conscious life (and beyond), taking into account all the data that have been accumulated in various spiritual traditions about such experiences, and yet remaining painstakingly critical about any speculative over-interpretation of these experiences. This book avoids both the Scylla of narrow-minded materialism and the Charybdis of facile esotericism, in a single stroke: the stroke which consists in adopting the phenomenological stance.

The importance of feeding the investigation about consciousness with its altered states pertaining to sleep, psychedelic drugs, or Yoga, is reluctantly accepted by philosophers, perhaps because discourse about these altered states has been hijacked by new-age circles. At any rate, the dominant prejudice in our Western culture is that there is just one reference state of consciousness which should be considered as the standard of validity for any statement, including statements about consciousness itself. This normative state of consciousness usually lacks a name, beyond its tautological characterization as "normal." But an important aspect of it has been captured by Husserl under the appellation of "natural attitude," which he differentiates from the attitude of "phenomenological reduction." The normative "natural" state of consciousness is alert, awake, and directed towards intentional objects (be they perceptive, imaginative, or intellectual). It thereby involves a spontaneous belief in the intrinsic existence of many of these objects, and it is mostly oblivious of the background condition for knowing and characterizing objects, which consists in being aware of their manifest presence and attentive to them. The natural attitude thus contrasts with other states of consciousness which are quite different from it either because they are not alert and awake (such as coma or sleep), or because they avoid any spontaneous ontological commitment towards their objects (such as lucid dreaming or phenomenological reduction). Considering the natural attitude as a standard for valid knowledge has mostly proved a good choice, in view of the technological achievements allowed by objective science. However, this is likely to become a hindrance when the sought knowledge no longer bears directly on objects of designation or manipulation, but reflectively on the preconditions for designating or manipulating, such as consciousness, the lived body, or the technical know-how of laboratory work.

Indeed, let's consider the consequences of taking the natural attitude as an ultimate standard of our research about consciousness. In practice, this means that any advance in the latter research must take the form of a better understanding of a set of relevant objects, be they biological or psychological. However, by doing so, one commits a *petitio principii*, by presupposing from the outset that consciousness is to be treated either as a domain of (psychological) objects or as a property of (biological) objects, and by discarding thereby any truly alternative, non-objectifying, approach of consciousness such as phenomenology (which is at best replaced by "heterophenomenology"). More basically, by adopting the "natural attitude," one automatically moves away from the non-conventional field which is to be studied, namely away from the experiential origin of any intentional directedness towards objects. For any act of aiming towards an object, or towards a situation meant by a proposition of language, brings attention far from the source of the act, and rather projects attention onto the target of the act; a highly detrimental move when the target of the sought knowledge identifies with its source. The exceptional status of the non-object of the study (namely phenomenal consciousness) is then bound to be neglected or forgotten as an automatic consequence of endowing the "normal," objectifying, state of consciousness with the status of an impassable standard. No wonder this sophisticated form of self-contradiction

gives rise to embarrassing foundational difficulties such as the hard problem of the origin of consciousness, or the explanatory gap between the physical and the experiential.

To compensate for this wrong starting point, one may benefit from Merleau-Ponty's (1964) fascinating definition of philosophy. According to Merleau-Ponty, philosophy is "(...)" the set of questions in which the one who questions is himself implicated in the question" (p. 47). The question about the nature of phenomenal consciousness is archetypically philosophical, in this sense. One cannot hope to address this question properly without accepting to be completely entangled into it. One cannot address the issue of consciousness without: (i) permanently realizing that any question about the origin of consciousness originates in a present act of consciousness (Bitbol, 2002, 2008, 2014); and (ii) bringing into play the variety of states of consciousness which one may adopt while addressing this issue.

Let us consider one example of this productive self-referential loop. It is clear that adopting the state of "phenomenological reduction" (and thereby suspending the "natural attitude") helps in moving the boundaries between what counts as *explanans* and what counts as an *explanandum*, when consciousness is at stake. For, in this state, lived experience presents itself as the manifest given, and therefore as a basis for any further explanation. Conversely, objects become what is to be explained, since one must account for the fact that they are considered as stable entities beyond their fleeting appearances presented in experience. In phenomenology, just as in Kant's philosophy, the latter issue is known as the problem of "constituting objectivity." Disclosing how objectivity is elaborated out of finite and transient episodes of phenomenal consciousness is considered by phenomenology as more relevant than asking, reciprocally, how phenomenal consciousness arises from certain objective processes. From this example, it appears that changing one's state of consciousness from the "natural attitude" to "phenomenological reduction" may be sufficient to invert the hierarchical relation between problems and solutions. At least, this inversion is likely to be carried out if the alternative state of consciousness is taken as a new norm, which, until now, has not happened outside the narrow circle of professional phenomenologists.

Other non-standard (or "altered") states of consciousness have had similar effects on the very definition of the problem of consciousness; and they were even more powerful than "phenomenological reduction" in this respect, because they became normative in a broad civilizational area. This is the case of the practice of Yoga, which is associated to highly popular doctrines such as *Advaita Vedānta* or *Kashmir Shaivism*. Going one step further than phenomenology and transcendental idealism, the latter doctrines consider the objectified world as a fabrication, or even an illusion. They start their investigation from a mindful survey of the flux of lived experience, and then describe at length how this experience feeds a (mistaken) twofold belief in (i) the existence of permanent and autonomous objects, and (ii) the identification of the ego to an objectified body or substance (Bansat-Boudon, 2011). It then turns out that each alternative state of consciousness might well have an important lesson to teach about how to tackle the problem of consciousness. Hence the remarkable effect of renewal of ideas and ways of thinking that can be expected from an accurate exploration of these states of consciousness, as it is beautifully undertaken in Thompson's book.

Summary of the Argument

The nucleus of Thompson's argument is likely to be found in a methodological remark, and in the correlative contrast between contemporary Western and traditional Eastern analyses of consciousness. The methodological remark is that the last resort criterion of consciousness used in modern cognitive science is verbal report (p. 98). Inability to elicit a verbal report, be it a retrospective report long after the events, is taken as a mark of the complete absence of consciousness. Relying on this criterion, a sharp divide is established between situations

in which consciousness is present (waking or dreaming) and other situations in which consciousness is missing (deep sleep, coma, or general anaesthesia). Another similar divide is established between conscious and unconscious mental activities, or between intentional and automatic mental processes. However, this dichotomic black-and-white view of consciousness should not be construed as a warranted result of cognitive science. It is rather a basic presupposition of its investigations. Indeed, the search for neural correlates of consciousness in the central nervous system relies on studying the differences between those neural activities which are associated to unconscious, automatic processing, and other neural activities which are associated to conscious, intentional, reportable mental activities. If no such dichotomy between the unconscious and conscious minds were assumed from the outset, no possibility to find the specific “neural signature” of consciousness would be left. But, as Thompson cogently argues (p. 49), this methodological presupposition might well be flawed, because it relies on a confusion between immediate appearance and cognitive accessibility, or between phenomenal consciousness and access consciousness (to borrow Ned Block’s celebrated distinction). How can we be sure that a mental event which is inaccessible to verbal report and/or episodic memory is thereby phenomenally unconscious?

This creeping doubt opens a large avenue of reflection in which many phenomenological findings of the contemplative traditions of the East fit nicely. For, according to these phenomenological findings, there is no mental process which can be said to be entirely unconscious. Instead of a conscious–unconscious divide, the contemplative traditions of the East then propose a more fine-grained subdivision of the *continuum* of consciousness. Already in the *Upanishads*, one finds a distinction between four states of consciousness, with no mention of (or no interest for) absolute unconsciousness. These states are: waking, dreaming, deep sleep, and the “fourth” state (pp. 9, 237). The first surprise, for us, is that deep sleep counts as a state of consciousness; and the second surprise is that there exists an even deeper state, which is just called “fourth” (*turiya*, in Sanskrit) due to lack of an entirely articulate characterization. This latter state can however be construed as “pure awareness,” non-dual, contentless, and unreflective but clear awareness.

When compared to this refined analysis of consciousness, modern cognitive research on consciousness appears to have missed a crucial point. True, it has produced an impressive amount of data about the neural correlates of higher-order functions of consciousness, such as meta-cognitive survey, or synthesis of a manifold of allegedly automatic mental processes; but it has remained mute about several basic situations which may involve subtle (hardly accessible) aspects of consciousness. Instead of the standard conscious–unconscious divide, Thompson writes, what should then be investigated is a threefold hierarchy of “awareness, contents of awareness, and self-experience” (p. xxxii). Here, awareness is the all-pervasive presence (or clarity) that can be modulated by contents, and further reflected in higher-order self-consciousness. A whole, and precious, chapter of the book is devoted to this usually unnoticed fact of pure awareness. Its very apt title is “Being” (p. 67): for pure awareness is just what it feels like to be, before any discrimination is made between various modalities and orientations of being. This chapter mostly relies on a discussion between the author and the Dalai Lama at the 2007 *Mind and Life* conference: a discussion which revolved around the Tibetan concepts of “subtle consciousness” and “clear light.” It also ponders upon one of the most manifest and yet most neglected facts of our lives, namely that consciousness is present even before we think of it (p. 96), and indeed before the concept of its alleged “neural basis” has been elaborated. This primordial fact is precisely the starting point of phenomenology.

From that point on, certain states which are usually considered as unconscious, such as deep sleep, are envisioned under a very different angle. While accepting that they may lack higher-order self-experience, and be very poor of content, the question still arises as to whether they involve some sort of pure awareness. To decide this

difficult issue, neuroelectric recordings are of little help. Only retrospective phenomenological descriptions could bring some light on the question. This sounds contradictory, because pure awareness is supposed to be a non-accessed form of consciousness. But something like hyperesthetic and retrospective access might still be marginally available. It might be present in trained subjects, either yogis or highly sensitive writers (such as Marcel Proust, who is often quoted in the book). Their reports usually bear on the fringe moment of initial awakening, when a flavor of what has been lived during the periods of deep sleep is still present. And, according to them, it turns out that the form of consciousness which subsists during deep sleep is both egoless and objectless (p. 238); it is consciousness for nobody (no individual person) and of nothing (no specific object). Whenever this kind of experience does not remain dumb, reckless, murky, but is rather reflected and later reported by expert yogis, it can give rise to the “fourth” state or “clear light” (p. 265). From the case of deep sleep, one then suspects that the only way to “bridge” neurocognitive and Eastern approaches may well be to promote training in meditative or yogic states (p. 264). Another case which favors the same conclusion is the study of discrete moments of awareness (p. 35). While untrained subjects report a continuous “stream” of consciousness, and are usually unable to discriminate events which are separated by less than 200 milliseconds (thus fitting a typical rhythm of large scale neural phase synchrony), trained subjects confirm a much bolder claim of *Abhidharma* teachings: that one can “discern events as fast as 10–20 milliseconds” (p. 46).

The distinction between awareness and self-experience has momentous consequences when non-standard experiences such as lucid dreaming are touched upon. In ordinary dreams, one is fully aware of the dreamt contents, and fully implicated in the situations they represent (p. 137). But in lucid dreams, while the awareness of their contents is retained, the dreamer distanciates from them and contemplates the show, so to speak, from without, thus realizing that it is “only a dream” (p. 143). Better still, lucid dreamers can go beyond monitoring their dreams; they can *guide* the unfolding of their dreams (p. 173), thereby “downwardly causing” an alteration of their neurobiological processes. A phenomenological description of what it feels like to have a lucid dream can be given in terms of a splitting of the *ego* into two centers of perspective. On the one hand, there is the dream-*ego*, who holds the position of an unselfconscious “hero” of her own movie; and on the other hand there is the dreaming *ego* who has gained the position of a spectator and sometimes of a stage director of the said movie (p. xxxvi). Such splitting sometimes occurs spontaneously, but it can also be trained systematically by practicing “dream Yoga.” However, the aim of this training should not be to replace ordinary dreaming with lucid dreaming altogether, for ordinary dreaming also has some value as an “expression of a kind of selflessness, radical acceptance, and full presence” (p. 199). The training is just meant to open us to additional modes of being, and to offer us additional capacities to transform our waking life together with its biological correlate (p. 173). This possibility to master somehow the contents and unwinding of our dreams yields a balanced conception of their status. According to Thompson, they are not to be considered as mere hallucinations or epiphenomena of a wild working of the brain stem; nor should they be considered as revelations of some other-worldly reality. A proper phenomenological analysis of dreams and hypnagogic states rather shows their kinship with (more or less controlled) imaginative processes (p. 188).

Such strategy, which I fully approve, is a healthy comeback to the firm ground of what appears, after having been stuck in a false opposition between two unwarranted “realisms”: the exclusive realism of material bodies, and the shaky realism of immaterial worlds. Thompson consistently follows his phenomenological middle-way between a neurobiological reductionist construal of lived experiences, and a “transcendent” or “supernatural” interpretation of the same experiences, by applying it to several other modalities of consciousness. In particular, he carefully explores this middle path when he evaluates sensitive issues such as out-of-the-body experiences and near-death experiences.

Thus, after a careful examination of testimonies and experimental work about out-of-body experiences, Thompson concludes that such experiences do not show that our consciousness is, so to speak, separate from the body, let alone that there exists some “astral body” apart from the visible and tangible body (p. 208). However, even though elementary out-of-body experiences can be triggered by many artifacts such as virtual reality headsets, drugs, or brain stimulations, they should not be taken as mere “illusions” (not any more than lucid dreams should). Actually, they disclose the deepest fabric of our lived embodiment. Indeed, embodiment is no simple feature of our experience (p. 206). It is a complex interplay of a feeling of ownership (of our body), a sense of agency (by means of our body), a process of self-location (where our body is situated), and the adoption of an egocentric perspective (here, at this very place). Out-of-body experiences, in which self-location separates from the sense of ownership, reveal this composite structure of embodiment. They show that the usual coincidence of the perception of our body as an object and the self-perception of our body as a subject (p. 210), cannot be taken for granted, but must constantly be re-elaborated. To a certain extent, this remark squares with Indian doctrines according to which our identification with what we call “our” body is a fabrication. However, it should be borne in mind that identification with the body is not fabricated by some immaterial soul-like entity; it is self-fabricated or self-constructed in experience as an aspect of the enactive process by which a unifying dynamic nucleus called the “ego” is elaborated and maintained (p. 362). In the same way as the processual ego is a construction but not an illusion (p. 359), the full sense of embodiment is clearly constructed yet not illusory.

The application of this phenomenological middle path to near-death-experiences is perhaps even more striking. Here again, a fierce debate is taking place as to whether near-death experiences are demonstrations of a real after-life, or just illusions triggered by altered physiology of the dying brain. As Thompson declares, and as I myself argued (Bitbol, 2014), this alternative does not exhaust the issue. Instead, one should pay attention to the self-ascribed meaning of this experience, to the way the dying (and resuscitated) human being is transformed by this experience. Being a transformative moment of life, a moment which has (usually positive) consequences for the worldview and the self-understanding of those who underwent it, near-death experiences can by no means be discarded as mere “illusions.” In fact, as it is widely accepted, no experience can be called an illusion by itself; only its (spontaneous or speculative) overinterpretations are usually illusory.

A Debate Between Mild and Radical Phenomenologists

Despite Thompson’s clear choice in favor of a phenomenological approach of the delicate issue of “altered” states of consciousness, one may feel that he persistently balks at drawing the ultimate consequences of this option. His hesitation is reflected in the table of contents of the book, insofar as the decisive reflection about “being” *qua* pure experience only appears in chapter 3, as if it were only one among many aspects of consciousness. Yet, on a phenomenological scale of priority, this point should be considered first and foremost. The effective primacy of lived experience should be given such prominence that every other aspect, content, achievement, distortion, and physicalist account of consciousness, is made conditional upon it. If “science always moves within the field of what consciousness reveals” (p. xxxv), if there is “no access to consciousness that’s independent of consciousness” (p. 99), this is a compelling reason to start the inquiry from where we are, namely from the midst of a complex, situated, conscious experience. One should above all avoid any initial concession to the “natural attitude” of common sense

or to the spontaneous beliefs of scientists. Instead, the genealogy of objective knowledge should be traced in lived experience (say, by way of Husserl's descriptions of intentional directedness or of noetic and noematic strata of experience), just as much as, conversely, one looks for correlates of elaborate aspects of consciousness in certain objective facts of nature. Such firm decision as to the most appropriate and primeval starting point of the investigation of consciousness would avoid many ambiguities which may arise from a non-critical reading of Thompson's book.

One central ambiguity bears on the status Thompson ascribes to neurobiological findings, and to scientific knowledge in general. From a (radical) phenomenological standpoint, and in agreement with its Kantian background, one must not mistake objectivity for reality. Reality is what is given and manifest, whereas objectivity is what is constituted by extracting structural invariants from the given experience. Along with this phenomenological approach, an objective science is not supposed to disclose reality as it is beyond appearances, but only to circumscribe some intersubjectively recognized features of the appearing reality. Having said that, neuroscientific data should not be granted a higher ontological status than phenomenological descriptions; they should not be given the power to render a compelling verdict about what is real and what is deceptive in our experience. Let's consider, for instance, the sentence according to which "near-death experiences are contingent upon the brain" (p. 309), which echoes the more general sentence that "consciousness, including pure awareness, is contingent on the brain" (p. xxxv). If the latter sentence is meant to avoid reification of consciousness (p. 95), and to deny the dualist view according to which consciousness (or at least subtle aspects of it) is some "thing" independent of spatio-temporally located things, so far, so good. If it is used against the *âtman*-view of *Advaita-Vedânta*, which tends to raise consciousness to the rank of an absolute; and if it is taken, conversely, as supporting the Buddhist *anâtman*-view according to which consciousness is "contingent upon the name-and-form" which we call matter, that's fair enough. The problem however, is that this expression "contingent upon" is asymmetric, and that, in the book, it is always used in the same biased way, namely with consciousness as a grammatical subject, and the brain as a grammatical object. This surreptitiously generates the feeling that neurobiological entities are ascribed a higher (or deeper) status than lived experience itself in the "great chain of being," despite several paragraphs wherein downward causation from mental to neural processes is invoked.

Indeed, notwithstanding the acknowledgement of downward causation, nowhere does one read that, conversely, neurobiological processes are contingent upon the mental conscious processes to which they correlate, let alone that they are contingent upon the phenomenological "constitutive consciousness." This asymmetry, which contrasts with the strict symmetry of the Buddhist concept of dependent origination, could just be a slip of tongue, or an indebtedness to the dominant language of the cognitive sciences. But in the end, it turns out that Thompson comes very close to accepting the physicalist hierarchy. Indeed, he declares that "sentience depends fundamentally on electrochemical processes of excitable living cells while consciousness depends fundamentally on neuro-electrical processes of the brain" (p. 343). As a negative statement, namely as a claim that information processing by cortical neurons can only correlate to the integrative and self-reflective functions of consciousness, but not to the underlying "sentience" or pure awareness, this is perfectly fine. But the positive aspects of the sentence look problematic to me. Firstly, saying that sentience depends on electrochemical processes is overspeculative, because (i) many other physical processes could play the same role (e.g., quantum coherences in neuron's microtubules, or global magnetic fields generated by local electrochemistry, etc.); and (ii) one cannot even figure out how this crucial role

of electrochemistry or other physical processes can be proved or disproved (not any more than one can prove or disprove the opposite statement that sentience arises in sufficiently complex non-living information processing machines). Secondly, and even more disturbingly, the verbal expression “to depend fundamentally” suggests a hierarchical dependence between what is fundamental (objectively characterized electrochemical processes) and what is derivative (subjectively lived sentience). But, again, this lopsided dependence cannot be reconciled with a serious phenomenological approach in which objectivity is never confused with ontology. In a phenomenological context, the remarkable correlation between neurobiological events and certain contents of consciousness must itself be approached phenomenologically. Indeed, if one sticks to the phenomenological stance throughout, it is obvious that this correlation is primary and manifestly given, whereas its possible interpretations in terms of one-directional causality are secondary to the procedure of constitution of a neurobiological region of objectivity. The neuro-phenomenological correlation is then seen and described as an internal feature of the whole of what shows itself, with its combination of directly lived experiences and indirectly objectified structures. It is understood phenomenologically as a joint manifestation of the propriocepted own-body and the exterocepted object-body (*Leib* and *Körper* in Husserl), by due analogy with the concomitance of the felt decision to move an arm and the empirical observation of this move (Merleau-Ponty, 1945). To sum up, from a phenomenological standpoint, the neuro-phenomenological correlation is plainly perceived as an extension of the lived sense of embodiment, not as a sign that some naturalistic one-directional “fundamental dependence” of consciousness on the bodily brain is taking place.

This brings us to a more general remark about the status of the discipline of neurophenomenology. According to a minimal version of it, the role of neurophenomenology is only to contribute to the findings of a hegemonic objective neuroscience, by increasing the intensity of the connections of neuroscientific data with verbal reports of experience, and by taking advantage of the reports for clarifying the function of various objective biological processes. This can be called a naturalistic reading and use of neurophenomenology. Another, mild version of neurophenomenology would consist in adopting a sort of uncommitted, quasi-Spinozistic standpoint, thus placing the phenomenological description and the neurobiological processes on the same footing, and dispassionately establishing “mutual constraints” between them. This is a tacitly neutral monistic view of neurophenomenology. From several sentences of his book (e.g., p. xviii), it looks like Thompson’s approach of neurophenomenology is predominantly “mild,” or “neutral,” with a few undertones of the “minimal,” or “naturalistic” version. But there is also a third construal of neurophenomenology, which one may call a full-fledged phenomenological approach of neurophenomenology, or a “radical” variety of neurophenomenological thinking. I am convinced that Francisco Varela was metaphysically or existentially committed to this latter variety of the discipline he founded, even though he pursued his daily neuroscientific research *as if* he had adopted its mild or minimal reading for all practical purposes. Indeed, according to Varela (1996, p. 334; 1999, p. 187), “lived experience is where we start from and where we all must link back to, like a guiding thread.” It is only from this recognition that first-person and third-person approaches are not two completely different species of knowledge, but rather two modes of orienting within one and the same lived experience, that the motivation to elaborate what Varela called a “methodological remedy” for the hard problem of the physical origin of consciousness arises. Indeed, only at this point does one realize that the very belief according to which a theory or a set of conceptual elements can solve the problem of the origin of phenomenal consciousness is misleading, since this belief is tantamount to overlooking the fact

that even theories or concepts are features of conscious experience. As soon as the latter fact has been paid due attention, the so-called “hardness” of the hard problem boils down to the difficulty of changing our conception of science in order to let it encompass its lived source, beyond its objects and achievements. Unlike the original one, this alternative hardness can easily be softened (i) by serious training to the phenomenological reduction and exploration of experience; (ii) by the completely renewed and broadened conception of science which is likely to be favored in the wake of such training.

Would adoption of this radical view of neurophenomenology have changed something in Thompson’s thorough exploration of uncharted regions of consciousness? It seems to me that this move would indeed have amplified the available range of interpretations of the altered states of consciousness which are documented in the book. Until now, we have listed three such interpretations of altered states of consciousness: two objectivist-realist and one non-committal (mild) phenomenological interpretation. According to the objectivist-realist approaches, these states refer to worldly or other-worldly objective processes. They refer either to an alteration of the brain’s biochemical balance, thus giving rise to hallucinations, or to a backstage supernatural (but “real”) world which discloses itself to (say) dying people. According to the non-committal phenomenological approach, instead, these states are relevant by themselves, as transformative experiences for those who live through them. This latter approach, cogently described by Evan Thompson, and which I have advocated for some time, represents a decisive step beyond the sterile conflict of naturalism and super-naturalism. It shows that despite their superficial disagreement, both positions share the same crucial but disputable strategy: escaping one’s own lived embodied situation and striving towards some (natural or super-natural) transcendent realm of being.

But the clarifying role of phenomenology is not bound to stop at this point. One can take further advantage of a truly radical phenomenological approach, and thereby endow the transformative experiences with additional significance. According to Merleau-Ponty (who partly agreed with Heidegger and Sartre on this point), phenomenology, in its mature state, becomes a new form of ontology: not a straightforward ontology of things facing an observer, however, but an “oblique ontology” of intertwining with what there is (Saint Aubert, 2006); not an ontology of manifest beings, but an ontology of self-manifesting being. As Merleau-Ponty writes, radical phenomenology does not yield a standard “exo-ontology,” but rather an unexplored “endo-ontology” (1964, p. 279). Merleau-Ponty here unambiguously alludes to an ontology expressed from the innermost recesses of the process of being, rather than to an ontology of the external contemplation of beings. This being granted, some altered states of consciousness can be understood neither dismissively as illusions, nor neutrally as enthralling experiences, but positively as revealing a state of being which happens to be hidden by intellectual fabrications and by the impulse of intentional directedness. Let me clarify one point, at this stage, to avoid misunderstandings. Unlike in super-naturalism, there is no question here of reaching some remote domain of transcendent being, but only of self-disclosing an exquisitely proximate mode of being, which is permanently present but usually neglected: perhaps what Tibetan *Dzogchen* practitioners call “the nature of mind,” which, in this non-dualist context, is likely to be simultaneously the (self-experienced) nature of being. Such an about-face concerning the interpretation of altered states of consciousness (in which “altered” becomes “fundamental,” whereas “standard” becomes “overfabricated”), has been advocated, inter alia, by the philosopher and specialist of Indian thought Michel Hulin (1993).

Concluding Remarks: What It is Like to be Awake

A recurring theme in Thompson's book is briefly expressed in the following question: "What if waking experience were a kind of dream?" (p. 164). This disturbing doubt is substantiated by comparing the status of the ego in dreams and in waking states (p. 174): in both cases the ego is dynamically elaborated, and yet mistaken for a "real and solid" entity. But at least, when one dreams, the option of lucid dream is available. The lucid dreamer then becomes aware that she holds the position of the stage director in a puppet show, and that the dream-ego is just a puppet ego. It looks like this additional level of awareness is not available to us in waking life. But is this true? In the Indo-Tibetan cultural area, it is common wisdom that one can awake from the dream of life, just as much as from the dreams made during sleep. This is called *moksa* (liberation), or *nirvāna* (extinction, appeasement). An awakening like this one does not mean promoting the end of life or the end of the dynamically constructed ego, but rather, like in lucid dreaming, being no longer taken in by ego-like and substance-like appearances (p. 366).

Now, there are Western equivalents of this ultimate awakening. In recent times, they have been equated to the phenomenological "epoché" (suspension of judgment) and reduction. Indeed, practicing the phenomenological reduction means coming in such close contact with one's own experience, that one is no longer taken in by object-like appearances, and becomes aware of the acts of consciousness which underpin them. Furthermore, as Sartre (1936/2000) pointed out, the ego-like appearances themselves fall under the phenomenological reduction. But that's not all. Even before phenomenology, philosophers of the post-Kantian tradition advocated an increased lucidity which was tantamount to epistemological liberation. Hegel thus considered that the horizon of history is a step-by-step recognition that what we take as things in themselves are merely in-themselves-for-consciousness. Similarly, Nietzsche (1882/2001) insisted that what our naive knowledge and our metaphysics take as absolutes, are just projections of our ideals. The one who thus recognizes her own projections is called the "free mind" or the "liberated mind" by Nietzsche.

So, why is this sort of lucidity, or accomplished awakening, so unpopular in the West, despite its ability to dissolve at once a host of false enigma such as the hard problem of the objective origin of consciousness? The most convincing answer to this question has probably been given by Descartes (1641/1984, p. 15): we "dread being woken up, and go along with the pleasant illusion as long as (we) can." Even though the illusion of substantiality is not always pleasant, it remains captivating as a lure and incentive for research, until such time as research pursued under this kind of presupposition stumbles against self-produced insoluble enigma or paradoxes.

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Once upon a time, a number of philosophers both influenced by Wittgenstein and interested in religion argued that ontological commitments are at best secondary within religious life. What is instead of primary importance is whether there is anything meaningful in religious practice, that is, in what religious people say and do. As D. Z. Phillips put it,

To ask whether God exists is not to ask a theoretical question. If it is to mean anything at all, it is to wonder about praising and praying; it is to wonder whether there is anything in all that. . . . “There is a God”, though it appears to be in the indicative mood, is an expression of faith. (1976, p. 181)

This stance has the virtue of not condescending to ordinary pious worshippers from a position of assumed intellectual authority (often scientific) with respect to ontological questions that are taken — or mistaken, Phillips argues — by the opponents of religion to be both addressable apart from practices of worship and crucial to religious life. Sadly, that kind of condescension is found, for example, in Richard Dawkins’ *The God Delusion* (2006) and Christopher Hitchens’ *God is Not Great: How Religion Poisons Everything* (2009). Both these writers focus primarily on reference and existence, and they (mis)take materialism for granted as a metaphysical stance that is mandated by modern science. Neither makes a serious effort to imagine what non-idolatrous religious people might mean by what they say and do. Happily, Phillips and other religious thinkers influenced by Wittgenstein have avoided this condescension.

Phillips’ view also resonates with broad Wittgensteinian ideas about the meanings of words as functions of their uses, not only of their senses and referents thought to exist apart from their uses. But it is otherwise not a fully happy stance. Just how is one to go about figuring out whether there is anything at all in praising and praying? Are the words of religious believers as they are used in their prayers and praises simply to be accepted as meaningful without any inquiries into reference? Is it reasonable to regard belief as wholly secondary within religious life and as insulated by its involvement in religious practices from external criticisms? To think of belief in this way at least verges on a form of religious quietism that is complacent in its rituals in virtue of being detached from the sorts of critical reflections about beliefs that are normal both within other practices

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and where divergent practices and their ontological commitments bump up against one another. By this standard, astrology might pass muster as a meaningful enterprise as long as its practitioners are sufficiently sincere and consistent.

In his new book, *Wittgenstein and Natural Religion*, Gordon Graham undertakes to avoid this kind of religious quietism and to do so by developing a more complex and accurate picture of Wittgenstein's views about meaning and their relevance to questions about religious life. According to this richer reading of Wittgenstein, practices and uses matter: Platonist and Fregean conceptions of abstract entities as eternal senses of expressions are rejected, and meanings are instead understood as established by commitments in practice to criteria for the uses of words. These semantic commitments are, however, neither isolated nor self-standing. Instead they are complexly bound up with significant ranges of epistemic and practical commitments, and critical questions both can be raised and will naturally arise about whether any given ensemble of commitments is coherent and stably livable over time. This is a significant theme in Hegel, most prominent in the transition from Chapter V to Chapter VI of the *Phenomenology*, where Hegel argues that epistemic commitments must be understood as figuring essentially within the larger ensembles of shared practical commitments that form a *Sittlichkeit* or form of ethical life. Similarly, Graham argues that we must acknowledge "the interplay between action, emotion, and belief" [p. 10]¹ in forming, living by, and testing any ensemble of commitments. As Hume saw, there are "distinctive roles within religion as it appears in the lives of human beings" for each of "the faculties of intellect, emotion and will" [p. 10]. Hence "philosophical understanding of religion as a human phenomenon" [p. xii] must be neither an abstract, intellectual theology, nor a form of physical-material science that denies the existence of will and commitment, nor a non-critical acceptance of all sincerely passionate ritual. Instead it must investigate "the proper place [— if any —] of religion in well-ordered human lives, on both a personal and a social level" [p. 7]. This will require distinguishing what Graham calls "true religion" (comparable to "true" or "genuine" friendship) or healthy religion, on the one hand, from superstition, idolatry, or otherwise unhealthy religion, on the other, so far as this distinction can be drawn [p. xiii].

But how is this distinction to be drawn? It is, again, not to be taken for granted that any sincere and passionate practices of worship contribute to healthy and well-ordered human life. Contra what Kai Niesen dubbed the "Wittgensteinian fideism" often associated with Phillips, Fergus Kerr, and Peter Winch, among others,

"surface" [or pointlessness] and "depth" [or significant point] cannot be simply read off the things religious believers say. Religious believers say lots of things, and the judgment that some of these are ridiculous, blasphemous, or obsolete requires us to relate them to the point of the activity, and to show how they could be changed or abandoned without loss to what [— if anything —] is essential. [p. 53]

Likewise, then, for establishing that what religious believers say has depth or point: it must be shown that what they say cannot be changed or abandoned without a loss of genuine significance in life. And here it will not do to say that what is essential to religious practice is *simply* the expression of a religious attitude. Instead, expression, attitude, and practice must be critically tested to see whether or not they contribute to healthy and well-ordered human life. (Toward the end of his life, Phillips himself disavowed fideism and held along the lines Graham favors that a genuinely Wittgensteinian conception of the relations among practices, beliefs, and meanings *does* leave room for the rational criticism of religious practices [Phillips, 2005].)

¹All page references to Graham will be placed in brackets.

Graham dubs critical inquiry into the point, if any, of religious practices a philosophy of natural religion, that is, of religion as it lived and practiced in ways that involve complexly entangled beliefs, emotions, and attitudes. Does any such ensemble of commitments have a point in contributing to well-ordered human life? To ask this question is in fact to engage in a kind of critical philosophical anthropology: anthropology insofar as the question is focused on the complex sayings, doings, feelings, and beliefs of human beings, together with their objects; philosophical insofar as the question attempts to characterize these sayings, doings, and so on not simply descriptively or as matters of cultural fact alone, but instead in relation to broad, general, philosophical conceptions of human well-being, health, and interest; and critical insofar as the question is prepared to compare and assess the point in furthering human well-being of a variety of human religious practices, including entertaining the possibility that none of them in the end has a healthy point.

Rightly and importantly, Graham argues that Wittgenstein was both arguing for and practicing an inquiry of this kind, guided significantly by the thought that distinctively philosophical-intellectual practices of inquiry may themselves not have a point. Whether they do is to be assessed by considering to what extent, if any, talk of Platonic forms, sempiternal objects, fixed frameworks of language, inner states of consciousness, rules established absolutely apart from human propensities and projections, and all the other favored objects of the discourses of the philosophers itself makes sense and contributes to healthy human life. Mostly, it turns out, it does not, and we would be better off to engage in critical reflective surveys of uses of words, as well as of larger practices and commitments in relation to human needs and interests, than to try to ground any of them absolutely by reference to something eternal. ("Survival" is a term introduced by G. P. Baker and P. M. S. Hacker in their commentaries on *Philosophical Investigations* roughly to translate Wittgenstein's *übersichtliche Darstellung* or "perspicuous representation" and to give a positive characterization of the reflective activity that the text both practices and urges on us [Baker and Hacker, 1980, p. 531ff].) It is both a considerable advance in Wittgenstein studies and an important point in the philosophy of religion on Graham's part to see Wittgenstein as showing us how to ask similar questions about religious talk and practice rather than as defending what came to be called Wittgensteinian fideism.

In order, however, actually to carry out the critical philosophical anthropological inquiry with respect to religion, there are a number of dangers that must be avoided. First, the inquiry must avoid fideism or religious autonomism; that is, it must reject the thought that religious language and practice are in principle immune to all possible external criticism. Graham both makes the case for avoiding this and successfully avoids it. Second, while rightly broad church in spirit, the inquiry must not be too ecumenical. That is, it must reject the thought that all religions are at bottom the same in functioning essentially as vehicles for the expression of a relatively uncontentful responsiveness to the divine or sense of the sacred. Arguably, John Hick makes this mistake in his interpretation of religious practices. Hick writes: "Seen in historical context these movements of faith — the Judaic-Christian, the Buddhist, the Hindu, the Muslim — are not essentially rivals. . . . The suggestion that we must consider is that these [movements of faith] were all movements of the divine revelation" (1989, p. 136). Since these traditions are in fact at odds with one another both practically and ontologically, to be this broadly ecumenical is to take none of them seriously. Hick responds to this worry by arguing that all major religious traditions involve responsiveness to God conceived of as an ultimate reality or *Dingansich* (along Kantian lines) whose nature we cannot know empirically. Hence there may be more consistency among these traditions than there appears to be at first glance. In order, however, to uphold the possibility of practical consistency across divergent traditions, Hick is forced to hold that "the question . . . whether belief, or disbelief, in incarnation [is] essential for

salvation/liberation. . . . is not soteriologically vital" (1989, pp. 368–369). Since, however, in many traditions it is orthodox that salvation does depend on specific kinds of actions motivated by specific kinds of beliefs, Hick's view threatens to amount to an ecumenicist and in fact non-religious defense of the moral life along Kantian lines. Graham effectively avoids this second danger of excessive ecumenicism by focusing primarily on the question of the worth of specifically Christian practices and commitments. Third, the inquiry must also not be too exclusivist and uncritical. Instead it must subject any religion to genuinely critical investigation in relation to a broad conception of healthy human life to which it may or may not contribute, pending the results of the investigation. It is less clear that Graham avoids this third danger.

The risk of falling into exclusivism is due in significant part to the fact that Graham focuses his critical anthropology only on the ritual of Christian communion. Despite the passage already cited in which he acknowledges that the inquiry must take up "the proper place [— if any —] of religion in well-ordered human lives, on both a *personal and a social level*" [p. 7, emphasis added], Graham pays no significant attention to the daily personal lives of practitioners of Christianity outside their participation in worship, to the forms of social life that are distinctive of Christians, or to non-Christian religion. In one way, Graham's concentration on the Christian order of worship is salutary: it allows him to develop a rich account of just what its practitioners might be doing in using its specific words. But it also has the disadvantage of drawing attention away from the issue of what a personal and social religious life outside the worship service might look like. No doubt there are no strict entailments from participation in the Christian order of worship to a particular way of life, personal or social, just as there are no strict entailments from professions of faith to personal and social daily life in other religions. There are, after all, both fundamentalists and liberals of many religious stripes. But if the issue is — as Graham takes it to be and as it should be — the role of religion (if any) in a healthy human life, then failing to consider and assess overall shapes of religious life, personal and social, is a large omission. One wants to know more here than Graham provides about whether and how participation in Christian worship might contribute to justice, decency, tolerance, and human flourishing in daily life, individual and joint. Traditionally within Christianity, participation in worship (as well as prayer) and working appropriately for justice (helping to prepare for the kingdom of God) are thought to reinforce each other. Thus it is at least an important empirical question whether this is true. It is to the credit of Dawkins and Hitchens that they do take up this issue in detail with respect to a variety of religions, even if one might wish for less heavy-handedness in their accounts. For example Hitchens argues that Martin Luther King was a good person whose activism improved countless human lives, but who also was not a Christian, given that he rejected the idea of a merciless and vengeful God (Hitchens, 2009, pp. 173–176). Here Hitchens shows less awareness of and respect for centuries of development of Christian thought and practice than he ought.

Graham's effort to fill in the required critical philosophical anthropology (or, in his terms, a philosophy of natural religion: that is, an account of religion's point and significance) of specifically Christian religious practices of worship comes in three steps. First there is the fact that many human beings, perhaps even the majority, possess "a sense of the sacred" [p. 113]. This is best understood not as a form of sense perception, but rather as a form of sensibility or a broad "feel" for what is to be done in certain circumstances, comparable to having a musical ear or a sense of hospitality. Such "a sense of the sacred can be perverted and distorted in ways that give rise to superstition and idolatry," Graham acknowledges, and some people may simply lack it, just as some people lack a musical ear [p. 113]. Nonetheless, there is, Graham argues, some "reason to regard those who lack [it]

as people whose lives are seriously impoverished" [p. 113]. Rather, having a sense of the sacred that is expressed legitimately, non-superstitiously, and non-idolatrously is at least a significant dimension of human flourishing.

Second, a sense of the sacred can be fitly expressed in worship as a form of ritual. Drawing on Giambattista Vico and Roger Scruton, Graham suggests that religious rituals arise as responses to the awe-inspiring presences in human lives of birth, sex, and death [pp. 180–181]. Participation in worship is "practical, but also purposeless" [p. 162]; that is, worshippers do things, but do not act instrumentally in order to achieve an end. (While one might accept Graham's rejection of intercessory prayer directed at worldly ends, one might also wonder whether prayer to receive and act according to grace or prayer for the kingdom of God to come quite fit this characterization.) That is, participants express their sensibility for the sacred; they "mark or shape time" through activities with plotted beginnings, middles, and ends that enable "acknowledgement of the infinity within which human finitude is set" [p. 165]. More specifically, the rite of Christian communion stands to spiritual identities and to the participants in the rite as a theater script stands to characters and to actors [p. 168]; by participating in the rite, agents take on a spiritual identity that they would not otherwise have, and they do so corporately, as a united body, not as merely cooperating individuals. "Christian communion . . . is thus to be seen as a ritual in which the faithful corporately enact the cosmic drama of the world's salvation" [pp. 168–169]. This ritual, however, is not merely expressive. "At its heart lies symbolic meaning rather than practical purpose or emotional expression," where the use of symbol involves "grapp[ling] with the edges of existence" [p. 178].

Third and most crucially, none of this is best understood merely psychologically as a function *only* of merely human needs and interests. Graham endorses the arguments of Alvin Plantinga and John Earman that propose that laws of nature are genuine, necessary, and govern the course of nature only on the condition that they are made by a divine will. "The will of a Supreme Being is a necessary pre-condition of the law-governed world disclosed by science" [p. 190]. And likewise for the sense of being governed non-idolatrously by the laws of (Christian) religious ritual. "A sense of the sacred, even if properly called 'natural' to human beings, must be God given and God guided" [p. 190].

Given these three crucial points — that (many) human beings possess a sense of the sacred; that this sense is (best) expressible non-idolatrously in Christian rituals of worship, especially in the rite of communion; and that the intelligibility of this ritual requires that it have been ordained to us by God — Graham's case is complete. As Graham puts it, citing Aquinas, the laws of the Christian worship service that specify its ritual acts (together, as well, with "revelation in Christ . . . and the legal and moral codes that societies promulgate") "enable human beings . . . to 'participate' in the eternal law of God . . . and to do so in an 'intellectual and rational manner,' in contrast to the way that 'irrational animals partake of the eternal reason'" [pp. 194–195]. The rituals of Christian worship stand as reasonably formed, self-conscious, and centrally apt forms of distinctively human responsiveness to God's ordonnance.

How persuasive is this argument? It is not intended as a proof or demonstration from premises that any reasonable person should accept, but rather as a reading of religious practices carried out from the point of view of someone passionately interested in what some of them might mean, that is, someone who is attempting to work through wonder and puzzlement at religious life in the hope of finding sense in it. Is this effort at working through wonder and puzzlement compelling?

It is not clear that it is. The third step, drawing on Plantinga and Earman, is distressingly theological, given Graham's effort to avoid "the distractions of metaphysical theology" [p. 201]. It involves conceiving of laws of physical nature as necessary and as

governing events in senses that can and must be explicated by whatever best account we can construct and specifically by the account according to which God made them. But why should we accept this account of laws of nature? Perhaps we ought to regard them as in some sense necessary, but why should we accept the thought that we are able to explicate the nature of this necessity? Why not say instead, as Newton said about the metaphysical nature and source of the law of gravitational attraction, “hypotheses non fingo”? Necessity may attach to this law, but we are not in a position to grasp and explain its nature. On this conception, laws of nature are descriptive of a necessity whose nature we cannot grasp; pointedly they are not, or not necessarily, laws that are legislated by a divine will. With this weaker conception of the nature of laws of nature than that favored by Plantinga and Earman, the third step collapses, and Graham is unable to establish that God is the creator of human beings, together with their needs and interests, and their fittest modes of response to those needs and interests in religious rituals that He has ordained. And without the undergirding theology provided by this questionable third step, Graham’s effort to establish the distinctive point and intelligibility of (Christian) religious worship comes dangerously close to collapsing back into the kind of fideism that he is rightly concerned to avoid.

Second and more broadly, Graham’s reading of human life arguably establishes persuasively that a sensibility for the infinite and involvement as a member in corporate, not merely cooperative, activity are things that enrich a human life. Absent the metaphysical theology, however, what makes the Christian rite of communion an especially central and apt mode of expressing that sensibility and engaging in corporate activity? For example, why cannot a passionate sensibility for the infinite be expressed in the corporate activities of a musical, literary, scientific, or political life? Wonder at shared finite human existence within a larger infinite order is certainly discernible in some reaches of these activities, as well as, of course, within quite disparate religious traditions. If these are all ways of expressing this sensibility equally aptly, then the argument lapses into a non-critical ecumenicism; if they are supposed not to be equally apt, and only the Christian rites are fully exemplary for this expression, then the metaphysical theology — specifically the theology according to which God ordained the specific laws of the rite of Christian communion through the teachings of His only begotten Son — is necessary in order to uphold this supposition and avoid an arbitrary exclusivism, and it is not clear that that theology can stand.

Finally, one wants, as already noted, to know much more than Graham provides about connections between participation in Christian worship and healthy individual and social daily life (familial, moral, political, economic, cognitive, and so on), beyond simply having a sensibility for the sacred. Graham might hope to evade this issue by arguing that participation in Christian worship and in other forms of non-idolatrous worship is per se an enrichment of human life comparable, again, to having a musical ear or sensibility. No matter whether a given individual life is virtuous or vicious, it will nonetheless be richer if it includes participation in some non-idolatrous form of worship than an otherwise identical life that does not. This reply, however, loosens the connection between participation in worship, on the one hand, and the activities of daily life, on the other, that is central to many religious traditions, including Christianity. In these traditions, participation in worship is typically taken to provide both understanding and motivation for transformed action in daily life. Hence two questions remain open: which specific forms of worship are non-idolatrous, and is a life that includes participation in them in fact made better overall by that participation? The possibility that participation in worship, even if per se enriching, might also motivate evil, complacency, arrogance, insensitivity or other forms of viciousness in daily life must be faced head on and defeated, if the overall value of religious ritual is to be defended. One might make a similar point about the overall value

in life of having a musical ear. It takes time, money, work, and contexts of interaction in order to develop a musical sensibility within a particular musical tradition, and it could turn out that participation in such a tradition distorts the lives of its members overall. Prima facie, having a musical life may seem more abstract and innocent than having a religious life, in that unlike religion it does not urge specific moral, economic, or political practices on its participants, but there is still an empirical question about the shape and value of a developed, specific, individual musical life as a species of overall human life.

It is, however, unclear where these objections to Graham's argument leave the question of the truth of Christian religion. Graham's effort to uphold Christianity's distinctive intelligibility and point is passionate, deeply informed, and argumentative. This effort bears comparison with the greatest argumentative effort to establish via metaphysico-interpretive means the distinctive truth of Christianity: Hegel's — in his *Lectures on the Philosophy of Religion*. Hence the thought that the case is nonetheless not settled by metaphysico-interpretive means might be regarded as Kierkegaardian, where Kierkegaard, and pointedly not Hegel, was a figure of major importance to Wittgenstein.

If the argument fails, even when taken as a reading of Christian religious practices rather than as a proof, that does not mean that its conclusion is false. Nor does it mean that Christian practices of worship are without some important point and value that might also be realized within other practices. Going further, however, to accept the truth of Christianity and the distinctive value of its ensemble of beliefs and practices may require not only argument in a broad, interpretive sense, but also the workings of grace. As Alan Donagan once observed, "From a contemporary naturalist point of view much of what we all reasonably believe about ourselves [e.g., that we have freedom of the will, a sensibility for the infinite, and possibilities of meaningful corporate activity] is unexplained, and the misery of the condition in which serious inquirers take themselves to be would have no remedy. In this situation, faith may seem to inquirers possible, and not irrational. And then, by some means they do not understand but which the church teaches is the operation of grace, it may become actual" (1999, p. 32). Or it may not: grace, if it exists, has its mysteries when seen from the standpoint of the intellect. Perhaps this is why Wittgenstein, lacking grace, was not able himself to embrace Judeo-Christian religion. In the words of Paul: "For Jews demand signs and Greeks desire wisdom, but we proclaim Christ crucified, a stumbling block to Jews and foolishness to Gentiles, but to those who are called, both Jews and Greeks, Christ the power of God and the wisdom of God" (Coogan et al., 2010, p. 1996; 1 Corinthians I: 22–24).

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