Consciousness and Cognition **9,** 584–590 (2000)
doi:10.1006/ccog.2000.0487, available online at http://www.idealibrary.com on IDEAL®

# Substantive Thoughts about Substantive Thoughts: A Reply to Galin

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In his commentary, David Galin raises several important issues that deserve to be addressed. In this response, I do three things. First, I briefly discuss the relation between the present work and the metaphoric theories of thought developed by cognitive linguists such as Lakoff and Johnson (1998). Second, I address some of the confusions that seem to have arisen about my use of the terms ''substantive thought'' and ''nucleus.'' Third, I briefly discuss some of the directions that Galin suggests for further research.


## *Relation to Cognitive Linguistics*

Galin notes that my hypotheses bears a strong resemblance to some of the theories propounded by cognitive linguists. In particular, Lakoff and Johnson (1998) have argued that abstract thought is understood by metaphoric reference to the physical world. For example, one understands the idea of ''grasping an idea'' by analogizing it to one's real-world experience of reaching for a physical object. In my article, I propose a similar analogy: moving from one thought to another is similar to moving from one place to another in the real world. Galin refers to the general thesis that abstract thought is based on physical thought as the ''perceptual-motor basis of abstract thought'' hypothesis.

It is important to distinguish between two different possible forms of this hypothesis. In the weaker form, the claim is simply that we conceptualize abstract entities and processes by analogizing them to physical entities and processes that have similar formal properties. For example, we analogize the process of ''moving'' from one thought to another to the physical act of ''moving'' from one place to another because the two processes resemble each other. In this form of the thesis, ''internal navigation'' is simply a metaphor. In the stronger form of the thesis, the abstract process and the physical process have the same phenomenological feel because they use the same cortical machinery. For example, ''internal navigation'' feels like ''external navigation'' in part because they both involve similar computations in the hippocampus. In my article, I have made the stronger claim for internal navigation and suggested that it may also be true for the operation of ''grasping'' for a thought (although here the evidence is less conclusive). In contrast, my reading of Lakoff and Johnson is that they generally argue only for the weaker claim. It would be interesting to see

Reply to Commentary on Russell Epstein (2000). The neural-cognitive basis of the Jamesian stream of thought. *Consciousness and Cognition* **9**(4), 550–575.



1053-8100/00 $35.00

how far the strong claim can be extended. Importantly, this is a hypothesis that can be easily tested by cognitive neuroscientific methods: for example, by using fMRI to scan people during the performance of analogous abstract and physical tasks.

*''Nucleus'' vs ''Substantive Thoughts''*

Galin suggests that we should not get too bogged down in hermeneutical discussions of ''just what [James] said, and just what he meant by it.'' Certainly, he is correct when he points out that James is sometimes confusing and not always consistent. The (in-)famous transition ''so much for the transitive states . . .'' (James, p. 249) is merely the most egregious example of this. However, anyone who tries to build a theory of consciousness around James's phenomenology and using James's terms needs to be clear about the definition of those terms. Thus, some discussion of James's vocabulary is inevitable. Galin points out several places where my arguments get ''muddled'' in James's ''metaphor stew.'' I believe that at least some of the confusion can be eliminated by more carefully distinguishing between two of the terms that I did not differentiate in my article: ''substantive thoughts'' and ''nucleus.'' In treating these terms as synonyms, I followed a general trend in the literature to conflate the two (Mangan, 1993, 1999; Galin, 1994). However, as Galin notes in his commentary (and as I noted in footnote 1 of the article) this is not entirely a correct reading of James. Here I explicate what I believe to be the difference between these two terms and show how this difference plays out in my theory.

In the two places that James uses the term ''nucleus'' (pp. 275 and 281), he makes it clear that he is referring only to a small number of generally imagistic features that compose the ''kernel'' of a more extensive mental experience. James sometimes refers to this kernel as the ''image.'' Although these ''sensorial imaginings'' dominate our awareness during each substantive thought, they do not comprise the whole of it. As James writes: ''With [the image] goes a sense of its relations, near and remote, the dying echo of whence it came to us, the dawning sense of whither it is to lead'' (p. 255). Not only does the fringe ''surround'' and ''escort'' the image, it is actually (as Galin notes) an integral part of the substantive thought, such that it is ''fused into one'' with the image and becomes ''bone of its bone and flesh of its flesh'' (all p. 255). James was quite clear on this point, going so far as to criticize Spencer for supposing that ''it is only in transitive states that outward relations are known; whereas in truth space-relations, relations of contrast, etc., are felt along with their terms, in substantive states as well as in transitive states'' (pp. 248–249).

Under this more careful reading of James, each substantive thought includes *both* a nucleus of (mostly perceptual; but see below) feature information *and* a fringe of felt relations. Once we understand this distinction between the nucleus and the substantive thought, certain parts of James that are otherwise confusing become much more clear. For example, consider again James' description of how ''topics'' get reified into ''conclusions'':

> In all our voluntary thinking there is some topic or subject about which all the members of the thought revolve. Half the time this topic is a problem, a gap we cannot yet fill with a definite picture, word, or phrase, but which . . . influences us in an intensely active and determinate psychic way. Whatever may be the images and phrases that pass before us, we feel their

> relation to this aching gap. To fill it up in our thought's destiny. Some bring us nearer to that consummation. Some the gap negates as quite irrelevant. (James, p. 259)

This description implies that our efforts to translate the unconscious topic into a conscious conclusion involves a process of sampling and rejecting a number of ''images or phrases'' before hitting on the right one.[1] Insofar as these ''test'' images are perceptual images, they have the same phenomenological quality as the ''nuclei'' of the substantive thoughts. However, these images are experienced only very briefly. If they have a fringe at all, it is little more than a feeling of ''that's not right.'' In contrast, the conclusion of the stream of thought ''arrests'' our interest and ''induces attention upon [itself] and makes us treat it in a substantive way'' (p. 260). Although both the final conclusion and the images that serve as stepping stones to it are imagistic representations, the conclusion is far more substantial because it reifies the topic and expresses a complete thought.[2] When we reach it, we have ''said what we intended to say'' (at least, to ourselves). As Galin notes, it is difficult to explain this process using the metaphor of the bird's flight—especially if one tries to equate both the intermediate nuclei and the final conclusion with the ''perchings'' of the bird.

How does this nucleus/substantive thought distinction impact the model I proposed? In my article, I hypothesized that the nucleus/substantive thoughts (which I did not clearly distinguish) were formed by binding between different cortical regions, possibly mediated by synchronous neural firing at 40 Hz. Galin points out a number of problems with the hypothesis that 40-Hz binding mediates the nucleus per se, including the fact that this would not account for the binding of the nucleus with nonconscious representations that occur with it and the fact that it would not explain how the fringe gets bound together (or gets bound to the nucleus). A further problem that he does not mention is the fact that such an account would be hard to reconcile with neurophysiological results that indicate that neurons in widely separate cortical regions, including both visual *and* motor areas, will fire in synchrony during the performance of a behavioral task (Roelfsema et al., 1997). If the 40-Hz binding process only bound the nucleus together, then we would expect that only neurons relevant to the particular nucleus would fire in synchrony at any one time—for example, only visual neurons if the nucleus was a visual image. A more feasible hypothesis is that 40-Hz oscillations bind together *all* the representations that make up the substantive thought, including both the perceptual representations that make up the nu-

[1] This scenario, in which number of imagistic representations are sampled and rejected before the right one is found, bears a strong resemblance to Baars's (1988) ''momentary access hypothesis,'' in which a number of representations can appear ''fleetingly'' in the global workspace without fully occupying it.

[2] James's use of the term ''conclusion'' is actually somewhat confusing and perhaps inconsistent. He describes the ''conclusions'' of the stream of thought as usually being ''a word or phrase or particular image, or practical attitude or resolve''—in other words, an imagistic representation—and notes that ''When we have uttered a proposition, we are rarely able a moment afterwards to recall our exact words, though we can express it in different words easily enough.'' However, he also describes these ''conclusions'' as being the ''meaning'' of the thought and ''that . . . what abides when all its other members have faded from memory.'' It appears that James is (inconsistently) using the term ''conclusion'' to refer *both* to (1) a particular thought and (2) the imagistic representation that expresses that thought. The *thought* is what gets encoded in memory, not the image or phrase that represents it.

cleus *and* the conceptual, orientational, and evaluative representations that make up the fringe. As I noted in my article, this equation of the substantive thoughts with a temporary synchrony of activity between different regions of the brain provides a route by which we might possibly explain (or begin to explain) several phenomenological features of these thoughts in neuroscientific terms, including their relative stability, memorability, the fact that they can potentially involve many different kinds of imagistic content (i.e., visual and verbal), the fact that they occur sequentially, and the fact that only a small number of imagistic features (i.e., the nucleus) can be conscious in each one.

The critical binding operation underlying substantive thoughts appears to be the linking together of perceptual representations with the frontal-hippocampal memory system. The former provides the imagistic nucleus, while the latter provides the fringe that guides the stream of thought. There is some behavioral evidence that suggests that (for the visual system, at least) only one such link can be active any one time. For example, in visual search experiments, Wolfe and colleagues (Wolfe et al., 2000; Horowitz & Wolfe, 1998) have demonstrated that one does not search over previously attended objects any faster than one searches over newly appearing objects. From this result, they argue that only one link between perceptual representations and long-term memory (LTM) can be active at any one time. Under this hypothesis, recognition of an object involves the establishment of a temporary connection with LTM that disappears when one moves onto another object. As Wolfe et al. note, the striking inability of subject to notice changes in the unattended part of the scene during change blindness experiments (Rensink et al., 1997; Simons & Levin, 1997) might be one consequence of this inability to simultaneously maintain more than one perceptual–LTM link. Interestingly, Henderson and Hollingworth (1999) found that subjects in a change blindness experiment tended to notice scene changes made during saccades only when the saccades were to or from the changed object *or when the subject subsequently refixated the changed object.* The latter results suggest that visual information about the earlier appearance of the changed object was stored in memory, but could only be reaccessed when the object was fixated again and another perceptual–memory link formed. This one-at-a-time feature of the perceptual–memory link is exactly what we would expect if each link is equivalent to a substantive thought.

Of course, this version of the ‘‘40 Hz’’ hypothesis does not say anything about the neural basis of the nucleus per se. Galin has argued in earlier work that the nucleus consists of the small number of features that maximally discriminate the currently focal object, event, or idea from the background within the context of our current goals. In this formulation, the nucleus can consist of either perceptual or conceptual features. For example, Galin (1994) suggests that when we attend to a car, either its color or its cost can form the nucleus. I find certain difficulties with this formulation. In particular, it is not obvious to me what it means to experience the ‘‘cost’’ of the car in the nucleus. My own impression is that when we look at a red sports car and think about how expensive it is, we tend to express the idea imagistically in the nucleus as a verbal representation (‘‘Damn! That’s expensive!’’) or an appropriate visual image (perhaps an image of a sneering rich fellow who could afford such an ostentatious vehicle). Alternatively, we might experience the visual appearance of the sports car in the nucleus accompanied by a vague emotion that conveys its value

in the fringe. In this view, the nucleus is restricted to certain kinds of mostly imagistic representations. This view is consistent with Jackendoff's (1987) intermediate level theory of consciousness, which postulates that the contents of consciousness consist of a restricted set of modality-specific representations (see also Prinz, 2000). For example, in language perception, we are most aware of phonological representations, but are not directly aware of syntactic or conceptual representations, while in visual awareness, we experience surfaces rather than ''low-level'' representations encoded by the retina (which would distinguish between input from the two different eyes) or ''high-level'' 3D object models. It is unclear why these particular representations are conscious while other representations (such as syntax or concepts) are not. Understanding why this is the case may be critical to understanding the neural basis of consciousness.

The distinction between the nucleus and substantive thoughts has one further important consequence: It allows us to understand how the background mental representations that I discussed could be both imagistic but not the nucleus of a particular substantive thought. Insofar as these representations have perceptual quality, they are of the ''nucleus-type.'' However, the use of the term nucleus to refer to these representations would be misleading because they are not the nucleus of anything—they are not links of the ''chain'' of thought. In this way, they are similar to the ''stepping-stone'' representations discussed above. I believe that these ''fleeting'' or ''background'' representations are a neglected aspect of the phenomenology of consciousness and that they tell us something very important: Despite claims to the contrary, consciousness is not really unified. We tend to think it is because we can only think one substantive thought at a time. But the substantive thoughts are not the only part of conscious experience—''background,'' ''fleeting,'' and ''transitive'' mental contents also exist.

### *Future Directions*

Galin suggests two promising directions for future research. First, he notes that I have emphasized hippocampal and neocortical structures but have not said much about other brain regions. In particular, he suggests that the basal ganglia and cerebellum might play a role in controlling the stream of thought. This is certainly an important suggestion. In addition, another important subcortical brain structure that I did not discuss in my article is the thalamus, which a number of researchers have suggested plays a key role in consciousness. Integration of the thalamus into the present theory may help us to understand how the nucleus is formed. However, I do not at present have any hypotheses to offer about how this might be done.

The other issue that Galin suggests for further investigation is the issue of cerebral duality. I tend to be sceptical of dual-brain theories, which have a long and sometimes checkered history (Harrington, 1987). However, there is one function of the brain that is undeniably lateralized: Language is almost always supported by the left hemisphere. In this context, it is interesting to note that Chafe (1994) has proposed that there is a close relationship between the rhythm of spoken language and the pulsate nature of the stream of thought. In particular, he argues that spoken language can be parsed into ''intonation units,'' which are generally four- to five-word phrases that

convey a single substantive thought. There is some evidence that language has evolved quite recently (Donald, 1991), and neuroimaging and neuropsychological evidence indicates that many brain regions are involved in linguistic processing. Together, these results suggest that language is a composite function that developed from a number of simpler, previously nonlinguistic, functions. It may be that the temporal features of language evolved specifically to interface with and control a preexisting pulsate rhythm of thought (in both ourselves and others). Although we experience both inner speech and visual images, we tend to more readily associate linguistic representations with ''thought'' (i.e., we ''think in words'')—perhaps because linguistic representations more readily mesh with the ''bird's life'' than do visual representations. If this is the case, then the left hemisphere might play a much more important role in controlling the stream of thought than the right hemisphere because of the linguistic processors within that hemisphere. Note that this does not mean that the right hemisphere ''isn't conscious''—only that the left hemisphere is usually the one that decides what we're going to think about. Indeed, some of the ''background'' mental representations that I discussed may be examples of consciously experienced nonlinguistic right-hemisphere representations that are not entirely integrated with the linguistically driven left-hemisphere stream of thought (see also Galin, 1974).

*Conclusion*

David Galin has pointed out an important connection between my hypotheses and the work of cognitive linguists and has outlined important avenues for future research. In addition, he has highlighted the importance of the distinction between the terms ''nucleus'' and ''substantive thought.'' Once these terms are properly distinguished, a number of potentially confusing aspects of my argument become clear. I thank Dr. Galin for his thoughtful commentary on my article.

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