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continued inside back cover

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CONTENTS

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Deep Naturalism: Patterns in Art and Mind

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This paper addresses the philosophical problem of how a physical conceptualization of mind can account for the "metaphysical" experience of being moved by a work of art. Drawing on theories in psychology about the role that patterns play in human cognition and various other insights from the mind sciences, it is argued here that it is possible to account for some features of our aesthetic experience with some types of visual art, such as Jackson Pollock's famous drip paintings, by appealing to our evolved pattern recognition capabilities. A speculative hypothesis is offered for why we are so adept at recognizing and creating natural patterns: we embody some of the very patterns that are ubiquitous in the natural world in which we evolved. The conclusion is reached that the interaction that occurs between our embodied patterns and the obscure patterns in Pollock's drip paintings is unavailable to our conscious mind though it affects us on a deeper level and thus takes on the subjective feel of being, in a sense, metaphysical.

Keywords: patterns, pattern recognition, aesthetic experience, Jackson Pollock

> *. . . considerith the simple forms or differences of things, which are few in number, and the degrees and co-ordinations whereof make all this variety.*
>
> Francis Bacon, 1605
> *The Advancement of Learning*

> *. . . aesthetic theories will only become intelligible and profound once based on the workings of the brain, and [. . .] no theory of aesthetics which does not have strong biological foundations is likely to be complete, let alone profound.*
>
> Semir Zeki, 1999
> *Inner Vision*

Recent contributions to our understanding of aesthetic experience at the neurobiological level, which constitutes one focus in the field of neuroaesthetics,

I am grateful to Raymond Russ, Editor, for his meticulous editing and patient guidance on earlier drafts of this paper. Thanks also to Judy Walker for reading the first draft of this paper and offering constructive criticism, especially on my usage of "metaphysical." Correspondence concerning this article should be addressed to Liz Swan, Ph.D., Philosophy Department, 223 Preston Hall, Mercyhurst University, 501 East 38th Street, Erie, Pennsylvania 16546. Email lswan@mercyhurst.edu

come from Zeki (Zeki, 1999, 2002; Zeki and Bartels, 2004; Zeki and Kawabata, 2004), Freedberg and Gallese (2007), and Taylor (Taylor, 2002, 2006; Taylor, Spehar, van Donkelaar, and Hagerhall, 2011; Taylor et al., 2005). Zeki (1999) has argued that vision is an active process, and that artists intentionally affect the visual process of observers. Freedberg and Gallese suggest that one element of aesthetic experience is the observer's empathic response, via neural mirroring, to the "trace" left behind by the artist's gestures in the creation of the work of art.[1] Taylor has done extensive research on the physiological responses observers have to the well-known drip paintings of Jackson Pollock, and has determined that obscure fractal patterns in the paintings mimic those found in nature which people find aesthetically pleasing. In this paper, I synthesize the findings from these researchers and others to suggest a new hypothesis about aesthetic experience, and human nature more generally: the reason we tend to find certain patterns aesthetically pleasing is because they resonate with the natural patterns embodied in us.

Before going deeper into my account of aesthetic experience, let me explicate the conceptualization of mind that is assumed in this paper. There is no such thing as "a mind" per se; rather, the term "mind" acts as a conceptual placeholder for a host of abilities that we and some other animals are able to do with our brains and bodies working in concert, such as: communicate, show affection, imagine, satisfy our needs, learn, feel and sense, remember, hold beliefs, and plan. All living organisms have a host of abilities uniquely attuned to their particular environments, which in some cases, such as the human case, are inclined to conceptualize as "having a mind." Mindedness is a biological phenomenon, thoroughly dependent upon a central nervous system in complex organisms such as humans and other primates, and a more diffuse kind of nervous system in less complex organisms. This simple observation implies that mindedness exists in degrees in the biological world, which entails that it certainly is not unique to humans, and that our particular kind of mindedness is just the most recent design in nature — its having existed in various forms long before hominins evolved. Given that the mind is a biological construct, it stands to reason that metaphysical, sympathetic, and empathetic responses are grounded in patterns that we recognize, consciously or subconsciously, and that we use repeatedly as reference points as we observe, analyze, and synthesize information at different cognitive levels.

The theme of the present paper is that an understanding of our mind's evolved pattern recognition capabilities can illuminate certain aspects of aesthetic

[1]Eliciting empathetic responses can be a thoughtfully intentional process. Aristotle pointed out in his *Poetics* that in drama, "(t)he imitation is not just of a complete action, but also of events that evoke fear and pity." In other words, the observer of the play felt empathy for and association with the actors in the drama (see *Poetics*, book 6, *Plot: Species and Components*. Chapter I, *Astonishment*).

experience. Michael Wheeler (1996) poses the provocative problem of how a fully scientific and wholly physical account of mind and human understanding could ever explain the aesthetic and even metaphysical experience one has while staring at a Mark Rothko mural. Appreciating a work of art can be considered "a humbling or spiritual experience" (to use Wheeler's terminology), an experience that traditional cognitive science, "restricted as it is to the subject–object dichotomy, and the language of representation and computation," has no tools to articulate (p. 234). It is apparent that something quite different is called for, and that something, according to Wheeler, is a fully embodied account of cognition that emphasizes dynamic interaction of — and rejects any real divide between — self and world.

I take as my starting point the intriguing philosophical problem that Wheeler touched upon: Is it possible for a physical account of mind to explain the metaphysical experience we have when we are moved by a work of art? I employ as a case study the drip paintings of Jackson Pollock to argue that our innate pattern recognition capabilities play a part in the visual processing involved in appreciating (at least) this one odd example of visual art.

It has been established that the underlying patterns of the famous drip paintings are similar to those found in nature, and furthermore that these patterns tend to have a soothing psychological effect on the viewer (Taylor, 2002, 2006; Taylor et al., 2005, 2011). I explain how these insights provide a glimpse into understanding why aesthetic experiences can feel metaphysical, as well as how it is possible to give a physicalist account of such experiences. I argue that we are adept at pattern recognition not only because we are embedded in a world where such capabilities are important to our survival, but also because we embody some of the same patterns found in the natural world in which we evolved, so that when we encounter complex or hidden patterns in artwork, they may affect us on a level much deeper than our conscious cognitive and linguistic selves; the experience might feel mysterious and ineffable, and we may even call it metaphysical.

The Rhythms of Nature

The claim that particular cognitive features may be evolutionary adaptations has been widely discussed in the evolutionary psychology literature. This paper extends the discussion to the realm of aesthetic experience, posing the question of whether aesthetic experience could be one such evolved cognitive feature, and if so, how and why. The central problem comes sharply into focus when one considers the progress made so far in the biological sciences in articulating how the human sensory systems work; for example, how the molecules particular to my favorite red wine produce, upon interaction with the sensors on my tongue, neural impulses that my brain interprets as pleasurable, and how sound waves

entering my ear canal vibrate the intricate organs inside to produce neural impulses my brain interprets as words or music. What is not so clear, by striking contrast, is how my gazing at a painting or sculpture can inspire in me feelings of awe, wonder, and humility; or, alternatively, disgust, embarrassment or sadness. Is it possible to give a physical account of such experiences?

Taylor suspected a particular pattern in Pollock's masterpieces and used computer analysis on twenty of the famous drip paintings, first scanning each painting and then superimposing on each a grid that divided the painting into 1,000 squares. He found that the chaotic-looking paint splatter patterns of all twenty of the paintings were, in fact, fractal in nature. Fractal patterns are self-similar in nature and maintain the same properties regardless of magnification.[2]

Taylor and colleagues used two forms of control in their experimental analysis of the fractal-patterned Pollock drip paintings: (1) several non-Pollock drip paintings, and (2) a paint splatter painting that they allowed the natural elements to freely guide during a wind storm by rigging up cans of paint on one side and a large sheet to capture the wind on the other, and draping a canvas on the ground below. All of the control paintings were analyzed using the same method that was used on the Pollock paintings and none of these patterns was found to be fractal in nature.

Taylor incurred assistance from psychologists specializing in visual perception to investigate the psychological effects felt by people who were viewing fractals. The samples of fractals came from three sources: natural (e.g., trees, clouds, mountains, see Figure 1); mathematical (e.g., computer simulations, see Figure 2); and human (sections of Pollock's paintings, see Figure 3). Taylor reports that, regardless of the pattern's origin — whether natural or computer-simulated — test subjects consistently preferred images with a fractal dimension in the range of 1.3–1.5. The fractal scale for paintings ranges between 1 and 2, with neither pole itself being fractal in nature, and the highest intensity of fractal nature occurring right in the middle of the two poles (see Figure 4). This middle range, which was reported to be the favorable one by participants in the study, is the range in which fell most of the twenty Pollock drip paintings that were analyzed.

Skin conductance and EEG readings were taken on participants in several different experiments in order to ascertain the effect of fractal viewing (Taylor et al., 2011). These physiological measurements were found to be consistent with the claim that viewing fractals with midrange values evoked feelings of peace and relaxation. Apparently, Pollock was creating fractals in his paintings

[2]The French mathematician Benoit Mandelbrot coined the term "fractal" in 1975 and is largely credited with being the first to articulate in detail fractals' strange nature which can be seen both in natural systems such as tree branching and snowflakes, and in computer generated patterns that resemble these natural systems, as well as the colorful and more abstract patterns popular in tie-dyed T-shirts.

Figure 1: Rock formations in Ouray, Colorado. Permission granted by the photographer, Eric Swan.

Figure 2: Computer-simulated plant grown using a Lindenmayer system. Permission granted by the creator, Bruce Damer.

Figure 3: Jackson Pollock's "Number 3, 1949: Tiger." Permission granted by Art Resource, New York. © 2013 The Pollock–Krasner Foundation/Artists Rights Society (ARS), New York.

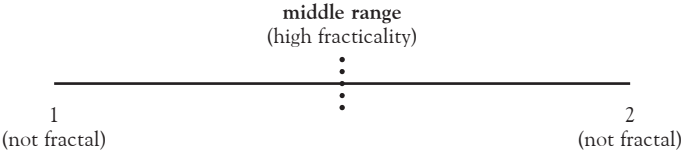

Figure 4: The scale of fracticality in two-dimensional objects such as paintings ranges between 1 and 2. Neither pole (1 or 2) is itself fractal in nature; the highest intensity of fracticality occurs in between the two extremes — around 1.5 on the scale — the range in which Pollock's drip paintings commonly measure.

decades before their discovery in mathematics. Pollock was quoted as saying that when he was engaged in the activity of painting, his concern was with "the rhythms of nature" (Taylor, 2006, p. 112). Pollock created patterns in his paintings that elicited positive changes in one's psychological state; intentional or unintentional, the fractal patterns that emerge elicit a metaphysical response in the viewer's consciousness.

Human Pattern Recognition

Fractal patterns are recognizable both in nature and in human artifacts — and on a spectrum of conscious and subconscious levels. We can create fractal patterns intentionally, as in computer simulations, or apparently unintentionally, as did Pollock. These observations suggest a hypothesis: the mind is structured in such a way to both recognize and create patterns — and perhaps even particular types of patterns, such as fractals. The fractal patterns uncovered in Pollock's drip paintings fall in the particular range of those found in the natural world in tree branching, mountain ridges, snowflakes, seashore waves, and wave-like patterns on sand dunes.

Fractals may be inherent only to certain types of paintings, whether intended or not, or even to just the twenty Pollock drip paintings analyzed. Of course, there are many other types of patterns and related principles that come into play in evaluating visual art, for example, symmetry, depth, shape, alignment, color, and angle. Analyzing a work of visual art using rubrics of this sort does not immediately seem to get to the heart of the question concerning our metaphysical experience of art. One might even argue that to evaluate a work of art in such an *analytical* way is to miss the point, for example by failing to appreciate its emotive quality. However, the example of Pollock's paintings provides insight into the larger philosophical question of why certain types of modern visual art would move us emotionally or affect us psychologically, and why we sometimes think of or describe these experiences as being metaphysical or ineffable.

Although Pollock was presumably aware of his interest in "the rhythms of nature," he was perhaps not aware that he was consistently creating patterns in his drip paintings that were *in nature*, and neither were viewers aware that they were responding to these patterns. Therefore, it is plausible to suggest that in appreciating one of Pollock's drip creations we are in effect responding to the rhythms of nature embodied in us through the long process of evolution, which does seem like an experience that would be inherently beyond articulation — something we are not accustomed to as linguistic creatures, and thus something that would engender in us feelings of awe, humility, and wonder.

The case of Pollock's paintings poses an interesting question for Steven Pinker's (1997) theory of the function of art. Pinker's view of art is that it is our way of "cheating" evolution by getting pleasure out of something that does not enhance biological fitness. That we like fattening foods, sexy movies, and paintings of hearth and home can all, according to Pinker, be explained by the fact that our brain's pleasure centers react to these things because they represent things that our ancestors would surely have found biologically advantageous: food, sex, and shelter.

I concur with much of Pinker's theory for what it says about our attraction to art in general, but what about the Pollock case in particular? Being attracted to Pollock's drip paintings is presumably *not* biologically adaptive (why would it be?), but being attracted to the paintings' underlying patterns, I would argue, most certainly is. Pinker believes that our appreciation of more abstract types of modern art, wherein the content is not warm scenes of home and hearth but jagged lines, angles, and repeated patterns, comes from our ancestral desire to make out clearly whatever is in our field of vision. He explains it as our preferring pizzazz to drab; we are conditioned to seek clues of depth, for instance, to help us make out clearly what is off in the distance ahead of us (a tall shadowy object), and we feel relieved when we are finally able to identify unambiguously what it is we see (a copse of pine trees). Perhaps then the essence of our experience of looking at a Pollock is the relief that comes from subconsciously having identified order in the apparent chaos.[3]

Andrea Lavazza's insights on the subject of abstract art coincide with those of Pinker's. He explains, "It can be argued that an abstract work of art suggests a vague and blurred set of references, none of them clearly identifiable. But their assembly is to trigger an emotional resonance in the fringe. [. . .] In other words, non-representational and abstract art could have an implicit cognitive aspect, necessary to cross the threshold of aesthetic experience" (2009, p. 179, footnote 25). This explanation suffices for understanding our experience with Pollock's creations because it could be argued that although we are gazing at the chaotic-looking display of colors on the canvas, our patternistic mind is actively detecting the underlying order — the discovery of which evokes a barely conscious sigh of relief.

Although Pinker's theory goes far in explaining why we are attracted to certain themes in art, even in the case of abstract patterns in modern art, it does not answer why we are adept pattern recognizers in the first place, why we are drawn to patterns in our environment. Could our pattern recognition capabilities be piggy-backing on top of the "real" evolved feature of human nature? Such a case would be difficult if not impossible to make simply because of the ubiquity of our pattern recognition capabilities. Jackendoff (1994) argues that pattern recognition plays a central role in our abilities in language, vision, and music. And I argue herein that pattern recognition plays some part in aesthetic experience as well.

Jackendoff has argued that the proper way to understand language, visual perception, and even musical acuity, is as complex interactions between innate structures of the mind and environmental stimuli. Jackendoff (1994) defends two of Chomsky's (1956) well-known arguments for (1) mental grammar, which consists of the innate part (our natural endowment for language and the general

[3]And in fact the title of Taylor's *Scientific American* article on Pollock is "Order in Pollock's Chaos."

properties of the mind) and the learned part, and (2) innate knowledge, the notion that the way children learn to talk implies that the human brain contains a genetically entailed specialization for language. Although Jackendoff does not, even in his discussion on vision, comment on our experience with visual art, his fundamental intuitions about the extent to which our capabilities of language, music, and vision depend on innate pattern recognition structures can be extended to our experience of visual art with a little interpretive license.

The notion of mental grammar can be understood as a heuristic used by the mind to enable us to interpret in a meaningful way sentences we have never heard before. It is unlikely that our brain has a "file" of all possible sentences in case we should encounter them in our lifetime, if for no reason other than our brain is of finite size and storage capacity, and the list of all possible sentences is essentially infinite. It is much more plausible that our knowledge consists of the *meanings of words* (the learned part) and the *patterns into which words can be placed* (the innate part).[4]

An important caveat of the concept of mental grammar is that it is subconscious and thus unavailable to us through introspection. It is likely that part of the intrigue and appreciation of a Pollock comes from our responding to the underlying order in his paint splatter creations. The belief that there was no method to Pollock's madness is strengthened by our seeing the artist in action in photographs that depict him as using the full power of his body to wildly and furiously throw paint onto giant canvases which lay on the ground. The following quotation from Isaiah Berlin was not written about Pollock, but could very well have been:

> . . . if everything in nature is living, and if we ourselves are simply its most self-conscious representatives, the function of the artist is to delve within himself, and above all to delve within the dark and the unconscious forces which move within him, and to bring these to consciousness by the most agonising and violent internal struggle. (Berlin, 2000, p. 89)

It is likely that the chaotic overlay of a drip painting, though inherently interesting to some, is not what really draws us in. Rather, our attraction to these peculiar works of art is due to the underlying order that affects our psychological state. If true, this speculation provides the beginning of an explanation for the difficult-to-articulate but intensely felt experience we have when we are moved

[4]Heuristics represent an important component of this discussion. Through the mechanisms of heuristics, the respondent relies on recognized elements to process new information. These elements, or tags, can be simple as in "noisy" or "red," but can be more highly developed, such as "muddy riverbed" or other evocative phrases or images. Thus when a respondent hears the phrase "snow storm" or hears high winds, the color white might come to mind. Likewise, in the subconscious mind, the recognition of fractal patterns in a Pollock painting evoke an emotional response that identifies elements that are meaningful to the observer.

by a work of visual art. That is, some forms of visual art may affect us in ways that are not available to introspection and thus cannot be made conscious through articulation.

Lavazza (2009, p. 159) explains that, "our appreciation of a work of art is guided by vague and blurred perception of a much more powerful content, of which we are not fully aware." He draws heavily on the dissertation of Bruce Mangan (1991) in which Mangan stresses that two features in particular of aesthetic experience had already been identified in ancient Greece: a sense of unity and its ineffable quality. The ineffable quality of Pollock's drip paintings has already been addressed. And the concept of unity that Mangan identifies, I believe, is related to the viewer's vague sense of the underlying order within a Pollock painting.

The second of Jackendoff's arguments, invoking the existence of an innate human specialization for language, seems especially compelling since humans are the only ones who use language.[5] According to Jackendoff's theory, our language abilities are transferred genetically like any biological trait except they are specific to our species because their instantiation depends on a particular brain structure. This assertion may partly account for the failure of artificial intelligence (AI) efforts to produce a computer program that can convincingly carry on a casual conversation. While computers are very good at pattern recognition (and were in fact developed for just that purpose, as code-breaking machines in World War II), they are nevertheless poor at learning or imitating human language, which depends on pattern recognition. A plausible explanation for this paradox is that since we do not yet have an explicit account of how humans exploit patterns that are innate in our cognitive architecture, it is not yet possible for us to simulate the process effectively in computers. And in the meantime, no matter how much vocabulary we stuff into a program, an AI system does not have the advantage of innate patterns to tell it *what makes sense* linguistically and it is not easy to see how such a feature, which evolved in humans over much time, could be built into such a system.

Recursive Patterns

Computer scientist (and father of the artificial life research program) Christopher Langton (1989) has noted that the different types of Lindenmayer systems used in artificial life programming very closely resemble the formal grammars delineated in Chomsky's theory of language. Lindenmayer systems are programs consisting of a small set of simple replacement rules that are applied recursively to generate complex structures (the computer simulated tree

[5]Jackendoff, I think rightly for this discussion, demarcates animal communication from human language.

in Figure 2 is one such example). The formal similarity noted between Lindenmayer systems and natural language suggests that our innate linguistic patterns might also be recursive in nature, wherein formal rules general enough to generate and interpret a language without recourse to specific cases are applied again and again.

There is insufficient human memory to account for every possible case; what progress was made in AI with the use of general heuristics instead of specific case algorithms gives credence to this observation. If cognition does depend heavily on innate pattern recognition capabilities that are recursive in nature, then it is not surprising that we would be especially attuned to identifying, even subconsciously, recursive patterns in the world, such as the fractal patterns in Pollock's drip paintings.

Certainly one can find countless examples where the ability to recognize patterns had particular advantages that facilitated, if not ensured, our survival — think for instance of early celestial navigation where a good working knowledge of the changing configurations of the stars was crucial. Our being embedded in a world full of patterns, the recognition of which has been crucial to our survival as a species, explains why we are so adept at recognizing patterns in nature and, much more recently, creating them with computers. Figure 5 compares three different kinds of systems (evolved, mathematical, and human-created) in terms of the innateness of their patterns. But there is a deeper explanation for our inherent pattern recognition capabilities that is not so obvious and yet is sug-

Patterns	Are they fractal or recursive?	Are they innate?
In the mind	Patterns are applied recursively to generate unlimited sentences	Yes
Lindenmayer systems	Recursive rules produce fractal structures	Yes, in the program
Pollock drip paintings	Recursive painting technique created fractal patterns	Yes (I argue)

Figure 5: Comparison chart of patterns inherent in human artifacts and innate in human cognitive architecture.

gested by our evolutionary history, which is this: because we evolved in and emerged out of the natural world which exploits the recursive use of sets of patterns to achieve unlimited complexity, we should expect to find at least some of the natural world's patterns embodied in us.

Patterns in Body and Brain

Gregory Bateson used the phrase "the pattern which connects" (1979, p. 8) to capture a broad, philosophical, and biological concept of a grand pattern connecting all living things, and he defined the term *aesthetic* as one's being responsive to this theoretical meta-pattern. Though Bateson focused on, for example, how crabs are related to lobsters in that their symmetries and relations among corresponding parts are encompassed in a crustacean meta-pattern, as well as how crustaceans are related to humans in an even broader biological meta-pattern, etc., many of Bateson's intuitions about how we identify and respond to patterns in nature hold true in the present context.

Taylor's research has shown that humans subconsciously respond to obscure meta-patterns in Pollock's paintings that are ubiquitous in nature as well as in the structure and function of human mindedness. However, this subconscious response to patterns is very different from Bateson's exercises of examining and comparing crabs and lobsters: in the case of humans observing Pollock's hidden patterns, the identification is below the level of conscious awareness and, thus, a resonance is sensed between observer and observed, but such resonance is inherently difficult if not impossible to articulate.

Alan Turing (1952) introduced what is now called the reaction-diffusion model, employed in artificial life simulations to generate simple but lifelike forms and patterns. The basic idea in Turing's original formulation of the idealized mechanism was that chemicals in the organism act as catalysts for the unfolding of the phenotype, wherein different spatial patterns (tubes, curves, indentations, spirals, etc.) are effected by different chemicals reacting with one another. On this account then, the end result, the adult organism, can be thought of as the expression of the sum total of patterns encoded in the genotype.

Mandelbrot is known to have speculated that Purkinje cells of the cerebellum are fractal in nature. There is a notable visual similarity between the branching structure of neurons and that of computer images generated with recursive pattern algorithms (for an example of this see the Lindenmayer system in Figure 2). The neuroscientist Andras Pellionisz (1989) built a computer model of two million brain cells to test his hypothesis that the Purkinje brain cells were not just fractal in appearance, but were actually so in function. He noted that there simply was not enough information in the human genome to specify the massive number of neurons in the cerebellum, and he speculated that some sort of "compression algorithm" must be exploited by nature in building the brain.

Pellionisz hypothesized that different brain cell types resulted from repetitive execution of certain genetic code sequences. Generally considered to be the main contribution of Pellionisz's thesis is the empirical evidence it provides for his theory that the study and application of fractal sets will elucidate certain aspects of morphogenesis.

More recently, work in neurobiology has exploded in the area of neural patterning or neural grouping, and overall grand-scale neural dynamics. Swan and Goldberg (2010b) developed an account of what they call "brain-objects" which are identifiable and repeatable patterns of neural activity occurring in conjunction with particular environmental stimuli (e.g., neural pattern A corresponds to a green traffic light and neural pattern B corresponds to a red traffic light). Their account of brain-objects is based on current research in neuroscience on the rat somatosensory system conducted by Nicolelis (2008; Nicolelis and Ribeiro, 2006) who identifies "neural assemblies" or "neural ensembles" and uses these terms in essentially the same way Swan and Goldberg use brain-object.

What is significant about recent research in neural dynamics in the context of this paper is that although the recorded brain activity of an organism engaged in a task appears to be wildly chaotic and random, it is not; neural activity consistently arranges itself into identifiable and repeatable patterns which are the neurobiological substrate of mental representation. For example, my understanding of the concept "red traffic light" is literally grounded in my brain by a particular pattern of neural activity that is instantiated every time I encounter or think about a red traffic light.

Similar notions abound in the mind sciences literature. Edelman (1987, p. 6) gives an extensive elaboration of a population model of neuronal activity that he calls the theory of neuronal group selection. Edelman explains that ensembles of neurons, or "neuronal groups," were dynamically selected from large networks of neurons. Successful selection of a neuronal group from tens of thousands of neurons in a network is dependent upon altering the synaptic efficacies among neurons in the network "so that there is an increased probability of their response to similar or identical signals," such as additional red or green traffic lights. These selected neuronal groups are composed of hundreds or thousands of strongly interconnected neurons that act as functional units and are correlated with signals from the environment. In essence, though there are billions of neurons in the brain, and a constant, seemingly random and chaotic flurry of neural activity when the organism is awake and active (and is never totally absent, even in sleep), this neural activity arranges itself into consistent and repeatable patterns that represent features of the environment that enable the organism to make sense of its world and survive. There is order in the disorder.

A closely related concept is Waddington's (1957) *chreods* — useful and well-worn neural pathways found in actional, mental, and symbolic operations. These neural tracks, for Waddington, were associated with goal-oriented behavioral

tendencies that are played out in concrete circumstances. The neural pathways are established by the organism's repeatedly receiving a certain stimulus. If the stimulus remains about the same in location and intensity, if it is repeated often enough, and if it requires a survival-enhancing response by the organism, then a chreod will be established in the neurobiological substrate. Chreods, in the context of this paper, constitute yet another example from the history of psychology of conceptualizing how the brain has the ability to produce ordered thought, language, and behavior from a substrate of seemingly chaotic and random neural activity.

The foregoing examples from philosophy of mind, psychology, neuroscience, and computer science are invoked for what light they shed on the hypothesis that the brain itself employs patterns (both in structure and in function) to make sense of the world, and that, given this particular disposition, it stands to reason that the human brain would be drawn to instances of visual art that give it the opportunity to make order out of disorder, an opportunity that is made especially salient by a Pollock drip painting. Given the broad responses already attributable to recognition of fractal patterns in other sensory spectra such as memory, taste, and language, it is plausible to hypothesize by extension that different visual cues exploited in other types of abstract art trigger other fundamental cognitive mechanisms, thus producing a prelinguistic, felt quality constituting some form of aesthetic experience.

Conclusion

In this paper I have argued that a naturalistic explanation of some types of aesthetic experience is possible, and offered a speculative hypothesis as to why such experiences might affect us in ways that seem ineffable. As suggested by Wheeler (1996) in his observation that traditional cognitive science lacks the tools to account for aesthetic experience, the effect that a work of art has on us is a dynamic interaction between self and world. Lavazza (2009, p. 174) explains it simply: "The aesthetic experience is a consequence of our basic cognitive mechanisms." We witness on a physical level, in Pollock's drip paintings, the invisible patterns at work in his, and more generally speaking, in human, consciousness.

What and how we experience a thing has a lot to do with what we *bring to* the experience. Our innate, embodied patterns and their recursive application not only in our organic development but also in our everyday thought, language and behavior enable us to process the unlimited variety of experiences we encounter, including our apperception of art that moves us in a seemingly infinite variety of ways. As Lavazza puts it, "An artifact 'works,' is 'successful' if its component parts integrate in line with the way our perceptive cognitive processes work" (2009, p. 171). This is an insight that Kant would have endorsed,

I believe, since it is reminiscent of a transcendental connection between the structure of our mind and the structure of the world, the interaction of which creates an experiential resonance that can in certain instances, such as in aesthetic appreciation, feel familiar or right as when something clicks into place, but is just out of the reach of direct conscious awareness.

The idea that the human mind is ontologically continuous with the rest of the natural world is not new, yet perhaps more deeply explicated in the context of the themes explored herein.[6] If mindedness is an enriched facet of life, a thesis that is held by the concept of strong continuity, then it makes sense that our ability to identify and recreate natural patterns follows from our being a physical phenotypical instantiation of the patterns encoded in human DNA, the very codes that direct the development of our brains. In essence, we are good at recognizing patterns because we are composed of patterns from the ground up, so to speak. And thus our being moved beyond words by a work of art such as a Pollock drip painting is less an instance of our reacting to the world *out there* and more one of our responding to patterns embodied *in us*.

I conclude with an explanation of the paper's title, "Deep Naturalism." There is a long history in the philosophy of mind of attempts to "naturalize" the mind, which usually takes the form of describing various aspects of human mindedness in terms that other philosophers have deemed "naturalistic." As a result, many projects aimed at a naturalistic account of mind wind up being just as abstract and removed from the natural world as accounts that are not intended to be naturalistic. I believe naturalism in the philosophy of mind needs to aim much deeper — to an understanding of how human structure and function evolved from the structure and function of the natural world.

What I have attempted to do in this paper is explain one aspect of human mindedness — aesthetic experience — in a way that is consistent with the natural history of mind. We evolved in a world that is replete with patterns, and thus we should expect to find some of these patterns embodied within us. And furthermore, becoming aware of the fact that we embody patterns from the natural world goes some distance in explaining why our encounters with such patterns — whether in nature or in works of art — strikes a resonance between us and what we observe. And this very fundamental resonance, in the many different forms it can manifest in human experience, begins to explain that felt but seldom articulated dimension of aesthetic experience.

[6]See for example, Godfrey–Smith (1994), Wheeler (1997), Stillwaggon (2005), and Swan and Goldberg (2010a).

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Aristotle and Modern Cognitive Psychology and Neuroscience: An Analysis of Similarities and Differences

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Aristotle extended his hylomorphic theory of reality to formulate an account of human psychology. This essay examines parallels and differences between Aristotle's account and that of modern day cognitive psychology and neuroscience. Most similarities appear to exist in the areas of sensation, perception, and memory; however, at the levels of higher cognitive functioning, Aristotle would assert the need for a dualist ontology.

Keywords: Aristotle, dualism, cognitive psychology, neuroscience

Aristotle's formulation of human psychology is presented primarily in his major work, De Anima (trans. 1907). As pointed out by Shields (2003), Aristotle's psychology is an extension of his general metaphysical position, hylomorphism, which postulates an understanding of reality by means of the four causes: efficient, material, formal, and final. The efficient cause is the agency generating a particular thing. The material cause is that from which something is generated. The formal cause is the structure the matter becomes, that which specifies what it is. The final cause is the purpose or end of the object, its function. A classic example of the four causes is Aristotle's commentary on sculpting a statue. The efficient cause is the sculptor and his sculpting; the material cause is the block of marble; the formal cause is the image to be sculpted, e.g., a statue of Hermes which specifies the "what it is" of the statue; and the final cause is the purpose, to create and

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exhibit art. Aristotle also used the concept of final cause at the intentional or mental level to describe the agent's plan for the work and purpose of the work.[1]

An important principle of the hylomorphic theory is the distinction between substantial and accidental forms. Substantial form is essential to the thing and accidental form is a quality of (inhering in) the substantial form but not essential to it. In the statue example, its substantial form would be that of a statue or depiction of someone or something. Accidental forms are such qualities as color, height, type of material, and such.

Aristotle applied hylomorphic theory in his analysis of human cognitive capacities, using the term soul (psyche) to describe the formal cause of that which makes a human, human. However, he did not start at the highest level of human cognitive capacities. Rather he described several capacities or faculties of the psyche, many of which are shared with other forms of life. Hence, he begins with nutrition and locomotion and proceeds on to perception and mind. For our purposes, I will focus on the faculties of perception and mind. For Aristotle, the capacity for perception marks the demarcation line between animals and plants.

Aristotle's explanation of perception relies on an extension of the hylomorphic theory of change. Shields (2003) states:

> Aristotle treats perception as a case of interaction between two suitable agents: objects capable of acting and capacities capable of being affected. Aristotle is happy to speak of the affected thing as receiving the form of the agent which affects it and of the change as consisting in the affected thing's "becoming like" the agent. (p. 11)

It is important to note that the receiving perceptual capacity must be attuned to receive the forms of the sending object. Hence, although reflected light waves from the book in front of me are impacting every other object in my office, only my eyes and related brain structures are capable of perceiving, that is, capable of receiving the sensory forms carried in the light waves resulting in visual perception. Light waves impacting my file cabinet do not result in perception.

Aristotle's consideration of perception focused on the five senses, shared in common by man and animals known at the time. However, he also described imagination, noted both in man and most animals, as a distinct faculty which produces, stores, and recalls images. Hence, he included a capacity for memory

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[1]For the most part, psychology has ignored Aristotle's hylomorphic theory. The most notable exception is the work Rychlak (1973) who incorporated hylomorphic theory in his formulation of personality and later made extensive use of Aristotle's concept of final cause in his development of logical learning theory (Rychlak, 1994). However, very recently, Spalding and Gagne (2013) made a forceful argument for use of the Aristotelian–Thomistic view of concepts as a theoretical framework capable of unifying competing theories in cognitive psychology. Their views complement one of the conclusions expressed in this essay, namely, that a Aristotelian meta-theory could serve as an organizing framework for cognitive psychology.

processes; and, as noted by Shields (2003), described these stored images as likenesses or copies of external objects. Later medieval philosophers (Avicenna, Aquinas), building on Aristotle, described five "internal" senses: the common sense, which receives and arranges all sense data; the phantasia or phantasm, which retains the sense data; the imagination which combines and reassembles images from the phantasia; the estimative faculty, which gauges the dangerousness of the sensed object; and the memory, which retains the sensory level images or representations for later use.

For Aristotle, it is mind or intellect which, in fact, creates the demarcation line between man and other animals. Aristotle defines humans as rational animals, sharing many capacities with other animals but not mind. It is this faculty or capacity in man that allows for understanding. Aristotle's position regarding mind in relation to that of cognitive psychology and neuroscience will be presented in more detail later.

Aristotle, Cognitive Psychology, and Neuroscience

The Mechanisms and Models

Cognitive psychology is concerned with multiple phenomena: sensation, perception, memory, and higher cognitive functions, such as category formation, thinking, decision making and the like. At every level, cognitive psychology employs psychological constructs, now often referred to as mechanisms or models, as essential components in theories designed to explain the phenomena in question. These mechanisms or models appear to be equivalent in philosophy of science terms to hypothetical constructs. McCorquodale and Meehl (1948) noted that psychological constructs, such as intelligence and motivation, contain surplus meaning not exhausted by single observable referents and were (and are) essential in formulating explanatory theories in all branches of psychology. Later, Cronbach and Meehl (1955) attempted to extend the conceptual meaning of hypothetical constructs via the notions of construct validity and the nomological network. They asserted that the meaning of, or at least the usefulness of, a hypothetical construct, such as intelligence, could be established by its ability to predict a wide range of behaviors and by its functional relationships in a network of other constructs. As cognitive psychology has aligned itself more with neuroscience and the computational model employed by most of neuroscience, the hypothetical constructs of cognitive psychology and neuroscience have been reduced in number but have not been eliminated.

Hypothetical constructs contain varying degrees of surplus meaning and meaning claims. Hypothetical constructs appear in at least two forms, those referring to "entity-like" structures used in explanatory accounts and those referring to hypothesized processes explaining how the entity-like structures

proceed or interact. Examples from the cognitive psychology and neuroscience literature will help clarify the point.

Perception. E. Roy John (2002) employs the construct of perceptual frames to explain perceptual binding:

> A degree of consistency must persist across a sequence of perceptual frames, analogous to a "sliding comparator." Adaptive response to the environment requires that sensory information be evaluated in the context of the previous frame, as well as working and episodic memories. (p. 5)

Although in John's schema the perceptual frame is anchored in brain structures, still this construct serves as the explanatory mechanism over and above those brain structures and even is claimed to have evaluative powers, tying the frames together and to other hypothetical cognitive structures involved in working and episodic memory. Hence, John's perceptual frame is an example an explanatory hypothetical construct having both an "entity-like" structure and hypothesized interactive processes with other "entity-like" structures.

Memory. Theories of memory require multiple hypothetical constructs, often tied together in a nomological network fashion. Baddeley and Hitch's (1974) model of working memory is a well-known example in which a master construct, the central executive, "acts as a supervisory system" controlling the flow of information into three lower-level "slave system" constructs: the phonological loop, the visuo-spacial sketchpad, and the episodic buffer. The theory holds that interaction among these systems accounts for empirical data observed in studies of normal subjects as well as those with brain lesions. Although these constructs have been increasingly identified with neuroscience and the computational model, they still have the ontological status of constructs and are, in fact, tied together in nomological network fashion.

Higher cognitive functions. Explanatory accounts of higher-order cognitive phenomena are replete with hypothetical constructs, usually presented in a multi-construct, nomological network fashion. For example, Smith, Patalano, and Jonides (1998), discussing cognitive psychology's four theoretical approaches used to explain category formation, focused on the two most prominent: rule application and exemplar similarity. In their discussion of rule application, Smith et al. state that individuals must abstract elements and then evaluate them in reference to the "representation of the test object." Additionally, individuals must keep the rule and the comparison elements in working memory. Here we see examples of a hypothesized process and two "entity-like" constructs (the representation and the working memory). With regard to the exemplar similarity theory, Smith et al. speak of "entity-like" structures, the exemplar and the exemplar as a representation. The hypothesized process of matching is facilitated by interaction with working memory. As with perception and memory, these constructs have increasingly been discussed within a neuroscience framework

in an attempt to weave together cognitive constructs and underlying brain structures (see Smith and Jonides, 2000).

Increasingly, neuroscience has attempted explanatory accounts that are primarily brain based. In a paper on categorization, Seger (2008) describes the basal ganglia and its corticostriatal loops as prominent in accounting for visual categorization. The discussion is primarily related to brain structures; however, the term representation is utilized in the account, suggesting that at least one hypothetical construct must be retained.

Aristotle recognized the need for hypothetical explanatory structures similar to the mechanisms and models utilized by modern cognitive psychology and neuroscience. Indeed, as will be elaborated later, he postulated mental mechanisms to explain observed phenomena in perception, memory, and especially higher-order cognitive events, such as abstraction, category formation, reasoning, and so on. After all, Aristotle himself was an empiricist, observing behavioral evidence of what plants, animals, and humans actually did. He was not an "arm chair" philosopher and broke with his mentor, Plato, over Plato's other worldliness as the basis of reality.

Aristotle not only recognized the need for mental mechanisms but also thought that these mechanisms interact in a nomological network manner. For example, he asserted that perception and the intellect interact in a network fashion and, although he did not comment on the issue directly, his assertion that perception is tied to the material body would lead him to agree that variations or damage at lower levels (sensation and the brain) impact functions of the intellect. Of course, his is a much simpler set of mechanisms than employed in modern cognitive psychology and neuroscience explanatory systems; however, the basic idea is the same.

Specifics of Aristotle's Account

Aristotle's Account of Sensation and Perception

Aristotle's position was that all knowledge is grounded in the senses (De Anima, trans. 1907):

> But, since apart from sensible magnitudes there is nothing, as it would seem, independently existent, it is in the sensible forms that the intelligible forms exist. And for this reason, as without sensation, a man would not learn or understand anything. (Book 3, Chapter 8, p. 145)

Physics and biochemistry have outlined the mechanisms of the five external senses; and, in conjunction with those basic sciences, cognitive psychology and neuroscience have extended discovery into the brain itself. All of these findings are consistent with Aristotle's view of the senses. Sensory and perceptual models,

such as perceptual binding, are also consistent with Aristotle's' views, in that he recognized we perceive reality as seamless, despite the fact that sense data are received in discrete units. In fact, given his general reliance on the hylomorphic theory to explain perception, it seems reasonable to think that he would interpret these descriptive advances as enhancing knowledge regarding how the receiving sense faculty operates, as it receives sensible forms from objects in the environment.

However, Aristotle encounters an initial difficulty over the adequacy of computational causative theory espoused by most of cognitive psychology and neuroscience. This is the ontological and epistemological position which asserts that mental representations at all levels are fully explained by brain architecture and neural networking (Pitt, 2008). Still, Aristotle might not object to computational ontology at the level of sensation and perceptual binding, as long as the neural networks simply described the underpinnings of organs capable of receiving sensible forms. In fact, the medieval philosophers, Avicenna and Aquinas, might well have accepted the computational model for the *sensus communis* (the common sense) and the phantasm, again with the stipulation that these computer-like neural structures were only elaborate descriptions of the "internal senses" and their ability to receive and assemble sensible forms.

Then there are the philosophical disputes over the qualia, that is, whether our ability to perceive the color red can be fully accounted for by neurochemical events in the CNS. Of course, modern philosophers of mind claim both the "yes" and "no" positions. Aristotle, again applying the hylomorphic model to the issue, could ignore the dispute and claim only that the organs involved can receive sensible forms such as red.

Aristotle's Account of Memory

Aristotle takes up memory, which he called the imagination, in Book 3, Chapter 3 of De Anima (trans. 1907) and describes its characteristics as he distinguishes memory from the external senses and from thought. He describes memory primarily as recall through images: "Imagination, in fact, is something different from both perception and thought . . . whenever we please, we can represent an object before our eyes, as do those who arrange things under mnemonic headings and picture them to themselves" (p. 123). As mentioned, the medieval philosophers, following Aristotle, went on to subdivide imagination into the five "internal senses," subdivisions, in many ways, similar to modern parsing.

Cognitive psychology and neuroscience have many impressive findings regarding memory: models of diffuse storage of long-term memory elements throughout the brain, molecular findings that short-term memory depends on existing synaptic connections, the growth of new synaptic connections facilitated by learning, genetic variations associated with memory, and on and on. Of course,

Aristotle had no detailed scientific data to consider; however, these models and findings are consistent with the hylomorphic theory in that they serve as the physical basis for receiving and storing sensible forms. When certain sensory or brain areas are damaged, sensible forms can no longer be received and stored. His later medieval commentators followed suit and, in fact, already had speculated on brain locations for the internal senses.

Aristotle's account of memory is presented within the hylomorphic framework. He does not discuss memory, which he calls imagination, in detail but does take pains to distinguish it from both perception and mind. He does assert that the imagination produces, stores, and recalls images. As such, his account, if formulated in accord with modern models and data, would require a good number of hypothetical constructs, assembled in networks, to explain findings. For example, he might adopt something like Baddeley and Hitch's (1974) construct model for working memory and would modify the model as new empirical data emerged. If this or similar models were ever closely tied to brain architecture at varying levels, such that a computer-like storage and assembly process began to emerge as a physically based explanation, Aristotle would understand this as an elaboration of the general mechanisms of memory, as memory manipulates sensible forms of particular, existing objects received first through the senses.

But would Aristotle completely abandon his "copy" theory of memory? The answer is no because modern cognitive psychology and neuroscience cannot do without the concept either; it is now referred to as the representation. Everything described above must finally end up as an image. For example, if I perform an act of episodic memory regarding my tackling Johnny Elam in the 1953 Lockhart–Luling football game, I have a visual image or representation involving shoving off the center, Elam coming right at me in the three hole, and the massive collision that occurred. The representation is primarily visual but involves action and is vivid. Like most vividly recalled life events, it was associated with a high degree of emotion. Hence, Aristotle, considering the facts of memory in 350 BC, recognized that, whatever is happening in the body, the result is ultimately a copy-like image. He referred to this image as an abstracted sensible form. Modern cognitive psychology and neuroscience call the image a representation and postulate a neural assembly process, not totally dissimilar to abstraction, to account for it.

Aristotle's Account of Higher Cognitive Functions

Cognitive psychology and neuroscience position a number of processes under higher cognitive functioning, including categorization, object recognition, decision making, theory of mind, mental imagery, knowledge of self, thinking, social exchange, and consciousness itself. To explain these phenomena, cognitive psychology and especially neuroscience advocate what has come to be known

as the computational theory of mind which holds that the brain is a form of computer and that cognitive events and processes at all levels are computations conducted by the brain. However, to say that cognitive psychology and neuroscience advocate this ontology is somewhat misleading because those disciplines rarely state this as their underlying ontology. They simply proceed with brain-based causal explanations.

As Pitt (2008) points out in his review of consciousness, at the theoretical or philosophical level, the computational theory of mind splits into two camps, the classicists and the connectionists. Cognitive psychology and neuroscience appear to fall almost exclusively under the connectionist sway. Connectionists claim that (1) mental representations develop from distributions of weights and connections at neural network levels; (2) the connection network is learned by repeated exposures with network growth and rearrangement occurring during learning; and (3) mental representations are lost or degraded if these networks are damaged. Hence, all events and processes of sensation, perception, and higher cognitive functions find their causal explanations within connectionist ontology. Further, this ontology is a materialist monism, implicitly or explicitly denying any form of dualism.

The following quote from Koch's (2004, p. 1107) introduction to a section on consciousness in a prominent neuroscience text illustrates the point: "The researchers represented in this section take the problem of consciousness, the first person perspective, as a given and assume that brain activity is both necessary and sufficient for biological creatures to experience something." The point can be further illustrated by recent books, such as *The Ethical Brain*, in which (Gazzaniga, 2005) asserts that all moral reasoning can be explained by brain function alone and by the works of philosophers of mind (Carruthers, 2000; Dretske, 1995) who draw on findings from cognitive psychology and neuroscience to assert that mind is no more than brain.

Aristotle parts company with cognitive psychology and neuroscience at this level, and the argument would center on ontology and causes. Aristotle's explanation of the list of phenomena under higher-order functions would be couched within hylomorphic ontology and involve the reception of intelligible forms by the intellect, regarded as the faculty uniquely able to abstract the common properties of objects. As Aristotle states in Book III, Chapter 4 of De Anima (trans. 1907):

> Thus, then, the part of the soul which we call intellect (and by intellect I mean that whereby the soul thinks and conceives of forms) is nothing at all actually before it thinks. Hence, too, we cannot reasonably conceive it to be mixed with the body, for in that case, it would acquire some particular quality, cold or heat, or would even have some organ, as the perceptive faculty has. But as a matter of fact it has none. (p. 131)

Later, in discussing the distinction between the sense organs and the mind, Aristotle states:

> Observation of the sense-organs and their employment reveals a distinction between the impassibility of the sensitive and that of the intellective faculty. The sense loses its power to perceive, if the sensible object has been too intense: thus, after very loud noises, and after too powerful colors and odors, it can neither see or smell. But, the intellect, when it has been thinking on an object of intense thought, is not less, but even more able to think of inferior objects. For the perceptive faculty is not independent of body, whereas the intellect is separable. (p. 131)

Reception of forms by the intellect occurs in the following manner. First, objects of thought enter as particular perceptions via the senses, are organized by the internal sense as described above, and are then "presented" to the intellect. The intellect abstracts common features of the objects as structural universals. Objects stored in the imagination as particular memories (as the example above — the grass, the football field, the people involved, and the action) can also be presented to the intellect for abstraction.

Hylomorphic theory requires that other phenomena of higher-order cognition be categorized as subdivisions of the hylomorphic framework. For example, categorization and object recognition are descriptions of the intellect's abstracting universal common properties of objects. Thinking is the formation of propositions involving universals and particulars, as in the proposition "John is a human being." Knowledge of self is an extension related to the capacity of the rational animal to think about its thinking.

Aristotle describes the mind or intellect (*nous*) as a capacity or faculty of the soul or psyche capable of receiving intelligible forms. As with the sense faculties, the intellectual faculty must be suitability qualified to receive intelligible forms. Shields (2003) summarizes: ". . . thinking consists in a mind's becoming enformed by some object of thought, so that actual thinking occurs whenever some suitably prepared mind is 'made like' its object by being affected by it" (p. 13). According to this model, thinking consists in a mind's becoming enformed by form.

This analysis implies an isomorphism between the intellect and object known — but what sort of isomorphism? Aristotle asserts that the isomorphism is between the intellect and the form of the known object. Thus, when one thinks of dogs in general (as opposed to perceiving a particular dog), the intellect grasps generalities about canines in an abstract and universal way. The universal concept of dog will be somewhat like a blueprint or structural model applicable to all dogs. This isomorphism is accomplished by the process of abstraction in which the mind can extrapolate the form of particular objects and produce a predicating judgment, such as "all dogs are animals." Knowing, then, can take

place at two levels: one tied to the particular sensed object (this dog Tippy) and the other knowing the common features of all canines (all dogs).

It should be noted that the product of the abstracting intellect is the concept which is universal and is described as a rational entity. The concept is a creature of the intellect, having no material properties.

Cognitive psychology and neuroscience and Aristotle's system hold different ontologies, leading to differing casual analysis. Cognitive psychology and neuroscience are committed to physical monism; Aristotle advocates a dualist ontology in which the higher-order cognitive functions of mind cannot be reduced to the physical, and the product of abstraction is the universal concept, also not reducible to the physical. To illustrate this point, consider how each position would explain my ability to utter the proposition "All dogs are animals."

The computational theory of mind claims that my brain, first of all, perceived and stored singular examples of dogs and singular examples of animals. Then, the brain instantaneously assembles all of these singularly stored representations to form the higher-level representations of "all dogs" and "all animals." At each stage of assembly, the mental representations are nothing more than the "distributions of weights and connections at neural network levels," as described by Pitt. My personal awareness of the elements of the proposition, "all dogs" and "all animals," and the connection between them is solely a product of brain neurochemistry and neural networks.

The hylomorphic claim is that sensory and perceptual experiences with singular existing dogs, both immediate and stored in memory, give rise to a universal concept of "all dogs" by the process of abstraction in which elements common to canines are realized by the intellect. As expressed by Shields, the intellect (mind) is enformed by the universal form of canineness. The same process would occur with other perceived animals in the sensory world, starting with numerous encounters with singular existing varieties of animals. By the process of abstraction, the mind becomes enformed with the elements common to "all animals." My personal awareness of uttering the proposition is simply the intellect's observed ability to reflect back on its own activity and consider the content and process.

Hylomorphic ontology requires dualism as opposed to the physical monism of the computational theory of mind. Neither the abstracted, universal concept nor the intellect as a faculty is reducible to physical events. But what type of dualism? This has been a source of controversy: was Aristotle advocating a Cartesian substance dualism literally postulating two separate substances, mind and body? Many think not. Perhaps Aristotle would advocate some version of property dualism, claiming that the existence of conscious properties are not identical with nor can they be reduced to physical properties.

Summary and Conclusions

It is reasonable to assert that Aristotle would be rather enthusiastic about many of the findings of cognitive psychology and neuroscience at the levels of sensation, perception, and memory. He might be more attracted to one set of explanatory constructs about these processes than to another; however, being empirically oriented himself, he would choose the models with the most convincing data.

Aristotle would oppose the computational theory of mind as being an ontological error. After all, physical monism had its proponents in ancient Greece (Thales, Anaximenes), and Aristotle opposed their ontology. Aristotle asserted that the superior position is dualism, principally because physical monisms, like the computational theory of mind, stretch credibility. Can we really believe that each time I utter "All dogs are animals," my whirring computer (the brain) assembles all of the components necessary for dogs (all dogs, not one dog) and animals (all animals, not one animal) and the connection between them, "are"? Then, of course, there is my conscious awareness of my utterance and ability to reflect on it. This has been labeled as the "hard problem" by Chalmers (1995) who argues that the gap between CNS neurochemical events and my conscious experience cannot be bridged. Aristotle and Chalmers agree on that that point.

Finally, it is interesting to speculate what might happen if, by some miracle, cognitive psychology and neuroscience abandoned the computational theory of mind and accepted the hylomorphic model. If such a paradigm shift occurred, neuroscience would behave in an ontologically different manner and claim its territory up through the "internal senses" only. Cognitive psychology would do the same but could also offer psychological data and theory related to the process of abstraction and the manipulation of concepts.

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Mentalism as a Radical Behaviorist Views It — Part 1

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For radical behaviorism, mentalism is an orientation to the explanation of behavior in which the cause of behavior is attributed to phenomena in an extra-behavioral dimension. The extra-behavioral dimension is often characterized by such terms as mental, cognitive, subjective, or spiritual. Some representative terms for the mental phenomena are acts, states, mechanisms, processes, representations, and cognitions. Part 1 of the present review examines definitional issues associated with mentalism and provides further examples of mentalism. The review then examines some possible reasons for adopting mentalism, from the standpoint first of mentalists themselves and then of radical behaviorists.

Keywords: mediational neobehaviorism, mentalism, radical behaviorism

According to Moore (2008), a widely accepted view in the last quarter of the nineteenth century and first quarter of the twentieth century was that consciousness or subjective mental life was an appropriate subject matter for psychology, and introspection was an appropriate method for investigating that subject matter. Despite the widespread acceptance of this view, some researchers and theorists voiced concerns that research findings associated with the view were unreliable and failed to promote agreement. These concerns led to the rise of behaviorism by the end of the first quarter of the twentieth century. Behaviorists such as Watson (1913b) argued that psychology should discard its longstanding concern with conscious mental life as a subject matter and introspection as a method. Rather, psychology should objectively embrace behavior as its subject matter, and rely on experimental observation of that subject matter as its method. By emphasizing objectivity and observability, behaviorism claimed it would avoid such problems as the lack of reliability and agreement that seemed to be inherent in introspective reports.

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However, not everyone was convinced that the proposed form of behaviorism could make good on its claims, and the debate about the relative merits of mentalistic and behavioral approaches to psychology has continued ever since. In particular, scholars have debated whether behaviorism ignored something essential, or at least treated it in an incorrect way, for the purpose of causal explanations of behavior. Four comments are illustrative. The first is from Sober (1983):

> [M]ental states are inner. They are the causes of behavior and are therefore not identical with behavior . . . . Besides claiming that mental states cause behavior, mentalism goes on to say how these mental states manage to do so. (p. 113)

The second is from Fodor (1983; see also Fodor, 1968):

> Behavior is organized, but the organization of behavior is merely derivative; the structure of behavior stands to mental structure as an effect stands to its cause. (p. 2)

The third is from Haugeland (1981):

> Cognitivism in psychology and philosophy is roughly the position that intelligent behavior can (only) be explained by appeal to internal "cognitive processes." (p. 243)

The fourth is from Flanagan (1984):

> Any psychology, therefore, that fails to talk about mental events and processes will not be remotely adequate. The transformations which take place between our ears are the missing links needed to account for the regularities between stimuli and responses. The behaviorist's tactic of only attending to lawlike connections between observable events is comparable to resting satisfied with the knowledge that the Big Bang is responsible for the present state of the cosmos and not giving a hoot about what has gone on in between. (p. 243)

The implications that intelligent behavior can "only" be explained by appealing to cognitive processes, and that behaviorists of any stripe, presumably including contemporary radical behaviorists, "only" attend to observable events, amply testify to the strong feelings involved. To be sure, different mentalists conceive of the causal phenomena in different ways. Nevertheless, mentalism typically holds that a causal explanation of behavior is incomplete at best and defective at worst if it deploys only concepts from the observable behavioral dimension and fails to appeal to unobservable causal phenomena from an extra-behavioral, mental dimension.

For their part, behaviorists have also voiced the merits of their position, in opposition to mentalism. Watson was of course well-known for his arguments at the inception of behaviorism:

> All of these tendencies, initiated by the psychologists themselves, lead directly over to our principal contention, viz., that there are no centrally initiated processes. (1913a, p. 423)

A dozen years later, Watson continued his argument:

> Behaviorism claims that "consciousness" is neither a definable nor a usuable concept; that it is merely another word for the "soul" of more ancient times. The old psychology is thus dominated by a kind of subtle religious philosophy. (1925, p. 3)

In later years, Denny (1986) argued that

> The breath of fresh air provided by the S–R, behavioristic tradition, if overthrown, could set back an objective, scientific view of behavior many years . . . . We simply cannot afford a regression to dualism before we've even shed its remnants . . . .
>
> Finally, cognitive terminology is the language of everyday speech, and because of this, despite its advantage for communicating with the man in the street, is metaphorical and imprecise . . . . It also includes misconceptions that were built into the language over its long span of development. For all of these interrelated reasons, the innumerable evolutionary and experiential variables that determine behavior, of which conscious humans are generally unaware, can be seriously shortchanged within a strictly cognitive framework. (pp. 35–36)

The radical behaviorism of B.F. Skinner differs from the behaviorism advocated by Watson and Denny, but is no less opposed to the role of mentalism and cognitive orientations in psychology. In the passage below, Skinner (1987) was quite explicit about his concerns:

> *I accuse* cognitive scientists of speculating about internal processes which they have no appropriate means of observing. Cognitive science is premature neurology . . . .
>
> *I accuse* cognitive scientists of reviving a theory in which feelings and states of minds observed through introspection are taken as causes of behavior rather than as collateral effects of the causes . . . .
>
> *I accuse* cognitive scientists of relaxing standards of definition and logical thinking and releasing a flood of speculation characteristic of metaphysics, literature, and daily intercourse, speculation perhaps suitable enough in such arenas but inimical to science. (p. 111)

Clearly, behaviorists support their position just as ferociously as mentalists support theirs. The aim of the present review is to examine the relation between mentalism and behaviorism in contemporary psychology by addressing the following questions: (a) How is mentalism defined? (b) What are some examples of mentalism? (c) Why do mentalists say they embrace mentalism? (d) Why do radical behaviorists say mentalists embrace mentalism? Because of the complexity of this topic, I at times take a historical–critical approach and also engage a wide variety of correlated matters, to provide some historical and conceptual background for

the review. Some references are therefore foundational and range from early to mid- to late twentieth century. I do not take a tiresome "straw-man" approach, but rather seek to establish a necessary framework for analysis and evaluation. Overall, I hope to clarify the differences between mentalism and behaviorism, with the ultimate goal of realizing an effective and coherent science of behavior.

How Is Mentalism Defined?

In a sentence, mentalism consists in explaining behavior by attributing its cause to phenomena from a dimension beyond the one in which behavior takes place. More formally, an explanation may be said to be mentalistic when it subscribes to the four assumptions outlined below.

The first assumption is that an organism's psychological makeup includes a dimension that is beyond the one in which behavior takes place, such as by being inside the organism in some sense. The dimension of an explanation is at issue when its concepts are not expressed in descriptively consistent terms and cannot be confirmed through modes of analysis that are methodologically consistent with the behavioral facts for which they are said to account. Terms that are commonly used for this extra-behavioral dimension are mental, cognitive, subjective, spiritual, psychic, conceptual, hypothetical, mystical, and transcendental — in short, the dimension of mind. Henceforth, I use the single term "mental," recognizing that different forms of mentalism emphasize different terms related to this inferred dimension.

The second assumption is that this internal dimension contains certain phenomena that cannot be characterized in the same terms as observable stimuli and responses. The phenomena are unobservable and inferred to underlie behavior. Moreover, the phenomena are inferred to actively modify or transform an individual's experiences in the world at large, rather than merely reflect those experiences in any passive or neutral sense. Terms that are commonly used for these nonbehavioral phenomena are acts, states, mechanisms, processes, entities, structures, faculties, representations, and cognitions. Mentalism applies whether the dimension and its causal phenomena subscribe to either a dualistic or purely materialistic metaphysics. Henceforth, I use the phrase "states and processes," recognizing again that different forms of mentalism emphasize different terms related to these inferred phenomena.

The third assumption is that an explanation of behavior properly and necessarily consists in an appeal to these inferred, unobservable states and processes as causes of behavior, rather than to causes that are to be found in the same dimension as behavior or environmental events, variables, and relations. The way that these states and processes cause behavior differs across different versions of mentalism, and typically ranges from initiating to mediating. By initiating I mean that the states and processes themselves are the source of the behavior,

such that no source beyond them is necessary to explain the behavior. By mediating I mean that observable external stimuli activate or trigger some unobservable intervening or mediating state or process that is causally connected in some complex but systematic way to an ensuing observable response. In any event, the causal principles of mental states and processes differ qualitatively from those of observable events, variables, and relations.

The fourth assumption is that the proper focus of psychological explanations is the specification of the causal properties and capacities of the mental states and processes that are inferred to underlie behavior, rather than the functional relations between behavior and environmental events and variables. Observable behavior is important insofar as it provides evidence to support inferences about the causal properties of the postulated unobservable mental states and processes, rather than because it is a subject matter in its own right.

What Are Some Examples of Mentalism?

For radical behaviorism, mentalism is a common feature of many attempts in Western culture to understand an organism's behavior. Mentalism is sometimes invoked to explain nonhuman behavior, as in the field of "cognitive animal learning" (e.g., Zentall, Hogan, and Edwards, 1984). More often, however, mentalism is invoked to explain human behavior. Although some versions of mentalism subscribe to traditional mind–body or substance dualism, many others deny that they are dualistic and assert they are just as physical and materialistic as any other science, although certain of their analytic concepts may differ from those of other sciences. In what follows, I refer to these versions as ostensibly materialistic mentalism.

Ostensibly Materialistic Mentalism

I begin with perhaps the most common example of ostensibly materialistic mentalism among contemporary psychologists. This example involves a mediational approach. In a mediational approach, some sort of organismic mediator is assumed to be inside the organism in some sense, as part of its psychological makeup. As an illustration, consider the words of Neisser (1967):

> Whatever we know about reality has been *mediated*, not only by the organs of sense but by complex systems which interpret and reinterpret sensory information. The activity of cognitive systems results in — and is integrated with — the activity of muscles and glands that we call "behavior." (p. 3, italics added)

The organismic mediator is neither behavioral nor environmental. Rather, it is an unobservable feature of another dimensional system, though not a dualism.

An important concern is whether the mediator functions according to the same principles as observable stimuli and responses (e.g., Zuriff, 1985, pp. 104, 156). For mentalism, the answer is no. For example, Wessells (1981) argues that generally speaking, "cognitive explanations are biologically oriented, nonphysiological and mechanistic; they bear the unmistakable imprint of rationalism" (p. 155). In light of the negative answers, the mediator has the status of a functionally autonomous causal entity in a nonbehavioral system that underlies behavior. In some versions of a mediational approach, the organismic variables are presumed to be causal by affording "competence" and making the behavior in question possible. In other versions the environment is held to activate or trigger in some complex but systematic way an organismic variable, which in turn is held to activate or trigger in some complex but systematic way an eventual response. The organismic variable is causal in the sense that the mediators are what are temporally contiguous with the response. Regardless, the causal nature of the organismic mediator, such as its features and operating characteristics, is taken as the proper focus of psychological explanations, rather than a functional relation between environmental circumstances and behavior.

Mediational Neobehaviorism

Often, the mediational approach entails a formal commitment to an S–O–R model. Interestingly, this approach is also called mediational neobehaviorism. The prefix "neo" suggests it is a newer form of behaviorism, arising in the second quarter of the twentieth century as a successor to an original, unadorned classical S–R behaviorism (e.g., Watson, 1913b; see also Moore, 2008). Mediational neobehaviorism can be characterized as follows:

S (environmental stimuli) => O (organismic mediators) => R (response)

In straightforward language, the mediational model states that observable environmental stimuli (S) trigger some unobservable organismic mediator (O), which in turn causes an observable response (R). Unlike observable stimuli and responses, the O terms are unobservable states and processes that are inferred to be inside the organism and to mediate the relation between environmental stimuli and responses, as in Neisser (1967).

Following from the philosophy of science, many mediational neobehaviorists typically designate the S and R terms as observational terms, in the sense that the terms can be measured using standard observational methods and instruments. The terms are said to be "intersubjectively verifiable." In contrast, the mediating variables are unobservable. Again following from the philosophy of science, mediational neobehaviorists typically designate these variables as "theoretical terms." The mediating theoretical terms are then "operationally defined" with

respect to publicly observable variables in order to argue that the whole project is scientifically respectable and suitably objective, empirical, and capable of generating agreement. Different versions of this neobehaviorist mediational approach are distinguished by different conceptions of the organismic mediators.

The present review considers mediational neobehaviorism to be mentalistic. Again, some neobehaviorists may well assert that their mediational approach is behavioral, material, and nonmentalistic. For instance, neobehaviorists may argue that the appeal to an organismic mediator is scientifically appropriate and nonmentalistic because the mediator can always be operationally defined by referring to observable stimuli and behavior. Thus, they may argue that they are not proceeding in the same way as traditional introspective psychology, so they should not be considered mentalistic.

I suggest that grounds for viewing mediational neobehaviorism as mentalistic may be found in the words of representative mediational neobehaviorists themselves. For example, according to Kimble (1985),

> Even in Watson's day there were those, most notably Tolman, who attempted to bring mentalistic-sounding concepts back into psychology by means of what amounted to operational definitions. In a general way, the operational point of view did nothing more than insist that terms designating unobservables be defined in ways that relate them to observables. From there it proceeded to a further insistence that concepts defined in this way must have a relationship to behavior. In this way these concepts became intervening variables, ones that stand between observable antecedent conditions on the one hand and behavior on the other. The diagram below serves to summarize this point:
>
> Antecedent — Mentalistic — Behavior
> Conditions Concepts
>
> Independent — Intervening — Dependent
> Variables Variables Variables
>
> Obviously, there is nothing in this formula to exclude mentalistic concepts. In fact, the whole point of it is to admit unobservables. (p. 316)

And according to Amsel (1989),

> It has never been debatable — certainly not among neobehaviorists — that explanations should involve constructs [representing nonbehavioral states and processes that are inside organisms] . . . . And it is really not debatable either that stimulus–response theory refers, as it did in Hull's 21 papers in *Psychological Review* . . . , as well as his *Principles of Behavior* (1943), to hypothetical states and processes that "go on inside organisms." [T]he fact is that for the present S–R theorist, as I think for Hull and certainly for Spence, the mediating machinery defined as hypothetical Ss and Rs are no more or less permissible, and no more or less observable, than are the cognitive constructs the "emergent behaviorists" are now willing to permit . . . . It is an essential contradiction to refer to models of observables; and as I indicated earlier, such a characterization of S–R models does not fit the neobehaviorism of Hull, Spence, Miller, or Mowrer — or any other version of neobehaviorism, including my own. (pp. 50–51, 71)

The passages above reveal the unselfconscious commitment of representative mediational neobehaviorists to mentalistic causal variables and explanations (see also Moore, 1996).

Computer Metaphor

A common metaphor for mentalism in psychology is the computer (e.g., Dennett, 1984; Zuriff, 1985, pp. 160 ff.). To be sure, the computer may be of a very special kind, and some mentalists have come to challenge the metaphor, but nonetheless, the computer metaphor is often cited to rebut charges that mentalism is dualistic. Obviously, nothing of a dualistic ontology is involved in the computer.

A computer has both hardware and software. In simple terms, the hardware corresponds to the brain, and the software to the mind. With respect to its hardware, a computer has input and output devices. On the input side are such things as keyboards, USB ports, and network connections from other computers. These correspond to a person's sensory systems — the basis for registering the S as observable input in the S–O–R model. On the output side are such things as video screens, printers, and network connections to other computers. These correspond to a person's behavior — the R as observable output in the S–O–R model.

The more relevant component of the computer metaphor for the explanatory project of mentalism is its software. With respect to its software, a computer has an operating system that allows it to execute a program. On a given input, the computer's software moves information or "representations" among buffers, registers, and memory locations. The information or representations that are processed can be specified in terms of data structures. The software creates and changes functional machine states in the computer's hardware according to principles that can be described computationally. The internal processes and routines of the computer and the principles according to which the computer creates and changes states metaphorically correspond to the mental or cognitive acts, states, etc., of a person's mind as the person processes information — the O as mediator in the S–O–R model. At issue are the functional capacities, principles, and operating characteristics of the mediating elements in the information processing system as well as the functional architecture of the system as a whole. The processing systems in the person's mind are held to be relatively independent of experience, just as operating systems in a computer are relatively independent of experience, with the unfortunate exception one supposes of some influence of malware. The information processing functions and principles can be specified on a purely abstract and conceptual level, independently of whatever hardware realizes the design in any particular case, though many argue that whatever theory a mentalist proposes, the mentalist should *in principle* be able to describe how it could be realized in an actual mechanism.

Conscious or Unconscious?

In other respects, the phenomena typically cited in mentalistic explanations may be either conscious or unconscious. By conscious I mean that under appropriate circumstances individuals can talk about these mental phenomena, and by unconscious I mean that even under appropriate circumstances individuals cannot. In cases when individuals can talk about mental phenomena, an account of how they come to do so is not offered. Rather, the ability to do so is simply taken for granted as an inherent property of one's mental life.

Why Do Mentalists Say They Embrace Mentalism?

I next review three arguments that mentalists often make about why they embrace their position. The three arguments follow from assumptions and inferences that mentalists typically make about how other forms of psychology approach the matter of explanation, how mentalism offers advantages, and how mentalism is therefore superior. Mentalists particularly contrast their position with any form of behaviorism, regardless of whether it is classical S–R behaviorism, mediational S–O–R neobehaviorism, or radical behaviorism.

Argument 1: Observability

First, mentalists assume that other forms of psychology, particularly behaviorism, are committed to explaining behavior in terms of publicly observable relations between stimuli and responses. Mentalists argue that this commitment leads behaviorists to develop incorrect explanations. Explanations should emphasize unobservable mental states and processes.

To be sure, mentalists acknowledge that a behaviorism committed to observables may once have contributed in some marginally positive fashion to psychological explanations by questioning the reliability of introspection (e.g., Zentall, Hogan, and Edwards, 1984). However, mentalists argue, psychological theories and explanations should no longer be limited to observables. Instead, given such explanatory safeguards as formal hypothetico–deductive practices that were developed after early behaviorism, theories and explanations should now be freely permitted to make use of unobservables, which are inferred to be theoretical and inside the organism in some sense.

Indeed, when it comes to Skinner's radical behaviorism, mentalists often assume that the adjective "radical" implies a fanatical or extreme position that mandates the consideration of only publicly observable variables. One illustration of this assumption is Neisser (1967): "From Watson . . . to Skinner . . . , radical behaviorists have maintained that man's actions should be explained only in terms of observable variables" (p. 5). Another illustration is Nelson (1969):

> Roughly speaking, the behaviorist maintains that the proper subject of animal psychology is overt behavior, i.e., bodily movements, verbal responses, and glandular secretions, and that behavior should be (and hence can be) explained in terms of directly observable events affecting the animal, stimuli, reinforcements, and the like. Some behaviorists permit in addition the use of "intervening variables" or certain "theoretical constructs" — terms which designate inner organismic occurrences of certain kinds. If the behaviorist uses such terms he does so not to throw light on inner occurrences but only as tools for explaining externally observable events; for him terms about inner events must be eliminable and must have a merely heuristic or concept economizing role in inquiry. In terms more familiar to the philosopher, behaviorism advocates employment of observation predicates, including disposition predicates, and eschews nonreducible theoretical terms . . . . For a behaviorist explanation implies a detailed discovery never of how an organism responds, but only of what if [sic] responds to, of the intensity of its response, and of external reinforcements. To the behaviorist the organism is a "black box" and remains such to the end of inquiry . . . . His purpose is to force the relation to be a function (to find a law) without recourse to inner states or biases . . . . He does not look for higher laws containing terms referring to the inner workings of the man from which to deduce the low-level S–R relationships. (pp. 418–419)

Nelson continues as follows:

> It is simply not possible . . . to account for external behavior without asking how the animal works. Psychological explanations *have to be* deductions of laws about external behavior from higher-level theoretical laws about the inner structure of animals. This holds not only for explanations of linguistic and other kinds of intelligent behavior (contrary to Ryle and Skinner) but for very primitive animal–automaton behaviors as well. Animals come with built-in rules, for in a sense this is what an internal state is, whether a memory state or a grammatical category. And there is no finding out about performance, verbal or otherwise (insofar as an animal processes "information"), without investigating the rules. (p. 451)

Thus, many mentalists argue that behavior can and should be understood in terms of some other causes than observable antecedent environmental stimulation. Those causes must be the underlying, unobservable, mental phenomena that yield such features as variability and creativity. One example is Fodor (1981), who appealed to the metaphor of a vending machine to make the case. The input to the vending machine is money, say, in the form of coins. The output is some consumable product, say, a soda. Now suppose that someone has inserted one less than the required number of coins to purchase a soda, and leaves the vicinity of the machine. The next person comes along, inserts a coin, and receives the soda much earlier than expected (i.e., predicted). Fodor argued that this event is entirely understandable from an internalist point of view such as found in cognitive psychology, but not from the externalist point of view such as found in behaviorism. According to Fodor, the dispensing of the soda can be understood (i.e., predicted) as a function of the internal state of the machine. The machine is in the intermediate (n–1) state, such that the relevant property of this state is that the next coin will cause it to progress to the next and terminal state, in which it dispenses a soda. The dispensing of the soda

cannot be understood simply on the basis of inserting coins. Remember that the second individual did not expect (i.e., predict) that the machine would dispense a soda after only one coin.

Another example is Nelson (1969), who appealed to the metaphor of a Turing machine. Such a machine accomplishes some psychologically interesting task by progressing through a series of steps, where each step can be defined as an internal state that follows upon a given input. Progress through the steps may be understood in terms of transitions between internal states, where each state is computationally derived from the application of the rule to the previous state, given an input. Any particular state (and, as necessary, its output) can only be understood on the basis of the internal rule for the transition; it is not fixed by the input into the system.

Finally, according to some mentalist accounts, many if not most of these mental causes are uniquely specialized and "modular" for the particular type of behavior they cause. They are not general purpose mechanisms or processes that can be conscripted to support other forms of behavior (e.g., Fodor, 1983). As Pinker (1997) put it,

> The mind is what the brain does; specifically, the brain processes information, and thinking is a kind of computation. The mind is organized into modules or mental organs, each with a specialized design that makes it an expert in one area of interaction with the world. The modules' basic logic is specified by our genetic program. The operation was shaped by natural selection to solve the problems of the hunting and gathering life led by our ancestors in most of our evolutionary history. (p. 21)

In sum, mentalists regard behaviorism as at best only atheoretical and descriptive, rather than theoretical and explanatory, precisely because of the way behaviorism limits itself to observables. Again, mentalists argue that mentalism is correct and superior to behaviorism because it takes underlying, unobservable causes from another dimension into account in a unique and theoretical way. These mental states and processes are independent contributions of the organism, and reflect an active mind. Any position that does not take these mental states and processes into account, as mentalists assume any form of behaviorism does not, must therefore be dead wrong.

Argument 2: Token and Type Physicalism

Second and related to the first, mentalists assume that other forms of psychology, particularly behaviorism, are committed to the principle of physicalism in an incorrect way. This commitment leads the other forms to develop incorrect explanations of behavior. This section looks first at physicalism, and then at the mentalists' objections to the behaviorist view of physicalism.

As originally interpreted, physicalism is the thesis that for every sentence P

in the language of a branch of science, including psychology, there must be a sentence Q in the language of physics such that P and Q can be logically deduced from each other, without remainder. Physicalism was strongly emphasized in logical positivist philosophy of science at the beginning of the second quarter of the twentieth century, as the logical positivists sought to rationally reconstruct science in ways that did justice to the cognitive significance of important scientific terms and concepts. Smith (1986) has suggested that many wrongly assume behaviorism is very tightly connected with logical positivism, if not subordinate to it.

Suppose a mediational neobehaviorist explains behavior by appealing to something that is not directly observable, such as a mediating "internal state" as an organismic variable. The internal state may in turn be interpreted as a theoretical concept. According to original interpretations of physicalism, the mediational neobehaviorist must in turn be prepared to identify the measurements or readings on instruments that justify talk about the internal state and make such talk meaningful. Such a justification would consist in reducing talk of the internal state to publicly observable readings on meters, dials, counters, and so forth, with nothing left over, so that agreement can be reached.

Pain is a suitable example. Suppose I say some person engages in a particular form of behavior because the person is in pain, where being in pain implies being in some particular internal state. Just what does being in an internal state of pain mean, in terms that are scientifically appropriate? One form of a physicalistic statement might be that a particular type of neurons at stereotaxic location x–y–z inside the skull are firing, where the firing can be detected by the instruments used in physics. Because of these firings, the individual then has a disposition to engage in (observable) behavior, such as moaning and groaning, again where this behavior is detected by the measuring instruments used in physics.

At issue here is the distinction between token physicalism and type physicalism. This distinction was actually framed several decades after the logical positivists advocated their physicalistic approach. Nevertheless, I examine the distinction here because of its direct relation to discussions about how physicalism should be applied in psychological theories and explanations. The first concern is whether an *instance* of being in a mental state can be adequately described in terms of its physical properties. That is, the concern is whether mental terms *denote* physical properties of the organism. This sense of physicalism may be called "token physicalism." Mentalists, at least those who are not overt dualists, say yes and accept token physicalism. Mentalists say it is correct to do so, as token physicalism is consistent with a materialist orientation. At the risk of some debate, I suggest that mentalists say both logical positivists and neobehaviorists also agree and accept token physicalism. Consequently, token physicalism is really not a source of disagreement between mentalism, on the one hand, and either logical positivism or neobehaviorism, on the other hand.

The second concern is whether being in a *type* of mental state can be adequately defined in terms of the *type* of physical properties manifested in the organism said to be in that state. That is, the concern is whether mental terms *connote* physical properties of the organism. This sense of physicalism may be called "type–type physicalism," or more simply just type physicalism. Mentalists say no and reject type physicalism. Mentalists argue that even though instances (i.e., tokens) of mental phenomena surely do have physical properties, which may well involve such features as the firing of neurons and dispositions to engage in some form of behavior, types of mental phenomena are not properly defined in terms of the types of their physical properties. Rather, types of mental phenomena are defined in terms of their *functional* properties. As formally developed, this position is often called "philosophical functionalism." For example, mentalists argue the type of mental phenomenon called "pain" is defined by, or connotes, being in the type of mental state that is causally related to behavior in a particular way, rather than by the type of physiological state defined by the firing of, say, particular neurons at a particular stereotaxic location inside one's skull. Being in that causal state could well be realized in multiple ways. The defining property connoted by each of these ways is that they cause behavior, rather than that they have a common physical property (e.g., Putnam, 1980). In other worlds, silicon molecules might be involved in pain rather than neurons being involved. Similarly, particularly stalwart Spartans might be in pain but would actually laugh and smile, rather than moan and groan. The functionalist argument is that the defining property of the type of psychological state called pain is its causal relation to a particular form of behavior, not any physically observable property. Again at the risk of some debate, I suggest that according to mentalists, both logical positivists and neobehaviorists accept type physicalism. However, according to mentalists, the logical positivists and neobehaviorists are wrong to do so. Mentalists argue that any position that reduces the defining properties of types of mental phenomena to the types of their physically observable properties, as mentalists assume any form of behaviorism (or logical positivism) does, is just dead wrong.

Argument 3: Explanation

Third, mentalists assume other forms of psychology, especially behaviorism, explain behavior in an inadequate way. Following from an emphasis on observables, behavioral explanations take either of two forms: (a) instantiation and (b) the covering law model (see Moore, 2008, chapter 13). Neither is adequate because neither typically identifies the underlying mental states and processes that are responsible for the behavior. The result is that behavioral explanations are dead wrong.

In regard to explanatory practices in mentalism, Wessells (1981) stated that

> One of the chief points made above is that the two approaches [cognitive and behavioral] diverge sharply in their metatheoretical claims and their conceptions about explanation. The chief aims of radical behaviorism are to predict and control behavior . . . . In contrast, the principal aim of cognitive psychology is to explain behavior by specifying on a conceptual level the universal, internal structures and processes through which the environment exerts its effects.
>
> Some unfortunate misunderstandings [between cognitivists and behaviorists] have probably arisen from the failure to discern and to analyze these differences in goals and conceptions about explanation. From the behaviorist outlook, cognitive explanations appear fictional in that they do not refer ultimately to the environment. From the cognitive outlook, behavioral explanations appear incomplete and misguided because they describe but fail to explain the effects of the environment. In order to achieve extensive cooperation between behaviorists and cognitivists, these differences in conceptions of explanation will have to be reconciled. (pp. 167–168)

In addition, Wessells (1982) observed that

> The trouble is that, for cognitivists, functional relations between environment and behavior are not explanatory . . . . No amount of order among observables will satisfy the desire to discover the internal processes through which the environment influences behavior. (p. 75)

It is useful to provide some further background to this argument, as the argument is central to understanding the differences between mentalism and behaviorism. According to instantiation, such events as instances of behavior are said to be explained when they can be described using a general proposition, equation, or law, with variables as parameters in the statement. The parameters can then take on different values in different cases (e.g., they can be "estimated" after the fact from obtained data), with the result that the statement is said to explain the data in question by symbolically representing the data.

An illustration of instantiation in psychology is the psychophysical law of S.S. Stevens: $\psi = kS^n$. Here, ψ is said to represent the strength of the psychological, subjective sensation, as inferred from the participant's reported numerical estimate; k is an individual difference parameter; S is the actual magnitude of the physical stimulus — measured objectively as the physicist would measure it; and the exponent n is the critical term for "sensitivity," relating the subjective estimate of the stimulus to its objective measure. The data from any particular subject were considered to be explained when they were described by particular values of the variables, but the general form of the equation was what was regarded as important, rather than the particular values of the variables. Worth noting further is that at face value, this explanatory strategy speaks only of relations between observable data, and avoids direct appeals to anything unobservable, as when late nineteenth and early twentieth century structuralism appealed to consciousness via introspective methods.

For cognitive psychology, instantiation is inadequate because it doesn't identify the underlying mental states and processes that cause the data to turn out the

way they do. Instantiation might in some cases be considered as a starting point for an explanation, by suggesting that an organism might have some sort of underlying mental states and processes with some sort of functional properties and capacities that are responsible for the data. However, instantiation is not an ending point because it stops short of specifying what the functional properties and capacities of those mental states or processes actually are.

As an aside, I note that cognitive psychology also makes a similar criticism of dispositional approaches to the mental, such as found in philosophical behaviorism. According to this criticism, rendering the mental in terms of a disposition to engage in observable behavior is hardly an explanation because doing so is at best merely descriptive: the rendering fails to specify the mental states or processes that cause the disposition.

The second explanatory strategy is the covering law model (Hempel and Oppenheim, 1948). According to the covering law model, such events as instances of behavior are considered to be explained when their descriptions follow as a valid deduction in a logical argument in which at least one of the premises is a covering law and at least one of the other premises is a statement of antecedent conditions. Adherents to a logical positivist view of the unity of science, including most neobehaviorists, particularly favored covering law explanations.

An illustration of covering law explanation in psychology is the explanation below of why a rat pressed a lever:

Covering law:	Organisms engage in behavior that has previously been reinforced.
Statement of antecedent conditions:	Lever presses have previously been reinforced in the presence of the given antecedent conditions.
Conclusion–description:	The rat pressed the lever.

A noteworthy feature of covering law explanations is the explanatory symmetry between description and prediction. For example, if the statement of the antecedent condition and the conclusion of the argument are in the past tense, the conclusion is in fact a description of what has already been observed. The event — lever pressing — is said to be explained. If the statement of the antecedent condition and the conclusion of the argument are in the future tense, the conclusion is in fact a description of something that has not yet happened but will happen if the antecedent conditions are imposed. The event is predicted: the rat will press the lever. Individuals can then impose the antecedent conditions and determine whether the prediction comports with

the facts of experience. The covering law model accommodates all these matters by emphasizing simply that explanation is a matter of the logical structure of the argument. In addition, given that science is presumed to strive toward the development of laws, the logical validity of the argument is taken as support for the validity of the covering law itself, though it cannot prove the law is true, as saying so commits the fallacy of affirming the consequent. Perhaps the most that can be said is that confirmed predictions "corroborate" the law.

Cognitivists have in general equated behaviorism with covering law explanations (see discussion in Cummins, 1983). Even though the covering law model of explanation has been extraordinarily influential, it has not been without its challenges. Cognitivists have not always originated the challenges, but cognitivists have certainly used them in their own criticisms of what they construe as behavioral explanations. The challenges are of many sorts, but two sorts are relevant for present purposes: (a) conceptual matters relating to the notions of "events," "descriptions," and "laws"; and (b) implications of the explanatory symmetry between description and prediction.

Cognitivists maintain that behaviorism is concerned with events, and that the concept of event is suspect and always has been, from Hume to Mill to the present day (see discussions in Salmon, 1984, 1989). Suppose an individual turns on a light switch while going downstairs in the middle of the night to get a glass of milk. In the process of turning on the light switch, the individual scares away a prowler. One could argue that any of several aspects of this scenario is the event: going downstairs, flipping the switch, the light coming on, or scaring the prowler.

As for description, let us suppose John is a bachelor. Further, suppose John also has red hair. It is unclear whether the John described as a bachelor is the same as the John described as having red hair.

Similar concerns may be raised about laws. Suppose we state a "counterfactual" law, such as saying "If ravens were white, then event N will take place if conditions a, b, and c obtain." According to the technicalities of truth functional logic, any conclusion is true in such cases, and the conclusion cannot be said to possess truth content (Sosa and Tooley, 1993, pp. 205–207, 217–233). Indeed, in a classic article, Meehl (1970, p. 389) pointed out that the problem of counterfactuals pertains directly to the logic of orthodox experimental designs comparing data from one or more control groups with data from one or more experimental groups. The logic of control group methodology is to say that if the control group had been treated the same as the experimental group, its data would have been the same. Again, according to truth functional logic, this conclusion is vacuous, in that it is without truth content. Cognitivists charge that these examples all pose considerable challenges to covering law explanations.

A second challenge to covering law explanations concerns the symmetry of description and prediction (Salmon, 1984, 1989). Three cases illustrate this

challenge. The first starts with the observation that the elevation of the sun above the horizon determines the length of the shadow cast by a flagpole of a given height. If an individual knows the height of the flagpole and the angle of the sun, geometry allows the individual to predict and therefore explain the length of the shadow. In like manner, geometry also allows an individual to determine the height of the flagpole from the length of the shadow. Saying that the length of the shadow "explains" the height of the flagpole seems unreasonable, but according to the covering law approach, it does.

A second case is as follows. Suppose an individual knows that if the barometer drops, there will be a storm. As before, saying the drop in the barometric reading explains the storm, which is an appropriate sense of explanation in light of the covering law model, seems unreasonable. More reasonable is to say the barometer and the storm are simply two effects of a common cause.

A third case is as follows. Suppose John Jones, a male, takes his wife's birth control pills and does not become pregnant. Moreover, any other male who regularly takes oral contraceptives will avoid becoming pregnant. This case conforms to the requirements for covering law explanation. Again, however, it seems unreasonable to regard it as a bona fide explanation of why John Jones or any other male does not become pregnant.

Thus, cognitivists argue against regarding explanation as fundamentally concerned with observable events that are described and then considered to be explained when they are subsumed under a covering law. Cognitivists similarly argue against any position that relies on the covering law model, as they assume any form of behaviorism does.

As an alternative, cognitivists generally favor explanations identifying mental states and processes that are inferred to underlie behavior, which we have seen throughout the present review. These states and processes are inferred to possess the functional capacities and properties that can explain the observed events, in the appropriate and meaningful sense of explain. Overall, the concern is not with performance as an event, but with the internal structures that make the event in question possible (Cummins, 1983). The question of "Why does x occur?" is taken to mean "By virtue of what capacities and properties in the object(s) under observation does x occur?" As before, any position that does not explain behavior in these terms, as mentalists assume any form of behaviorism does not, must be dead wrong.

Why Do Radical Behaviorists Say Mentalists Embrace Mentalism?

In this section I examine how the three mentalist arguments above apply to mediational neobehaviorism and radical behaviorism. I argue that mentalism seriously misunderstands both mediational neobehaviorism and radical behaviorism, though in different ways. I conclude that mentalism and neobehaviorism

are actually compatible, not different from each other as each maintains, and that each differs from radical behaviorism.

Argument 1: Observability

Recall the first mentalist argument assumes that behaviorist explanations wrongly appeal primarily if not exclusively to publicly observable stimulus–response relations. Mentalists argue that explanations should appeal instead to unobservable mental states and processes.

With respect to mediational neobehaviorism, I point out that it actually does not assume explanations should be limited to observables. In fact the whole history of appeals to organismic mediators as theoretical terms in neobehaviorism is surely evidence that neobehaviorist explanations freely appeal to unobservables, as the previously cited passages from Kimble (1985) and Amsel (1989) indicate. The emphasis on operationism may make the appeal to unobservables in neobehaviorism indirect rather than direct, but the appeal is there nonetheless. Indeed, neobehaviorism favors its versions of unobservable organismic mediators for many of the same reasons that cognitive psychology favors its versions of cognitive states and processes. Ironically, cognitive psychologists are just as incorrect in arguing against neobehaviorists as neobehaviorists are in arguing against cognitive psychologists: cognitive psychology and neobehaviorism are comparably mentalistic precisely because of the way they both appeal to mediating causes from another dimension in their theories and explanations.

With respect to radical behaviorism, an important matter concerns the notion of antecedent causation. Roughly speaking, the notion of antecedent causation consists in the commitment to some antecedent factor as the principal if not exclusive cause of the event in question. Mentalism implicitly accepts the notion of antecedent causation, such that causal analysis consists in identifying one or another underlying mental state or process as the casually effective antecedent for behavior.

Moreover, mentalism assumes that radical behaviorism also accepts the notion of antecedent causation, but that it is committed to the wrong antecedent. That is, mentalists apparently assume that radical behaviorism is committed to the view that behavior is determined in a one-for-one way by an observable environmental stimulus, as some form of S–R psychology, rather than by an underlying mental state or process. The passage from Nelson (1969), cited earlier in the present review, is surely evidence of this assumption. Although there is a sense in which antecedent causation may be relevant in analyses of respondent behavior (recognizing that neither unconditioned nor conditioned respondent behavior is as simple as some take it to be), for radical behaviorism the important form of behavior is operant behavior, not respondent behavior. For operant behavior, the important causal mode is selection by consequences, not antecedent

causation. Thus, cognitive criticisms assume radical behaviorism is committed to antecedent causation in terms of observable antecedent environmental stimuli, when the very concepts of operant behavior and selection by consequences plainly indicate it is not. Once again, cognitive criticisms are wide of the mark, and the grounds for holding cognitive explanations to be necessary and superior are incoherent.

For its part, radical behaviorism suggests that the undeniable richness, novelty, and rapid development of verbal behavior can be a function of stimulus generalization as well as equivalence relations. Textbooks are full of common examples. Consequently, further examples are not offered here. Suffice it to note that the very notion of operant behavior suggests an organism that is actively operating on its environment. Once again, it is incorrect for mentalists to claim unique credit for their position. Radical behaviorism works according to the framework of operant behavior, which differs from the S–R framework of classical behaviorism. Many mentalists fail to recognize the difference, assuming all forms of behaviorism accept the S–R framework. Thus, the understanding that radical behaviorists have of the provenance and maintenance of both nonverbal and verbal behavior is very different from the understanding that cognitive psychology and mediational neobehaviorism have. Consequently, radical behaviorism ends up at a very different place.

Finally, I point out that radical behaviorism doesn't prescribe that theories and explanations of behavior should be limited to events, variables, and relations that are publicly observable, and has never claimed they should be so limited. For example, an important feature of Skinner's radical behaviorism is that of a private behavioral event. A private behavioral event occurs within the skin in a way that is not accessible to any other person. Nevertheless, a private behavioral event is regarded as within the behavioral dimension, and amenable to the same type of analysis as is a public behavioral event. Therein lies the difference between radical behaviorism, on the one hand, and both mentalism and mediational neobehaviorism, on the other hand. As Skinner put it,

> No matter how clearly these internal events may be exposed in the laboratory, the fact remains that in the normal verbal episode they are quite private . . . . There is, of course, no question of whether responses to private stimuli are possible. They occur commonly enough and must be accounted for. But why do they occur, what is their relation to private stimuli, and what if any, are their distinguishing characteristics? (1945, p. 273)

> When we say that behavior is a function of the environment, the term "environment" presumably means any event in the universe affecting the organism. But part of the universe is enclosed within the organism's own skin. Some independent variables may, therefore, be related to behavior in a unique way . . . . With respect to each individual, in other words, a small part of the universe is private.
>
> We need not suppose that events which take place within an organism's skin have special properties for that reason. A private event may be distinguished by its limited accessibility but not, so far as we know, by any special structure or nature. (1953, pp. 257–258)

Again, however, the radical behaviorist basis for including phenomena that aren't accessible to more than one person differs from that of mentalism and mediational neobehaviorism. The mentalist argument, whether by cognitive psychologist or mediational neobehaviorist, implicitly accepts the mentalistic view that words are things whose meanings are established by determining what the words symbolically represent or refer to: either observable objects or events in the world at large or unobservable acts, states, etc., in the minds of individuals. On this view, the term behavior is taken to refer to something that is observable. If something is not observable, it must not be behavioral. Rather, it must be going on in the dimension of mind, such that it must be dealt with in a different way than is observable behavior. Radical behaviorists reject this symbolic, referential view of verbal behavior and its assumption of events in the mind as erroneous. Readers may consult Skinner (1957) for a comprehensive treatment of how the functional view of verbal behavior in radical behaviorism differs from the symbolic, referential view in mentalism. Consequently, any verbal distinction between what is and is not publicly observable needs to be considered very carefully. In particular, radical behaviorism argues that the mentalist position about the role of unobservables in the history of science seriously misreads the nature of scientific behavior, especially scientific verbal behavior, for example, as found in Skinner (1957, chapter 18 on logical and scientific verbal behavior; and 1953, p. 275 ff., on the verbal process of abstraction). Thus, radical behaviorism finds the mentalist alternatives, based on the supposedly unique and theoretical way mentalism accommodates unobservables, as distinctly unsuitable.

As seen in the previously cited passages from Skinner (1945, 1953), radical behaviorism argues that some parts of the environment as well as some instances of behavior are private or covert, in the sense that they are not accessible to more than one person. However, there seems to be no good reason to label them as from a mental rather than behavioral dimension, simply because they are not observable from the vantage point of another person. The private, covert phenomena may be talked about and incorporated in the same way as observable stimuli and behavior.

As one example, consider the topic of introspection. Radical behaviorists argue that when individuals introspect they are behaving. Individuals introspect when the social community in which they live induces them to respond either verbally or perhaps even nonverbally to their own behavior and the circumstances that cause that behavior. Individuals introspect when they engage the full ecological context of their lives. Introspective terms do not mean individuals are reporting on as many as 42,415 different mental states and processes that cause their behavior. In the first place, the processes that would be necessary to establish such fine-grain verbal discriminations are not plausible. In the second, humans do not even have nerves going to the right places (e.g., in their brains) to make contact with the supposed causal states and processes.

As another example, consider terms held to manifest "propositional attitudes," such as beliefs, desires, and intentions. Radical behaviorists argue such terms are concerned with operant behavior. In these cases, behavior is guided by an actor's own verbalizations of what the actor is doing and why, particularly concerning the consequences of those actions, however incipient or inchoate such verbalizations may be. As with introspection, such terms do not mean that an actor's behavior is caused by mental phenomena in another dimension. Comparable analyses may be carried out on other nominally mental terms, such as agency or intensionality. Thus, radical behaviorism may well include explanatory and interpretive concepts that are occasioned by events, variables, and relations not accessible to others, but it does so very differently than does the mentalism of cognitive psychology and neobehaviorism.

Argument 2: Token and Type Physicalism

Recall the second mentalist argument assumes that behaviorist explanations wrongly subscribe to type physicalism. Mentalists argue that explanations can legitimately involve token physicalism but not type physicalism.

Interestingly, contemporary forms of mediational neobehaviorism don't actually hold to physicalistic definitions in the way that mentalists charge. To be sure, historical review suggests that mediational neobehaviorists do adhere to the distinction between observational terms and theoretical terms. As in logical positivism, observational terms can be measured using the instruments of physics. Theoretical terms are unobservable. At issue then is how to define theoretical terms. The common answer is through the operational definitions: by referring to the observable operations and calculations entailed in their measurement (Bridgman, 1927). Logical positivists had initially embraced the idea that theoretical terms were to be exhaustively defined in a physical-thing language. That is, on the basis of their interpretation of physicalism, logical positivists held that theoretical terms and concepts were to be defined *without remainder* by referring to observables. Similarly, mediational neobehaviorists initially embraced a particular interpretation of operationism that involved exhaustive definitions of theoretical terms and concepts in a physical-thing language. Such an approach implies that the position later called type physicalism was essentially correct.

However, logical positivism actually dropped the requirement for exhaustive definitions during the 1930s (e.g., Carnap, 1936, 1937; see Zuriff, 1985, chapter 4). The logical positivists instead came to favor partial definitions. Partial definitions explicitly allowed for the term to have meaning that applied to other situations. The logical positivists were particularly concerned about the existential status of a dispositional property if the test operation that was held to demonstrate or measure the property was not being carried out at literally that moment in

time. Suppose we ask why sugar dissolves when it is placed in a beaker of water. One answer is that it does so because it is soluble. This answer invokes solubility as a dispositional property, defined as the robustly high probability of dissolving when put in water. The answer carries a number of implications: (a) that solubility is a property that exists and is possessed by the sugar, even though the test operation to demonstrate solubility isn't being conducted at literally that moment in time; (b) that the solubility of sugar applies tomorrow just as much as today, even though the sugar hasn't yet been put in the water; (c) that sugar's solubility could be revealed by another sort of test operation, if only in a different beaker of water; and (d) that the meaning of any particular theoretical term is only partially rather than exhaustively established by any particular test operation, given that other test operations might be devised to demonstrate the property. Given such implications, the logical positivists came to embrace the idea of partial definitions, which allowed them to neutralize concerns about the generality and flexibility of theoretical terms.

An approach based on physicalism and mandating exhaustive definitions of theoretical terms ultimately proved as controversial in mediational neobehaviorism as it had in logical positivism. There was general agreement that scientific statements should in fact be general and broadly applicable. However, exhaustive definitions were problematic because they explicitly limited the range of application to the one case in which they were formulated. In a controversial article on operationism in *Psychological Review*, the psychologists Israel and Goldstein (1944) commented critically on the relation between operationism and the breadth of meaning of psychological terms, and how that meaning in turn affected research methods in psychology. The article caused such a stir that E.G. Boring, long an advocate of operationism, suggested to Herbert Langfeld, the editor of *Psychological Review*, that a symposium be convened under the auspices of the American Psychological Association to resolve some of the disputed points. Six individuals participated: E.G. Boring, P.W. Bridgman, H. Feigl, H. Israel, C. Pratt, and B.F. Skinner. Boring devised a series of questions that each participant might address. Participants were also asked to add their own questions. In their answers, participants danced around the questions, mainly restating entrenched positions. Regrettably, nothing of substance was actually resolved.

More than ten years after logical positivism had moved beyond the requirement for exhaustive definitions and three years after the aforementioned Symposium on Operationism, the psychologists MacCorquodale and Meehl (1948) published a landmark article in which they proposed a linguistic convention concerning unobservable theoretical terms. More specifically, they suggested one type of theoretical term be called an "intervening variable," and another a "hypothetical construct." An intervening variable was simply a summary term and did not refer to an entity that actually existed. For example, it might be the product of a mathematical function. It was exhaustively defined according to the processes

and operations in its computation. In contrast, a hypothetical construct was assumed to have some existential status. Importantly, it was not defined by a single referent or process. Rather, it had multiple referents, no one of which was all inclusive. Given its existential status, it was assumed to have properties and implications and extrapolations that hadn't yet been demonstrated. Any particular explanatory application only partially rather than exhaustively defined its meaning.

Mediational neobehaviorists looked favorably upon the MacCorquodale and Meehl (1948) distinction, as it resolved many of their earlier concerns. Under a hypothetical construct interpretation, psychological terms could now admit "surplus meaning," which they could not under exhaustive definitions. It was not that prior to 1948, all theoretical terms for mediational neobehaviorists were intervening variables, and after 1948, all theoretical terms were hypothetical constructs. Rather, the controversy was that psychologists had assumed all along that most of their theoretical terms were things that did actually exist, for example, as independent variables that influenced the behavior of subjects, but had to be exhaustively defined. However, given an exhaustive definition, psychologists expressed concern because they couldn't then use the term to develop general principles or build general systems. The advent of hypothetical constructs afforded the necessary flexibility. In this regard, readers may recognize that Miller (1959) later talked of how the meaning of psychological terms had become "liberalized" in mediational neobehaviorist theorizing.

In any event, because mediational neobehaviorism came to accept a hypothetical construct interpretation of theoretical terms that permits surplus meaning, especially concerning the mental (e.g., Amsel, 1989; Kimble, 1985), I argue that contemporary forms of mediational neobehaviorism accept token physicalism but not necessarily type physicalism, just as mentalists say is appropriate. Thus, mentalists err when they condemn contemporary forms of mediational neobehaviorism for their supposed acceptance of type physicalism. Cognitive psychologists are just as incorrect in arguing against contemporary forms of mediational neobehaviorism as contemporary mediational neobehaviorists are in arguing against cognitive psychology — cognitive psychology and contemporary neobehaviorism are comparably mentalistic.

For his part, Skinner was influenced a great deal by Bridgman and operationism, as he acknowledged later on: "In my thesis I had proposed an operational definition of a reflex, drawing upon Bridgman, Mach, and Poincaré" (Skinner, 1979, p. 116). What Skinner was talking about here was his dissertation from the winter of 1930–1931, and about the writing of which he had sparred extensively with Boring, one of his mentors in the Harvard Department. Skinner's interpretation of Bridgman and operationism as reflected in his 1945 Symposium contribution differed from that of the others, especially Boring. For Skinner, operationism entailed the functional analysis of verbal behavior. Early in his contribution to

the Symposium, Skinner (1945) argued that

> A considerable advantage is gained from dealing with terms, concepts, constructs, and so on, quite frankly in the form in which they are observed — namely, as verbal responses. There is then no danger of including in the concept that aspect or part of nature which it singles out . . . . Meanings, contents, and references are to be found among the determiners, not among the properties, of response. (p. 271)

For Skinner and his radical behaviorism, the determiners in a causal analysis of verbal behavior are the elements of the contingencies that govern the emission of the response (e.g., Skinner, 1957, p. 10). Particularly important are the antecedent circumstances that occasion the verbal response in question. In everyday language, the concerns focused on the events, variables, and relations with which the speaker was in contact, and that lead to the verbal behavior in question. Skinner's contribution rejected the idea that operationism should be interpreted from the standpoint of the symbolic, referential view of language. Yes, the question of how to engage the meaning of scientific terms was important, and yes, operationism contributed to an answer. However, it did so by assessing the extent to which scientific verbal behavior was occasioned by scientific operations and contacts with data, as opposed to other, incidental sources of control that were cherished for extraneous and irrelevant reasons. Verbal behavior under the latter source of control could be safely discarded because it did not lead comparably to effective action. In particular, operationism did not contribute as traditionally assumed, namely, by legitimizing the use of public observations as proxies to represent an unobservable but nonetheless causal mental process going on in a nonbehavioral dimension, just so people could agree. With regard to psychological terms, some of the determiners may well be private behavioral events inside the skin, but again they may be accommodated in the same way as such determiners as public behavioral events, outside the skin. The terms do not symbolically represent a mental process that differs from a behavioral process. This view of verbal behavior promotes an understanding of the relation between private behavioral events and both nonverbal and verbal behavior, and ultimately promotes effective action, such as prediction and control.

In his contribution, Skinner (1945) pointedly argued against the traditional view of operationism, which implied that any operation can be asserted after the fact to be the measure of any desired unobservable causal phenomenon, and that the approach should therefore be considered scientific. Surely, Skinner argued, this approach will not do. Thus, Skinner argued the traditional view of operationism only perpetuated rather than resolved the longstanding mental–physical distinction in psychology and the attendant view that mental phenomena caused behavior.

Later in his contribution, Skinner (1945) stated as follows:

> The public–private distinction apparently leads to a logical, as distinct from a psychological, analysis of the verbal behavior of the scientist, although I see no reason why it should. Perhaps it is because the subjectivist is still not interested in terms but in what the term used to stand for. The only problem which a science of behavior must solve in connection with subjectivism is in the verbal field. How can we account for the behavior of talking about mental events? The solution must be psychological, rather than logical, and I have tried to suggest one approach in my present paper. The complete lack of interest in this problem among current psychological operationists is nicely demonstrated by the fact that the only other members of the present panel who seem to be interested in a *causal* analysis of verbal behavior are the two non-psychologists (one of them a logician!). (p. 294, italics in original)

The passage above is noteworthy in its forceful commitment to a "*causal* analysis of verbal behavior" and reformulation of the relevance of a so-called "logical analysis," especially in cases of psychological terms. In another portion of his contribution, Skinner argued that "If it turns out that our final view of verbal behavior invalidates our scientific structure from the point of view of logic and truth-value, then so much the worse for logic, which will also have been embraced by our analysis" (p. 277). This entire orientation is decidedly at odds with a traditional orientation, certainly within philosophy but also psychology, that emphasizes language as inherently a symbolic, referential process, and logic as a kind of superordinate template from another dimension to which language must conform, such that specification of the logical status of terms is necessary for the proper determination of what language means. Indeed, to so view logic is part of the problem that mentalism causes.

Importantly, the functional approach recognizes that stimuli and responses are generic concepts — they belong to classes, and the functional relations (such as the one called reinforcement) obtain between classes of stimuli and responses. To be sure, radical behaviorism does accept that there is a physical, material world that affects the behavior of organisms: "What is lacking [in traditional mentalistic psychology] is the bold and exciting behavioristic hypothesis that what one observes and talks about it is always the 'real' or 'physical' world (or at least the 'one' world) and that 'experience' is a derived construct to be understood only through an analysis of verbal (not, of course, merely vocal) processes" (Skinner, 1945, p. 293). However, as before, radical behaviorism proceeds very differently with its explanatory concepts than does the mentalism of mediational neobehaviorism and cognitive psychology. Once again, the basis for the radical behaviorist position differs from the mentalism of both mediational neobehaviorism and cognitive psychology.

Argument 3: Explanation

Recall the third mentalist argument against behaviorism concerns explanation. For mentalists, behavioral explanations wrongly take the form of instantiation or more often deductions from covering laws involving publicly observable vari-

ables. Mentalists argue that explanations should appeal instead to the causal properties and capacities of mental states and processes.

The distinctions and practices of radical behaviorist explanation often do not map neatly onto traditional distinctions and practices. In the most general and conventional use of the term "explanation," radical behaviorism labels an instance of verbal behavior as an explanation when the verbal behavior in question is occasioned by the causal influence of environmental factors on behavior at the level of phylogeny, ontogeny, or culture (Moore, 2008, chapter 13). Typically, that influence takes the form of a functional relation. For instance, in talking of behavior that developed during an organism's lifetime, Skinner (1964) stated "When I said 'explanation,' I simply meant the causal account. An explanation is the demonstration of a functional relationship between behavior and manipulable or controllable variables" (p. 102). Thus, the radical behaviorist position is that an event is explained when a speaker's verbal behavior is under the discriminative control of the observed functional relation, that is, under the discriminative control of the functional relation between the variables participating in the event and the behavior of interest. Causal explanation plays a central role in Skinner's system, given the fundamental concern with practical outcomes, and causation is expressed as a functional relation, in the fashion of Mach and Russell. To say that an event is explained is equivalent to saying that the events, variables, and relations that caused it have been identified. The events may be described in abstract and economical terms using a minimal number of concepts, showing relations among the elements so described, but at the heart of the explanatory process is the identification of functional relations. When individuals are asked to explain what they mean, they are typically being asked to specify what has caused them to say what they have said.

In any event, radical behaviorism does not adhere to instantiation or covering law approaches to explanation in the same sense as does neobehaviorism. Instantiation fails to identify the contingencies responsible for the behavior being described. In the case of Stevens' psychophysics, the mentalistic assumption is that the verbal report (or a discrimination procedure more generally) veridically reflects the sensation as an internal cause. For a radical behaviorist, individuals clearly do have sensations, such as those caused by environmental circumstances. To say otherwise is to adopt the dualistic Cartesian view that individuals just do have such clear and distinct perceptions about phenomena inside them that the individuals could not possibly be incorrect when they talk about those phenomena. In this regard, the assumption is that individuals are just automatically able to correctly describe their internal events, by virtue of having a "private language" that enables them to do so. Day (1969, p. 495) argued that in many accounts, an appeal to a private language is a prime indicator of mentalism, if not dualism.

Regarding radical behaviorism and covering law approaches, I note that in principle, manipulation of verbal statements may well inform decisions about what interventions may be expected to produce what effects, as a pragmatic matter. Indeed, the derivation of empirically supported generalizations that can guide effective action without others having to go through the derivation is surely one of the goals of science. Often such generalizations are sufficiently abstract to be called "laws." Nevertheless, at issue is effective action, not the logical form of an argument. On the one hand, suppose an individual wants to have a flagpole of a given height. If so, the individual can just build it. Individuals can't independently manipulate the length of a shadow in a way that would allow them to predict whether its height meets their needs. On the other hand, suppose for some reason an individual wants to have a shadow of a particular length at a particular time of day. If so, the individual can independently manipulate the length of the flagpole, so that it does produce a shadow of the desired length. It isn't that logic is irrelevant, but rather that practical, effective action is the fundamental concern.

Simply put, the argument here is that radical behaviorism does not adhere to instantiation and covering law approaches to explanation as those approaches are traditionally conceived. Accordingly, attempts in cognitive psychology to discredit radical behaviorism by discrediting instantiation and covering law approaches and then implicitly linking radical behaviorist explanatory practices to these approaches is well wide of the mark.

Moreover, radical behaviorism calls attention to the continuing problem of the source of control over the supposedly unobservable, underlying acts, states, etc., of cognitive explanations. For radical behaviorism, much of the control over the verbal behavior called a cognitive explanation is to be found in extraneous sources that are cherished for irrelevant and incidental reasons: (a) social–cultural traditions as exemplified in "folk psychology," (b) linguistic practices in which adjectives and adverbs are reified into nouns and awarded causal status, and (c) mischievous metaphors. Such sources of control are at variance with the established observational foundations of science. Cognitive psychologists argue that the history of science reveals unobserved factors should not be ruled out of consideration — talk of atoms and subatomic particles is valid in physics and chemistry, talk of receptor sites is valid in biology, and so on. Radical behaviorists answer that it is necessary to examine the sources of control over any verbal behavior taken as explanatory. As Day (1969) noted, "To fail to view the problem of explanation . . . as *inescapably* an empirical and behavioral problem, is perhaps to miss the force of what well may be Skinner's major contribution to psychological thought" (p. 505). An instrumentalist orientation does not justify appeals to cognitive processes in another dimension any more than it justifies appeals to a luminiferous ether, phlogiston, or vitalism in other sciences.

To be sure, explanatory extensions of known processes in the one dimension are well accepted in science, even though formal laboratory or experimental analyses have not been conducted. Lyell had a principle of uniformitarianism. Geologists appeal to plate tectonics. Biologists appeal to evolutionary mechanisms. The laws of physics are taken to apply in outer space or the deepest depths of the ocean. Radical behaviorists call this practice "interpretation" (e.g., Moore, 2008, chapter 13). Indeed, in testimony to the importance of such interpretive extensions Skinner (1957) called his account of verbal behavior "an exercise in interpretation rather than a quantitative extrapolation of rigorous experimental results" (p. 11). The important point is that such interpretive extensions do not appeal to causal events that are assumed to be taking place somewhere else, at some other level of observation, which must be described in different terms and measured, if at all, according to a different ontology than known processes. Thus, cognitive explanations are not interpretive in the present sense. As Skinner put it, appeals to mediating mental states and processes in cognitive psychology "have nothing to do with scientific advances but rather with the release of the floodgates of mentalistic terms fed by the tributaries of philosophy, theology, history, letters, media, and worst of all, the English language" (Catania and Harnad, 1988, p. 447). If the hallmark of explanation is effective action, such as prediction and control, the radical behaviorist argument is that cognitive explanations do not sufficiently advise anyone what to do, or what to take into account, in order to secure a given outcome in the one, behavioral dimension.

Causes

The present argument is that to explain an event like behavior is to specify its cause. Aristotle's classic approach in terms of material, efficient, final, and formal causes may be reconstrued to outline the possibilities for variables and relations that can be manipulated to cause some desired outcome (e.g., Moore, 2008, chapter 13). Here, the material cause may be reconstrued as the physiology of the sentient organism. The efficient cause may be reconstrued as the contingency: the interrelation among antecedent circumstances, behavior, and consequence of the behavior. The final cause may be reconstrued as the consequence itself, providing a function of the behavior in the life of the organism. The formal cause may be reconstrued as the antecedent circumstance or source of discriminative stimulation in the contingency. Logic serves its valuable purpose by examining the boundaries of the classes of variables and relations participating in such actions. The concern is with identifying the circumstances under which a contingency (with such and such a discriminative stimulus and such and such a consequence) can be expected to produce such and such a behavioral effect. Again, the relations so expressed may be abstract, but in principle they can be traced to pragmatic concerns about what actions yield what outcomes.

Physiological manipulations literally change the state of an organism, as a material cause. For example, food deprivation brings about physiological changes called a state of hunger, and water deprivation brings about changes called a state of thirst. In this sense it is meaningful to say that depriving a rat of food or water *causes* it to press the lever when food or water is a consequence of doing so. In addition, there are other motivating operations that pertain to the concept of state. Social psychologists manipulate mood or attitude in an experiment by presenting stimuli correlated with various social practices in culture, such as what is likely to be reinforced or punished. These manipulations make some classes of actions more or less probable by changing the behavioral effectiveness of other consequences. Presumably, these manipulations have changed something physiological inside the behaving organism, although the locus of the change is typically not specified. Traditional psychology embraces these manipulations as affecting the internal state as a mediating organismic variable from another dimension in the S–O–R model. On a traditional view, operational definitions are held to safeguard the process and promote agreement, thereby making the whole process legitimate.

Zuriff (1985, p. 57) points out that a state can function as a parameter in expressing the relation between stimulus and response, and vice versa. Thus, statements 1 and 2 below are logically equivalent:

1. Given (state of organism), if (contingency), then R will occur
2. Given (contingency), if (state of organism), then R will occur

Suppose a covering law model of explanation is accepted. If statements 1 and 2 are logically equivalent, then radical behaviorism pragmatic considerations prevail for the purpose of explanation. At issue is what is to be done to cause the event in question, or what is to be done to predict and control. In principle, accepting either the state of the organism or the contingency as given and then imposing the other will suffice. With respect to statement 1, the pragmatic issues are (a) how to put the organism in the state in question, so that the desired behavior follows; and (b) how to discern that the organism is actually in some particular state, if a manipulation hasn't been performed to put it in the state. With respect to statement 2, the pragmatic isssues are (a) how to put the contingency in effect, so that the desired behavior follows; and (b) how to determine the range of states over which the contingency may be expected to produce the desired behavioral effect.

Behavior analysis has no particular problem with a pragmatic interpretation of states. Indeed, in a discussion of his own research, Skinner pointed out that "One of my first papers . . . was on the state of hunger (or 'drive'), and I have been interested in states off and on ever since" (Catania and Harnad, 1988, p. 122). Elsewhere, Skinner stated that "The organism behaves as it does because of its

present state" (Catania and Harnad, 1988, p. 305). The radical behaviorist concern about mentalism is that states are traditionally conceived as in an extra-behavioral dimension, and to follow different rules than variables and relations in the behavioral dimension. One problem with traditional psychology is that the logical equivalence of statements 1 and 2 above is taken to justify the reality of the state variable however it is conceived, even if from a mental dimension.

A radical behaviorist view leads on to different views of the epistemological role of theories, models, and equations in science. For radical behaviorism, they are typically verbal products called abstractions, continuous with or extensions of basic data. They are economical and abstract descriptions of organizations and relations among data, expressed in a minimal number of terms. The periodic table of elements is a suitable example. The periodic table is a statement about organizations of data. Similarly, the gas laws are abstract statements about relations among pressure, temperature, and volume, apart from the specific events that cause the changes in pressure, temperature, and volume. These forms of science obviously do not appeal to intervening or mediating acts, states, mechanisms, processes, entities, and so forth from a different dimension.

Material causes for radical behaviorism are about the physiology of the organism and its states, where states are interpreted as above. Information about material causes can be used to predict and control, recognizing that the organism is also always going to be in contact with some specific set of environmental circumstances. Being able to produce a given behavioral effect by putting an organism in a given state, even though environmental circumstances may vary widely, adds to the value of knowing about actual state manipulations. Being able to produce a given behavioral effect by imposing a given set of contingencies, even though an organism's initial state may vary widely, adds to the value of the contingency manipulations. Those questions and trade-offs are empirical.

Manipulations of environmental circumstances are the stuff of efficient, final, and formal causes. Obviously these causes are not independent of material causes. If the formal cause is the discriminative stimulus, an auditory stimulus of 30,000 Hz is not going to function as a discriminative stimulus for a human because of the limitations of the material cause. If the final cause is the reinforcer, a food pellet is not going to increase the probability of the response if the organism is not hungry, given that a state of hunger may be construed as a material cause. Thus, it is meaningful to say that turning on a discriminative stimulus *causes* a rat to press the lever, or the consequence of a food pellet *causes* a rat to press the lever, or the contingency involving discriminative stimulus, response, and consequence *causes* the rat to press the lever. As before, these variables and relations derive from the one, behavioral dimension, not a mental dimension. Importantly, they are relevant to prediction and control when manipulated or at least known about.

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The Locus of Stimuli Meaning in the Influence of Attention on Movement: Meaning-Dependent Response Activation Model

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Studies are reviewed regarding the influence of attention capture (in either an endogenous or an exogenous manner) on movement. Those studies used discrete-trial movements, such as grasping or reaching for an object, to account for that influence. This review and its conclusions are derived from a more ecological, realistic perspective, taking into account the possible application of future findings on real-life tasks. In general, previous models and theories have highlighted the spatial and temporal characteristics of the way stimuli present into the visual scene. This present work is not focused on analytical, physical features of stimuli, but on a holistic, mental meaning of stimuli's representation accounting for the distinct kinds of effect given on this cognitive-processes relationship. A new perspective is proposed, relying on the meaning a stimulus can have per se, or on the context wherein a stimulus is presented, to explain prior findings and to address future issues on this topic. This original account can be applied practically to scientific analysis, for example, of those points in roads with high likelihood of car crash — also known as "black spots" in road safety. It is assumed that current road designs do not take into account possible, non-obvious counterproductive effects given by the interaction of different meanings together and inserted in a determined context.

Keywords: movement, endogenous, exogenous

Spatial attention has been classically conceived within a setting of a supramodal control mechanism (see Posner and Dehaene, 1994, for a review) that improves the processing of sensory information coming from a determined part of environmental space. Nonetheless, Rizzolatti, Riggio, Dascola, and Umiltà (1987, for an introduction) challenged this classical view by proposing that the movement of attention is caused, in part, by the activation of common structures for the to-be-

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performed action, thus introducing a completely new perspective. Current evidence for this assumption comes from a series of experiments where overlaps have been found for both underlying neuronal networks (Corbetta et al., 1998; Nobre, Sebestyen, and Miniussi, 2000) and similar differentiation of the areas that make up their structure in spatial coordinates (Rizzolatti, Riggio, and Sheliga, 1994). The so-called *premotor theory* (Rizzolatti et al., 1987) suggests that cognitive systems for attention and action are more closely linked than previously supposed; assuming that attention derives from preparation to move the eyes towards the cued location. Therefore, there is no need to postulate two distinct mechanisms for the control of attention and action. Evidence seems to support this assumption since, when the eyes cannot move towards a certain location, the attention cannot move either (Craighero, Carta, and Fadiga, 2001; Craighero, Nascimben, and Fadiga, 2004).

The concept of affordance affirms that the perception of any object elicits a response that can be carried out with that very object (see Tucker and Ellis, 1998, for a review). Tipper, Lortie, and Baylis (1992) proposed that this repertoire of available actions makes necessary the existence of an action-selection mechanism for deciding what action to perform in order to best achieve the subject's goals.

The perception both of target (defined as that stimulus which is related to a subject's goals) and distractor stimuli (those stimuli which are not related to the subject's goals) triggers the automatic initiation and parallel programming of suitable movements in response to each one and the subsequent inhibition of the interfering motor process elicited by the distracter. The consequence of this action-selection process is not only a longer reaction time by the subject but also a longer time for the entire movement compared with the same goal in the absence of distracters (Weir et al., 2003).

Coherent with the idea of the competition between target and distracters to emerge in behavior, various studies have dealt as well with the plausible spatial repercussions on movement (e.g., its trajectory). However, for some time these studies were inconsistent in their results, finding the trajectory of movement, in some cases, was veering towards the distractor allocation (Tipper, Howard, and Houghton, 1999) and, in other cases, away from it (Tipper, Howard, and Jackson, 1997). This literature (based on discrete-trial tasks with simple limb movements, such as reaching, aiming, or grasping) has suggested two main theoretical models that try to account for the pattern of results typically found.

Response Vector Model and Response Activation Model

The vector response model (Houghton and Tipper, 1999; Tipper et al., 1999) is based on evidence that, when responses are needed, different subpopulations of directionally-tuned cells are activated. In Georgeopoulos's (1990) studies,

the response programming in rhesus monkeys was determined by the vector sum of the preferred movements by a large population of neurons. Considering this, Tipper et al. (1999) assumed that in a complex environment with more than one stimulus, when both kinds of stimuli (target and distractor) are present at the same time, a population of neurons is activated — one for each stimulus.

This activation of neurons has a direction in the form of a vector. Tipper and colleagues proposed that the final movement carried out by subjects would be the result of the response competition and subsequent inhibition of one of these two populations of neurons. According to these authors, both populations are partially overlapped, thus both movement representations would interfere with each other. The vectors for both codifications would be affected and, therefore, the plausible unresolved response competition could produce a deviation towards the distractor at the moment of movement initiation as a consequence. The inhibitory mechanism would attempt to keep any one of the two responses from occurring (based on the subject's goal). If this inhibitory process becomes large enough, it not only could cancel the movement towards the distractor but even invert it, thus inhibiting not only the population of neurons for the movement-to-distractor codification, but also the amount of neurons shared with the movement-to-target one. The model posits that the deciding factor for the stronger or smaller activation of the inhibitory process relies on how salient the distractor is. Thereby, the more salient the distractor is, the stronger the activation of the inhibitory process would be, resulting in participants deviating from the position of the distractor for the ongoing to-target movement. On the other hand, the less salient the stimulus is, the smaller the activation of the inhibitory process would be, therefore allowing the activation of distractor programming response to partially remain, resulting in a slight deviation towards the allocation of the distractor.

The response vector model was refuted by the response activation model proposed by Welsh and Elliot (2004). This model is based on a partial overlap of the movement codifications towards the target and distractor stimuli (as the previous model is), but it postulates that the inhibitory process of the response codified towards the distractor is always the same, and that process requires some time to execute and complete its action. Therefore, the differential effects on movement found in the previous literature (attractive or repulsive) can be explained as caused by different stages of the inhibitory process wherein the influence of a distractor in the movement towards the target is ascertained. To test this hypothesis, Welsh and Elliot (2004) used several SOAs (target/distractor stimulus-onset asynchronies) to check what happens when an inhibitory process is given a larger or a smaller amount of time. Welsh and Elliot's results show that when the participant is given a certain amount of time (750 ms) between the appearance of the distractor and the appearance of the target, the final movement veers away partially (in spatial terms, between other parameters)

from the position of the distractor. That is to say, when the inhibitory process completes its action, the system cannot count on the overlapping part of the neurons between both movement codifications to execute the movement towards the target, since that shared population of neurons is inhibited at the time of conducting the ultimate movement. When the participant's inhibitory process is not given sufficient time to inhibit the response towards the distractor (250 ms), the final movement approaches partially (also in spatial terms) the allocation of the distractor. In other words, in this case, when the inhibitory process has not completed its action, there is some activity remaining in the system, belonging to the codification of the movement towards the distractor.

Types of Attentional Cue and Effects on Movement

Before Welsh and Elliott (2004) began to analyze the time course of the inhibition process, Lee (1999) reported on the kinds of stimuli that could influence movement trajectory. There are at least two distinct modes of attentional control, according to Jonides (1981). The exogenous mode, amongst other characteristics, triggers a priming effect, captures attention automatically, and facilitates the processing of stimuli presented in the same area shortly afterward. In contrast, the endogenous control develops more slowly and in a voluntary manner.

According to Lee (1999), the majority of studies dealing with this topic have had a limited concept of movement, given that they focus only on the influence attention has on reaction times, using solely non-continuous key-pressing tasks to test the plausible effects. Lee's work aimed to show that attention could also influence other aspects of movement, such as the initial direction of a movement or its trajectory. Only a few studies before the work of Lee had examined this issue and, in those, cued locations never became targets of the movement. Lee, using both endogenous and exogenous cues and checking if there were significant differences in the initial direction of the movement, tested the effect of giving meaning to the cue. Hence, the main hypothesis was to verify whether a priming effect could be attained depending on the meaning given to the cue; in other words, presenting a valid cue in the space which could be later occupied by a target.

In order to show both kinds of influence, a tracking reflective marker with a 3D electro-optic sensor monitored participants' hand movements (Lee, 1999). Participants sat facing a computer monitor on which concentric circles were constantly displayed in the centre of the screen. Four small grey circles were presented around the circumference of the large circle, remaining equidistant from each other. The central red circle was illuminated at the beginning of every trial. When it was turned off, another of the four circles situated around the circumference of the large grey circle was illuminated in red. Participants were instructed to relocate a feedback cursor as quickly as possible on the one peripheral circle illuminated in red.

For the first experiment of the series, Lee (1999) examined the effects of peripheral/exogenous cues (a light cueing one of the four small circles) on the initial direction and latency of hand movements. On each trial, movement initiation was divided into intervals with limits of 0, 100, 200, and 300 ms and the spatial relationship between target and cue had four possible values: 0, ±90, and 180° (in an anti-clockwise direction). The results showed that when the target was preceded by an invalid cue, the latency between the appearance of the target and the initiation of the response increased compared to the control condition with no cues. For latencies of less than 200 ms, hand movements veered towards the cue, while for those greater than 300 ms, the majority veered towards the target. When the latency was between 200 and 300 ms, the direction of the movement was strongly influenced by the relationship between the positions of cue and target. Likewise, when the spatial relationship between them was 180°, the movement could be initiated towards either the target or the cue, the difference being average. However, when the spatial relationship was 90°, the initiation of the movement gradually changed from a movement towards the cue to a movement towards the target, in accordance with the rise in latency of initiation.

The subsequent experiments attempted to determine whether the central/endogenous cues (a line segment pointing to one of the four plausible peripheral circles this time) could have the same effect on movement direction as the exogenous one did, and how the two types of cueing interacted. The results of these experiments showed that endogenous cues provoke an effect on movement with the same characteristic that the exogenous one does and exogenous and endogenous cues do not interact with one other (which means that their effects are essentially the same). Indeed, Lee (1999) found that with both types of cue, only those movements wherein distractors had been presented in a ± 90° position from the target and with a determined movement initiation (between 200 and 300 ms after the appearance of the target) began with an initial veering to some point between target and cue positions, and were gradually corrected thereafter.

Although Lee (1999) did not properly quantify the time course of this inhibition (using only ad hoc time intervals), the main contribution of this series of experiments was to demonstrate that both kinds of cue (exogenous and endogenous) can influence movement execution. A secondary importance was the demonstration of the relevance of the possible meaning that a cue has in the determination of its effect on movement.

Relevance of Meaning and Context for Movement

The results above show the link between attention and action on discrete-trial-task movements unlike eye-tracking movements (classically used for supporting the premotor theory). However, at a certain point it was necessary to

test to what extent and in which direction the shown effects could be relevant for more real tasks, like driving. With that aim in mind, our own research (Vilchez and Tornay, 2012) used a tracking task normally conceived as a simplified version of a real driving context that has been often used in ergonomic research (see Wickens and Hollands, 2000, for a review).

Since previous studies were based on discrete trials, they were limited to a determined set of possible positions for target and distractor. The tracking task, even when it is a simplified driving task, allows presenting multiple dirtractors in multiple positions and an animation that seems continuous to the participant, which makes the task more realistic. This methodology registers a individual's movement frame by frame (which produces a large amount of information), allowing a deeper analysis of the behavior (such as in Lee's 1999 studies) and, especially, the possibility of measuring the continuous, ongoing movement as well (which was an original point in this research line).

A series of experiments (Vilchez and Tornay, 2012) were conducted to determine whether the simple presentation of an exogenous cue (singleton) could exert an influence on movement execution. A simulated black road with a continuous, yellow middle and bordering lines appeared on a computer screen with a green background. The participants controlled a blue circle considerably smaller than the width of the road, and a red singleton appeared randomly on almost any part of the screen (at no time were two distractors presented simultaneously).

A veering away effect was found from the allocation of the distractor (exogenous cue) on the trajectory of the blue circle controlled by participants for following the middle line of the road. Specifically, the mean trajectory deviation when there was no distractor increased gradually in the opposite direction to the allocation where the distractor was presented. That is to say, when distractors were presented on the left side of the blue circle, the mean of deviations was displaced to the right (taking more positive values), compared to the mean of deviations when the distractor was not present. Likewise, when distractors were presented on the right of the blue circle position, the mean of deviations rose towards the left (taking more negative values). Given that a similar pattern of results was found in all experiments using distinct peripheral devices for controlling the movement, it is possible to affirm that this effect does not depend on either the type of movement control device or the particular muscles involved in operating it. The fact that the movement is always away from the distractor is at odds with Welsh and Elliott's (2004) response activation model — which was so far the only unfalsified model in the literature — after they showed that the response vector model could not explain even the data in the discrete-trial task used in Welsh and Elliott's studies. With these new findings, there does not seem to be a second phase (as the response activation model would propound) in which the movement is directed towards the distractor when

the action of the inhibitory process begins to emerge in behavior. The possible meaning of "obstacle" or "danger" in this context (given the overlap of the distractor on the road, the abrupt invasion of the visual scene, and the appearance in unpredictable positions), seems to be behind this completely veering-away movement. This gives a more holistic rather than purely analytical perspective to the topic (see Ganel and Goodale, 2003, for a review of both concepts).

This action meaning-dependency is not new in the literature. Biersner and Melzack (1966), using two kinds of frogs (*rana pipiens* and *rana castesbeiana*), showed that those animals approached or avoided objects moving towards them depending on object-size. There was a critical size for which smaller objects were approached and larger ones were avoided. The rationale underneath these findings seems to rely on the meaning of something-I-can-eat or something-that-can-eat-me, since for the larger frogs (*rana pipiens*) the critical object-size for approaching or avoiding was significantly larger as well (increasing the rage of something-that-I-can-eat). The meaning that individuals give to stimuli not only determines the action to be performed but the manner in which it is conducted. In a series of experiments, as an example, Buckingham, Cant, and Goodale (2009), using illusory visual cues, showed how the grip and load forces for lifting objects can be influenced based on participants' expectations.

Meaning-Dependent Activation Model

Taking into account the data from our own studies (along with the results from Lee's 1999 studies), a revision of the response activation model by Welsh and Elliott (2004) can be undertaken. Under these new findings of a continuous effect with neither different phases of the inhibition process nor a turning point in which the effect passes from a repulsive effect to an attractive one or vice versa, this model remains unsubstantiated. The hypothesis, derived from our own work (Vilchez and Tornay, 2012), revolves around the fact that the meaning given to the distractors causes the differential effects on movement. According to this new explanatory perspective, where the main referent is the distractor's meaning, Welsh and Elliott's (2004) data could be differently explained. Presenting the distractor/non-target stimuli in different time intervals causes their meaning to be perceived in a qualitatively different manner. In other words, in the 750 ms condition, the subject can distinguish that the distractor is not really the target of the task; therefore, the final codification conducted on the target is repulsive. When the movement is executed towards the target, the resulting movement is a mixture of the non-target repulsive codification (partially inhibited, but with remaining activity) and the target attractive codification. Since the movements were conducted in the same spatial line, the final movement veers away partially from the non-target because of the remaining activity from the codification meaning something-to-move-away-

from (repulsion movement, without requiring the codifications of such movements to be neutrally overlapped). In the 250 ms condition, the participant does not distinguish appropriately the meaning of the non-target stimulus and, as it could be a target, it codifies its meaning as something-to-move-close-to (attractive movement). Therefore, when the final movement is conducted towards the target, the resulting movement contains the codification attracted towards the non-target (which is conceived as a possible target).

In Lee's (1999) studies, there is evidence to support this conception. For latencies of initiation under 200 ms, there is no time for participants to distinguish the actual meaning of the cue/non-target (which could be a target), hence, the initial direction is programmed under the codification of a possible target (something-to-move-close-to) and, as a result, the hand movements veered toward the cue (attractive movement). For latencies of initiation over 300 ms, there is enough time to properly distinguish the real meaning of the cue/non-target, therefore, the codification of the initial direction is something-to-move-away-from and, as a result, the hand movements are initiated toward the target (repulsive movement to the cue allocation). Finally, for latencies between 200 and 300 ms, both codifications are active (attractive to both kinds of stimuli, target, and cue). The initial direction, as a result of the response competition, is a mixture between both directions towards both stimuli, which depends, in turn, on the spatial relationship between target/cue (just for ± 90° positions, given that, for 180° and 0° distractor-target positions, movements are carried out in the same line).

The relevance of the meaning that a stimulus can have is evidenced in everyday situations. For instance, when we pick up a very hot object, we do not only inhibit the response we were codifying. If we did so, we would remain close to the object and we would simply stop coming closer to it. What we also do is to codify another repulsive movement towards the object that is hurting us because its new meaning is pain.

Welsh (2011) has recently reviewed his own model but, in spite of citing Lee's (1999) study, Welsh failed to realize the importance of meaning in the codification of movement. Admittedly, Lee did not point this out per se, but Welsh should have understood the essence of distractor/non-target stimuli for explaining their effects on movement.

The justification for the system to engage attention on some stimuli and not on others (Folk, Remington, and Johnson, 1992) is the match between target and non-target characteristics. This argumentation was already pointed out in the theory of event coding (see Hommel, Müsseler, Aschersleben, and Prinx, 2001, for an introduction), in which a partial matching between the features of the representation of both the perceiving stimulus and the voluntary action for that stimulus would provoke an interaction between action-related processes (in this case for both target and non-target). Even though this totally new postulate

for the response activation model (Welsh, 2011) would partially explain the effects found on movement using stimuli (targets and non-targets) with similar characteristics, there remains the question of "why an irrelevant-for-a-task and non-similar singleton can cause a repulsive effect on movement in a tracking task?" (Vilchez and Tornay, 2012). In our prior studies, the used singleton was a red small circle that did not share any characteristic with a black simulated road (with a continuous middle and bordering yellow lines). It is evident that this kind of stimulus, under response activation model assumptions (Welsh, 2011), could not capture attention but, even though so, it did trigger a clear, complete repulsion effect (Vilchez and Tornay, 2012).

The meaning that a stimulus can have in an ascertained context as the base of explanation for the effects of attention on movement (found in the literature) would be conceptually closer to the ideomotor phenomenon (Carpenter, 1852). In our experiments (Vilchez and Tornay, 2012), the appearance of a non-target/distractor stimulus in unpredictable positions overlapped on the road and with an abrupt invasion of the visual scene could rationally trigger the meaning of danger. This highlights the influence of past experience in current behavior (e.g., Arrington, Weaver, and Pauker, 2010; Buckingham and Goodale, 2010; Lien and Ruthruff, 2008). The meaning could successively evoke the automatic, vivid representation of any dangerous circumstance. This can be seen in Rothi, Raymer, and Heilman (1997): the new stimulus perceived derives from the input praxicon (a long-term mnemonic structure for storing visual attributes). That idea of danger would provoke, in turn, the action-related process of escape (or something-to-move-away-from), recruiting it from the output praxicon (another structure for performance-related sensational or perceptual codes in the form of motor programs). This visuo-kinaesthetic relationship would be conceptually also close to the concept of affordance (Tucker and Ellis, 1998) in the sense of triggering the suitable response for the ongoing experience-related representation.

Taking into account all theories and assumptions reviewed above, a new and original model is proposed. The meaning-dependent response activation model posits the following: there are different codifications for different stimuli, without the premise (used by previous models) of the necessary existence of an overlap between the codifications corresponding to the target and distractor stimuli; dependence on the kind of codification (such as attractive or repulsive) according to the meaning the stimulus has or the individual provides to it — not the stimulus saliency per se or its shared characteristic with other stimuli in the visual scene; and the existence of an efficient but not completely effective inhibitory mechanism to leave out the competitive, unsuitable responses triggered by distractors — since the presence of the distractors causes a significant and involuntary effect on the movement until it is totally inhibited, as described in our own and all reviewed studies.

It can be argued that the meaning-dependent response activation model provides a more accurate way of describing not only the effect of attention on movement for trial-discrete tasks but for closer-to-daily-life tasks and is, therefore, a more useful tool in analyzing cognitive ergonomic situations. As an example of this last point, it currently remains unclear what kind of meaning a traffic sign (or other kind of roadside element) can have for an individual in specific contexts and, hence, what counterproductive effect it could have on movement in certain situations. Future works will be driven in that direction.

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Problematizing Tye's Intentionalism: The Content of Bodily Sensations, Emotions, and Moods

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Intentionalism claims two different assumptions. On the one hand, it defends that every mental state is directed to an object external to one's mind, which is the content of the mental state. On the other hand, the content of every mental state is always a proposition. Since some of our mental states are about something, the requirement of intentionality of our mental states seems adequate. The problem is that, when we attend to mental states such as pain, to feel love, to be sad, and other related sensations, their content seems to be non-propositional. The aim of this essay is to provide an alternative to Tye's intentionalist thesis about mental states regarding our own bodies, emotions, and moods. First, Tye's theory advocates that the content of our conscious states is identical to the representational, propositional content that an individual possesses when she is in a certain perceptual state. Second, I analyze the problematic nature of the conclusion that the content of every mental state (including our conscious states) has propositional content. Finally, Tye's thesis about the transparency of the phenomenal content of some bodily states and other related sensations is in contrast to my argument: the idea that there are some mental states that are about non-propositional objects.

Keywords: representation, mental content, propositionalism

There is a commonly accepted idea, an idea that Tye assumes, about the relational nature of mental states. Mental states are usually considered in the

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binary relationship between psychologically endowed subjects and their contents. Propositional attitudes make clear this particular relation. Mental states such as beliefs, desires, and some perceptions suppose the relation between a subject (who possesses them) and a certain kind of object: a proposition (the content of the particular mental state). Propositions are usually characterized as abstract entities that have some particular constituents. They can be understood as concepts (in a Fregean sense) or as the objects of the world and their properties themselves (in a Russellian sense). [There is also a third option that characterizes propositions as abstract entities with functions that determine truth-conditions according to the possible world we talk about; nevertheless, I avoid this interpretation here].

> In other words, mental states are characterized by showing intentionality:
> Intentionality (I): mental states are directed, in a representational way, to their contents.

As Tye says, mental content accomplishes the condition of aboutness claimed by Brentano and Meinong: "mental [states] generally involve a primitive, unique, nonphysical relation of aboutness . . . among its relata" (Tye, 2000, p. 109).

> Then, intentionality usually accepts representationalism:
> Representationalism (R): the content of every mental state is characterized by the relation between the subject and the particular way the perceived object is experienced.

In other words, "your awareness of what it is like, of the phenomenology of your experience, is not de re awareness of the experience or its qualities. It is de dicto awareness *that* you have an experience with a certain phenomenal character" (Tye, 2003b, p. 165). So, when one contemplates a picture, for instance, she is experiencing an external object with its particular characteristics as relevant for the individual according to the properties that she predicates of the picture through propositions. This assumption implies propositionalism:

> Propositionalism (P): the role of mental content, which always is a proposition or something proposition-like, will depend on its relation with its object.

Or, expressed differently, "ways things look to people are typically expressed by predicates . . . and predicates express qualities" (Tye, 2003b, p. 165).

Intentionalism claims, then, two different assumptions. On the one hand, it defends that every mental state is directed to an object external to one's mind,

which is the content of the mental state (as expressed by I and R). On the other hand, the content of every mental state is always a proposition (as expressed by P). Thus, intentionalism claims that every mental state has as object, is about, or is directed to something that is not just a physical object or a particular feature of the world, but is or involves some descriptive, discursive verb-embedded abstract object expressed in a representational way by a natural language sentence. As Tye's says, "phenomenal character is one and the same as a certain sort of representational content" (2009, p. 112).

Therefore, according to intentionalism, we can explain Nicole's belief of having done a good work as the existing relation between Nicole's certain mental state as a subject and the propositional content "to have done a good work" (usually expressed by the designation BEL(Nicole, *p*), where BEL stands for the propositional attitude of believing that Nicole has and *p* stands for the particular propositional content associated to this concrete belief). We can explain David's desire to drink a beer as the existing relation between David's mental state as a subject and the propositional content "to drink a beer" (usually expressed by the designation DES(David, *p*), where DES is the particular propositional attitude of desiring that David has and *p* is the particular propositional content associated to the particular desire). Thus, we can also explain Jordi's perception of a red tomato as the existing relation between Jordi's mental state as a subject and the propositional content "seeing a red tomato."[1]

Now imagine that we are trying to explain Pablo's state of pain after he has hit his finger with a hammer. Intentionalism, as does Tye's theory, accounts for this feeling as the existent relation between Pablo's state and the propositional content "to feel pain in my finger." But this is counterintuitive. It seems that this state of pain cannot just be reduced to this relationship because of the difficulty that just such a proposition expresses exhaustibly the sensation of pain. Then, since the nature of certain mental states such as bodily sensations but also emotions and moods, one can assume, cannot be explained by propositional content, propositionalism should be abandoned. My purpose is to clarify what kind of content these mental states have, how they differ from propositional attitudes, and what implications my conclusions have for representational theories about mind.

Since Tye's theory about the content of our conscious states has become a paradigm of intentionalism, I will analyze the problematic nature of his conclusion that every mental state (including our conscious states) has propositional con-

[1]Some defenders of the Russellian content of mental states say that, because of the difficulty of characterizing the content of perceptual experiences, we should understand the content as directly describing the properties of the objects. Tye assumes this particular interpretation. Nevertheless, as I will explain below, since it is controversial what nature the content of perception has, the relation between a subject of perception and its object can be considered as a border-case. Therefore, the designation PER(Jordi, *p*) to refer to this relationship should be avoided.

tent. I will focus specially on Tye's thesis about the transparency of the phenomenal content of some bodily states and other related sensations, such as pain, to feel love, or to be sad. I argue that the particular nature of these phenomenal states problematizes every representational account about mind that claims propositions as the content of every mental state because of the same nature of propositions. As I will advocate, an alternative view will accommodate propositional attitudes as well as phenomenal states. This view claims content as an expression of the particular perspective adopted by the individual to access the world.[2] In other words, some of our states are not relations to propositions at all, but relations with things; some states just show the way that the things really are.

In this way, my view also characterizes the content of propositional attitudes as related to propositions. Content has the following characteristics. First, an individual can have a perception about something unreal or illusory and, nevertheless, there still is some content, even though the particular object that the proposition describes does not exist.[3] Second, since one can have a belief whose content is false, the fact that one possesses a certain mental state with a typical content can simply assert the truth-conditions of the particular proposition but says nothing about how to satisfy them. Third, the fact that someone possesses a mental state with certain content depends on the proposition adopted by the individual. Fourth, the fact that someone possesses a certain mental state with certain content has a causal power on her behavior.

To establish natural laws that explain the relation between mental and physical states becomes, then, necessary. There are two different ways of approaching nomological explanations. On the one hand, there are those who think all mental states are essentially different from physical states, and that the mind links elements with their propositional content depending on intrinsic properties (for instance, Fodor, 1975, 1983; Millikan, 1984; Searle, 1983). These properties

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[2]This distinction between propositional and non-propositional content renews the classical polemics: if the content of our mental states has an objective character or, contrarily, if the content is not so-clearly-objective. Evans's (1982) intention to introduce the distinction between conceptual and non-conceptual content (see footnote 4 below) was precisely to deny the existence of subjective content in our mental states as interpreted under a Fregean sense. As the reader has realized, I avoid the designation *subjective* to refer to the non-propositional content of certain mental states. I am not defending the idea that some mental states refer just to objects that just I (individually) have the capacity to see. What I am advocating for is the broader idea that some mental states just express how the things are from the perspective one accesses the world, and this will be available to everyone who adopts the same perspective. See Grzankowski (2013) for further explanations about non-propositional content.

[3]In other terms, since existence is not a property, the only thing that we can say is that "someone that experiences such-and-such exists," but neither that "the object experienced exists" nor "the experience *x* exists." Notice that this interpretation of content is the preferred Fregean characterization, in which concepts understood as functions map the possible truth-values. I use quotation marks to refer to propositional content, as is customary.

are in a way totally independent from external conditions, though these conditions might cause them.

On the other hand, there are those who think the inner view cannot adequately explain the mental content because intrinsic properties are too narrow and restrictive. But the propositional content is linked to the subject's mental states through external facts (Burge, 1979). My alternative view argues for the second kind of approach to propositional attitudes. But I will adopt a different way than traditional externalist accounts do to explain other mental states, such as bodily sensations, emotions, and moods, because externalism still claims that content is propositional. Some exceptions can be found. This is the case of Dretske (1980, p. 354; 1997), who explicitly rejects the fact that every mental state possesses propositional content. I will assume some of his conclusions (see Montague, 2007 for further non-propositional views).

There is a subsequent distinction about the nature of mental content that I would like to focus on before analyzing Tye's position. When we attend to propositional attitudes, the content can be expressed according to conceptual terms. But mental states such as bodily sensations, emotions, and moods have a not-so-clear conceptual content. This second type of mental state is directly linked with our neurobiological distribution and our particular cognitive history: the so-called non-conceptual content.[4] Tye characterizes the content of bodily sensations, emotions, and moods as non-conceptual, something that I agree with. Unfortunately, Tye also accepts that this content is always directed to propositions.

Tye's Characterization of Conscious Content

Tye advocates intentionalism as an explanation for the content of propositional attitudes as well as the content of our conscious states. According to Tye, the phenomenal character of our conscious experiences is identical to the representational, propositional content that an individual possesses when she is in a certain perceptual state. For Tye, the content is instantiated by the activation of a certain physically functional structure in the particular individual.

[4]It is more or less controversial whether the content of our mental states has a conceptual or a non-conceptual nature. For instance, Fodor (1983) defends that every mental state is conceptual. Differently, Bermudez (2003) argues that every mental state has non-conceptual content. Tye (1995) says that we can find both types of content in our phenomenal states, but Tye (2003b, 2004) claims that they can just have non-conceptual content. Beyond this interesting polemic, I would like to note that both conceptions still understand the nature of content as propositional. This mistake resembles the way that Evans (1982) introduced the notion of non-conceptual content to explain the nature of certain experiences. As we will see below, this presents some problems. As the reader has noticed, this distinction is close to the previous differentiation between either to understand the content of our mental states as Fregean or to understand it as Russellian. For additional details, see Toribio (2007).

Tye claims the identification of representations with some genotypic elements. However, he does not claim a reduction of phenomenal experiences to these physical elements because content (understood as propositions) simply expresses contingent truths (Tye, 2003a), clearly distinguishable from other approximations that consider them as a priori truths (as, for instance, Jackson, 2000).

According to Tye, these experiences have non-conceptual content because they are our ordinary sub-personal level of referring to objects in Russellian terms, and not according to particular descriptions (Tye, 2000). Since the particular context will reconstruct the components of the functionally dependent content, the content is externally individualized. Only this way might we explain how two functionally identical subjects can differ in their phenomenal content when presented with the same experience, even though it is the very same conscious experience.

Tye further claims a strong, non-reductive, non-conceptual, and externalist representationalism. Why say that this is intentionalist? According to Tye, the content is the representation of objects, the objective properties that the individual predicates upon the external circumstances in which the experience occurs. The content thus is always directed to objects, and represents certain specific qualities of them rather than particular concepts that the individual possesses. This means that there is always an objective, publicly observable element characterizing and individualizing a certain experiential state: the particular natural language sentence that represents the characteristics claimed by the proposition. And this objective element should be *transparent*: the properties we are aware of in perception are predicated upon the objects as perceived (Tye, 2010, in press). However, as I will show, this conclusion presents several problems.

The Characterization of Bodily Sensations

According to Tye, the content of every conscious state is a non-conceptual, propositional, and intentionally directed representation that refers to the most relevant qualities of the object perceived as predicated by the individual. Thus, representational content depends on an objective view that allows for the acquisition of certain content: the proposition. But then, how can we explain experiences such as bodily sensations, emotions, and moods habitually considered subjective if it seems impossible to relate them to propositions? This is to say, since some experiences appeal to the way the subject feels them rather than through the objective predication of features, how can we characterize these states?

Take the case of perception of colors. For Tye, experiences of color seem to be subjective since they tend to be defined at least partially for their purely phenomenal aspect. But, Tye says, if this is the case, then two individuals can possibly perceive two different colors from the same experience of color, in spite

of the fact that the color has an objective reality. And this is something undesirable.

How to explain these cases from a representational theory? According to Locke's classical approach, something turns out to be red, for example, and it is therefore interpreted as such. The particular observed object has a disposition to be seen as (having the property to be) red by a normal individual in a normal situation. However, this interpretation presents a basic problem: it explains the quality of red from a disposition but assumes without explanation both that there must be something red and that the individual really has the concrete skills to grasp subjectively this particular feature.

Jackson (1977, 2001) assimilates this theory by assuming a Lockean interpretation, which considers colors as intrinsic and subject-embedded qualities. In this particular approach, colors also are subjective-dependent dispositions; they do not remain with the objects when we stop contemplating them. The experience of color is subjective, and has no real existence in the physical world. The color exists because the subject gives it reality.

Unlike Jackson, Tye argues that color appears as something phenomenal, as an invariable quality of objects. If this is so, then our visual system grasps the phenomenal features predicated. What happens when two different subjects perceive different hues from the same object? If we accept that "the color of an object" (its propositional content) is a vague expression, Tye says, the content of the same perception can vary across individuals according to lighting or other physical variables, allowing different descriptions of the same perception. Then, two functionally identical individuals can have different perceptions of the same object depending on the particular external conditions under which both individuals have the same experience (as shown by the description of *biting the bullet* in Tye, 2000). Therefore, what really counts as the color of an object is the particular wave spectrum that instantiates in our visual system, exciting particular cells in our eyes that causally explain the experience, in the sense that there will be a propositional content in accordance with the relevant characteristics predicated. In the same way, the flavor of a certain object will not depend on the individual perception of the flavor, but on the substances that stimulate the adequate taste buds and other related physical events as predicated by the propositional content.

According to my view, color experiences and other secondary qualities are border-cases because, though it is true that phenomenal content completely depends on perception, some objective system of instantiation is always required to determine the existence of experiences and to catalogue the different sensations. In the case of colors, for instance, some researchers contend that the human cognitive visual system distinguishes countless different hues, and directly depends on the vision spectrum of the human eye. Yet we just have a scant number of names to refer to all of them (Maerz and Paul, 1950). What this tells us, according

to Tye, is that our non-conceptual phenomenal content is more richly explained by not appealing to conceptual content. If the explanation of our mental content were held in conceptual terms, then it would be impossible to differentiate the huge amount of different hues.

We have the capacity to do so by directing our attention to the different properties of the objects of the world. And one proof is that we can differentiate among different colors and hues by using some technological devices capable of discriminating different light spectra. The sensation of temperature functions similarly. Even though the content can differ between individuals from their diverse inner thermal sensations that indicate that one feels cold or warm, there are some devices, such as thermometers and thermostats (or even some machine capable of measuring the speed of molecular movement), which indicate in an objective way the temperature of an object, a room, and so on. But there are some other cases where the reference to an external object becomes much more complicated.

Think of the case of pain, for instance. Tye examines the way in which our brain establishes an image of our body because individuals indicate how pain is located in the part of the body that hurts. I agree with Tye that some studies that investigate certain alterations in the distribution and functionality of the brain (identifying chemically altered states, physiological diseases, and cerebral injuries, for example) show how the total image of the body changes, upsets or, even, gets lost any time that the particular subject feels pain.

For some scholars, our brain articulates a global sensation and then a unified image of the body. The concrete sensation that one has in a determined moment in a part of his body shows that the individual has a representational image of the way in which he feels his body and the space that it occupies in time. According to Tye, this explains the phenomenal unity of bodily sensations. But, according to my view, this explanation presents some problems. What kind of unity does pain show? How do we explain the different sensations that someone has and feels through time? Where can we locate the pain?

According to folk psychology, the experience of pain is necessary and essentially private and subjective. One cannot feel your pain and you cannot feel the pain of another. The most commensurate explanation considers pain as a sensation understood as a mental object. But this interpretation presents some problems. For instance, since the particular sensation of pain is thought of as some mental object, when the thing that hurts is your left arm, where is the pain located? Is it located in your mind? If, for example, a person has a pain in his back, the pain seems be in his back. But if it is thought that the pain is a mental object, one cannot say simultaneously that it is located both in his back and in his mind because we said that pain is a mental object (an abstract entity) that should be placed in his mind rather than a material object that can be placed somewhere in his body.

Folk explanations argue that in cases of pain the content can also be placed in the concrete part of the body that hurts, even though it is a mental object. This deals with a special, causal sense because the pain and the sensation of pain in, for instance, the individual's back are one and the same thing. This explanation is not very useful, for two reasons. First, someone could only know her pain in an a posteriori way from empirical observation of the particular part of her body that hurts. This conclusion is in conflict with the previous assertion that the individual would have a direct, a priori knowledge of the phenomenal content of her mental states. Second, the sense of "placed *in* the body" here employed is a multicausal notion, far away from the ordinary use, making it hard to locate the origin of the particular experience or sensation involved.

Other representationalist theories also consider pain as being *in* the body. Such accounts claim that the representation of pain is what the individual really feels rather than the pain itself. But, according to my view, this conception implies absurd situations: suppose a person has a pain in the thumb of her right hand. Imagine that she has hit her finger with a hammer when fixing a nail. As a reflected act, she introduces her finger to her mouth with the intention of calming the pain. According to the representationalist, the pain as a representation is projected *in* her finger, but as her finger is *in* her mouth, where really her pain is located is *in* her mouth and not *in* her finger (Jackson, 1977), something implausible because we bi-locate the source of pain. The pain, therefore, should be understood as an epiphenomenon without causal power on behavior.

In addition, this thesis also fails when we attend to problems relative to certain sensations of pain from cases like the phantom limb. As it is known, many people who have lost some part of the body, a leg for instance, often feel pain in the leg that they no longer have. If one thinks that the representation projects *in* the affected member where the pain is felt, the argument fails when the part of the body is absent. In other words, the thesis is false if the individual no longer has the member *in* which the sensation of pain should be located.

Another related problem appears when the individual misrepresents the pain that he feels. Suppose that one has a pain in his left arm. According to the representationalist interpretation, the pain is a representation that he projects to the mental image of his arm. Imagine that the pain in his arm is not linked to any wound or any anomaly in his arm, but to a problem derived of a cardiac dysfunction (for instance, to a heart attack). Unlike the defended premise, we should say that the pain *in* his left arm is not derived *in* his arm but is really derived *from* his heart.

In spite of these difficulties, Tye considers the problem of pain from a representational perspective. In his view, as with colors and other secondary qualities, the argumentation refers directly to the qualities predicated through propositions. According to Tye, sensations externally depend on the sensory structure of individuals. From this view, unlike inner representationalists, the experience of

pain must recount qualities. These qualities are not from the experience itself but from disagreeable features in the body that concern the affected regions where they occur. Therefore, the experiences relative to the body have two dimensions: a sensitive element (that refers to the way in which pain is felt), and an affective element (relative to the way in which the experience is evaluated). Though it is true that there are cases that lack evaluative elements, for instance in cases of dissociation or in instances of a split-brain individual who has lost all aversive sensations of pain, Tye assumes that individuals are always able to perceive both elements. Take the example of a two-month-old child who tastes chocolate for the very first time. The child responds in such a way that her behavior *indicates* that she wants more because the chocolate tastes good. The "goodness" experienced provokes the child "asking for more."

According to Tye, the child's gustatory experience represents a certain flavor (the sensitive component) and the child experiences the flavor "being good" (the evaluative component) without previous experimentation or conceptual content. In the same way, a young child who experiences pain for the very first time yields a similar sensation. Previous to the experience of pain, the child avoids experiencing it because the child recognizes it as "being bad." Pain is a certain experimentally represented quality, in indicative terms. This is to say, the individual predicates certain properties that characterize the object perceived, and this explanation, according to Tye, avoids such problematics.

In explaining the experience of pain relative to phantom limbs, Tye says that the individual can represent a certain experience as pain (or having the property "to be painful"). Thus, this pain would be representationally experienced as bad, independently of the real existence of the particular limb represented. Unlike the previous cases of misrepresentation of pain that one would feel in the left arm but that really comes from a heart attack, according to Tye, we should say that we do not need to locate the pain in a certain place, because it is abstract and subjective. Again, the individual will represent a certain experience as painful, and this pain would be experienced as something bad. The difference here is that it would not be necessary to locate the experience in the bodily image. It would be enough to know that these experiences refer to different parts of the body. In these cases, the experiences represent some features (in a sensory/indicative and an evaluative sense) that refer to certain parts of the body.

The main problem here, I think, is that Tye argues for representational content of phenomenal experiences as something understandable from an indicative perspective, and this supposes a cognitive closure (Block, 2006; Noordhof, 2006), an epistemological impasse that constrains the individual to be always aware about the content of her mental states. Tye supposes that what counts as a phenomenal experience is the particular object (the Russellian proposition) that fits into our sensorial system in a determinative way. The sensorial substructure will

respond to a certain stimulus, as an output from the adequate input, and this will be tried as a particular mental state with the content required, causing other mental states and behavior (saving the requirement that every mental content has to be poised, as expressed by his PANIC theory. See Tye, 2000).

From my view, this thesis renews some classical issues in functionalism, such as the problem of causal over-determination (the same stimulus could be explained by more than one cause), or the problem of dualism of properties (presupposing the presence of something, even though this something was postulated as physical, in a sub-personal level that can be considered as both a sensation and an experience). Because, at the end, there is no room either to determine adequately the concrete mental state that this particular experience instantiates or to establish the nomological role of this state in the complete explanation of behavior.[5]

Another issue concerns the alleged incoherence of representationalist positions. Tye's intentionalism affirms that the phenomenal content of an experience is identical to its representational content, and this is the requirement for the transparency of content: the idea that the properties we are aware of are attributed to objects perceived. According to Tye, as we saw, the content identifies a proposition with respect to the objective relevant characteristics that the experience represents. In this sense, Tye's theory claims that the subject always knows that the particular content that the state represents is the object perceived as having these particular properties. How can we identify a *what-it-is-like* experience with a proposition if a proposition always is an abstract entity and a what-it-is-like experience is the quality of an experience (a singular thought)? This weakens Tye's thesis because, at the end, a certain kind of state (as, for instance, states of pain) does not seem to be transparent in the same way that other states are.[6]

One can say that Tye is claiming that an experience only has a certain phenomenal character if it has a certain intentional content. Thus, Tye would not

[5]As Martínez (2011) says, probably the problem of representationalist theories about content, as that defended by Tye, is that these theories analyze phenomenal character in terms of indicative content rather than as imperative representational content, which according to Martínez provides a solution to the difficulties presented by representationalists. According to my view, this is not correct because the main difficulty is to consider all content as propositional, and this imperative interpretation still maintains this characterization.

[6]In some sense, this criticism about the thesis of transparency of mental states is similar to the thesis of anti-luminosity defended by Williamson (2000). Someone can defend the idea that arguments against luminosity fail in four different ways (Ramachandran, 2009), but this interpretation is based again on a characterization of the mental content as propositional, even though it is reflected in a Fregean conception of propositions (Ramachandran, 1993). Independently of my sympathies for this favored type of interpretation of propositions, I think it is a mistake to characterize the content of every mental state as propositional because most of our phenomenal states are non-propositional.

be defending the transparent character of content. But this option is even worse. To assert that an experience has a phenomenal character supposes that it is identical to the possession of certain content. Nevertheless, the same problems remain because the content is still understood in a propositional way by claiming the features predicated as belonging to the object perceived. Since the fact that pain is felt as something negative, it does not seem to be representational at all, because it is not possible to take a concrete content that represents adequately this character of pain in every particular situation.

This disadvantage might be avoided by insisting on the possibility that the pre-conceptual content presupposed in phenomenal experiences can be interpreted from a different non-propositional perspective. In other words, the previous problems can be solved if everything that individuals feel is interpreted from the point of view of the ordinary way that we, conscious beings, perform and react to stimuli. Because our experiences do not represent the way that we predicate characteristics of the things in the world, we show how they really are. Then, the behavior of the two-months old child with the "good" experience of tasting chocolate and "asking for more" can be explained as the usual way in which conscious beings normally act in these situations. What I claim is not for some particular subjective content that the individual has when she perceives. What I advocate is for the necessity of appealing to the particular point of view from which the individual accesses the world explains the way that her experiences directly relate her with the things of the world.

Think, for instance, of the following scenario. Someone can scream, cry, take her hand to her cheek, or even utter the sentence "I have a toothache." All are instances of usual behavior when one experiences a toothache. We can imagine even more performances of this pain that the individual can enact when she experiences a toothache. We can see these different acts as interchangeable. But they are simply the normal, standard way that conscious beings behave in these situations. And it does not mean that the content of the performative must be understood as propositional. Some states, as I said, have propositional content. In other cases, the informational flow of our internal and external senses is just stimulated by these sensations in a non-propositional way.

The View of Emotions and Moods

According to Tye, the content of emotions and moods is directed to propositional representations that predicate concrete characteristics of a particular experience. This is true not only in human beings but also in other creatures, in two different ways (Tye, 2008, p. 31): either through perceptual experiences or in thoughts about them. These thoughts are not necessarily endorsed in beliefs. When an emotion is felt, Tye says, the individual attributes some properties to the particular object of emotion.

Hence, emotional experiences are also directed towards objects external to the mind, and they have evaluative features as well as a distributed, sensitive causal bodily disturbance. The external object is initially represented either by a perceptual state or by a non-perceptual thought. Thus, the emotional state *s* represents the concrete object *o*, through its evaluative features, causing the particular representation *r*. Thus, the phenomenal feeling of an emotional experience is determined by its representational content. Emotional experiences are, then, representational states.

To prove this thesis, imagine the following scenario. You were so absorbed in your reading of the latest papers about consciousness that you have not realized that it has gotten dark. You decide to go home. You go to the parking lot to pick up your car. It is a really dark night. There is no moon and the clouds are thick. The street lights on campus are not enough to illuminate the area. In addition, the street light closest to your car does not work. You hear a strange noise. Turning, you observe a strange, threatening silhouette that comes closer and closer. You are shaken by a distressing sensation of fear and you accelerate your steps, walking faster, hastily extracting the keys of your car from your pocket and rapidly getting into the car. Once inside, you observe that the thing that scares you really was a colleague from the department who also left her office late.

What has happened? According to Tye, your experience was informed by your representation of both the noise and the silhouette. This experience has been represented as dangerous (because you attribute to it the property "to be dangerous"), which provoked your (sensation of) fear. This does not mean that what is experienced should be frightening, just to represent the content of the sensation as something dangerous, or fearsome, which causes the emotion of fear.

Thus, emotional experiences provide to individuals a quick assessment about the value of the particular perception as something dangerous, and this would provide a causal answer. Individuals are wired with value-tracking detectors that instantiate the most adequate behavior to their survival according to the particular situation as experienced.

When we have emotional experiences then, according to Tye, they are about emotions. If one feels fear, she undergoes an experience that represents aspects of her own experience as dangerous. This is also an evaluative feature of the object from which the fear is derived, along with a causal connection between both. Hence, the experience represents a causal complex of internal and external properties. And every experience that represents an appropriately similar complex of properties should be understood as an experience of fear. So, emotions are just patterns of behavior that undergo certain emotional experiences in concrete situations. An emotional experience is, therefore, a state of a sort that is rationally justified to have other related propositional states (Tye, 2008, pp. 40–41).

Nonetheless, I think, not every emotional experience can be explained this way, by appealing to propositional causal content. Sometimes, in the same way that we saw in the case of bodily states such as pain, emotional experiences show other kinds of content. Imagine the next scenario. Someone is angry because her teacher has handed out an inappropriate punishment, and the content of her experience of anger should be associated to a conceptual content attached to her state. The justification of these mental states comes in more than one form. Justification often consists of giving propositional reasons for something. But other times justification also requires premises and conclusions about the object that the particular state is directed towards, and this additional requirement supposes other kinds of content.

According to Tye, corresponding justifications are often available in emotional experiences. On the basis of perceptual and bodily experiences, an overarching experience of anger is generated through further reliable processes. Of course, emotional experiences do not always involve primary emotions but, in the case of secondary emotional experiences, there is a complex content, part of which is conceptual and the other part can be considered as non-conceptual, related by a causal nexus. The conceptual part is essential in the normal behavior of individuals.

This is to say, the conceptual part is the evaluative side of the emotional state, and this evaluative character of content will be the causal nexus with the particular cognitive structure of the individual. This evaluative character of content is similar to its phenomenal character. In this case, the identification of the object of emotion (which will permit one to say what kind of emotion the individual possesses) will be previous to the evaluation of the situation. After that, the causal justification just will happen whether the subject is involved in a conceptual world because she will need reasons to modify her behavior accordingly. But this appeal to reason will be always further from the identification of the particular emotional state.

Remember that, according to Tye, the thesis of transparency is also obvious in the emotional experiences for two reasons. On the one hand, there is no place where attention goes when one attends to an emotional experience, even if transparency holds. On the other hand, some of the qualities represented by emotional experiences are evaluative features of objects in the world. If the character of emotional experiences is properly appreciated, Tye states, the difference between the case of perceptual experiences and emotional experiences will depend on the particular identification that the individual has of the particular object that characterizes the content of the emotion that she feels (Tye, 2008, p. 47).

An Alternative View of the Content of Bodily Sensations, Emotions, and Moods

As I have argued from the beginning, one of the motivations of Tye's intentionalism is the requirement of transparency. That is to say, the introspective reflection on a conscious experience shows the relevant qualities of the external object to which the experience is directed. But, as I have shown, this position never exposes the intrinsic qualities that characterize the experience itself. And it seems controversial to me to say that, when someone appeals to concrete cases where experiences refer to something that does not exist, as cases of illusion or hallucination, the properties we are aware of are attributed to an absent object.[7]

There is a paradigmatic case of this kind of phenomenal experience as well: the scenario of blurry vision. In cases of blurry vision, one observes every object of the environment as blurry. According to Tye, the experience represents the object viewed and its relevant qualities as blurry. The representation depends on the quality of blurriness that the individual will attribute to the object and, therefore, it will completely depend on the way in which her cognitive system represents and associates the particular propositional content to the perception.

According to this view, it seems indeed plausible to affirm that, in certain cases (as in blurry vision scenarios), the individual is conscious of something more than just the way in which he represents the world, or the objects that his experience represents. In cases like blurry vision, when something appears as blurry to the individual, he does not necessarily represent the world as being blurry. The response is simple. In a certain moment, he sees blurry things, but it does not mean that these objects should be represented as blurry, *pace* Tye's objections (Tye, 2000, chapter 4).

From my view, cases of blurry vision can be explained as the particular way the things exist in the world from a certain perspective. Hence, blurry vision and other phenomena will be a part of the character of the same perceptual experience. These phenomena are only one manner of presentation, a concrete way that the particular experience can be felt. And this is simply because this is the particular way in which an individual usually perceives the world. In other words, this is one of the ways that things appear to us. The phenomenal character of our mental states is determined by the experience that the individual has in the particular moment of perception. This is to say, the experiences of blurry things depend on the keenness of the perception rather than on the fact to-be-aware-of in its representational or propositional content.

In cases of emotional experiences, the same kind of problem appears. Let us revisit the example of the parking lot. The noise and the silhouette that provoked

[7]And Tye has realized that. As it is shown by his actual line of investigation, Tye tries to block precisely this kind of problematic case by appealing to some reformulations of the thesis of transparency in scenarios of illusion and hallucination. See, for instance, Tye (2011).

your fear really were groundless. Your representation of the situation as dangerous was erroneous. But it does not mean that the sensation of fear did not exist. In fact, you had the experience of fear because in the concrete moment the experience appeared as dangerous. You were in the particular state that usually an individual is in when experiencing a situation of fear. In other words, the particular way in which you experienced that particular situation was the habitual way that every particular subject might experience this kind of situation, if the subject would be in a state of fear.

The way that you have accessed the world was the habitual way of accessing the world that everyone else does when experiencing fear. This state can be explained by appealing to the particular way that the subject experienced this sensation, as a dangerous one, or any other associate property. Again, the identification of the particular state as fear should be previous to the possibility to interpret the content as having the property of dangerousness, that is to say, as having propositional content. And this is because the phenomenal character of our experiences should accomplish the following characteristic:

> Non-Propositional Perspectival Affectivity (NPPA): the content of our mental states should be identified with the way that the things really are as accessed from the particular perspective adopted, and this has causal power enough to determine and modify our behavior because of the particular way that a certain state can *color* the rest of our mental states.

To bring some light to this view, let us look to the following example. In an old episode of *The Simpsons*, Bart is afraid of clowns. What provokes this fear in Bart? Objectively, it seems that nothing external to Bart provokes the fear. Nothing is placed on the fact that the clowns provoke the experience of fear. How could Bart represent a clown as dangerous (or as an object of fear) or even to attribute the property of dangerousness to clowns? Based on this example, it seems that Tye's thesis is untenable. Let me show why.

According to Tye, Bart at a certain moment observes a clown as an imminent danger. Given the propositional content of the experience ("seeing a clown"), Bart is conscious of something in the way he represents the world. He consciously has a fear of clowns, finding them dangerous. He predicates the property "to be dangerous" to any clown that he experiences. This is due to a disagreeably relevant incident that happened in his cognitive history, nothing more. But the thing is that, as Tye defends, if that is the case, then it is the personal level rather than the sub-personal level which makes Bart contemplate the world in a different way from all those who believe that the clowns are inoffensive. Understood this way, the content acquires a Fregean characterization that is denied by Tye.

Thus, the simple appeal to transparency is not enough to explain the intentionality of experiences. We could affirm, nevertheless, that there is something beyond the simple awareness of the representation. My fundamental criticism was that something like represented experience, as in the case of Tye's intentionalist theory, shows that the individual should have her experience by appealing to a previously familiarized way of considering the phenomenon that caused the experience in the first place. If my claim is right, then the misidentification of the (type and content of a particular) mental state is impossible under the representationalist theory because when an experience is defective or non-veridical, one should assert that there is no such familiar phenomenon. In other words, there are no sources of experience for the particular mental state (as Travis, 2004 claims). If we think that the character of an experience is determined by the experience's intentional nature, an explanation of the intrinsically established connection between the intentional and the phenomenal is necessary. Furthermore, the appeal to transparency is not the only representationalist attempt to explain the phenomenal character of conscious experiences. Byrne (2001), for instance, tries a different approach, but his arguments also fail (by reasons exposed by Crane, 2007).

Following Crane's (2007) suggestions, analyzing the relation between how the world appears to the individual and the way that an experience represents it is derived from two notions that have a common core. Both describe what intentionality captures at an abstract level: the content of experiences. From this perspective, perception always implies the existence of an individual and the way one perceives the particular content of experience.

Thought this way, my view suggests that things always appear as they are according to the certain way that individuals can access them, a kind of intentionality can be conserved: the intentionality present in the concrete perspectival mode of the experience. Thus, the phenomenal character of the experience can be saved without necessarily appealing to representations within propositional content. This view also allows an explanation of the unity of consciousness under the notion of *point of view* (see Charro and Colomina, 2013; Vázquez and Liz, 2011).

And my view also can explain the causal power of phenomenal states (as required for the poiseness of content claimed by Tye). Return to the previous parking lot example. Your fear did not have a representational object, but did not lack of causal power because the fear caused your bizarre behavior. Maybe it was caused by the strange noise that you heard or by the strange silhouette or by your tendencies to imagine things. This experience of fear probably was different from how you feel habitually when you walk to get your car.

This concrete experience of fear changed your behavior completely. For example, you accelerated your steps. You rapidly inserted your hand into the

pocket searching for the keys of your car. You impulsively jumped into the car. Your heart hastened and your sweat glands expelled additional sweat. Your entire world was altered in the same moment in which the sensation of fear appeared. The rest of your experiences were determined by this initial sensation of fear. In the same way, certain moods also change our personal world. The depressed person, for example, is plunged into such a state that the rest of her experiences are modified by this initial mood. It seems as if *her world* was different from *our world*.

What I mean is that the content of some experiences should be understood from a certain point of view: the view from where we have access to the things of the world. And from there, how things really are. In other words, the content of our mental states is informed by the perspective that we access the world, and how the things come from that perspective. And things will appear the same to everyone who has access to the world on that perspective, causing other mental states. Then, some experiences *tinge* the rest of our mental life, the rest of our mental states, acquiring the same affective character of that previous experience. This is to say, when one is in a depressive mood or has an experience of fear, the content of these experiences affects the rest of one's experiences, changing completely one's view of the world. Hence, further perceptions and experiences will be contaminated from the previous affective perspective, changing the *tonality* from where one will experience them.

Instead of insisting that every mental state has a propositional content, as Tye's intentionalism does, one can argue that the content of our mental states appears in very different manners, many of them in an affective more than in an evaluative way. And this way the contents are not simply reducible to propositions. The same affective aspect can be included in different experiences and in different mental states, allowing a generalization of the concrete emotions and moods experienced. The affective aspect of our mental states can be different in various diverse individuals depending of the perspective from where they access the world. Since the mental states can change the rest of the particular mental aspects of the individual, they have the capacity to conform a personalized view of the world.

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Critical Notices
Book Reviews
Book Notes

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On Orbit and Beyond: Psychological Perspectives on Human Spaceflight. Douglas A. Vakoch (Editor). New York: Springer. 2013, 317 pages, $129.00 hardcover.

Reviewed by George Michael, Westfield State University

Well into its sixth decade, people still wonder what achievements await the Space Age. The popular next choice would be a manned mission to Mars. According to a recent poll, 75 percent of those Americans surveyed agreed that the National Aeronautics and Space Administration's (NASA) budget should be substantially increased in order to fund this endeavor (Koebler, 2013). A mission to Mars, though, will test the physical and mental endurance of astronauts. Accordingly, the psychological aspects of space travel will loom larger as astronauts spend more time with one another with greater autonomy from Mission Control. In an edited volume — *On Orbit and Beyond: Psychological Perspectives on Human Spaceflight* — Douglas A. Vakoch, Professor of Clinical Psychology at the California Institute of Integral Studies and also the Director of Interstellar Message Composition at the SETI Institute, assembles a collection of essays written by a number of leading experts in the field of space psychology.

From its inception, psychological screening played an important role in the American space program. In the chapter "Behavioral Health," Albert A. Harrison and Edna R. Fiedler provide an overview of the history of psychological screening in the space program. As they explain, early astronauts were chosen for their "right stuff." Initially, NASA intended to recruit astronauts from a wide variety of backgrounds including military and commercial aviators, mountain climbers, polar explorers, and deep sea submersible operators, but with strong pressure from the White House, the candidate pool was limited to military test pilots who had already demonstrated their skills and temerity (p. 13). Intelligence, motivation, fitness, good decision-making skills, high tolerance for stress, emotional maturity, and the ability to work with others were the necessary traits for the demanding job of an astronaut.

But as the American space program progressed, interest in psychology waned. After five Mercury flights without serious performance deficits, NASA officials decided that there was no pressing need to continue exhaustive psychological testing procedures. Inasmuch as NASA managers were preoccupied with the scientific and engineering facets of spaceflight, behavioral health received short shrift. Therefore, psychiatrists and psychologists played only a minimal role in the selection process of astronauts

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from Gemini until well into the early Shuttle missions (pp. 13–14). The faintest possibility that a space mission would be compromised by psychological factors could be a public relations disaster for NASA (p. 7). The stereotype of the right stuff deterred snooping and prying that might suggest a real or imagined blemish that could lead to mission disqualification — a most dreaded result for an astronaut. Even the American press was loath to report negatively on any aspects of the lives of astronauts. Rather, the media sought confirmation that the astronauts embodied America's deepest virtues.

By the start of the twenty-first century, however, cracks began to appear in this image. Research suggested that astronauts suffered from a number of maladies as a result of their missions. Harrison and Fiedler found some astronauts reported depression, substance abuse problems, marital discord, and jealousy after completion of their missions (pp. 8–9). Psychological issues could no longer be ignored. Not only could unresolved mental problems jeopardize space missions, they could result in a public relations disaster. Inasmuch as NASA funding depends in large part on public perceptions, the space agency could not risk such an eventuality. Several developments rekindled interest in space psychology. The first missions into space were of short duration, lasting only hours or days, and the crews were small. But since the end of the Apollo program, the trend has been in the direction of larger crew sizes, greater crew diversity, and longer mission duration. Concern over psycho-social adaptation was heightened in the mid-1990s when astronauts joined cosmonauts on the Russian space station *Mir*. For that reason, cross-cultural issues have become more salient (p. xxviii). Current estimates suggest that a round trip mission to Mars along with a scientific expedition would take roughly two and a half years. To date, astronauts have not experienced missions of such long duration. Two particular factors that will compound an astronaut's stress are the deprivations of living in a confined environment and the inability to escape it.

Due to the infrequency of space flights, researchers have looked for alternative ways to study the psychological implications of long duration missions. Although there have been only limited opportunities to study astronauts in space, as Sheryl L. Bishop notes in her chapter "From Earth Analogues to Space: Learning How to Boldly Go," there are ample opportunities to study people in environments that resemble that of space. By studying these analog substitutes, researchers found good examples of exploration that exposed human frailties and group failures (pp. 25–50). Examples included long-duration missions to severe, remote areas, such as Antarctica. Though these settings were quite different than the near zero gravity environment of space, people who worked in them had to deal with stressful situations that might give insights that could be applicable to space crews. Historical exploratory expeditions were typically of long duration and involved many unknown risks. Because of the uncertainty, there was often a high degree of situational decision-making. Studying individuals in analog environments has taken two basic approaches. One involves constructing an environment within a laboratory setting with maximum control over exogenous variables and utilizing research subjects. To that end, several space-analogous settings have been created including the NEEMO underwater habitat located new Key Largo, Florida, the Haughton–Mars project on Devon Island in Canada, and the Mars500 simulation at the Institute for Biomedical Problems in Moscow (p. 27). The second approach examines in situ groups in real environments. For example, studies of submarine crews were thought to be applicable to spacefarers insofar as submariners operated in tightly-confined environments for missions of long duration (p. 40).

For long-term missions, temporality may affect an astronaut's psychological well-being. Some reports suggest that crewmembers in space and analogue environments

experience psychological and interpersonal difficulties at the start of the third quarter of a mission. According to this view, the relief that the mission is half over is overcome by the realization that the second half is yet to come. To test this hypothesis, Nick Kanas and his colleagues conducted two large international on-orbit studies involving crew and Mission Control personnel during a series of missions to the Russian *Mir* Space Station and the International Space Station; however, as they explain in their chapter "Psychology and Culture During Long-Duration Space Missions," they found no evidence to support the "third quarter" thesis. Actually, there was significantly greater mood disturbance and more tension during the first half of the mission than during the second. One explanation for this is the fact that crewmembers were supported by space psychologists and flight surgeons in Mission Control that employed a number of countermeasures to help the astronauts deal with stress and monotony as the mission progressed. Cohesion scores, however, dropped significantly during the last third of seclusion (pp. 153–184).

As the composition of space crews become more heterogeneous, more opportunities for interpersonal issues arise. Interpersonal difficulties can lead to increased depression, irritability, and homesickness. The problems can in turn foster territorial behavior and a reduction in group cohesion. Kanas and his colleagues identified a number of issues that might interfere with crew cohesion: (1) crew tension resulting from environmental stress and factors related to crew heterogeneity, (2) temporal-related drops in cohesion, most notably during the second half of the mission, (3) poor leadership skills, and (4) stress due to cultural and language differences (p. 174).

Despite all of the associated pitfalls, living in isolated and confined environments can also have growth-enhancing effects. For instance, the experience of people working in polar environments suggests that prolonged space travel could actually increase fortitude, perseverance, self-reliance, ingenuity, camaraderie and even decreased tension and depression (p. 162). Paradoxically, Palinkas (2003) found that a depressed mood was inversely associated with the severity of station environments — that is, the better the environment, the worse the depression. For example, in Antarctica, the winter-over experience was associated with reduced rates of hospital admissions (p. 42). Palinkas speculated that the experience of adapting to isolation and confinement may actually improve an individual's self-efficacy and self-reliance thus engendering coping skills that could be applied to other areas of life to counteract stress.

According to the research of Jason P. Kring and Megan A. Kaminski, evidence from space flights, and also from analogous settings such as Antarctica and submarines, suggests that the size of the crew has a major impact on its members. Large crews possess several advantages over smaller ones, for instance, a greater range of skills and abilities, as well as presenting opportunities for forming friendships and creating a more interesting social experience. Moreover, members of larger crews appear to get along better, exhibit less hostility, are more stable, and make better and more efficient decisions (p. 125).

In her research on astronauts aboard space stations, Phyllis J. Johnson notes that over time, crewmembers began to identify the space station as their home; nevertheless, they also wanted reminders of their home on Earth. For her chapter "The Roles of NASA, U.S. Astronauts, and Their Families in Long-Duration Missions," she reviewed autobiographical documents and discovered ways in which astronauts maintained some semblance of their lives on Earth. Engaging in a variety of activities, including reading, watching videos, and exercise, made the experience on the space station more bearable. Birthdays of the crew and their friends on Earth were celebrated along with various holidays and important landmarks in the history of space exploration. The opportunity to talk with their families was very important for crewmem-

bers. In recent years, astronauts have used platforms such as Facebook and Twitter to stay in contact with family, friends, and the public (p. 18). Exercise was important to maintain both mental and physical wellbeing. According to Johnson, looking out the window of the spacecraft was mentioned as the most favorite leisure activity for astronauts. Crewmembers enjoyed noting the locations of their homes and other personally relevant places on Earth. Likewise, in the chapter "Patterns in Crew-Initiated Photography of Earth from the ISS: Is Earth Observation a Salutogenic Experience?," Julie A. Robinson and her colleagues describe how observing the Earth from space can help support the health and wellbeing of the crewmembers (pp. 51–68). Because viewing Earth is a positive experience for space crews, the "Earth-out-of-view" problem could arise with astronauts on long-distance missions, such as a trip to Mars, in which the home planet will be reduced to an insignificant-looking dot in space (p. 156).

Initially, the astronaut corps was comprised almost exclusively of male military pilots; however, over the years, there has been increasing representation of different professions and a greater number of women and ethnic and racial minorities. Even before *Apollo* astronauts stepped foot on the Moon there was political pressure to increase the diversity of the astronaut corps by including women as well as representatives of different racial and ethnic groups. Nonetheless, President John F. Kennedy's admonition to place a man on the Moon before the end of the decade was interpreted by NASA to mean that the agency could not divert resources to sending women into orbit (p. 16). In their chapter "Gender Composition and Crew Cohesion During Long-Duration Space Missions," Jason P. Kring and Megan A. Kaminski examine the effect of gender on social interaction and interpersonal cohesion of crewmembers. Their research suggests that men and women carry out work in slightly different ways. In some contexts, all-male teams make less accurate and more overly aggressive decisions than mixed-gender teams. Unique contributions from each gender often improve team performance in settings such as health care, manufacturing, and extreme environments. These findings support the use of mixed-gender teams (pp. 123–124).

The Space Age commenced as a rivalry between the two superpowers, but since the end of the cold war, crewed flights have transitioned from fiercely competitive national space programs to collaborative efforts with international crews. Despite national rivalries, the quest for knowledge at times motivated the cold war enemies to work together in space exploration. Over time, space exploration took on a more multinational character, as both the United States and the Soviet Union included crewmembers from their respective allies, and eventually, from each other, in their missions. As Peter Suedfeld, Kasia E. Wilk, and Lindi Cassel point out in their chapter "Flying with Strangers: Postmission Reflections of Multinational Space Crews," at first, the inclusion of international crewmembers was primarily a propaganda move. Both superpowers offered room and board in the space capsules to citizens of their respective blocs. The foreign spacefarers were granted only limited access to their host's spacecraft. In 1984, President Ronald Reagan approved the development of another U.S. space station to replace the *Skylab*, but its construction was delayed for almost fifteen years, when in 1998 President Bill Clinton finally decided to cast the project as a truly worldwide venture which became the International Space Station. This change in orientation has led to more inclusive crews representing a greater number of nations. International crewmembers bring with them different cultures that can impact interpersonal relations. For example, studies suggest that whereas Russian culture values collectivism, hierarchy, and paternalism, American cultural values favor individualism, egalitarianism, and autonomy. In order to minimize misunderstanding that could arise from the interaction of different cultures, Suedfeld

and her colleagues recommend that both crew members and ground staff take in situ language training and familiarization in each other's countries (pp. 185–209).

In their chapter, "Cross-Cultural and Spaceflight Psychology: Arenas for Synergistic Research," Juris G. Draguns and Albert A. Harrison make the case that international flights make good sense for a variety of reasons. First, drawing from an international pool allows space managers to select astronauts from a broad range of interests and skills. Second, inasmuch as space missions are overarching and superordinate endeavors that encourage nations to work together, they could serve as a prototype for other collaborative ventures. Third, the more nations that participate in a mission, the greater the number of people that can identify (if only vicariously) with the challenge and triumphs of spaceflight. Finally, international missions can reduce duplication of effort, thus defraying the enormous costs of spaceflight (pp. 211–228).

As more nations work collaboratively in space, it is imperative that their astronauts overcome cultural differences. Although subjective culture is implicitly known to its members, its knowledge is rarely overtly articulated. Draguns and Harrison advocate using a culture assimilator to build cross-cultural awareness and sensitivity. Developed by F.E. Fiedler, T. Mitchell, and H.C. Triandis, this program consists of 100 to 200 scenarios in which people from two cultures interact. Each scenario is followed by four or five explanations of why the member of the culture acted in a specific way. The trainee then selects one of the explanations and is asked to turn a page (or go to the next computer screen), where feedback is provided concerning the chosen explanation. Over time, the trainees tend to become more specific and complex and less ethnocentric in their attributions in the exercise. Furthermore, they become better at predicting what members of the target culture will do. As a result, a great deal of anticipatory cultural learning takes place in a short time. As the composition of space crews becomes more diverse, Draguns and Harrison argue that this training could be useful to instill a greater awareness of sensitivity to different cultures. Moreover, they argue that cultural assimilators could be applied not only in international situations, but also to different levels within organizations. For instance, the training could help bridge the gap between different occupations within NASA.

The experiences of astronauts on both the *Mir* Space Station and the International Space Station have demonstrated that crews from a variety of national and ethnic groups can work effectively together. But as Harvey Wichman notes in his chapter "Near-Term Extended Solar System Exploration," to date, these missions have taken place in quasi-military structures. However, we are now on the cusp of a new age of space flight that will allow tourists to visit space. In fact, Bigelow Aerospace in Las Vegas has successfully launched two inflatable habitats that orbit the Earth. The firm intends to someday lease the station for research, industrial testing, and space tourism. Along with the high purchase prices for their space vacations, tourists will expect commensurate services. Space tourism will vastly broaden the spectrum of participants in the space program. This historic shift in space exploration will occasion a reconsideration in the way engineers, designers, and flight managers approach their tasks. Drawing upon the results of a simulation designed to mimic a single-stage orbit rocket, Wichman found that not only could minimally trained civilians tolerate the extreme environment of a space simulator, they could also find the experience very pleasing. As a result, Wichman is sanguine about the prospects of the fledging space tourism industry (pp. 267–280). Rather than emphasizing selection criteria that would restrict the number of prospective tourists, Wichman argues in his other chapter "Managing Negative Interactions in Space Crews: The Role of Simulator Research," that the space program should focus on environmental design and training so that the

prospective pool of spacefarers could be broadened. The primary tool for this effort, he proposes, is the spaceflight simulator (pp. 107–122).

For better or for worse, as spacefarers travel farther and farther from Earth, they will work under conditions of greater autonomy from Mission Control. Communications between the crew and ground control will become increasingly delayed. Depending upon where the planets are in their respective orbits, the time required for round-trip electronic transmissions between Earth and Mars would range from six to forty-four minutes (p. 246). Astronauts en route to Mars will not be able to rely upon automated life-support systems or short-term rescue possibilities in the case of emergencies. Consequently, autonomy will increase.

Greater autonomy could lead to possible breakdowns in interpersonal interactions both within the crew and with Mission Control. There is a danger that crewmembers may increasingly view ground personnel as an out-group, thus leading to mutual tension and misunderstanding. On occasion, conflicts have emerged between the flight crew and the ground control, leading to displacement. Displacement occurs when people cannot express emotion to those who are the source of the anger, for example, a boss for fear of retaliation. Instead, the aggrieved person takes his frustration out on safer targets — for example, his spouse or children — who are innocent victims of the anger (p. 94). Typically, anger wants an outlet — and a target — and the astronaut has three from which to choose. First, astronauts can vent their anger at another crewmate, but usually try not to do so because it would make a bad situation even worse. They are stuck with each other and they obviously cannot walk out of the mission. Second, a crewmember can direct his frustration inward, resulting in possible depression (Roach, 2010). Finally, crewmembers can displace their frustration at Mission Control. To mitigate displacement effects, in his chapter "Human Interactions On-orbit," Nick Kanas recommends periodic "bull sessions" whereby crewmembers and Mission Control can address issues before they begin to fester (pp. 93–106). He counsels that it is important to deal effectively with tensions that are sure to arise in the stressful environment of space. Group sensitivity training involving both crew and ground personnel could reduce the influence of personal, cultural, national, and other peculiarities during the mission.

Increased autonomy can also have some positive effects. Nick Kanas and his research team examine this issue in the chapter "High Versus Low Crewmember Autonomy in Space Simulation Environments." Exploring pilot studies from numerous space-analogous settings, they found that greater autonomy was associated with increased creativity, improved performance, and higher mood and morale (pp. 231–244). Likewise, in their chapter "Effects of Autonomous Mission Management on Crew Performance, Behavior, and Physiology: Insights from Ground-Based Experiments," Peter G. Roma and his colleagues concluded that greater autonomy was associated with enhanced performance and fewer negative emotional states (pp. 245–266).

Some space psychologists, however, fear that the more autonomous structure of extended missions could lead to groupthink, that is, a situation of greater conformity and reluctance to express concerns or disagreements about decisions. This could have serious implications for a manned mission to Mars insofar as the crew will experience high autonomy and interdependence. To be sure, a consensus of values can enhance team performance and make for harmonious personal interactions during space missions; however, the complete removal of interpersonal tensions may not be desirable. In their chapter "The Risk for Groupthink During Long-Duration Space Missions: Results from a 105-Day Confinement Study," Gro Mjeldheim Sandal, Hege H. Bye, and Fons J.R. van de Vijver examined how personal values change over the course of mission

simulations. For their analysis, they examined the Mars 105-day confinement study, which was conducted at the Institute of Biomedical Problems in Moscow in 2009. Counter-intuitively, they concluded that rather than converging, differences in values among crew members actually increased over time. Furthermore, there were greater tensions arising from value conflict at the end, rather than the beginning, of the mission. These findings suggest that rather than converging toward conformity, crewmembers actually began to drift apart in their thinking (pp. 135–149).

New breakthroughs in nanotechnology and computers could someday enable long-range space missions including a round trip to Saturn and its moon Titan. But several perils will face those astronauts who embark on long-duration missions. For instance, astronauts would encounter increased levels of cosmic radiation. They could not rely on the Earth's Van Allen Radiation Belts for protection. Inasmuch as humans have evolved for life on Earth, living in space is very difficult. Initially, weightlessness can be an exhilarating experience; however, the novelty quickly wears off. Furthermore, living in a zero gravity environment can have serious health consequences including the deterioration in muscle and body mass. The lack of the usual gravitational force in space can also affect brain mechanisms (p. 169). Currently, the practical limit on weightlessness has been six months. One method to facilitate long-duration space travel would be to produce centrifuge gravity in the space vessel. This method was used in the rotating spaceship that was featured in the film *2001: A Space Odyssey*. According to Robert Zubrin (2008), a 1,500-meter-long tether could be used to connect a space vessel with a small rocket. Once in space, firing the rocket would cause the system to rotate. He estimates that even a slow rotation rate of 2.6 RPM (rotations per minute) would produce artificial gravity about equal to that on Earth (p. 274).

In his chapter "Near-Term Extended Solar System Exploration," Harvey Wichman argues that there are advantages to returning to the Moon, as that could serve as an important step toward exploratory missions to Mars and future missions to asteroids. Returning to the Moon would be a suitable way to test equipment that will be used for a mission to Mars. Using the analogy of the settlement of the American West, Wichman notes that the frontier was initially opened up by intrepid explorers. They were followed by trappers and hunters who found ways to exploit the resources of the new land. Next, settlements were established, which ultimately turned into permanent communities (pp. 267–283).

In the chapter "From Earth's Orbit to the Outer Planets and Beyond: Psychological Issues in Space," Nick Kanas discusses the mental health implications for extended and multigenerational missions. The first mission to Mars will likely involve a crew of six or seven astronauts. Using current technology, a roundtrip to Mars would require twenty-four months. With six months on station, the journey would take thirty months. A roundtrip to Saturn without any time on a station would take fourteen years. This will create a situation in which crewmembers experience an acute sense of isolation and separation from Earth. The crew will have only infrequent supplies and it will be impossible to evacuate to Earth for emergencies (p. 286). For such long trips, individuals might be reluctant to apply because of the terrestrial opportunities they would have to forgo. For example, a forty-year old astronaut on a mission to the planet Saturn would be well into her fifties when she returned. Children would have grown up with family members and friends, perhaps dying in the interval. For interstellar travel, an astronaut might be kept in some form of suspended animation. But if she would ever return to Earth, all of her family and friends would be dead. How could the person be reintegrated after such a long time away from Earth (p. 291)?

One way out of this conundrum would be for whole communities to travel together in space. Several scientists including Gerard Kitchen O'Neill, Freeman Dyson, and

Isaac Asimov have speculated that giant self-contained generation ships might be used someday to travel across the galaxy (Asimov, 1979). As Kanas points out, the psychological impact of a permanent divorce from the home planet is unclear. To be sure, the effects on the first generation of colonists would be profound, as the crew would vividly remember life on Earth. For subsequent generations, though, their total existence and reference point would be the generation ship. Images and stories of Earth would be preserved, perhaps forming the subject of future lore as the colony evolved over time (p. 293).

Inasmuch as space missions will continue to change, there will always be a need for more research and new operational procedures. With new advances in technology, astronauts will be able to monitor their own behavior, thus reducing the threat that performance lapses could lead to flight disqualification. Such self-monitoring has been achieved by means of computers and personal digital assistants that are designed to measure several dimensions of cognitive functioning (e.g., attention, processing, and recall) [p. 20]. New technology will surely lead to new human–machine partnerships. In fact, with advances in artificial intelligence, it might soon be possible to send androids into space. In his 2005 book, *The Singularity Is Near: When Humans Transcend Biology*, the noted futurist Ray Kurzweil predicted that by the year 2042 computers will become self-aware and greatly exceed humans in intelligence. From the perspective of space engineers, sending robots might seem more feasible than sending humans as the former require no water, oxygen, or food supply. Moreover, there is no need to worry about interpersonal issues that might arise with a human crew. With their physical limitations and short life spans, assigning human astronauts to deep space missions might seem increasingly quixotic when more able androids are up to the task. If Kurzweil's singularity does indeed lie ahead in the near future, then it might be more practical to send intelligent machines on the first long-range space missions to Mars and beyond. Be that as it may, nothing excites the human mind more than to know that flesh and blood people are exploring the cosmos.

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CONTENTS