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Unconscious Cognition and Behaviorism

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This paper suggests the utility of studying unconscious cognition from a selectionist perspective, specifically as outlined by theory and research in the field of behavior analysis. Currently, issues surrounding the complexity of the unconscious cognitive behaviors, the number of variables involved, and the multidirectional influences of these variables, are of utmost concern to theories of mind and behavior. Unanswered questions about these factors leave us without the ability to predict outcomes in an individual case or adequately manipulate variables in order to alter outcomes. Multiple examples of current work by behavior analysts are suggested as potentially fruitful ways of addressing some of these concerns.

Keywords: unconscious cognition, behaviorism, selectionism

Psychologists are interested in understanding events concerning biological systems that act and behave. Sometimes we are interested in such events on the phylogenetic scale, as when we consider species differentiation. Sometimes we are interested in such events on the ontogenetic scale, as when we consider change across the lifespan of an organism. Sometimes we are interested in events on a much shorter scale, as when we consider interactions between two individuals. Furthermore, in each of these situations, it is always the case that an action or a behavior involves the interaction of multiple organismic and environmental elements. These multiple elements are constantly changing and change is often nonlinear. Actions and behaviors are context-sensi-

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tive, and task-specific (Gottlieb, Wahlsten, and Lickliter, 1998; Hartelman, van der Maas, and Molenaar, 1998; Oyama, 1989; Plotkin, 1994; Ruhland and van Geert, 1998; Thelen and Smith, 1998; van der Maas and Hopkins, 1998; Wimmers, Beek, Savelsbergh, and Hopkins, 1998).

Given the importance of the dynamic structure of behavioral events and actions, direct investigation of local fluctuating perturbations in behavioral phenomena as they relate to both past and future events, and analyses of patterns of change in well-defined and observable variables, are essential (de Weerth and van Geert, 1998; Smith and Thelen, 1994; Thelen and Smith, 1993, 1998). We propose that the selectionist account of behavior change as first conceptualized by Skinner has evolved through the work of other operant theorists to provide guidance in this endeavor (Baum, 1994; Bijou, 1995; Donahoe, Burgos, and Palmer, 1993; Donahoe and Palmer, 1994; Glenn and Madden, 1995; Herrnstein, 1970; Keller and Schoenfeld, 1995; Kuhn and Phelps, 1982; Reese, 1968; Reese and Lipsett, 1970; Sidman, 1960; Skinner, 1938, 1953, 1963, 1974). This paper will argue that cognitive scientists should reconsider the basic principles of behavior analysis for understanding behaviors and actions, particularly for those aspects of cognition that are unconscious or implicit.

Skinner's selectionism, best known as behavior analysis, concentrates on the operant, a class of responses affected similarly by a consequence. By describing how a set of different responses can be selected by consequences, Skinner expanded the influence of the environment on behavior beyond the elicitation of a fixed response, and explicitly included variation in responding in the subject matter of behavior analysis (Shahan and Chase, 2002). By including variation in responding, concepts such as imitation and rule governance can be analyzed in terms of their consequences. Such operants are often referred to as "higher order" because of the vast topographic variability in responses that are grouped together according to common consequences (Shahan and Chase, 2002). In addition, the discriminated operant, or the three-term contingency of antecedent–behavior–consequence, was defined by Skinner as the fundamental unit of operant behavior. Because the discriminated operant is based on relations between classes of stimuli and classes of responses, accounting for variation in classes is a primary facet of behavior analytic research.

Modern behavior analysis is the study of ongoing activity in real-time, a description of performance as opposed to a description of underlying structures, representations, or competence. These features of the experimental analysis of behavior are grounded in the functional analyses of behavior change that encompass the selection of behavior by consequences in the presence of antecedent conditions (Gewirtz and Pelaez-Nogueras, 1996; Harzem, 1996; Horowitz, 1992; Marr, 1997). Modern behavior analysis has become a rich source of ideas for cognitive research and theory in the study of those

aspects of cognition about which the organism is unaware (i.e., implicitly learned behaviors which involve "the ability to adapt to environmental constants . . . in the absence of any knowledge about how the adaptation is achieved" [Frensch and Runger, 2003, p. 15]). For example, the methods developed by behavior analysts allow one to focus on the process of behavior change: tracking the rapid, unconscious, fine-grain changes in behavior through cumulative records and time series analyses. If we think of examples of complex cognitive behaviors that involve implicit processes, like language or social cognition (e.g., a "theory of mind"), as not being specified in advance, but as adaptations to a constellation of phylogenetic, ontogenetic, and environmental factors interacting over time, we might focus more on multiple datum points within a specific context for any given behavior of interest. The use of single-subject methodologies with multiple measures of behavior within and across sessions, which have been refined within behavior analysis, might be helpful for such research.

The selectionist theory of behavior analysis also consistently exemplifies core elements of a natural science (Schlinger, 1995). With its roots in Darwin's (1859) theory of natural selection, selectionism should appeal to many cognitive scientists. A selectionist approach to behavioral change has three main features: variation, selection, and retention (Campbell, 1960; Donahoe, Burgos, and Palmer, 1993; Donahoe and Palmer, 1994; Kaufman, 1995; Plotkin, 1994). Structures and behaviors vary, selection leads to some outcomes being favored over others, and these outcomes are retained differentially (Cairns, Elder, and Costello, 1996; Campbell, 1960; Donahoe and Palmer, 1994; Mayr, 1961; Plotkin, 1994). Selectionist approaches are not new to psychological science (e.g., Anderson and Schooler, 1991; Shepard, 1994; Sporns and Edelman, 1993), and attempts to integrate evolutionary theory with cultural and instructional influences have been forthcoming (e.g., Cosmides, 1989; Geary, 1995). When applied to the problems of studying unconscious cognition, though, the focus on variation, selection, and retention helps to unify the variables that are purported to influence all behavior.

Further, selectionist theory does not distinguish between the parts of the biological system that are observable and not observable. As in any natural science, the events manipulated and measured in any particular investigation are always observable, but the interpretation of behavior that cannot currently be observed involves the same variables as that which can be or has been observed (Palmer, 2003). Although such theory progresses without ever knowing whether the unobservable event can really be accounted for by the same variables as that which has been observed, this kind of inference is no different than those made throughout science. Questions of how well a finding concerning observed events generalizes to other phenomena that have not been observed leads to development of measurement systems that allow

the previously unobservable to be made observable. Within current technology examples of this progress include the use of magnetic resonance imagery to "see" what is occurring in the neurological system and the use of neural network modeling to make explicit the kinds of structures needed to produce adaptive learning (Donahoe, 2003). The benefit for an approach that makes these relations explicit for those interested in implicit, automatic, or unconscious events is that these events are not given any special status; they can be integrated into the study of other behavioral events. When combined with the micro-analytic techniques of single-subject methodology, research conducted from a selectionist perspective frees the scientist interested in implicit events to look at behavior change over time unfettered by assumptions of difference across levels of observation. This consistency across levels of observation is one of the hallmarks of behavior analytic research, and it has fostered continual interactions among scientists studying behavior at all levels of analysis, from that of single-celled organisms to behavior in complex organizations (see Lattal and Chase, 2003 for an edited book dedicated to this integrated body of work).

In addition, the current interest scientists have in dynamic and complex systems theory approaches implies an acceptance of many of the tenets of selectionism (e.g., Fogel, Lyra, and Valsiner, 1997; Fogel and Thelen, 1987; Ford and Lerner, 1992; Gottlieb, Wahlsten, and Lickliter, 1998; Kelso, 1995; Siegler, 1996; Thelen and Smith, 1998; van Geert, 1994). For example, those aspects of dynamic and complex systems theories that account for the increasing complexity of organisms and behavior over developmental time (e.g., the notion of self-organization, see Lewis, 1997; Lewis and Granic, 1999; van der Maas and Hopkins, 1998) share significant overlap with those aspects of the theory of natural selection that account for the increasing complexity of species over evolutionary time (Kaufman, 1995). Interestingly, in recent years there has been parallel attention paid to dynamic systems concepts by behavior analysts (e.g., Galbicka, 1992; Marr, 1992, 1996a; Novak, 1996, 1998; Pelaez–Nogueras, 1997). Here, however, we want to consider the relevance of basic notions of consequences and variation in terms relevant to those studying implicit cognitive functioning. Behavior analysis has much to say about selection by consequences and variation. Work on the development of these concepts may be particularly important for those studying unconscious cognition because these concepts do not assume the necessity of verbal or imaginal cognition. The behavior analytic literature on these concepts focuses on behavior change over time and suggests that the individual does not have to be conscious of the underlining neurological events in order for the events to affect cognitive functioning.

Consequences

Inherent to selectionist approaches of change are consequences. Consequences within a behavioral system are defined as reinforcing if they increase the behavior that they follow or as punishing if they decrease the behavior that they follow (e.g., Mazur, 1983; Nevin and Baum, 1980). While cognitive scientists have begun to examine consequences as they look at task structures and specific behaviors during problem solving (e.g., Thornton, 1999), more direct investigation of how consequences determine subsequent performance is needed in order to understand unconscious behavior.

Intricate manipulation of consequences and the careful examination of the results of manipulations are central to operant psychology. For example, while it is common knowledge that there are important differences in outcomes depending on whether consequences occur on regular or variable schedules and according to ratio- or interval-distributions (Ferster and Skinner, 1957), it is also the case that outcomes differ depending on whether consequences occur immediately after a behavior or are delayed, and whether schedules of consequences are chained (e.g., Williams, 1997). Furthermore, consequences can be signaled or unsignaled (e.g., Badia, Ryan, and Harsh, 1981). And, habituation to consequences can occur (e.g., McSweeney and Weatherly, 1998). In other words, multiple trials with multiple schedules of consequences at various latencies produce very complex patterns of behavior over time (e.g., Marr, 1997), and it is the complexity of these patterns that is under intense examination by behavior analysts (e.g., Grace, Schwendiman, and Nevin, 1998; Schaal, Shahan, Kovera, and Reilly, 1998). Although much of this fine-grained work on consequences has been done with non-human animals, the generalization of these results to humans has been achieved within basic research with humans, applications to a wide range of socially important behaviors, and through systematic interpretation of complex behaviors (Lattal and Chase, 2003).

While the usual practice in animal experimentation has been the contingent presentation of food or water under various levels of deprivation in strains of species bred for homogeneity, it is important to understand that this methodology is for obvious practical reasons only. The transfer of results from this research is very plausible as we develop a more thorough understanding of what consequences are effective for specific organisms, what levels of deprivation those consequences involve, and take account of the genetic determinants of behaviors in other ways. The effectiveness of any stimulus depends not only on its physical aspects, but also on the perceptual capacities of the organism, the state of arousal of the organism, and the organism's experiential and developmental history (Gottlieb et al., 1998).

Mainstream psychology has assumed that human behavior, including unconscious cognitions, can be maintained by phenomena like perceptual stimulus changes, movement relative to the external environment, the successful manipulation of objects, proprioceptive feedback, and novelty. These events have been studied and interpreted by selectionists as types of reinforcers that come under the category of ecological or automatic stimuli (Bijou, 1995; Bijou and Baer, 1965; Malcuit and Pomerleau, 1996; Novak, 1996; Sundberg, Michael, Partington, and Sundberg, 1996; Vaughn and Michael, 1982).

Cognitive scientists have also assumed the strong effects of social stimuli as reinforcers for humans, particularly in their role as state regulators (e.g., Cohn, Campbell, Matias, and Hopkins, 1990; Field, Healy, Goldstein, and Guthertz, 1990; Kaplan, Jung, Ryther, and Zarlengo–Strouse, 1996; Kuhl, Andruski, Chistovich, Chistovich, Kozhevnikova, Ryskina, Stolyarova, Sundberg, and Lacerda, 1997; Papousek, Papousek, and Symmes, 1991). Current behavior analytic work has been busy systematically manipulating some of these stimuli as consequences in order to further our understanding of species-typical reinforcers and how they function. In the developmental area, touch, vocalizations, facial expressions, and imitation have been investigated (e.g., Gewirtz and Pelaez–Nogueras, 1992; Pelaez–Nogueras, Gewirtz, Field, Cigales, Malphurs, Clasky, and Sanchez, 1996). In the study of complex adult behavior in organizations, the study of feedback as social consequences has revealed the interplay of immediacy, frequency, and source of feedback with the frequency and patterning of behavior (Balcazar, Hopkins, and Suarez, 1986).

The operation of selection by consequences also involves an examination of the context prior to any given behavior (Morris, 1988; Pelaez–Nogueras and Gewirtz, 1997): all consequences do not have their effect all of the time due to differences in the conditions under which they occur. In order to explore the antecedent environmental control of behavior (Baer, 1997; Baer and Pinkston, 1997; Baum, 1989), behavior analysts use concepts like setting events (Bijou, 1995), setting factors (Kantor, 1959), stimulus equivalence (Sidman, 2000), and establishing operations (Michael, 1993), in addition to more traditional concepts like stimulus generalization, stimulus discrimination, and conditional discrimination (e.g., Dougherty and Wixted, 1996; Herrnstein, 1990; Honig and Fetterman, 1992). In addition, the notion that antecedent stimulus control is not restricted to momentary causes is of great current interest to the field of behavior analysis (Paniagua, 1997; Rachlin, 1992, 1994, 1995). For example, behavioral history forms a context that influences the effects of contingencies (Wanchisen and Tatham, 1991). This acknowledgement of the role of experience provides a theoretical connection between the automaticity literature, which has been used to understand unconscious behavior, and the behavior analytic focus on practice, fluency, and rate of reinforcement (Dougherty and Johnston, 1996; Doughty, Chase,

and O'Shields, 2004). In addition, behavior analysts even have become interested in the effects of context at the level of culture (e.g., Glenn, 1997, 2003; Guerin, 1994). Very interesting possibilities for convergence across cognitive science and behavior analysis occur when taking into account the notion that behavior involves extended patterns over time (Harzem, 1996; Rachlin, 1992, 1994, 1995, 2003; Skinner, 1953, 1957), and that the effect of contingencies is not always at the molecular level (Baum, 1989; Donahoe and Palmer, 1994; Hineline, 2003; Marr, 1992, 1996b; Moxley, 1995; Reese, 1994; Thompson and Lubinski, 1986; Williams, 1995).

Finally, contingencies themselves can even serve as contextual discriminative stimuli (Bower, 1997; Denney and Neuringer, 1998; Reese and Lipsitt, 1970, pp. 187–191). It is here that the importance of variability to selectionist accounts is highlighted.

Variability

Variability is particularly prevalent in the early stages of the development of new skills (Dougherty and Haith, 1997; Frick, Columbo, and Saxon, 1999; Siegler, 1996; Sophian, 1997; Thornton, 1999). In addition, "blind" variability has been placed at the center of creative thought (Campbell, 1960), play, and exploratory behavior (Gibson, 1988; Neuringer, 1999, 2003). Examination of relations between operant conditioning and behavioral variability are ongoing in the field of behavior analysis (e.g., Cherot, Jones, and Neuringer, 1996; Donahoe and Palmer, 1994; Hunziker, Saldana, and Neuringer, 1996; Machado, 1989; Morgan and Neuringer, 1990; Neuringer, 1992, 1993, 2003).

Variability is critical to describing the process by which new behaviors emerge because *differential* retention by consequences cannot occur without such variability (Plotkin, 1994; Siegler, 1994, 1996; Smith and Thelen, 1994). Specifically, selections occur under current conditions, but the outcomes of these selections are influenced by previous selections that effected variability — in any given instance there are limitations on the variation that selection has to work on and these limitations are based on previous selections. Changes in variability, as one product of previous acts of selection, thus provide the continuity and coherence behind the relation between environmental order and organismic organization (Neuringer, 1999; Plotkin, 1994). Donahoe and Palmer have put it this way: "The objects of selection — the structure and behavior of living organisms — play an active role in channeling the development of complexity. However, they do not play an autonomous role — i.e., a role independent of the environment — because they are themselves the products of prior selections" (1994, p. 19); [see also Nelson and Bloom, 1997, for a similar conceptualization of how structures, in this case, genes, interact with environmental influences in determining outcomes]. In other words, when

one speaks of a behaving organism (Plotkin, 1994), one is addressing the previous selections, both phylogenetic and ontogenetic, that have produced whatever organization of factors is present in behavior at that moment in time. These previous functional adaptations constrain the effect of subsequent consequences. By situating real-time organizations within the context (or constraints) of the organism's unique history of variability and consequences, the emergent properties of actions, including the implicit or unconscious components, become demonstrable (van der Maas and Hopkins, 1998).

A selectionist account that fully acknowledges the interaction between current consequences, past selections, and variability may be just what is needed to bring behavior analysis and mainstream psychology into contact with one another again. Radically different conceptualizations of voluntary action and intentional behavior were a major philosophical component of the original divisions between the two fields, but acceptance of determination without one-to-one predictability within a selectionist perspective provides the basis of a rapprochement. First, with the firm placement of the determinants of behavior in the phylogenetic and ontogenetic environment, the study of "re-presentations" and increasingly complex "re-descriptions" (Karmiloff–Smith, 1992) become the study of past interactions with antecedent and consequent stimuli. Symbolic re-presentations and re-descriptions in the form of verbal behavior and imagery are also analyzable as the outcomes of current and past behavioral events regardless of whether they are made public or kept private.

Second, adaptations are dynamic and functional but not perfect, and complexity leads to the unpredictability of any given outcome that provides the compelling illusion of "free will" for humans (see Dennett, 2003; Wegner, 2003 also for current discussions in this area). The critical relation between consequences, the cornerstone of modern behavior analysis, and variability thus has significance for our understanding of notions of choice, strategy, and intentional behavior. The possibility of multiple courses of action (variability) in any given situation, influenced by complex patterns of past and current selections by consequences, and the emergence of novel forms, is as plausible an account of the experience of "choice" and goal-directed problem solving in an active, intelligent organism (Neuringer, 1999, 2003) as is the theory of natural selection for evolution.

Conclusion

Other features of modern behavior analysis also make much of its empirical and theoretical work relevant to cognitive science. For example, there is growing acceptance of, and attention to: (1) the influence of genetics and biology (e.g., Donahoe, 1996; Hunziker, Saldana, and Neuringer, 1996; Reese,

1994; including research on the effects of drugs on behavior, e.g., Hoffman, Branch, and Sizemore, 1987); (2) the presence of qualitative, not just quantitative, changes in behavior (Ribes, 1996; Rosales–Ruiz and Baer, 1996); and (3) interactions between respondent and operant conditioning (Donahoe and Palmer, 1994; Ribes, 1986). Finally, there is continuing debate in behavior analysis concerning the appropriateness of laboratory manipulations that may not reflect real-world phenomena. Functional analyses of human behavior do not have to depend on methods that precisely mimic operant chamber procedures (e.g., Malcuit and Pomerleau, 1996; Shull and Lawrence, 1991).

Behavior analysts are also interested in such topics as the development of self-control versus impulsivity (e.g., Barkley, 1997; Paniagua and Black, 1990; Saldana and Neuringer, 1998). Behavior analysts are very active in the field of developmental disabilities (e.g., Barnes, McCullagh, and Keenan, 1990; Eikeseth and Smith, 1992; McIlvane, Dube, Kledaras, Iennaco, and Stoddard, 1990; McIlvane and Stoddard, 1981; Neef and Peterson, 2003; Saunders and Spradlin, 1990; Schriebman, 1997; Sidman and Stoddard, 1969) and education (see Chase, 2003). Unconscious cognitive "behaviors" such as procedural knowledge in animals (Eisler, 1984) and attention and eye movements (Case, Ploog, and Fantino, 1990; Dinsmoor, 1985; Malcuit and Pomerleau, 1996; Schroeder, 1997), to name just a few, are also being studied from a behavior analytic perspective.

In summary, the field of behavior analysis has much to contribute (see Friman, Allen, Kerwin, and Larzelere, 1993, for a review of citation rates), but there still exists almost total separation in publishing outlets and conference attendance for behavior analysts versus mainstream psychological scientists. This review has provided a large number of citations from work published in behavioral analytic journals in order to encourage cognitive scientists to explore what current experimental behavior analysis can contribute to their research and theory.[1] The differences in terminology used by the two fields can be daunting (Hineline, 1980), but we hope that readers will see the utility of becoming more familiar with current theory and research in modern behavior analysis.

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