The Psychological Record, 2000, 50, 251-265

EXPLAINING COMPLEX BEHAVIOR: TWO PERSPECTIVES ON THE CONCEPT OF GENERALIZED OPERANT CLASSES

DERMOT BARNES-HOLMES and YVONNE BARNES-HOLMES
National University of Ireland, Maynooth

The concept of generalized, higher-order, or overarching operant classes has been invoked by a number of researchers when dealing with complex behavior. For example, identity matching, generalized imitation, and relational framing all rest firmly on this concept. However, if the use of the term generalized (or higher-order/overarching) is to carry any explanatory value it needs to be clearly defined. The current article examines two approaches to clarifying this definition. The first approach suggests that generalized operants may be defined in terms of the different orders of contingencies involved, relative to nongeneralized operants, but fails to specify the exact nature of these different orders of contingencies. The second approach suggests that the term generalized should be used in a nontechnical way to emphasize that certain operant classes can only be specified in purely functional terms. This nontechnical definition appears to circumvent some of the thorny problems that arise in attempting to define generalized operants in terms of different orders of contingencies. However, other issues are raised by the latter, nontechnical definition of the generalized operant when it is applied to complex human behavior. These issues are examined and are found to be largely unproblematic.

The concept of a generalized (higher-order or overarching) operant class has been called upon by several researchers as a means of interpreting or explaining some types of complex behavior (e.g., Barnes, 1994; Catania, 1996, 1998; Hayes, 1991; Healy, Barnes, & Smeets, 1998; Horne & Lowe, 1996; Lowenkron, 1998). In calling upon this concept, however, it is important that it be used in a clear and precise way. Without this precision, the concept may do more harm than good as an explanatory device. In the interests of working towards this precision, the

We thank Bill McIlvane and an anonymous reviewer for their helpful and constructive comments on an earlier version of the current article. Address requests for reprints to Dermot Barnes-Holmes, Department of Psychology, National University of Ireland, Maynooth; Maynooth, Co. Kildare, Ireland. (E-mail: Dermot.Barnes-Holmes@may.ie)

current article examines two interpretations of the generalized operant, one offered by Catania (1996, 1998) and the other by Relational Frame Theory (RFT) (e.g., Barnes, 1994; Barnes & Roche, 1996; Hayes, 1991; Hayes, Gifford, & Wilson, 1996; Hayes & Wilson, 1996). We begin the current article by briefly outlining the concept of an operant class. We then consider Catania's definition of the generalized operant, including specific problems raised by this definition. Subsequently, derived relational responding, as an example of complex behavior, is outlined, and the RFT interpretation of this behavior, as a generalized operant, is considered. The RFT definition of the generalized operant will then be presented, and an argument is made that the RFT perspective avoids the conceptual and practical problems raised by Catania's definition of the generalized operant. Finally, we consider two additional issues that are raised by the RFT interpretation of derived relational responding as generalized operant behavior.

The Concept of an Operant Class

The essential property of an operant is the correspondence between a class of responses defined by its consequences and the variety of responses generated by these consequences. In effect, the behavioral properties of operant classes are based on differential consequences or reinforcement—the reinforcement of only those responses that fall within a specified class. This operation makes subsequent responding conform increasingly to the defining properties of the class.

Operant response classes are defined by their functions and not by their topography or form. Consider, for example, the rat's lever press. The rat may press the lever with its nose, left paw, right paw, tail, and so forth. Such responses appear different in form, but they are all lever presses and count as members of the same operant response class because they all share a common function (i.e., they all produce the same consequences). Contingencies select the members of operant classes and make all of the members of the class functionally equivalent. This functional equivalence, in effect, defines operant classes.

General, Overarching, or Higher-Order Operant Classes

Presumably, few behavior analysts would disagree, in any fundamental way, with the foregoing definition of operant classes. However, the definition of *generalized* operant classes does not appear to be equally straightforward (for the purposes of the current article we will use only the term *generalized*, rather than *higher-order* or *overarching*, with the explicit assumption that these three terms are essentially synonymous). The key point here, is that using the term *generalized* begs at least two important questions: (a) what exactly is meant when an operant class is described as generalized, and (b) how does this type of operant class differ from one that is not generalized?

As stated previously, the current article attempts to address these questions by considering the two respective definitions of generalized operants offered by Catania and RFT.

Catania (1996, 1998)

According to Catania, generalized operants involve classes embedded within other classes. In other words, a generalized operant includes within it other classes that can themselves function as operants. According to this view, therefore, contingencies arranged for some subclasses may *generalize* to all of the others. For illustrative purposes, consider two of the examples that Catania provides of such classes.

Identity matching. In identity matching, each specific match defines a class, but identity matching, as an operant, is a generalized class that includes all of the specific matches as its components (i.e., classes embedded within another class) (see Catania, 1996, p. 7). In matching-to-sample, the matching of green to green, or yellow to yellow, may exist as separate operants. They may be treated as instances of identity matching only if they can be shown to be components of a single generalized operant defined by the identity relation between sample and comparison. One test for this generalized operant involves determining whether novel relations can be demonstrated, such as the matching of new colors (e.g., red to red); a second involves changing the contingencies only for a subset of classes, and then determining whether the matching subclasses are maintained as a single class.

Generalized imitation. Generalized imitation refers to a functional relation between a model, an imitator, and a history of differential consequences for imitating (see Catania, 1998, pp. 157-158). Imagine, for example, a child learning to imitate several instances of behavior modeled by a puppet, such as jumping, skipping, and clapping. If a novel behavior is then produced by the puppet (e.g., sitting), the child may imitate this behavior despite the fact that this particular imitative response was never reinforced (e.g., Poulson, Kymissis, Reeve, Andreatos, & Reeve, 1991). The operant class is generalized, therefore, in that the class contains imitative responses *in general* and not just those that have been differentially reinforced. As another means of testing for generalized imitation, imagine that consequences are arranged to maintain all the imitative responses, but then imitating the clapping is no longer reinforced. In this case, the child may readily continue to imitate the clapping along with the other responses (e.g., Baer, Peterson, & Sherman, 1967). In effect, the imitation of clapping has become part of a generalized operant class because it is maintained with the other imitative responses, despite the fact that it is no longer explicitly reinforced.

These and other examples of generalized operants provided by Catania (e.g., learning set) appear to support his definition of a generalized operant as composed of component operants that are maintained together. Upon closer scrutiny, however, this definition is not without its ambiguities. The key problem we have identified is that so-called component operants may themselves be composed of component operants that are maintained together. In effect, the component operants may also be defined as generalized operants, and thus the term generalized, in this context, becomes redundant. For illustrative purposes, consider the following passage from Catania (1996):

> Much research on complex discrimination is concerned with distinguishing between higher-order operants and the component operants that are their subclasses. In matching-to-sample, for example, the matching of green to green or of red to red or of yellow to yellow may each stand as separate operants. They can be treated as instances of identity matching only if they can be shown to be components of a single higher-order operant defined by the identity relation between sample and comparison. (p. 7)

The problem here is that presumably the matching of one particular color (e.g., red with red) may itself be composed of other component operants. For example, illuminating the sample may function as a discriminative stimulus for pecking the sample, and pecking the sample may be reinforced when it dims and the comparisons are illuminated; illuminating the comparisons may be partly discriminative for pecking one of them which is then reinforced by the presentation of food; consuming the food may be partly discriminative for orienting towards the sample (in anticipation of the next trial), which is then reinforced, after the intertrial interval, by the illumination of the sample; and so on. Furthermore, each of these component operants may be composed of yet "smaller" operants.

To find out whether the matching of one particular color is a generalized operant, we might determine whether matching red to red, for example, would continue if we removed one or more of the possible components (e.g., stop dimming the samples and/or the comparisons when they are pecked, and/or remove the intertrial interval). If the operant of matching red to red was maintained, after one or more of the components were removed, then it could be defined, according to Catania, as a generalized operant. As indicated above, the term generalized now appears redundant because it applies equally to the operant of identity matching and to the component operants that go to make up that matching performance.

Catania does appear to be aware of this problem because he attempts to make a distinction between component and generalized operants by appealing to the different orders of contingencies involved across the two types of operant:

> Like the various topographies of a rat's food-reinforced lever-pressing, higher-order classes of behavior are held together by the common contingencies. In these cases, however, the contingencies are of different orders. For example, the contingencies that operate on the following of orders in general, which are usually social and *verbal*, are different from those that operate on the following of a

> particular order, which may be completely nonverbal (consider the military command to attack a machine gun nest across an open field of fire). (Catania, 1996, p. 7)

The foregoing passage, however, fails to specify the different orders of contingencies involved, but instead provides an example of a generalized operant that appeals to the ill-defined concept of *verbal* contingencies. We are forced to conclude, therefore, that the concept of contingencies of different orders does not readily distinguish between non-generalized and generalized operants. In other words, the different orders of contingencies must be specified precisely if the concept is to distinguish clearly between generalized and nongeneralized operants. From our reading of Catania (1996, 1998) this has not been achieved.

One empirical solution to the problem of distinguishing between generalized and nongeneralized operants might be to focus on the possible disruption caused when a component operant is removed from an operant class. Imagine, for example, that the operant of matching red with red is disrupted in some way when the intertrial interval is removed (e.g., the number of matching errors increases following its removal). We might take this "disruption" as evidence that it is not a genuine, generalized operant. In adopting this approach, however, other complex issues arise. Imagine, for example, that the number of matching errors increases after the intertrial interval has been removed, but more trials are completed per session, thus maintaining the same overall rate of reinforcement. In this case, one might argue that the matching operant was not, in fact, disrupted, because the level of reinforcement remained unchanged after the intertrial interval was removed. Alternatively, imagine that the number of matching errors remains unchanged, but the overall rate of reinforcement increases (because more trials are completed per session). Would this outcome be defined as disruption? Finally, imagine, that matching errors increase *and* level of reinforcement decreases, but only temporarily (e.g., after 200 trials, these measures return to baseline levels). Would this temporary disruption be sufficient to define the matching operant as nongeneralized, or could one argue that it is evidence of a "weak" generalized operant, relative to one that shows no disruption at all (i.e., a "strong" generalized operant)? Clearly, focusing on the issue of disruption appears to create more problems than it solves in attempting to identify a precise definition of the concept of generalized operant classes.

Summary. Catania's definition of the generalized operant appears to rest largely on the concept of contingencies of different orders. Without this concept, the term generalized, as applied to operant classes, appears to be redundant. However, Catania has not yet specified the exact nature of these different orders of contingencies, and thus his definition of the generalized operant remains vague.

Relational Frame Theory and Generalized Operants

In the remaining half of the current article we first outline the phenomenon of derived relational responding. We then examine the RFT explanation of this phenomenon as a form of generalized operant behavior. The concept of the generalized operant, as used by RFT, is then scrutinized. Finally, we consider some of the criticisms of RFT within the context of its definition of generalized operant classes.

Derived relational responding as generalized operant behavior. In recent years, behavioral researchers have been developing experimental procedures that generate derived relational responding. This form of responding is often studied using a "matching-to-sample" format to establish a number of related conditional discriminations among sets of stimuli. An example of this format might involve presenting one of two "sample" stimuli along with each of two "comparison" stimuli. The samples and comparisons may be nonsense syllables, abstract shapes, or any stimulus event, the only constraint being that the stimuli must not be related to each other along any consistent physical dimension (e.g., size, color). In accordance with tradition, we normally refer to the samples and comparisons using alphanumeric labels (subjects never see these labels). A typical procedure for studying derived relational responding might involve reinforcing the selection of comparisons B1 and B2 in the presence of samples A1 and A2, respectively, and reinforcing the selection of C1 and C2 in the presence B1 and B2, respectively. Once these conditional discriminations have been established, verbally-able humans often reverse the explicitly reinforced conditional discriminations in the absence of any further training. That is, they match A1 and A2 to B1 and B2, respectively, and match C1 and C2 to B1 and B2, respectively. When this occurs, responding in accordance with derived symmetrical, or *mutually entailed*, stimulus relations has been shown. In addition, subjects also often respond in accordance with derived transitive and equivalence relations in the absence of any further training. Transitive relations are shown when subjects match C1 and C2 to A1 and A2, respectively, and equivalence relations are shown when subjects match A1 and A2 to C1 and C2, respectively (note that RFT uses the term *combinatorial entailment*[1] to subsume both transitive and equivalence relations). When these types of matching performances emerge for a set of stimuli, the stimuli involved are said to participate in an equivalence class (Sidman, 1990, pp. 100-102; Sidman, 1992, pp. 18-19) or in a relational frame of equivalence (e.g., Barnes, 1994; Hayes, 1991). As an aside, there are many variations on the training and testing design described above. For instance, instead of training A-B and B-C relations,

[1]Relational frame theory employs the generic terms "mutual entailment" and "combinatorial entailment" because not all stimulus relations are symmetrical or transitive/equivalent. For example, if a subject was taught that A is larger than B, the derived relation is not symmetrical (i.e., B is smaller, not larger, than A). Similarly, if A is hotter than B and B is hotter than C, C is not hotter than A, as would be required if the relation was one of equivalence. Rather, C is cooler than A.

some studies have involved training A-B and A-C, and then testing for B-A and C-A mutually entailed relations, and B-C and C-B combinatorially entailed relations (see Sidman, 1990, p. 102).

Relational frame theory aims to explain the phenomenon of stimulus equivalence, and derived relational responding more generally, by drawing upon the concept of the generalized operant. However, the prefix "generalized" is not used by RFT to indicate that such operants are in some way new or different. Instead, the term "generalized" is used simply to emphasize the purely functional nature of such operants. In order to explain this use of the term "generalized," we will first outline how RFT interprets derived relational responding as generalized operant behavior.

According to RFT, derived relational responding is established, in large part, by an appropriate history of multiple exemplar training (see Barnes, 1994, 1996; Barnes & Holmes, 1991; Barnes & Roche, 1996; Hayes, 1991, 1994; Hayes & Hayes, 1989). Learning to name objects and events is perhaps one of the earliest and more important forms of such relational responding. For instance, a caregiver will often utter the name of an object in the presence of a young child and then reinforce any orienting response that occurs towards that object. We can describe this interaction as, hear name A → look at object B. Sometimes, the caregiver will also present an object to the child and then model and reinforce an appropriate "tact" (Skinner, 1957), and this interaction may be described as see object B → hear and say name A (see Barnes, 1994, for a detailed discussion). During the early stages of language training, each interaction may require explicit reinforcement for it to become established in the behavioral repertoire of the child, but after a number of name-object and object-name exemplars have been trained, the generalized operant response class of "derived naming" is established. In other words, the multiple-exemplar training gradually abstracts out specific contextual cues as discriminative for the derived naming response. Suppose, for example, a child with this multiple exemplar naming history is told "This is your ball." Contextual cues, such as the word "is" and the naming context itself, will now be discriminative for symmetrical responding between the name and the object. In the absence of further training, therefore, the child will now point to the ball when asked "Where is your ball?" (name A → object B) and will say "ball" when presented with the ball and asked "What is this?" (object B → name A). Hayes et al. (1996) recently summarized this interpretation of derived relational responding in the following way:

> Suppose a person is taught A-B and later B-A relations. With one exemplar the specific formal characteristics of each relation will dominate (e.g., "given green box pick red circle and given red circle pick green box"). With additional and diverse exemplars, discriminative control becomes increasingly refined, and there is a gradual exclusion of an increasing number of irrelevant formal characteristics. As more and more formal properties are excluded, through exposure to an increasingly rich history of differential reinforcement across varying complex stimuli, eventually the

> behavior of relating itself is discriminated (something more like "given that this thing is related to that one, that one is related to this one"). (p. 287)

Relational frame theory argues that any stimuli may participate in relational responding in the presence of the appropriate contextual cues, and moreover RFT views stimulus equivalence as an example of such responding. For instance, when a young girl is exposed to a matching-to-sample procedure, contextual cues provided by this procedure may be discriminative for equivalence responding. In fact, the matching-to-sample format itself is a likely contextual cue in this regard, because it is often used in preschool education exercises to teach picture-to-word equivalences (see Barnes, 1994, and Barnes & Roche, 1996, for detailed discussions). Relational frame theory therefore defines equivalence as a generalized operant response class insofar as it is created by a history of reinforcement across multiple exemplars, and once established, any stimulus event, regardless of form, may participate in the relational frame of equivalence.

Relational frame theory and the definition of generalized operants. Relational frame theory clearly aims to provide an account of derived relational responding in terms of generalized operant response classes. Nevertheless, the question still remains: How exactly does RFT define the concept of the generalized operant? To answer this question, it should first be noted that for RFT a response class with an infinite variety of topographies is a defining property of operant behavior. Relational frame theory also recognizes, however, that topographical and functional classes of behavioral interactions quite often overlap, and thus the two may become confused. Lever pressing, for example, may be defined by the effect of activity upon the lever, but almost all lever presses involve "pressing" movements. For example, a sensitive lever may be activated by coughing, but normally such instances may be ignored. Sometimes, however, the independence between topographical and functional classes is made very clear. In the case of relational framing, for instance, any stimulus event, regardless of form, may participate in a frame (see previous paragraph). The concept of generalized imitation (Baer et al., 1967; Gewirtz & Stengle, 1968) is also often cited by relational frame theorists as another example (Barnes, Healy, & Hayes, in press; Hayes et al., 1996). That is, after a generalized imitative repertoire is established, an almost infinite variety of response topographies may be substituted for the forms used in the earlier training. For RFT, the behavior of imitating is described as generalized because it is not limited to any particular response topography. In a similar vein, some behavior analysts have argued that it is possible to reinforce "generalized attending" (McIlvane, Dube, & Callahan, 1995; McIlvane, Dube, Kledaras, Iennaco, & Stoddard, 1990), although *what* is being attended to will change.

Although these and other examples (see Neuringer, 1986; Pryor, Haag, & O'Reilly, 1969) constitute a simple extension of the three-term contingency as an analytic unit, RFT argues that specific qualifiers, such as "generalized," "higher-order," or "overarching" should be included when operant classes are not readily defined topographically. The key point here, is that for RFT these qualifiers are not used in this instance as technical terms, and they do not imply the existence of mediational processes leading to the formation of operants of this type. Instead, these qualifiers emphasize that a specific operant class cannot be defined by its response forms, a fact that is true in principle for all operant classes. In short, the prefix "generalized" is not used by RFT to make a technical distinction between two types of operant classes. Instead, it serves merely to emphasize the purely functional nature of specific operant classes, of which relational framing is but one example.

The definition of generalized operants: RFT compared to Catania and other issues. Because RFT considers generalized operants to be no different, at a technical level, to operant classes in general, no further conceptual or empirical questions are raised concerning the nature of the concept of the generalized operant. In contrast, Catania (1996, 1998) suggested that generalized operants involve contingencies that are of different orders, and thus questions concerning the extent and nature of these different orders need to be addressed. The RFT definition of the generalized operant appears, therefore, to be more clear cut than Catania's. Nevertheless, questions are raised by the RFT argument that derived relational responding is a form of operant behavior. The two main questions that arise in this regard are concerned with the nature of the relevant history of reinforcement, and the possible role played by a mediating behavioral process, in producing derived relational responding. These questions have a direct bearing on the concept of the generalized operant, as an explanatory device for complex behavior, and so we will consider these questions in some detail.

Two Questions Arising from the RFT Interpretation of Generalized Operants

The question of history. One important question raised by the RFT interpretation of derived relational responding, as a form of generalized operant behavior, concerns the reinforcement histories that are required to produce various repertoires of relational framing (see Hayes, 1991). For example, some researchers have asked whether equivalence responding requires explicit training in mutual *and* combinatorial entailment, or in mutual entailment alone (e.g., Boelens, 1994; Horne & Lowe, 1996). For RFT, however, the exact nature of the histories involved is largely an experimental issue, and thus the histories are not specified a priori. In effect, RFT generates important empirical questions that will need to be answered. Consider the following quotation from Hayes and Wilson (1996):

> How much and what kind of training is needed for generalization of a relational response *is an empirical matter.* However, the general logic of RFT suggests that at least some direct training in combining

> relations (e.g., both A→C and C→A training [following A→B, B→C, B→A, and C→B training]) is necessary. Using RFT terms, this point has been made explicitly in early expositions; for example equivalence emerges because "mutual entailment, combinatorial entailment and transfer of functions are *directly* trained" (Hayes, 1991, p. 25). It is important to note here that combinatorial entailment subsumes both A→C and C→A relations . . . It does seem likely, however, that once the most basic relational unit is established through training in mutual and combinatorial entailment, relatively fewer trained instances of combinatorial entailment will be needed to build out this relational response. Were it not true, every level of relational complexity (e.g., with larger and larger sets of related stimuli) might have to be arduously trained. Consider, for instance, a case in which one was taught to select B in the presence of A, C in the presence of B, D in the presence of C, and so on to the 100th node. We doubt that an individual would have to have a history of direct training to match the 100th stimulus to the 1st, the 100th to the 2nd, the 98th to the 1st, . . . and so on for all possible transitive and equivalence relations among the 100 stimuli. *At some point RFT would predict that the operant of combining relations would itself generalize* (p. 227).

For RFT, therefore, a relatively complete definition of a relational operant (or relational frame), as a unit of analysis, is in part an empirical issue. In keeping with the inductive nature of behavior analysis, the concept of a relational frame as a generalized operant class will gain or lose strength through basic and applied research rather than logical analysis *per se*. Such research will involve, for example, identifying the nature and number of multiple exemplars that are needed to establish particular repertoires of relational responding. This will be a relatively straightforward matter (see Barnes & Hampson, 1993, 1997), because the definition of a relational frame has been clearly outlined, and generic predictions have been made with regard to the types of histories that are required for relational framing to emerge (Barnes, 1996).

Mediating behavioral processes. Another common question that is often asked of RFT concerns the nature of the behavioral process that supposedly allows a history of multiple exemplar training to generate derived relational responding. Critics of RFT often agree that a history of multiple exemplar training could generate generalized identity matching, for example, because the physical property of identity can be abstracted across the various common pairs of stimuli employed during the training (e.g., red with red, green with green, etc.). However, when each of the stimulus pairs is arbitrary and thus has nothing in common (e.g., red with triangle, green with circle, etc.), such critics claim that it is difficult to see how abstraction could occur, because there is no common physical property to be abstracted. These critics argue, therefore, that some other process (possibly verbal), in addition to multiple exemplar training, is needed to mediate derived relational responding. Sidman (1994), for example, put it this way:

> I find it difficult to see how a common response . . . to exemplars that have nothing in common except the relation could arise in the absence of a highly complex verbal repertoire. . .
>
> A linguistically naive organism's abstractions among commonalities from a set of exemplars that share no physical feature requires more of an explanation than just a history of experience with the exemplars. (pp. 556-557)

Relational frame theory currently offers four responses to the argument that a mediating behavioral process is needed to account for the effect of multiple exemplar training on derived relational responding. We will now consider each of these in turn.

1. As outlined earlier, the concept of an operant is a purely functional one, although in many instances structural or topographical features of a particular response or stimulus class may be identified. Because such features are often present, some behavior analysts may be seduced into assuming that *all* operant classes *must* possess such structural properties. This structuralistic definition of the operant appears to be the main basis for arguing that multiple-exemplar training cannot, without some form of mediating process, explain derived relational responding (i.e., because there are no *common physical or structural properties* to be abstracted across the exemplars). Of course, behavioral researchers are free to adopt this structuralistic position, but in doing so they are clearly challenging the purely functional nature of the operant. Relational frame theorists would ask these behavior analysts to be explicit about their nonfunctional definition of the operant, and to defend the definition on conceptual and empirical grounds.

2. Relational frame theory has generated and continues to generate a range of empirical studies, all of which suggest that derived relational responding exhibits the properties of operant behavior (see Hayes, 1994, for a detailed discussion). In particular, such responding shows (a) development over time (e.g., Lipkens, Hayes, & Hayes, 1993), (b) flexibility (e.g., Roche, Barnes, & Smeets, 1997), (c) antecedent stimulus control (e.g., Dymond & Barnes, 1995; Steele & Hayes, 1991), and (d) consequential control (e.g., Healy et al., 1998). All of this research has been generated within the conceptual framework of RFT without appealing to any form of mediating behavioral process, and thus postulating such a process is not required in order to mount a behavior-analytic research program into derived relational responding. For RFT, therefore, there is no immediate need to posit any additional behavioral processes beyond that of the generalized operant.

3. As stated previously, RFT is a largely inductive theory and thus does not provide, a priori, detailed predictions concerning all of the behavioral events that may be involved in derived relational responding. In general, RFT assumes that such events are largely an empirical concern and will therefore be identified and analyzed in the course of RFT-based experimental research. Some of these events may be defined

by certain researchers as constituting a mediating behavioral process, but for RFT such events are deemed to be part of the generalized operant of relational framing itself. Consider, for example, what Barnes (1994) called *indirect reflexivity.* According to RFT, indirect reflexivity occurs when one stimulus comes to elicit some of the perceptual or other functions of a second stimulus. This may occur, for example, during matching-to-sample training, when the repeated reinforced pairing of a sample-comparison relation causes a subject to see privately the comparison stimulus when he or she is presented with the sample. As a result, the private event (elicited by the sample) physically matches the actual comparison stimulus. This matching of a private event with an actual stimulus is termed indirect reflexivity. According to RFT, indirect reflexivity may function as a contextual cue for symmetry and equivalence responding, but only after an appropriate history of multiple-exemplar training. Consider, for example, a symmetry test trial. During such a trial, the "correct" comparison elicits a private event that matches the actual sample, but the subject cannot choose the sample stimulus. If the subject has a history of bidirectional relational responding, the occurrence of indirect reflexivity will be discriminative for reversing the trained relation (i.e., for choosing the comparison that indirectly matches the sample). Without such a history, however, indirect reflexivity will have no such function, and thus symmetry will less likely emerge. The important point here, is that RFT considers what some may call a mediating behavioral event (e.g., indirect reflexivity) to be part of a relational frame (e.g., a contextual cue for symmetry). In this way, RFT is particularly parsimonious because it incorporates a so-called mediating event into the generalized operant of relational framing itself.

4. Although there are currently two behavioral theories that explicitly postulate mediating processes as a means of explaining complex behavior (including derived relational responding), these theories are less parsimonious than RFT. The details of these theories are not important here. What does matter, is that upon close inspection both theories postulate a mediating process *and* draw on multiple-exemplar training as an explanation for the controlling properties of the mediating processes themselves. The two processes in question are the higher-order name relation (Horne & Lowe, 1996) and joint control (Lowenkron, 1998). With regard to the former, Lowe and Horne (1996) explicitly stated that the higher-order name relation only functions as such after it has been repeatedly reinforced across numerous novel objects (i.e., multiple exemplars):

> With each reinforced repetition of the name relation, perhaps as new object class members are encountered (e.g., a new dog, a new chair), naming as a functional higher order class is further strengthened. Thereafter, explicit reinforcement by caregivers for new name relations becomes less important as the automatic reinforcing consequences of naming things become the more potent source of control. (p. 318)

Similarly, Lowenkron (1998) suggested that the process of joint control comes to determine object selection because the controlling relationship between joint control and object selection is incidentally reinforced across a number of exemplars (see p. 334). In effect, the theories of both Horne and Lowe and Lowenkron each posit *two separate* behavioral processes —a mediating process *and* a process of multiple exemplar training that provides the former process with its controlling properties. In contrast, RFT, as we have seen, can incorporate so-called mediating behavioral events (e.g., indirect reflexivity) into the *single* concept of the generalized operant of relational framing (e.g., indirect reflexivity may function as a contextual cue within a frame). Consequently, RFT appears to offer a more parsimonious approach to explaining complex behavior than the alternative approaches offered by the concepts of higher-order naming and joint control.

In summary, RFT argues against the need to postulate mediating processes to account for derived relational responding because (a) RFT embraces a purely functional concept of the operant, (b) a relatively active RFT-based research program has been mounted without postulating such processes, (c) those events that some might define as a mediating process may be incorporated into the single concept of the relational frame, and (d) the two currently available theories that postulate mediating processes are less parsimonious than RFT.

Summary and Conclusion

Relational Frame Theory uses the term generalized (higher-order or overarching) to emphasize that operants of this type cannot be defined topographically. Furthermore, RFT does not consider the term generalized, when used in this way, to be a technical one. Consequently, Catania's concept of *contingencies of different orders* is not included in RFT's definition of generalized operants, and thus no technical or empirical questions are begged by RFT in this regard. On balance, however, RFT's definition of generalized operants raises other questions concerned with reinforcement history and the need for mediating processes. Nevertheless, these questions may yield more readily to experimental and parsimonious conceptual analyses than the questions raised by Catania's suggestion that the contingencies involved in generalized operants are of different orders. We therefore prefer the suggestion by RFT that generalized operants do not involve any additional processes, and that the term generalized, when used in this way, is not a technical one.

References

BAER, D. M., PETERSON, R. F., & SHERMAN, J. A. (1967). The development of imitation by reinforcing behavioral similarity to a model. *Journal of the Experimental Analysis of Behavior*, 10, 405-416.

BARNES, D. (1994). Stimulus equivalence and relational frame theory. *The Psychological Record*, 44, 91-124.

BARNES, D. (1996). Naming as a technical term: Sacrificing behavior analysis at the altar of popularity. *Journal of the Experimental Analysis of Behavior*, 65, 264-267.

BARNES, D., & HAMPSON, P. J. (1993). Stimulus equivalence and connectionism: Implications for behavior analysis and cognitive science. *The Psychological Record*, 43, 617-638.

BARNES, D., & HAMPSON, P. J. (1997). Connectionist models of arbitrarily applicable relational responding: A possible role for the hippocampal system. In J. W. Donahoe & V. P. Dorsel (Eds.), *Neural network interpretations of cognition: Biobehavioral foundations* (pp. 496-521). Netherlands: Elsevier.

BARNES, D., HEALY, O., & HAYES, S. C. (in press). Relational frame theory and the relational evaluation procedure: Approaching human language as derived relational responding. In J. C. Leslie & D. E. Blackman (Eds.), *Experimental and applied analyses of human behavior*. Reno, NV: Context Press.

BARNES, D., & HOLMES, Y. (1991). Radical behaviorism, stimulus equivalence, and human cognition. *The Psychological Record*, 41, 19-31.

BARNES, D., & ROCHE, B. (1996). Stimulus equivalence and relational frame theory are fundamentally different: A reply to Saunders' commentary. *The Psychological Record*, 46, 489-507.

BOELENS, H. (1994). A traditional account of stimulus equivalence. *The Psychological Record*, 44, 587-605.

CATANIA, A. C. (1996). On the origins of behavior structure. In T. R. Zentall & P. M. Smeets (Eds.), *Stimulus class formation in humans and animals* (pp. 3-12). North Holland: Elsevier Science.

CATANIA, A. C. (1998). *Learning* (4th ed.). New Jersey, Prentice-Hall.

DYMOND, S., & BARNES, D. (1995). A transformation of self-discrimination response functions in accordance with the arbitrarily applicable relations of sameness, more than, and less than. *Journal of the Experimental Analysis of Behavior*, 64, 163-184.

GEWIRTZ, J. L., & STENGLE, K. G. (1968). Learning of generalized imitation as the basis for identification. *Psychological Review*, 5, 374-397.

HAYES, S. C. (1991). A relational control theory of stimulus equivalence. In L. J. Hayes & P. N. Chase (Eds.), *Dialogues on verbal behavior* (pp. 19-40). Reno, NV: Context Press.

HAYES, S. C. (1994). Relational frame theory: A functional approach to verbal events. In S. C. Hayes, L. J. Hayes, M. Sato, & K. Ono (Eds.), *Behavior analysis of language and cognition* (pp. 9-30). Reno, NV: Context Press.

HAYES, S. C., GIFFORD, E. V., & WILSON, K. (1996). Stimulus classes and stimulus relations: Arbitrarily applicable relational responding as an operant. In T. R. Zentall & P. M. Smeets (Eds.), *Stimulus class formation in humans and animals* (pp. 279-299). North Holland: Elsevier Science.

HAYES, S. C., & HAYES, L. J. (1989). The verbal action of the listener as the basis for rule-governance. In S. C. Hayes (Ed.), *Rule-governed behavior: Cognition, contingencies, and instructional control* (pp. 153-190). New York: Plenum Press.

HAYES, S. C., & WILSON, K. (1996). Criticisms of relational frame theory: Implications for derived stimulus relations. *The Psychological Record*, 46, 221-236.

HEALY, O., BARNES, D., & SMEETS, P. M. (1998). Derived relational responding as an operant: The effects of between-session feedback. *The Psychological Record*, 48, 511-536.

HORNE, P. J., & LOWE, C. F. (1996). On the origins of naming and other symbolic behavior. *Journal of the Experimental Analysis of Behavior*, 65, 185-241.

LIPKENS, R., HAYES, S. C., & HAYES, L. J. (1993). Longitudinal study of the development of derived stimulus relations in an infant. *Journal of Experimental Child Psychology*, 56, 201-239.

LOWE, C. F., & HORNE, P. (1996). Reflections on naming and other symbolic behavior. *Journal of the Experimental Analysis of Behavior*, 65, 315-340.

LOWENKRON, B. (1998). Some logical functions of joint control. *Journal of the Experimental Analysis of Behavior*, 69, 327-354.

MCILVANE, W. J., DUBE, W. V., & CALLAHAN, T. D. (1995). Attention: A behavior analytic perspective. In G. R. Lyon & N. A. Krasnegor (Eds.), *Attention, memory, and executive function* (pp. 97-117). Baltimore, MD: Paul H. Brookes.

MCILVANE, W. J., DUBE, W. V., KLEDARAS, J. B., IENNACO, F. M., & STODDARD, L. T. (1990). Teaching relational discrimination to individuals with mental retardation: Some problems and possible solutions. *American Journal on Mental Retardation*, 95, 283-296.

NEURINGER, A. (1986). Can people behave randomly?: The role of feedback. *Journal of Experimental Psychology: General*, 115, 62-75.

POULSON, C. L., KYMISSIS, E., REEVE, K. F., ANDREATOS, M., & REEVE, L. (1991). Generalized vocal imitation in infants. *Journal of Experimental Child Psychology*, 51, 267-279.

PRYOR, K. W., HAAG, R., & O'REILLY, J. (1969). The creative porpoise: Training for novel behavior. *Journal of the Experimental Analysis of Behavior*, 12, 653-661.

ROCHE, B., BARNES, D., & SMEETS, P. M. (1997). Incongruous stimulus pairing and conditional discrimination training: Effects on relational responding, *Journal of the Experimental Analysis of Behavior*, 68, 143-160.

SIDMAN, M. (1990). Equivalence relations: Where do they come from? In D. E. Blackman & H. Lejune (Eds.), *Behaviour analysis in theory and in practice: Contributions and controversies* (pp. 93-114). Hove, England: Erlbaum.

SIDMAN, M. (1992). Equivalence relations: Some basic considerations. In S. C. Hayes & L. J. Hayes (Eds.), *Understanding verbal relations* (pp. 15-27). Reno, NV: Context Press.

SIDMAN, M. (1994). *Equivalence relations and behavior: A research story.* Boston, MA: Authors Cooperative, Inc., Publishers.

SKINNER, B. F. (1957). *Verbal behavior.* New York: Appleton-Century-Crofts.

STEELE, D., & HAYES, S. C. (1991). Stimulus equivalence and arbitrarily applicable relational responding. *Journal of the Experimental Analysis of Behavior*, 56, 519-555.