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Relational Frame Theory

Implications for Education and Developmental Disabilities

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There is now a substantive knowledge base in support of the basic concepts of relational frame theory (RFT) that provides good reason to begin to explore applications of the theory in educational and clinical contexts (Dymond & Roche, 2013; Hayes, Barnes-Holmes, & Roche, 2001). The application of behavioral concepts in educational settings has been dominated by the use of applied behavior analysis (ABA) with individuals with intellectual disabilities. And this is for good reason, as ABA has been undeniably effective and beneficial in this regard (Peters-Scheffer, Didden, Korzilius, & Sturmey, 2011).

But how does a field, such as behavioral psychology, know when it is doing the best it can? Often that is agreed only when the majority of individuals exposed to interventions show considerable educational or clinical gains (e.g., via randomized controlled trials, RCTs). It is perhaps surprising, therefore, that there are few RCTs examining the impact of ABA. Nonetheless, where these are available, the data suggest, for example, that adaptive and cognitive behavior are increased to the extent that original diagnoses of autism are reduced (e.g., Dawson et al., 2010).

If, in this context, we ask about whether behavioral psychology could yet produce better educational outcomes with individuals with intellectual disabilities, the current authors think the answer is "yes." Not, in our view, because the interventions currently in use aren't excellent, but because we think, as basic behavioral researchers, that the application of behavior analytic principles has yet to fully embrace relational frame theory (RFT). And we believe that doing so could potentially enhance educational outcomes emanating from behavioral psychology.

The current chapter is divided into three sections. Section 1 provides an overview of the general learning prerequisite skills for derived relational responding. These include establishing: preferences; on-task behavior (e.g., sitting and attending to task-based stimuli); generalized imitation; attending to others; simple and complex discriminations; and joint attention and social referencing. Each subsection also provides examples of how these skills may be established. Section 2 provides an overview of

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Skinner's verbal operants and explores how these speak to RFT's account, particularly with regard to the distinction between nonverbal and verbal behavior. This section goes on to summarize the core concepts of RFT, explaining how derived relational responding lies at the heart of the theory's approach to language. Subsections here include summaries of the different relational frames identified thus far and of some of the evidence supporting these concepts, as well as consideration of the optimal training sequence for establishing or facilitating the various frames. Section 3 explores what appear to be among the most complex types of relational responding proposed by RFT, namely the perspective-taking relations and analogical reasoning, again summarizing evidence in support of each area. Taken together, the chapter aims to provide an overview of where RFT concepts and supporting evidence are currently at in terms of applicability to education, especially in the context of the challenges presented by developmental disabilities.

Section 1: Prerequisite Skills for Derived Relational Responding

In this section, we provide a summary of the prerequisite skills that comprise some of the essential foundations for the subsequent emergence or acquisition of verbal behavior (see also Horne & Lowe, 1996). These general learning prerequisites include establishing: preferences (related to positive reinforcement procedures); on-task behavior (e.g., sitting and attending to task-based stimuli); generalized imitation; attending to others; simple and complex discriminations; and joint attention and social referencing. Each subsection also provides examples or suggestions for how these skills may be established.

The broad aims of behavioral intervention programs that include facilitating the derivation of stimulus relations are usually to teach learners complex verbal, social, and emotional repertoires (Lovaas, 2003). At this early point, it seems important to explain what we mean by "derivation" in this context (there will be more on this later). The term "derived" refers to stimulus relations that emerge and are not taught directly when language-able humans learn. For example, if a learner is taught that stimulus "A" is the same as stimulus "B," the individual will derive a bidirectional relation in terms of "B same as A." With an appropriate learning history and multiple-exemplar training, a young child taught to orient toward her mother on hearing the word "Mummy" (i.e., a word–person relation of coordination) may subsequently say "Mummy" when her mother is present (i.e., derived person–word coordination relation). Derived relational responding is thought to be essential, and fundamental, to the acquisition of advanced verbal repertoires and emergent or novel verbal responding. The following sources may be of benefit to readers of the current chapter. For RFT's theoretical account, see Hayes et al. (2001). For practical applications of RFT, see Rehfeldt and Barnes-Holmes (2009). And, for a recently developed behavioral teaching program that integrates traditional concepts of verbal behavior and derived stimulus relations, see Dixon, Belisle, Whiting, and Rowsey (2014).

Although verbal behavior is a ***primary*** learning target in ABA, many ABA programs do not ***begin*** with verbal behavior, preferring instead to establish basic nonverbal repertoires, thought to be prerequisites of verbal skills. This type of learning sequence tries to ensure that the nonverbal and preverbal bases of verbal behavior are established

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for the learner before language is targeted directly. The short subsections below summarize each of these important prerequisite skills for verbal behavior and derived stimulus relations.

Establishing Preference Assessments

An individual's choice of reinforcers may be highly idiosyncratic, especially for learners with developmental disabilities, but effective reinforcement is considered crucial for all forms of behavioral teaching. Although reinforcement involves more than stimulus preferences (Logan & Gast, 2001), stimulus preference assessment (SPA) procedures are often used to identify potential reinforcers, especially with individuals with developmental disabilities (Hagopian, Long, & Rush, 2004). For instance, the gold standard SPA is the paired stimulus (PS) method, also known as forced choice (Fisher et al., 1992). The instructor begins with an array of 10 items. She presents only two items from the array on each trial and requires the learner to select only one item per trial. These preferred items are then presented in pairs simultaneously across trials in order to establish a hierarchy in which each of the preferred items may be ranked in terms of selection percentages. Although this method boasts much supporting evidence with individuals with developmental disabilities (e.g., Hagopian et al., 2004), it is only rarely used because of the length of time it takes to complete (e.g., 10 items require a minimum of 20 trials). While alternative *shorter* SPA procedures are available, such as the multiple stimulus without replacement (MSWO) method (e.g., Carr, Nicholson, & Higbee, 2000), these appear less effective in identifying potential reinforcers. For example, an instructor only knows which items are preferred in terms of high versus low preference, but it has not been established that the high preference items actually function as reinforcers or that the low preference items do not (Rush, Mortenson, & Birch, 2010). Whether reinforcement *occurs* or not (i.e., behavior changes) will ultimately identify reinforcers. However, preference assessments can provide the instructor with a useful initial guide.

Establishing On-Task Behavior

Establishing on-task behavior often commences with shaping gross motor topographies (e.g., sitting) to eliminate competing disruptive behaviors (Lovaas, 2003) and is primarily concerned with teaching learners generalized attending (e.g., looking, listening, staying in-seat). Establishing attending repertoires in learners with developmental disabilities is notoriously difficult because of the variability in the stimuli that need to be attended to across tasks (Tarbox, Ghezzi, & Wilson, 2006). Nonetheless, attending to task-based stimuli (including the instructor) is essential for the student to learn to correspond her own behavior with what is seen and what is heard (e.g., to look at an object when an instructor says "Look at this," see Keohane, Pereira-Delgado, & Greer, 2009). This type of teaching often begins with establishing visual tracking procedures that involve conjugate reinforcement. That is, the instructor establishes attention to a target visual stimulus by pairing unconditioned or conditioned reinforcers with direct stimulus observation (Keohane, Greer, & Ackerman, 2006). Where verbal behavior in spoken form is the instructor's ultimate goal, aural tracking skills will be necessary to coordinate a spoken verbal stimulus and the correct speaker. Where

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verbal behavior in written form is the ultimate goal, visual tracking skills will be necessary to coordinate a spoken verbal stimulus and the correct printed stimulus.

Establishing Generalized Imitation

Imitation is pivotal to behavioral interventions and observational learning (Leaf & McEachin, 1999), in part because learners with developmental disabilities (especially autism) often do not readily imitate the behavior of others (Ledford & Wolery, 2011). The term "*generalized* imitation" refers to the ability to imitate a model's behavior regardless of the topography of the behavior, and imitating novel behavior is important in learning (Lovaas, 2003; Malott, 2008). The two most common means of establishing generalized imitation in learners with developmental disabilities include simultaneous stimulus prompting (Wolery, Holcombe, Billings, & Vassilaros, 1993) and shaping procedures that use differential reinforcement for successively improved approximations of that target response (Maurice, Green, & Luce, 1996). Ironically, the most common problem with efforts to establish generalized imitation is failure to *generalize* responding, wherein the imitative response is restricted to one or two explicitly taught topographies (e.g., Erjavec, Lovett, & Horne, 2009; Horne & Erjavec, 2007). Where this occurs, mirror procedures are used to enable a student to observe herself while imitating (Pereira-Delgado, Greer, & Speckman-Collins, 2006), and also to enhance correspondence between what the instructor says and what the child does.

Establishing Attending to Others

The two crucial skills on which attending to others is based are listening to others' voices (i.e., orienting appropriately when speech is heard) and eye-to-eye contact (i.e., orienting eye-gaze toward a speaker). Teaching attending to voices usually begins with conditioning procedures to establish the sound of the human voice (speaker) as conditioned reinforcement (Greer, Pistoljevic, Cahill, & Du, 2011; Peláez-Nogueras, Gewirtz, & Markham, 1996). Once this is established (or during these procedures), appropriate eye-to-eye contact is also taught. Eye-gaze repertoires have long been considered pivotal in behavioral intervention programs (e.g., Greer & Ross, 2007), but there is now recognition that this skill is established more effectively when integrated with various forms of attending to others. Specifically, integrated attendance involving appropriate eye-gaze toward a speaker is preferable to earlier procedures teaching eye-to-eye contact separately and maintaining eye-gaze for longer and longer time intervals in a manner that is unusual in the social community (Carbone, O'Brien, Sweeney-Kerwin, & Albert, 2011). In addition to conditioning procedures, positive reinforcement may be useful in establishing attendance skills for learners with developmental disabilities (Greer & Ross, 2007).

Establishing Simple and Conditional Discriminations

There are a number of types of discriminations that are important to the acquisition of educational skills (Stubbings & Martin, 1995). These vary considerably in terms of complexity, and the more complex discriminations are considered to be pivotal prerequisites for verbal behavior and related social skills.

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Positioned at the lower end of a continuum of complexity are simple discriminations that occur within a standard three-term contingency. This type of discrimination is referred to as "simple" because the discriminative function of a given stimulus is not dependent upon any other stimulus. Typical examples of simple discriminations from educational interventions include simple intraverbals, expressive labels, vocal imitation, and nonvocal imitation (Tarbox, Dixon, Sturmey, & Matson, 2014). It is important to distinguish between simple and conditional discriminations. Indeed, simple discriminations are often taught using shaping procedures, because if the target behavior (e.g., selecting a red card) was established by presenting a cue, prompt, or instruction (e.g., saying "match"), that would not be a simple discrimination, it would instead be a conditional discrimination (because selecting red also depended upon the presence of "match").

Conditional discriminations occur within a four-term contingency and involve responding to a discriminative stimulus given a conditional stimulus (Axe, 2008). That is, the presence of a sample (conditional) stimulus alters the function of a discriminative stimulus. Matching-to-sample (MTS) is the prototypical format in which conditional discriminations are taught. Reflexivity (identity matching) is the simplest type of conditional discrimination and usually front-ends all intervention programs that aspire to establishing complex conditional discrimination repertoires. For example, a learner might be presented with a red card as a sample and an identical red card as a comparison, and reinforcement is provided for selecting the comparison only when the word "same" is present. Although the two stimuli are physically identical, this is still a conditional discrimination because reinforcement is differentially provided for selecting the red comparison in the presence of the red sample and the word "match," but not when the red sample is absent.

A more complex type of conditional discrimination occurs when physical stimuli are replaced with spoken words. For example, a learner might be presented with the spoken word "ball" followed by an actual ball and reinforcement is provided for touching the ball upon hearing the word "ball." Again, this is a conditional discrimination because reinforcement is differentially provided for touching the ball only in the presence of the spoken word "ball," and not when the spoken word is not emitted. Although the word in this case refers directly to the object, this is not identity matching because the stimuli are not identical.

Teaching conditional discriminations can be made more complex by presenting multiple comparison stimuli from which a learner is required to select only one. For example, in the presence of a blue circle as a sample with comparisons that include a blue circle, a red circle, and a black circle, reinforcement is provided for selecting the correct comparison (blue circle) from the array of three. In simple terms, what the learner is being taught to do is to ignore all comparisons except the blue circle (e.g., Grow, Carr, Kodak, Jostad, & Kisamore, 2011).

Conditional discriminations often involve ***nonarbitrary*** relational responding, because the target response is based, in part, on the formal or physical properties of the stimuli (Hayes et al., 2001). For instance, the shared color (e.g., blue) of the sample and comparison stimuli often controls a matching response. But conditional discriminations may also involve ***arbitrary*** relational responding, in which the target response is ***not*** based on the nonarbitrary properties of the stimuli, and these constitute more complex conditional discriminations (Stewart & McElwee, 2009). For example, when the sample stimulus is the spoken word "blue," and comparisons include black, red,

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and blue cards, selecting the blue comparison is based on an arbitrary coordination (same-as) relation. Specifically, the word "blue" has been socially designated by the verbal community to signify the color blue. This is an arbitrary relation in that there is nothing physically similar between the word and the color. This type of arbitrary relation is what is typically being referred to in RFT when defining arbitrarily applicable relational responding as fundamental to language and cognition.

Establishing Joint Attention and Social Referencing

Joint attention and social referencing are essential features of human social interactions, and both need to be established even before simple discriminations can be taught.

Joint attention appears to emerge before, or alongside, social referencing (Slaughter & McConnell, 2003), and various behavioral teaching programs require that joint attention is already well established as a prerequisite skill. For example, if a learner is unable to attend to an instructor, it will be very difficult for the instructor to even orient that learner to a teaching trial that requires any sort of discrimination. In simple terms, joint attention involves following an instructor's eye-gaze or finger-pointing to coordinate attending to a stimulus, in such a way that the learner and the instructor have some element of shared experience.

There is evidence to indicate that joint attention can be established effectively when it is found to be deficient or absent in an individual. For example, MacDonald et al. (2006) investigated joint attention in students with autism and found that after one year of participation in a comprehensive treatment program, all of the individuals demonstrated gaze shifts, gestures, and vocalizations at levels commensurate with typically developing peers. Similarly, McClannahan and Krantz (2006) demonstrated that these effects generalize to novel stimuli.

While the boundaries between joint attention and social referencing are somewhat subtle, social referencing refers specifically to checking another person's expression and responding to a stimulus on the basis of that expression (Peláez-Nogueras & Gewirtz, 1997). For example, if a child discriminates a fearful expression on his mother's face as he reaches toward a dog, he may be less likely to touch the dog. Social referencing is clearly essential to emotional and social bonding because it allows learners to discriminate the subtle relationships among contexts, expressions of others, and predicting the potential reinforcement of stimuli or events. Gewirtz and Peláez-Nogueras (1992) described various ways in which the emotional aspects of social referencing can be effectively established even in very young children.

Perspective-taking is one of the most crucial aspects of behavior in which joint attention and social referencing play a central role (Moll & Meltzoff, 2011), for example, in conversation, cooperative play, empathy, compassion, deception, and storytelling. If a learner cannot discriminate the perspective of others, this individual will be unable to interpret how another person might feel in a given context. Foundational perspective-taking can be taught using an RFT approach (see below).

Summary

Five general prerequisites appear to be pivotal to the emergence of verbal behavior, including on-task behavior; attending to others; generalized imitation; simple and conditional discriminations; and integrated attending (joint attention and social

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referencing). It is not surprising, therefore, that these target skills feature strongly in early behavioral intervention programs. Fortunately, the body of evidence to indicate that this array of skills can be readily established even in children with developmental delay or disability is both sizeable and compelling (e.g., Greer et al., 2011; McClannahan & Krantz, 2006; Pereira-Delgado et al., 2006).

In the following section, we explore in detail the key features of verbal behavior itself as verbal operants using Skinner's account and as derived relational responding, from the perspective of relational frame theory.

Section 2: Language and Derived Relational Responding

Establishing Skinner's Verbal Operants

Most ABA language programs are Skinnerian in their conceptual roots. And, a large body of evidence supports the educational utility of Skinner's (1957) functional account of verbal behavior, especially with individuals with autism and other developmental disorders (Greer & Ross, 2008; Sundberg & Michael, 2001). In short, Skinner proposed that verbal behavior is learned (in much the same way as other behavior) via behavioral principles (such as modeling and positive reinforcement) with the exception that there must be a "listener" with a history of reinforcement within a verbal community. Skinner defined several distinct verbal operants, namely mands, tacts, echoics, intraverbals, and autoclitics, each of which is summarized below.

A ***mand*** is synonymous with a request because it specifies to the listener the response or stimulus that will function as a reinforcer. For example, the mand "I want candy" specifies candy as the reinforcer. Manding, therefore, provides the speaker with some level of control over the physical and social environment. However, motivating operations (MOs) are also needed to provide the motivational context for the mand to occur in the first place (Laraway, Snycerski, Michael, & Poling, 2003). Mands are typically the first type of verbal operant targeted in traditional ABA programs, and these simply attempt to teach the learner to request an item in the presence of a relevant MO, without a prompt (Sundberg, Loeb, Hale, & Eigenheer, 2002). This usually requires the instructor to either capture naturally occurring MOs and/to or contrive MOs (Albert, Carbone, Murray, Hagerty, & Sweeney-Kerwin, 2012; Gutierrez et al., 2007; Shafer, 1994). An example of a contrived MO would involve arranging conditions of mild water deprivation for a child learning to mand for "water." The child is more likely to mand for water in MO conditions of water deprivation than if she/he has had copious amounts to drink, as satiation effects reduce motivation. A large body of evidence supports the utility of mand training in providing a learner with indirect control over the environment (see Sautter & LeBlanc, 2006 for a review).

A *tact* is similar to (but not synonymous with) a label emitted in the presence of a stimulus and the response is controlled by generalized social reinforcement (Skinner, 1957). For example, saying "tree" upon seeing a tree in the presence of others may result in a parent saying "That's right, it's a tree." Tacting is not reinforced by access to the tacted stimulus. For example, the tact "my tummy aches" is under the control of an internal stimulus, but evokes external social comforting. Naturally, although very simple in most respects, tacting is essential to social interactions, and is thus a

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foundation in verbal intervention programs (Leaf & McEachin, 1999; Lovaas, 2003; Sundberg & Partington, 1998). A large body of evidence supports the utility of establishing tacts (Horne, Lowe, & Randle, 2004; Sautter & LeBlanc, 2006).

Echoics are verbal behavior under the control of a verbal stimulus with full point-to-point correspondence between the verbal stimulus and the echoic response (commonly known as vocal imitation). Reinforcement, however, does not involve access to the stated stimulus – that would be a mand. For example, in teaching the echoic "puppy," the instructor says "puppy," the learner repeats the word "puppy," and the instructor delivers positive reinforcement. A large body of evidence supports the utility of training echoics (Sautter & LeBlanc, 2006). However, perhaps more importantly, echoic responding is often used to facilitate the establishment of other verbal operants, because vocal imitation provides an effective prompting procedure (Tarbox, Madrid, Aguilar, Jacobo, & Schiff, 2009). Furthermore, combining concurrent echoic training with mand or tact training has been shown to increase unprompted manding and tacting via the transfer of stimulus control (Finkel & Williams, 2001; Kodak & Clements, 2009; Valentino, Shillingsburg, & Call, 2012; Vedora & Meunier, 2009).

Intraverbals are verbal behavior under the control of other verbal stimuli. But (unlike echoics) there is no point-to-point correspondence with the verbal stimulus that evoked the intraverbal (Michael, Palmer, & Sundberg, 2011). For example, a learner may say "I'm going home now," to which another learner may respond "See you later," and the two responses are dissimilar in terms of verbal topography. Intraverbals are maintained by social reinforcement and may have primary antecedents that involve extremely complex verbal stimulus control. For example, the statement "I'd like to know what, in your opinion, are the defining features of a scientific method of research?" is a complex antecedent intraverbal that may result in an equally complex intraverbal response (see Axe, 2008; Sundberg & Sundberg, 2011). Indeed, conversations consist largely of intraverbal behavior. It is perhaps surprising, therefore, that there is much less research on intraverbals, relative to Skinner's other verbal operants (Sautter & LeBlanc, 2006). Indeed, much of the research on teaching intraverbals has focused primarily on teaching students to answer questions. For example, Finkel and Williams (2001) compared the effectiveness of textual versus echoic prompts when attempting to teach a six-year-old boy with autism to answer questions with sentences. The results suggested that textual prompts were more effective than echoic prompts in teaching intraverbals (see also Vedora & Meunier, 2009).

Autoclitics are verbal operants that depend upon the emission of other verbal behavior (Skinner, 1957). For example, if a speaker begins an interaction with the phrase "under the table," this autoclitic will affect the behavior of the listener by referencing some property of the speaker's behavior. Once again, although autoclitics (at least from Skinner's perspective) are central to verbal behavior, the research base suggesting how this operant should be trained is limited, relative to the other verbal operants (see Sautter & LeBlanc, 2006 for a review). Luke, Greer, Singer-Dudek, and Keohane (2011) described the utility of multiple exemplar instruction (MEI) for establishing autoclitic frames for spatial relations with novel tacts and mands.

ABA programs commonly target Skinner's verbal operants according to an assessment of the learner's baseline outcomes on the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008) or the Assessment of Basic Language and Learning Skills (ABLLS; Partington & Sundberg, 1998).

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The same assessment measures are then used throughout training to track the learner's progress on the range of target verbal operants. In general, ABA advocates argue that the well-established success of ABA, particularly as a program of language remediation, attests to the accuracy and utility of Skinner's verbal operants, as measured using these tools (e.g., Sundberg & Michael, 2001).

Verbal versus Nonverbal Operants

While there is clearly good supporting evidence for the utility of Skinner's verbal operants in educational applications, not all behavioral researchers are convinced that Skinner adequately distinguished between verbal and *nonverbal* operants (e.g., Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000). A key criticism in this regard is that Skinner's analysis cannot distinguish between verbal operants that are explicitly taught and those that are not but are instead emergent or derived, and that only those not explicitly taught warrant definition as "verbal." For illustrative purposes, consider manding. Murphy and Barnes-Holmes (2009) demonstrated derived manding in children with autism when manding with appropriate cards for specific tokens emerged untaught. Imagine a learner who is taught to mand for a teddy bear by pointing to the teddy (i.e., direct reinforcement of access to the teddy for the specific topographical mand). According to Murphy and Barnes-Holmes, this may be described as a nonverbal mand because the manding was directly reinforced.

Now imagine that the child learns to mand for the teddy by saying "teddy" (i.e., direct reinforcement of access to the teddy for the specific topographical mand). This might also be described as a nonverbal mand, because the child has simply learned to use a specific vocal topography to produce that reinforcer. In simple terms, the child in this case may not understand that the word "teddy" is coordinated with the object teddy in the verbal community. However, according to Skinner, the latter response is verbal. But according to RFT, this response is nonverbal.

Now consider that the child is taught that "teddy" refers to the object teddy (e.g., hear "teddy" and orient to the teddy), and subsequently mands for the teddy using the word "teddy," ***without being directly taught to do so.*** In this case, according to RFT, the mand is verbal because the word "teddy" participates in a relation of coordination with the object teddy. Hence, the word now has a symbolic quality and the mand is derived on the basis of that coordination relation. Furthermore, if the child now learns that "teddy" is a bear (i.e., bears and teddies are coordinated) she or he may subsequently mand for teddy using the word "bear," again without being explicitly taught this response. This would also be a derived and verbal mand, because "bear" participates in a coordination relation with other stimuli, and is not an empty or incidental vocal topography that has been taught as a mand by means of direct reinforcement. A number of researchers have described procedures for generating derived manding with individuals with autism and other developmental disorders (Murphy & Barnes-Holmes, 2009; Rosales & Rehfeldt, 2007). Similarly, Halvey and Rehfeldt (2005) used conditional discrimination instructions to establish derived tacting in adults with severe intellectual disabilities. And Pérez-González, García-Asenjo, Williams, and Carnerero (2007) used MEI to establish derived intraverbal antonyms with children with pervasive developmental disorders.

The debate around whether or not Skinner's verbal operants are more accurately defined as verbal or nonverbal (depending upon whether they have been directly

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reinforced or are derived) is of scientific importance, but it may also have implications for educational applications. For example, if training programs focused on derivation as generalized operant behavior, perhaps fewer individual topographies would need to be directly taught. In the subsections below, we review generalized verbal operants as defined by RFT.

Relational Frame Theory

It is important to emphasize that in an applied context (amongst others), RFT is not greatly at odds with traditional (Skinnerian) ABA programs. However, RFT places its most significant emphasis on the concept of derivation (Barnes-Holmes, Hayes, Barnes-Holmes, & Roche, 2002), as a defining feature of verbal behavior, with less of a focus on topographical responses. Indeed, numerous RFT researchers have argued that ABA programs *do* establish arbitrarily applicable relational responding, even though it is not targeted *directly*. Overall, the potential difference between the two schools of thought may have more to do with degree and sequencing, than teaching content. It is not surprising, therefore, that a working synthesis between Skinner's and RFT's accounts of verbal behavior has been suggested (Barnes-Holmes et al., 2000). Specifically, this type of synthesis involves combining the application of Skinner's behavioral principles, such as positive reinforcement, prompting, fading, and certain aspects of verbal behavior, with an RFT emphasis on derived relational responding (Berens & Hayes, 2007; Halvey & Rehfeldt, 2005; Murphy & Barnes-Holmes, 2009; Rosales & Rehfeldt, 2007).

In the subsections below, we summarize the core concepts of RFT and their utility in educational contexts. To begin, however, there are a number of fairly simple tenets that are fundamental to RFT and which should make understanding the following material somewhat easier. These are as follows: (1) For RFT, most of the behavior verbally sophisticated individuals engage in is verbal. (2) While these individuals are clearly capable of nonverbal behavior, their behavior is dominated by a verbal context. (3) While both animals and humans engage readily in nonarbitrary relational responding, verbal behavior comprises derived relational responding with an arbitrary or nonphysical basis. (4) While nonhumans may, in principle, be capable of this type of arbitrarily applicable relational responding, there is little robust evidence that they (or preverbal infants) show this type of behavior readily. (5) Nonarbitrary (i.e., nonverbal) relational responding is an essential prerequisite to verbal relational responding, but, once the latter develops, very little of the former occurs.

Arbitrary versus nonarbitrary stimulus relations. Relational frame theory distinguishes fundamentally between nonarbitrary relational responding and arbitrarily applicable relational responding (AARR). The latter is unlike the relational behavior demonstrated so readily and with such complexity in nonhumans (e.g., birds discriminating different trees based on relative greenness), because responding is not based on formal stimulus properties (Barnes-Holmes et al., 2002).

Derivation. As described previously, derivation occurs when a verbal response emerges without being directly reinforced, due to transfer or transformation of function effects. Consider a child taught to ask for a seat using the word "seat," and who subsequently learns that "seat," "chair," and "stool" are all similar (i.e., all participate in a relation of coordination). The child may then mand to sit using the word "chair" even though this response has not been previously reinforced. This is a derived mand.

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Contextual cues. For RFT, relational responding is verbal when it is under the control of contextual cues *beyond* formal stimulus properties. For example, the word "is" most often functions as a contextual cue to control responding on the basis of the relation of coordination. For example, "this is an apple" or "that is a table" both often function as cues for word–object coordination relations, and this emerges across many exemplars, such that novel relational responding between two stimuli can emerge even though it was never explicitly taught. The learning process requires that specific words or phrases (such as "same as," "contrary to," "part of," "more than") become contextual cues for the specific relation (or Crel) that is to be applied. It is important to note that the cues may be considered to have an arbitrary basis in the sense that the terms have no physical similarity to the relations indicated. Nevertheless, the social community has assigned different terms to particular relations, and the terms must consistently apply only to those relations; that is, they are not arbitrarily applied on an ongoing basis (e.g., "window" always refers to a window in English).

Multiple stimulus relations. What distinguishes RFT from other accounts of derived relational responding, such as stimulus equivalence (Sidman, 1971), is its focus on ***multiple*** stimulus relations. The various patterns or "relational frames" identified thus far include coordination, opposition, distinction, comparison, hierarchy, and perspective-taking (see Hayes et al., 2001). All relational frames are thought to involve generalized verbal operant responses that comprise the properties of mutual entailment, combinatorial entailment, and the transfer or transformation of stimulus function. What distinguishes one relational frame from another is the nature of the derived response and the specific transformation of functions in accordance with this.

Multiple-exemplar training (MET). According to RFT, MET is a critical component in the learning history that gives rise to the target generalized relational skill. Exemplars facilitate the learner abstracting the appropriate relation based on contextual cues, as unrelated to response topographies. For example, cues for coordination relations include "banana ***is*** a fruit," "fabric ***means*** cloth," and "education ***goes with*** school." In these examples, the topographies are unalike, but coordination relations are indicated in all cases. Similarly, cues for comparative relations include, for example, "a dollar ***is more than*** a quarter" and "her love for animals ***is greater than*** her love for people." Cues for distinction relations include, for example, "kindness ***is not the same as*** love" and "health ***is not just*** the absence of disease." And cues for opposition relations include, for example, "hot ***is the other extreme of*** cold" and "***at the other end of the continuum.***" The following subsections review research that has demonstrated these types of differentiations in derived relational responding.

Establishing the relational frame of coordination. The frame of coordination is the most basic relational activity that infants learn in natural language and the one upon which subsequent relational frames appear to be built (Lipkins, Hayes, & Hayes, 1993). Luciano, Gomez-Becerra, and Rodríguez-Valverde (2007) demonstrated combinatorial entailment within coordination relations in a 19-month-old infant, the earliest age at which this type of derivation has been empirically demonstrated. Coordination is likely to be the first relation to be taught in educational or learning programs. For illustrative purposes, consider experimental trials presented by O'Connor, Rafferty, Barnes-Holmes, and Barnes-Holmes (2009) who successfully employed MET to establish coordination relations in children with autism. The target coordination relations involved written words ("A" stimuli), objects that relate to the words ("B" stimuli), and pictures of the objects ("C" stimuli). Participants were

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taught to relate the A stimuli to the B stimuli (word–object relations) and the B stimuli to C stimuli (object–picture relations). Tests for combinatorial entailment (A–C and C–A relations) showed that participants derived word–picture and picture–word relations without explicit teaching (see also Carr, Wilkinson, Blackman, & McIlvane, 2000). Interestingly, the study by O'Connor et al. (2009) also suggested a relationship between verbal ability and exemplar training requirements, such that participants with lower verbal ability required more exposures to explicit training of the target combinatorially entailed coordination relations before these performances emerged with novel stimuli (i.e., more training exemplars were necessary prior to the target performances being derived).

Luciano, Rodríguez, Manas, and Ruiz (2009) demonstrated the establishment of contextual control for coordination with nonarbitrary relations (i.e., same-as relations with identical stimuli), prior to teaching arbitrary coordination relations. And Barnes-Holmes, Barnes-Holmes, Smeets, and Luciano (2004) demonstrated the derived transfer of happy and sad mood functions through coordination relations in adults.

Establishing the relational frame of opposition. Behaving in accordance with the frame of opposition (e.g., big is opposite to small; day is opposite to night) requires the abstraction of a particular dimension along which stimuli can be differentiated at bipolar extremes. In the example of "big versus small" size is the relevant dimension, while in "day versus night" light levels and time are the relevant dimensions According to RFT, opposition relations likely emerge after coordination relations, because opposition relations *involve* coordination relations. For example, if A is opposite to B and B is opposite to C, A and C are most likely the same. Barnes-Holmes, Barnes-Holmes, Smeets, Strand, and Friman (2004) successfully employed MET to establish opposition relations in typically developing children. In short, learners were required to select the most valuable coin/s from four possible options after being instructed that: "Coin A buys many; and A is opposite to B, and B is opposite to C, and C is the opposite to D." After extensive MET, the children demonstrated opposite responding on novel 10-coin randomized sequences. Explicit training and increasingly complex testing (e.g., where the coins were presented randomly) continued until participants were responding correctly to trials with 10-coin sequences.

Luciano, Rodríguez et al. (2009) demonstrated the establishment of contextual control for opposition with nonarbitrary relations, prior to arbitrary opposition relations (i.e., the latter involved socially designated opposite relations, rather than physical opposites, such as big vs. small). This usually involves training the student to match very different stimuli under the control of "pick the opposite of." Dunne, Foody, Barnes-Holmes, Barnes-Holmes, and Murphy (2014) who published the first study of opposition relations in children with autism reported that yes/no responding was essential prior to establishing nonarbitrary opposition relations. The researchers then taught nonarbitrary opposition relations by presenting objects such as a big ball and a small ball, and asking the learner "Show me the big/small one" followed by "Show me the opposite of big/small." These nonarbitrary opposition relations were established across a range of stimulus dimensions (e.g., long vs. short; wet vs. dry) and with novel stimuli, under the contextual cue "opposite of."

Dunne et al. (2014) also reported the establishment of arbitrary opposition relations and the same 10 dimensions targeted in the nonarbitrary trials (i.e., now using identical stimuli). To promote flexibility in relational responding, Luciano,

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Rodríguez et al. (2009) suggested that training should alter the contextual cues for opposition and coordination relations, once both have been firmly established.

Dymond, Roche, Forsyth, Whelan, and Rhoden (2007) have also demonstrated the derived transfer of avoidance functions in accordance with taught opposite relations. And Whelan and Barnes-Holmes (2004) have demonstrated the transfer of a punishing function through taught opposition relations.

Establishing the relational frame of distinction. The relation frame of distinction involves responding to differences among stimuli, along a particular dimension, by applying the relational cue "is different from" (Dixon & Zlomke, 2005; Roche & Barnes, 1996; Steele & Hayes, 1991). Dunne et al. (2014) established contextual control for distinction with nonarbitrary relations in two children with autism. That is, given two identical pictures and a third different picture, participants were asked: "Show me the picture that is different." These nonarbitrary relations were taught across a range of stimulus dimensions (e.g., color, length, texture, and shape), using novel stimuli. Dunne et al. (2014) also established contextual control for distinction with arbitrary relations. That is, given two identical boxes, participants were instructed "Box A is the same as Box B" and asked "Are they different?" The results demonstrated that one of the children required extensive training on combinatorially entailed distinction relations.

Establishing the relational frame of comparison. Comparative relations involve responding to one event in terms of quantitative or qualitative relations along a specified dimension with another event. Luciano, Rodríguez, et al. (2009) describe ways in which contextual control for comparison with nonarbitrary relations can be established (e.g., more–less, heavier–lighter, etc.). And Barnes-Holmes, Barnes-Holmes, Smeets, Strand et al. (2004) successfully employed MET to establish arbitrary comparative (more-than and less-than) relations (e.g., "Coin A buys less than coin B, so which coin would you take to buy as many sweets as possible"?) These outcomes were replicated by Berens and Hayes (2007). Only two studies have established comparison relations in children with autism (Dunne et al., 2014; Gorham, Barnes-Holmes, Barnes-Holmes, & Berens, 2009). The results demonstrated that these children required extensive explicit training on the target arbitrary comparison relations.

Vitale, Barnes-Holmes, Barnes-Holmes, and Campbell (2008) investigated adult performances on different types of comparative relations, including unspecified relations (e.g., if A > B and C > B, then one cannot determine the relationship between A and C). The results indicated that accuracy on unspecified relations was significantly lower than on specified relations, especially when mixed comparative relations were presented (e.g., more–less, rather than more–more). The study also demonstrated that a combination of feedback and presenting trials in nonarbitrary form generated the largest improvements in the weak baseline performances.

Vitale, Campbell, Barnes-Holmes, and Barnes-Holmes (2012) replicated various aspects of the original Vitale et al. (2008) study, but used real word tasks (e.g., involving color names and spoken nonsense syllables). The results were largely consistent with the original study in that the weakest performances were recorded on the unspecified mixed comparative relations, but these were readily rectified with feedback and nonarbitrary trials.

Establishing the relational frame of hierarchy. Responding in accordance with hierarchical relations is usually under the control of contextual cues such as

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"contains," "is an attribute of/member of/part of," or "belongs to." Hierarchical relations also comprise other relations because members of a hierarchical class can be organized in many ways. Hence, learners probably require strong existing capabilities in the other relational frames before hierarchy can be established.

There appear to be only two studies to date that have been conducted on hierarchical relations with adults (Gil, Luciano, & Ruíz, 2008; Griffee & Dougher, 2002). Dunne (2011) established hierarchal relations in two participants with autism, beginning with nonarbitrary relations and involving sweets versus musical instruments. Assessment of these relations commenced with distinction relations to ensure that the two types of items were distinct (e.g., "Are toys different to items you find in the kitchen?") Establishing arbitrary hierarchical relations involved subdividing the two categories into two further categories (e.g., sweet vs. nonsweet foods and wind instruments vs. others) and introducing pictures pertaining to the various items. For example, the researcher held up one a picture of a marshmallow and asked "Where would you put the marshmallow?" and "Is the marshmallow more like sweet food or nonsweet food?" One participant passed all aspects of testing, while the second required training before doing so.

Sequencing of relations. The sequence in which the core relational frames above were described does not reflect empirical evidence to indicate that this is the natural sequence in which they emerge, although, for example, it makes intuitive and developmental sense that coordination relations develop first and emerge before the more complex hierarchical relations. However, several RFT authors and recent studies have explored the potential sequence in which these frames appear to unfold. Consider the following comments. First, coordination relations probably emerge initially, because they pertain most directly to mutual and combinatorial entailment (e.g., if A=B and B=C, then B=A, C=B, A=C, and C=A). Second, distinction relations may emerge thereafter because a learner cannot comprehend or derive the relation "different-from" if "same-as" relations are not intact (Rehfeldt & Barnes-Holmes, 2009). In other words, the concept of difference cannot arise without the concept of sameness. Third, opposition relations may emerge then because one would find it difficult to know that two stimuli were opposite without first determining that they were different (i.e., opposition is perhaps an extreme type of distinction) and coordination relations may be derived from opposition relations (e.g. if A is opposite to B and B is opposite to C, then A and C are the same). Fourth, comparison relations may follow thereafter because a learner would have to first comprehend the variations of distinction and opposition to appreciate several ways in which two stimuli might be different, while at the same time being similar along a specific dimension. For example, the statement "apples are redder than peaches" may contain many complex relations such as comparison (more/less red), difference (apples not same as peaches), and opposition (not extremely different/opposite). Fifth, hierarchical relations probably appear thereafter because they are more complex in that they involve containment, which can occur at many levels (e.g., atoms are contained in material objects, material objects are contained in the Earth, Earth is contained in the Universe).

A small number of studies have explored the putative emergent sequence in developmental terms in search of the optimal sequence for educational purposes (e.g., Cassidy, 2008; Dixon et al., 2014). For example, Dunne et al. (2014) established the following sequence of relations: coordination, opposition, distinction, and comparison, in a group of children with autism. All 10 children were successful in demonstrating

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coordination relations; four children subsequently demonstrated opposition relations; and two children demonstrated distinction, comparison, and hierarchical relations, in that order. The results also indicated that the number of teaching trials decreased steadily across the five frames for several children, thus implying that the earlier relational frames facilitated learning the subsequent more complex frames. More recently, Kent (2014) directly compared two training sequences. Training Sequence A consisted of teaching coordination, distinction, comparison, opposition, and hierarchical relations, while Training Sequence B switched the order of the comparison and opposition relations (coordination, distinction, opposition, comparison, and hierarchy). The results indicated that participants who completed Training Sequence A demonstrated significantly better performances in the emergence of comparison relations than did participants who completed Training Sequence B. This finding suggests that establishing opposition relations may facilitate the emergence of comparison relations.

Section 3: Higher Order Cognition and Complex Relational Responding

In the final section we review two additional RFT concepts, namely, the deictic or perspective-taking relations and the relating of relations, which looks like a functional account of analogical reasoning. While both of these concepts do not differ functionally from those described above, they do permit RFT to address highly complex features of verbal behavior.

Perspective-Taking as Relational Responding

According to RFT, perspective-taking comprises complex repertoires of derived relational responding that encompass our understanding of person, place, and time. Specifically, RFT proposes the three perspective-taking or deictic frames of: I versus you (also called interpersonal relations), here versus there (spatial relations), and now versus then (temporal relations). Although a considerable body of RFT evidence supports the functional distinctiveness of these three types of relations, it appears that these interact with each other in distinct ways as part of normal verbal behavior. Specifically, "I" is always responded to from "here" and "now," such that one's perspective comprises I–HERE–NOW.

I–YOU relations. The interpersonal relations appear to be the first of the deictic relations to emerge, and also form the basis of the spatial and temporal relations that follow. Empirical evidence also suggests that these emerge in simple form prior to the ability to reverse them in what looks like a relatively high level of relational complexity. Consider the following simple I–YOU trial from the original deictic protocol developed by Barnes-Holmes (2001) in which the researcher said "I have a red brick and you have a green brick. Which brick do I have?" and "Which brick do you have?" It is important to remember that these trials, although categorized as "simple," are still verbal because no actual props are employed. What simple I–YOU trials do is to ascertain whether the words "I" and "you" control the appropriate perspective. For example, when the researcher says "I," the learner must interpret this as "you" from

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the learner's perspective, and similarly when the researcher says "you," the learner must interpret this as "I" from the learner's perspective.

Barnes-Holmes (2001) studied these relations in two typically developing children and reported that both the four-year-old and the seven-year-old could derive simple I–YOU relations. McHugh, Barnes-Holmes, O'Hora, and Barnes-Holmes (2004) studied groups of participants that ranged in age from early childhood to adulthood (i.e., 3–30 years old), and reported that all five groups showed high levels of accuracy on simple I–YOU relations. Similarly, Weil, Hayes, and Capurro (2011) reported strong performances for typically developing children aged 4–5 years, as did Heagle and Rehfeldt (2006) with typically developing children aged 6–11 years (see also Davlin, Rehfeldt, & Lovett, 2011; Rehfeldt, Dillen, Ziomek, & Kowalchuk, 2007). In the latter study, Rehfeldt et al. reported similar performances with children with autism aged 6–13 as did Gore, Barnes-Holmes, and Murphy (2010) with adults with mild to moderate intellectual disabilities, and McGuinness (2005) with participants with Asperger's syndrome aged 8–11.

Several studies have shown that learners capable of demonstrating simple I–YOU relations may be *unable* to show I–YOU reversals. Consider the following trial from Barnes-Holmes (2001) in which the learner is instructed as follows: "I have a red brick and you have a green brick. *If I was you and you were me.* Which brick would I have?" and "Which brick would you have?" These trials ascertain whether the statement "If I was you and you were me" will facilitate reversal of the original "I" and "you" perspectives as controlled by the words "I" and "you." For example, rather than the learner now responding to "I" as from her own perspective, she must now switch and respond from "you" and, similarly, rather than the learner responding to "you" as from an alternative perspective, she must now switch and respond from "you" as her own perspective. This type of reversal appears to involve greater relational flexibility than a simple I–YOU trial because it asks the learner to temporarily take the perspective of another in a specific context.

Although the four-year-old in the study by Barnes-Holmes (2001) could derive simple I–YOU relations, he failed to show I–YOU reversals, while the seven-year-old produced perfect performances on these relations also. Similarly, McHugh et al. (2004) reported significantly more errors on I–YOU reversals versus simple I–YOU trials for all five age groups. Similar effects have also been recorded by Weil et al. (2011), Heagle and Rehfeldt (2006), Gore et al. (2010), and McGuinness (2005). Interestingly, Davlin et al. (2011) reported that one of their three typically developing participants produced higher accuracies on reversed than on simple I–YOU relations.

HERE–THERE relations. The spatial relations have been studied in a similar manner to the interpersonal relations, but are almost impossible to investigate without reference to the interpersonal relations. That is, HERE–THERE relations appear to contain I–YOU relations (i.e., there can be no here without I). Consider the following trial from Barnes-Holmes (2001): "I am standing here at the yellow door, and you are standing there at the brown door. Where are you standing? Where am I standing?" This trial attempts to determine the perspectives controlled by the words "I," "you," "here," and "there," and it is almost impossible to decipher whether it is the interpersonal relations, the spatial relations, or both, that control responding.

Once again, Barnes-Holmes (2001) reported that both the four-year-old and the seven-year-old could derive simple HERE–THERE relations. McHugh et al. (2004) reported that all five groups showed high levels of accuracy on simple HERE–THERE

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relations. Similar effects have also been recorded by Gore et al. (2010), and McGuinness (2005). Furthermore, Weil et al. (2011) reported that all three participants responded with more errors on HERE–THERE relations than on I–YOU relations.

Although the spatial relations incorporate the interpersonal relations, Barnes-Holmes (2001) created a trial that attempted to reverse one of these relations while holding the other simple (albeit not something done in everyday language). Consider the following trial that contains a simple HERE–THERE relation, but a reversed I–YOU relation: "I am standing at the yellow door, and you are standing at the brown door. If I were you and you were me, where would you be standing? Where would I be standing?" This trial attempts to ascertain whether the reversal of the I–YOU relation controls responding, in which case the perspectives should be switched. Now consider a similar trial but in this case the I–YOU relation remains simple, while the HERE–THERE relation is reversed: "I am standing at the yellow door, and you are standing at the brown door. *If here was there and there was here*, where would you be standing? Where would I be standing?" This trial attempts to ascertain whether the reversal of the HERE–THERE relation controls responding, in which case the perspectives should again be switched. While responding correctly is the same across both types of trial, any switching of perspectives relative to completely simple trials suggests that the reversal controlled responding.

Although the four-year-old in the study by Barnes-Holmes (2001) could derive simple HERE–THERE relations, he failed to show HERE–THERE reversals, while the seven-year-old produced perfect performances on both. Similar to I–YOU relations, McHugh et al. (2004) reported significantly more errors on HERE–THERE reversals versus simple HERE–THERE trials for all groups of participants. Those researchers also compared performances on HERE–THERE reversals versus I–YOU reversals, and reported significantly more errors on HERE–THERE. Similar effects have also been reported by Gore et al. (2010), McGuinness (2005), and Weil et al. (2011).

NOW–THEN relations. Similar to the spatial relations, the temporal NOW–THEN relations must always be combined with the interpersonal relations in order to have meaning (i.e., it is always from one's perspective that one discriminates time). However, Barnes-Holmes (2001) demonstrated that the temporal relations, when presented in the original protocol, must be delivered in a somewhat different format, if the researcher does not wish to make trials longer by providing additional information. Consider the trial: "Yesterday I was reading; today you are watching television." If you were then asked "What was I doing then? What are you doing now?" you would be able to answer. But if you were asked, "What am I doing now?" and "What are you doing then?," you could not answer because these relations cannot be derived from the information provided (i.e., I–NOW and YOU–THEN remain unspecified). As a result, Barnes-Holmes constructed NOW–THEN trials in which *either* I or YOU were presented, but not both.

McHugh et al. (2004) reported significantly more errors on NOW–THEN simple relations than on HERE–THERE simple relations, indicating that responding in accordance with the NOW–THEN frame produced the most difficulty for all participants. Similarly, Weil et al. (2011) reported that performances on simple NOW–THEN relations were weaker than on the other simple relations, as did Gore et al. (2010) and McHugh et al. (2004). Interestingly, McGuinness (2005) reported nearly perfect scores on simple NOW–THEN relations that were similar to those reported for simple I–YOU and simple HERE–THERE relations.

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Similar to the two other deictic relations, the temporal NOW–THEN relations can also be reversed (e.g., "Yesterday I was reading, today I am watching TV. *If NOW was THEN and THEN was NOW*, what would I be doing now? What would I be doing then?) However, because of the need to isolate only one perspective (I or YOU), responding correctly can only be on the basis of the reversed temporal relation. That is, there is no switch in perspectives across people, just a switch in the reversed NOW–THEN relation.

McHugh et al. (2004) reported significantly more errors on simple NOW–THEN compared to reversed NOW–THEN relations, and more errors on reversed NOW–THEN versus reversed I–YOU relations. But, interestingly, those researchers reported no difference between reversed NOW–THEN and reversed HERE–THERE relations.

Double reversed relations. Just as any of the three deictic relations can be reversed while an adjoining relation remains simple (e.g., a simple I–YOU with a reversed HERE–THERE relation), Barnes-Holmes (2001) also constructed two types of trials in which two deictic relations can be reversed simultaneously. Consider the following trial referred to as a double reversed I–YOU/HERE–THERE relation: "I am standing here at the yellow door, and you are standing there at the brown door. If I was you and you were me, and if here was there and there was here, where would you be standing? Where would I be standing?" This trial attempts to reverse perspectives as controlled by *both* the interpersonal and spatial relations, and as a result a correct response is designated by no reversal. That is, if you switch perspective through the I–YOU reversal, you must then *switch back to the original perspective* through then reversing the HERE–THERE relation. As a result, responding in a reversed way would suggest that only one reversal controlled responding (although it would be impossible to know which), while responding in a nonreversed way (as if it was a simple trial) would suggest that responding had been controlled by both reversals. Barnes-Holmes reported that the seven-year-old participant produced greater errors on double reversed I–YOU/HERE–THERE relations compared to all other relations including other reversals. Similar findings were reported by McGuinness (2005).

Just as double reversals can be created by simultaneously reversing I–YOU and HERE–THERE relations, Barnes-Holmes (2001) also constructed double reversals by combining reversals on HERE–THERE and NOW–THEN relations. Note that given the focus on only I or YOU in the temporal relations, there is no way of creating a double reversal with I–YOU and NOW–THEN relations. Consider the following trial referred to as a double reversed HERE–THERE–NOW–THEN relation: "Yesterday I was sitting there on the blue chair, today I am sitting here on the black chair. If HERE was THERE and THERE was HERE, and if NOW was THEN and THEN was NOW: Where would I be sitting now? Where would I be sitting then?"

This trial attempts to reverse one's temporal perspective as controlled by *both* the spatial and temporal relations, and as a result a correct response is designated by noreversal. That is, if you switch your temporal perspective through the NOW–THEN reversal, you must then *switch back to the original temporal perspective* through then reversing the HERE–THERE relation. As a result, responding in a reversed way would suggest that only one reversal controlled responding (although it would be impossible to know which), while responding in a nonreversed way (as if it was a simple trial) would suggest that responding had been controlled by both reversals. McHugh et al. (2004) reported a high level of errors for double reversed HERE–THERE/

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NOW–THEN relations. Interestingly, there were no significant differences in double reversed HERE–THERE/NOW–THEN compared to double reversed I–YOU/HERE–THEN relations.

Generalizing deictic responding to natural language. Several of the studies of the deictic relations cited above have attempted to explore the extent to which performances or training on the deictic protocol generalize to natural language. Heagle and Rehfeldt (2006) presented the perspective-taking protocol to three typically developing children and tested for generalization to real-world conversation (e.g., consider the generalized simple I–YOU trial: "I have a hamburger and you have grilled cheese"). Only one child required explicit training at all three levels of relational complexity, while the remaining participants required training on the reversal and double reversals only. Following explicit training, these skills generalized to real-world conversation. Similarly, Davlin et al. (2011) presented a modified perspective-taking protocol to three typically developing children in which the YOU was replaced with the perspective of a story character (e.g., "You are reading books with me. Cinderella is doing chores. What are you doing? What is Cinderella doing?"). Following substantive training on the protocol, all three children demonstrated the target generalized performances.

In summary, basic RFT research on the deictic relations has stimulated a considerable body of empirical investigation. While there are clearly unresolved issues regarding what precisely controls responding, the evidence does support both the functional distinctiveness of the three types of deictic relations and of the three levels of relational complexity. Some studies also highlight the educational utility of establishing these relations and the possibility that these effects may generalize to natural language.

The relationship between deictic relations and emotions. In very preliminary unpublished research, Barnes-Holmes (2001) investigated the possible transfer of emotional functions through the deictic relations with the two young children described above. In short, this research suggested that once the deictic relations are operational, emotional functions can transform through them with little or no explicit training. For example, if I am happy and you are sad, and if I was you and you were me, you would be happy and I would be sad. And even more complex examples can be illustrated involving other types of relations between I and you. For example, if I feel happy and I see myself as more emotional than you (i.e., a comparative relation), I would derive that you feel less happy. Hence, competence and flexibility in the deictic and other types of relations (e.g., comparison) would be necessary for emotions to be transformed accordingly.

However, from an intervention or remediation perspective, Valdivia-Salas, Luciano, Gutiérrez-Martinez, and Visdómine (2009) argued that several other basic skills must be established before this type of sophisticated relational and emotional responding can be demonstrated. First, a learner must be able to discriminate whether events, including emotional experiences, have aversive or reinforcing functions, and must be able to tact these in a way that is interpreted appropriately by the listener. According to Skinner (1945), labeling your own emotions is part of tacting private experiences more broadly, and is established by the verbal community via public correlates (e.g., correlating an accident with pain. Second, competent perspective-taking requires a learner to discriminate and/or predict and tact the emotions of others. And third, a learner must learn to respond appropriately.

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Luciano, Cabello, Molina, Gomez, and Ortega (2003) explored these skills by presenting 42 adults with a series of cards depicting the character Alfredo in different contexts (working, stressed, and with flowers). Each of these roles was signified by a specific contextual cue that coordinated that role with a particular thought and with a subsequent action (e.g., when Alfredo is stressed he sweats). As a result of multiple exemplar training, the majority of participants correctly predicted Alfredo's thoughts and actions in novel situations, and had thus learned to abstract the relevant cue that indicated the presence of specific thoughts and actions.

The relationship between deictic relations and self-rules. Self-rules are an essential feature of the relationship between public and private events, as one learns to act in accordance with one's environment now and in the future. For RFT, public and private events merge into coherent relational networks in which the deictic relations play a central role. Consider a learner who can demonstrate all of the perspective-taking and related skills described above. In this case, this individual will also be able to adopt the perspective of "I–HERE–NOW" as the locus of all her private experiences and can, from this, discriminate the causes and consequences (immediate, delayed, and probabilistic) of her behavior and the behavior of others. In short, this individual will know how to direct her own behavior and what controls it.

According to Luciano, Valdivia-Salas, Gutiérrez, Ruíz, and Páez (2009), this type of self-directed behavior is often controlled by hierarchical relations between the self and private events. Consider the following intervention for sleep disturbance reported by those researchers with a six-year-old. The child reports the following: "When I close my eyes at night I am afraid I will die, so I need to have the light on." This fear results from seeing a dead person with closed eyes on TV. The instructor altered the coordination relation between sleep and death by demonstrating that death involves much more than having one's eyes closed. For example, the child was asked to close her eyes for 30 seconds and then notice that she has not actually died.

In summary, the deictic relations appear to exert a very strong influence over our behavior and the way in which we control it. In addition, these relations also allow us to account for the complex relationship between the self and emotion and between emotion and behavior. Although much more research is need in each of these areas, it is certainly the case that these RFT concepts have added much to previous behavioral accounts of these complex verbal phenomena.

Training Analogical Reasoning as Relational Responding

No summary of RFT, from a developmental or educational perspective, would be complete without at least some recognition of the potential utility of RFT's basic account of analogical reasoning, not least because this type of behavior is so central to complex language and cognition.

Barnes, Hegarty, and Smeets (1997) provided the first RFT model of analogical reasoning as the derivation of equivalence (coordination) relations between equivalence relations, which they labelled as equivalence–equivalence responding. Consider the classic analogy: apples are to oranges as dogs are to sheep. In RFT terms, apples and oranges participate in a relation of coordination on the basis that both are fruits, while dogs and sheep also participate in a relation of coordination, but they do so on the basis that both are domestic animals. In this example, a correct analogical response involves the derivation of these two equivalence relations and the derivation

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of a further equivalence relation between the two equivalence relations (in other words, apples are equivalent to oranges just as dogs are equivalent to sheep, because each are members of the same respective class).

When presenting classic analogies of this type to children, Barnes et al. (1997) demonstrated that both 9 and 12-year-olds readily demonstrated the target equivalence–equivalence relations (i.e., they could perform the analogies). And similar outcomes have also been reported by Carpentier, Smeets, and Barnes-Holmes (2002) with adults and nine-year-olds. However, Carpentier, Smeets, and Barnes-Holmes (2003) showed that five-year-old children failed to solve the target analogies without explicit training. Indeed, Stewart, Barnes-Holmes, and Weil (2009) described an RFT-based protocol that targets equivalence responding and related composite skills that are necessary in order to establish the basis of analogical abilities. The protocol consists of 10 phases that progress with increasing complexity from training simple A–B relations to testing equivalence–equivalence relations. Although there is no published supporting evidence at present, this protocol may prove beneficial for training analogical reasoning on populations where these complex verbal skills are found to be deficient.

Conclusions

The body of basic research supporting the core concepts surrounding derived relational responding, and particularly as proposed by RFT, is large and compelling. And the related body of evidence investigating and supporting the applicability of these concepts to educational settings is also growing. But there is a great deal more basic and applied research to be done. In bringing behavioral psychology's basic account of verbal behavior into the twenty-first century, RFT offers the promise of enhancing the already proven track record that traditional ABA has in remedial education and particularly with individuals with developmental disabilities. But still, outcomes are far from perfect, and undoubtedly many more learners could have their lives enhanced by thorough teaching programs that will allow them, where possible, to reach their full potential in complex verbal behavior. The concepts and interventions discussed in the current chapter give us hope that the science of behavioral psychology and its educational application will continue to make progress on this important front.

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