The Study of Perspective-taking:

Contributions from Mainstream Psychology and Behavior Analysis

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Abstract

The key purpose of the current article is to provide a comprehensive overview of the literature on perspective-taking from within mainstream psychology and behavior analysis. The primary focus will be on the behavior-analytic approach to perspective-taking, which is divided into what may be described as: (1) traditional behavior analysis; (2) an area within behavior analysis that is concerned specifically with human language and cognition, known as relational frame theory (RFT); and (3) an updated version of RFT that is used to provide the beginnings of a detailed and systematic account of the processes involved in perspective-taking abilities.

Key words: Relational frame theory, perspective-taking, false belief, behavioral processes

Perspective-taking has long been considered pivotal for human socialization (Mead; 1934; Piaget, 1948) in terms of enabling an individual to overcome early egocentrism and to adjust their behavior according to the expectations of others. The ability to take another's perspective is crucial in: competitive settings (Galinsky, Maddux, Gilin, & White, 2008; Galinsky & Mussweiler, 2001); the establishment and maintenance of healthy interpersonal relations (Arriaga & Rusbult, 1998; Hughes & Leekam, 2004); and strengthening social bonds (Galinksy & Ku, 2004; Vescio, Sechrist, & Paolucci, 2003). Indeed, there is evidence that perspective-taking deficits are associated with significant impairments in social skills (e.g., Tager-Flusberg & Anderson, 1991).

Perspective-taking has been broadly defined as the ability to interpret and predict the thoughts, emotions, or behaviors of oneself and of others (Carpendale & Lewis, 2006) in terms of being able to 'assume an alternative perspective' where necessary. While most research on perspective-taking has investigated the ability to assume the perspective of another (e.g., Baron-Cohen, Tager-Flusberg, & Cohen, 2000), the metacognitive (self-based) aspect of perspective-taking has also been emphasized (for a review see Bernstein, Hadash, Lichtash, Tanay, Shepherd, & Fresco, 2015). When both self- and other-based aspects of perspective-taking are acknowledged, the key skill is often perceived as the ability to put oneself in the 'mental shoes' of others in terms of imagining how they perceive, think, or feel about an object or event (Moll & Meltzoff, 2011a) and to understand that these beliefs/perceptions may be different from one's own (Sigman & Capps, 1997).

The key purpose of the current article is to provide a comprehensive overview of the literature on perspective-taking from within mainstream psychology and behavior analysis. Our primary focus will be on the behavior-analytic approach to perspective-taking, which we will divide into what may be described as: (1) traditional behavior analysis; (2) an area within behavior analysis that is concerned specifically with human language and cognition, known as

relational frame theory (RFT); and (3) an updated version of RFT that is used to provide the beginnings of a detailed and systematic account of the processes involved in perspective-taking abilities. We will begin our review by summarizing the main ways in which traditional psychological research has studied perspective-taking.

The Mainstream Psychology Approach to Perspective-taking

Perspective-taking abilities have been subdivided into three domains: *visual or spatial* perspective-taking (Flavell, 1992; Moll & Tomasello, 2006; Tversky & Hard, 2009); *affective or emotional* perspective-taking (Dunn & Hughes, 1998; Wellman, Phillips, & Rodriguez, 2000); and *cognitive* perspective-taking (Flavell, 2004; Gopnik & Slaughter, 1991; Wellman, Cross, & Watson, 2001). Although these domains are often studied independently, all three appear to be involved, to varying degrees, in the ability to take the perspective of another.

Visual perspective-taking. Visual perspective-taking is often also referred to as *spatial* perspective-taking, with the two terms used interchangeably. Flavell (1977) proposed two distinct levels in its development. *Level 1* involves appreciating what others see only from that specific viewpoint (e.g., recognizing that you may be able to see something that someone else cannot see). In a typical task assessing Level 1, a child is asked to position an object so that another person cannot see the object, or to determine whether another individual can see an object that the child can see. Competence on tasks of this kind has been observed in children as young as twelve and a half months (Luo & Baillargoen, 2007; Sodian, Thoermer, & Metz, 2007).

Level 2 of visual perspective-taking involves appreciating that even when two people can see the same object, they may do so from different vantage points. Typical tasks of this level are similar to Piaget's *Three Mountain Problem,* in which a child must choose the photograph that matches what another person sees, rather than what the child sees (Piaget &

Inhelder, 1956). Competence on this type of task has been observed in children aged four years and older (Flavell, Everett, Croft, & Flavell, 1981).

The large gap in the ages at which competence in Levels 1 and 2 of visual perspective-taking has been observed (12 months versus four years) is generally consistent with other evidence of variations in age-based outcomes for this skill (see Frick, Möhring, & Newcombe, 2014 for a review), and may pertain to the use of different methodologies. For example, using a more child-friendly task than the Three Mountain Problem, Moll and Meltzoff (2011a) reported that children as young as three years old show Level 2 visual perspective-taking.

Affective perspective-taking. Affective perspective-taking is often also referred to as *emotional* perspective-taking, again with the two terms used interchangeably. Affective perspective-taking involves the ability to recognize the emotional state of someone else (particularly when this differs from the emotional state of oneself), and to understand the relationship between different situations and the specific emotions they typically elicit (Cutting & Dunn, 1999). For example, a child capable of affective perspective-taking can recognize that, while they could be happy after winning a race, other children in the same race may feel sad because they lost. Competence in this regard has been observed in children aged between two and three years old (Eisenberg, Spinrad, & Sadovsky, 2006), and is typically associated with the emergence of simple emotion-based words, such as “happy” and “sad” (Dunn, Bretherton, & Munn, 1987). Indeed, affective perspective-taking is believed to be associated with social and emotional functioning (Arsenio, 2003; Izard et al., 2001), especially the ability to show varied and empathic responses to the distress of others (Eisenberg et al., 2006). For example, Wellman et al. (2000) have shown that two to three year-olds can determine whether someone has received a desirable or undesirable object based on their emotional reactions to that object.

It is perhaps not surprising that the conceptual and empirical work conducted to date on affective perspective-taking has highlighted the difficulties in separating this ability from related skills, such as empathy (e.g., Farrant, Devine, Maybery, & Fletcher, 2012) and having a theory of mind (e.g., Cutting & Dunn, 1999). Indeed, many affective perspective-taking tasks require relatively sophisticated cognitive and linguistic skills, and thus result in floor effects when presented to young children (Eisenberg et al., 2006). In addition, affective perspective-taking tasks often require an understanding of conflict between one's own emotional response to a situation and the emotional response of another (Harwood & Farrar, 2006), which is hard to distinguish from an understanding of false belief. It is perhaps in part for this reason that some authors have proposed an overlap between affective and cognitive perspective-taking as described below (e.g., Harwood & Farrar, 2006). On balance, other authors maintain that these complex repertoires are better understood as two distinct forms of social cognition (e.g., Cutting & Dunn, 1999).

Cognitive perspective-taking. Almost all of the research on cognitive perspective-taking has been conducted under the rubric of *theory of mind (ToM)*, although ToM has sometimes also been used to refer to visual and affective perspective-taking (Howlin, Baron-Cohen, & Hadwin, 1999). The core skill is believed to involve the correct attribution of mental states to oneself and others as a means of explaining and predicting behavior (Baron-Cohen, et al., 2000; Harrington, Siegert, & McClure, 2005). While the term ToM was first coined by Premack and Woodruff (1978) in research with chimpanzees, the ability to form a theory of mind is believed to be universal only in human adults (see Call & Tomasello, 2008, for a review).

Cognitive perspective-taking and ToM skills are typically divided into two levels (Baron-Cohen, 2001). *First-order* false beliefs refer to assumptions made about another person's beliefs and *second-order* false beliefs refer to another person's assumptions about

beliefs held by a third party (Boucher, 2012), with the latter deemed to be the more complex. Consider the first-order false belief scenario presented in the *Sally-Anne Test*, in which a child is asked about a protagonist known to hold a false belief (e.g., that there is a cookie in the cookie jar, rather than the jar containing nuts) about a situation because this belief differs from the child's own true belief (e.g., that the cookie jar contains nuts). Wellman et al. (2001) reported that children aged four years typically pass the Sally-Anne Test, thus showing first-order false belief attribution. Second-order false beliefs are typically assessed through change in location stories and determine a child's understanding that someone can hold a false belief about someone else's belief (e.g., Flobbe, Verbrugge, Hendricks, & Krämer, 2008). Consider the following scenario from the *Unexpected Transfer Task*. The child is presented with the following scenario: 'Mary and Simon are given a chocolate bar to share. Both put the chocolate in the fridge before going out to play. Soon after, Simon returns to the kitchen and takes the chocolate out of the fridge and puts it in his bag. Later, both children are told that they can eat their chocolate bar.' Then the child is asked: "Where does Simon believe that Mary believes that the chocolate is?" The correct response 'Simon believes that Mary believes that the chocolate is in the fridge' indicates the attribution of a second-order belief (see Sullivan, Zaitchik, & Tager-Flusberg, 1994). Astington, Pelletier, and Homer (2002) demonstrated competence in second-order false belief attribution in children aged six to seven years.

Relatively recent research has focused less on ToM directly in terms of when it is present in a child's repertoire, and more on the developmental precursors that are necessary for ToM to emerge in the first place. For example, Brooks and Meltzoff (2015) reported that infant joint attention (i.e., tracking another's eye gaze or finger-pointing in order to coordinate attending to a stimulus, such that the learner and the instructor have some element of shared experience regarding that stimulus) predicts mental-state term usage (e.g., using phrases such

as "she knows" and "he thinks") at two years. It also predicts competence in ToM at four and a half years (see also Colonnesi, Rieffe, Koops, & Perucchini, 2008; Kristen, Sodian, Thoermer, & Perst, 2011). Declarative pointing (i.e., pointing that functions as a means for a child to achieve joint reference with the addressee) in infancy also predicts ToM in preschool activities (Sodian & Kristen-Antonow, 2015).

Cognitive perspective-taking in atypical development. Similar to the research noted above, a small number of studies have examined the impact of congenital deafness on the subsequent development of ToM. For example, Schick, de Villers, de Villers, and Hoffmeister (2007) found that hearing-impaired infants, born to hearing-abled parents, show delays in passing false belief tasks at the typical age. Most of the ToM literature has explored other types of developmental deficits in atypical populations (e.g., Broekhof et al., 2015), including: attention deficit hyperactivity disorder (ADHD, Uekermann et al., 2010) and autism spectrum disorder (ASD, Frith, Morton, & Leslie, 1991). In particular, research on the potential deficits in ToM in individuals with ASD has led to the "*Impaired ToM" Hypothesis* (see Baron-Cohen, Leslie, & Frith, 1985). This suggestion is based on evidence that at least some children with ASD fail to shift from their own perspective to the perspective of another (e.g., Baron-Cohen, 1989), and that some older children and even adolescents from this group fail ToM tasks that can be passed by typically-developing children as young as four years (see Peterson, Wellman, & Liu, 2005).

In contrast, there exists a considerable body of evidence that questions the view that ToM is typically deficient in individuals with ASD. For example, Boucher (2012) reviewed a number of studies in which individuals from this group passed both first- and second-order false belief tasks, as well as other types of assessments of ToM, involving metaphor, faux pas, and sarcasm (e.g., Scheeren, de Rosnay, Koot, & Begeer, 2013). In support of these outcomes, Happé (1995) suggested that verbally-competent individuals with ASD *can* pass false belief

tasks when given ample time because their core deficits may lie more broadly in social affective information processing (see also Tager-Flusberg, 2007).

In the ToM literature, it is widely accepted that ToM skills emerge in tandem with biological maturation (e.g., Grosse Wiesman, Schreiber, Singer, Steinbeis, & Firederici, 2017). Some support for this view comes from evidence that older children and adults generally show greater speed and flexibility in perspective-taking than younger children (Apperly, Back, Samson, & France, 2008; Im-Bolter, Agostino, & Owens-Jaffray, 2016). On balance, competence in ToM in children is susceptible to training, and thus may be influenced as much by specific developmental contexts as by broad maturational changes (see Hoffman et al., 2016).

In any case, the relationship between perspective-taking and maturation does not appear entirely one-dimensional, because some evidence shows that under certain conditions even adults show slower responding and make more errors on ToM tasks than would generally be expected for their age (Epley, Caruso, & Bazerman, 2006). The findings in this regard may be summarized as follows. (1) Attributing beliefs to others is slower than attributing beliefs to oneself (Bradford, Jentzsch, & Gomez, 2015). (2) Switching from self-perspective to other-perspective is slower than switching from other-perspective to self-perspective in the context of false belief (Bradford et al., 2015). (3) More complex tasks produce more errors (Bull, Phillips, & Conway, 2008) and non-mentalistic, reality-based tasks are completed more quickly (Apperly, Riggs, Simpson, Chiavarino, & Samson, 2006). (4) Greater demands on cognitive load generate more errors and longer reaction times (McKinnon & Moscovitch, 2007). (5) Tasks requiring inhibitory control of self-perspective take longer (than non-inhibitory control tasks, Birch & Bloom, 2007; Keysar, Lin, & Barr, 2003). Taken together, numerous authors have argued that these differential outcomes highlight the role of executive functioning in ToM, and suggest that at least some of the weak

ToM performances observed in adults and atypical samples reflect broader deficits in executive functioning, rather than in ToM per se (e.g., German & Hehman, 2006; McKinnon & Moscovitch). Other researchers working under the rubric of Relational Complexity (RC) Theory have proposed that variability in outcomes on perspective-taking and ToM tasks in typical and atypical individuals depends upon the level of relational complexity that is comprised of the number of variables that are to be related in a given task (Andrews, Halford, Bunch, Bowden, & Jones, 2003; Halford, Wilson & Phillips, 1998).

Cognitive perspective-taking in psychological suffering (psychopathology).

According to Vaskin et al. (2015), different error patterns in ToM tasks may help to distinguish clinical from non-clinical populations, especially Borderline Personality Disorder (BPD) and schizophrenia. Specifically, given that disturbances in interpersonal relationships and the misreading of the intentions of others are believed to be core characteristics of BPD, it is perhaps not surprising that some individuals have shown different ToM outcomes, relative to controls (see Németh et al., 2018 for a review). However, the findings in this regard are again inconsistent, with some studies showing that individuals with BPD perform *better* than control participants (e.g., Fertuck et al., 2009) and potentially highlighting 'hypervigilance' to social cues, but others showing that individuals with BPD perform w*orse* than controls (e.g., Sharp et al., 2011), thereby suggesting ToM deficits. Similar to the developmental evidence discussed above, the ToM competencies of this clinical group appear to be influenced by the type of ToM task employed. For example, Preißler, Dziobek, Ritter, Heekeren, and Roepke (2010) found that individuals with BPD were more likely to make ToM-based errors on ecologically valid tasks with greater complexity than on simpler tasks. Indeed, Roepke, Vater, Preißler, Heekeren, and Dziobek (2013) argued that the more complex tasks may be necessary to tease out ToM deficits in this group.

Several studies have reported that individuals with schizophrenia have also produced different outcomes on ToM tasks, relative to controls (e.g., Savla, Vella, Armstrong, Penn, & Twamley, 2013). That is, some have found weaker performances in the attribution of thoughts or intentions to others, and particularly in the attribution of emotional states (e.g., Shamay-Tsoory et al., 2007), and others have found correlations between negative symptoms and the attribution of overly simplistic mental states to others (Montag et al., 2011; Pickup & Frith, 2001). Positive symptoms have also been associated with the attribution of overly complex mental states to others (Fretland et al., 2015). However, as noted previously, these performances are also influenced by task-specific features, suggesting that they may not be reflecting ToM deficits per se in this population. For example, on the *Reading the Mind in the Eye Test*, Scherzer, Leveille, Achim, Boisseau, and Stip (2012) found no significant difference in ToM performances between individuals with schizophrenia and a group of healthy controls. However, performance on the *Hinting Task* was significantly more impaired for individuals with schizophrenia compared to the non-clinical group. Once again, generic deficits in executive function may be at play, in that numerous studies have found a correlation between poor ToM and deficits in inhibition and cognitive flexibility in this sample (for a review see Pickup, 2008).

The mainstream psychology approach to the potential 'processes' involved in perspective-taking. The reviews above of the developmental and clinical literatures on perspective-taking and ToM highlight the difficulty of ruling out the potential role of broader cognitive concepts and capabilities, of which perspective-taking may be a component. As a result, the field of perspective-taking appears to have struggled to formulate an operational definition of what these skills involve (Davis, et al., 2004). Davis et al. summarized the core steps involved in perspective-taking as follows: (1) imagining what the observer themselves would do in that position; (2) imagining similar circumstances from the observer's own past;

(3) imagining what the other person would do based on the observer's knowledge of the other person's history; and (4) following general social rules about what others might typically do in that type of scenario.

In a similar vein, Epley and Caruso (2009) proposed three possible steps in perspective-taking that highlight three points at which an individual may falter. (1) The first step involves successfully activating the ability to perspective-take. That is, a person may fail to identify an instance where another's perspective should be considered, and this may result from factors such as the absence of sufficient effort or training (e.g., Idson et al., 2004). (2) The second step involves adjusting one's own egocentric perspective to accommodate that of another, with failure to do so rendering judgments biased in the direction of the initial self-perspective (for reviews, see Epley, 2004; Keysar & Barr, 2002). Indeed, Davis et al. (2004) found that explicit instructions to adopt another's perspective increases the accessibility of self-related thoughts. Furthermore, egocentric biases increase when individuals are asked to respond quickly, but decrease when financial incentives accompany correct responding (Epley, Keysar, Van Boven, & Gilovich, 2004). (3) The third step in perspective-taking depends upon the information about others that is provided, which ranges from idiosyncratic knowledge about specific individuals to general information and even stereotypes (Ames, 2004).

Summary. In mainstream psychology, the broad concept of perspective-taking has been subdivided into visual perspective-taking, emotional perspective-taking, and cognitive perspective-taking (usually referred to as ToM). Visual perspective-taking has been observed in infants as young as 12 months. Affective perspective-taking emerges later, usually around age two, and cognitive perspective-taking (ToM) comes even later around age four, with false belief understanding observed around age six. However, there have been wide variations in the ages at which these skills are first observed, with outcomes apparently sensitive to both

methodological variations and broader individual differences, especially in executive functioning. There is evidence of weaker perspective-taking performances in samples with a diagnosis of ASD, BPD, or schizophrenia, but these too appear to be influenced by task-specific features, and broader executive functioning abilities. Indeed, the reviews above of the developmental and clinical literatures highlight the difficulty of ruling out the potential role of broader cognitive concepts and capabilities in assessments of perspective-taking. These difficulties perhaps account for why mainstream psychology has not yet reached consensus on the processes involved in perspective-taking. We will continue our review by summarizing the ways in which traditional behavior analysis has studied perspective-taking, and, as will become clear, the basic (behavioral) processes in perspective-taking are only now beginning to attract attention.

The Traditional Behavior-analytic Approach to Perspective-taking

In the field of behavior analysis, the ability to respond to one's own responding is pivotal to an understanding of the concept of 'self'. The earliest behavioral writings on self include those by Skinner (e.g., 1974), who proposed that self-knowledge develops through shaping by the knowledge of others and by social contingencies that reinforce the discrimination of one's own behavior. By asking questions such as "How are you feeling?", other members of the verbal community, in effect, shape an individual's ability to discriminate their own behavior. Across such exemplars, an individual is believed to become more self-aware, thus acquiring better prediction and control over their own behavior (Skinner). However, it is perhaps surprising that the empirical support typically cited for Skinner's interpretation of self-awareness has come from studies with nonhumans, such as Lattal's (1975) demonstration that the behavior of pigeons may be brought under the control of their own previous patterns of responding.

Few in the behavior-analytic community have explicitly attempted to connect the Skinnerian concept of self with the skills involved in perspective-taking, even though they are intuitively linked. However, some researchers have attempted to interpret ToM tasks and performances using behavioral concepts. For example, Spradlin and Brady (2008) interpreted ToM performances in terms of Sidman's (e.g., 1971) equivalence relations. Similarly, Okuda and Inoue (2000) and Schlinger (2009) attempted to interpret these performances in terms of operant stimulus control. And, DeBernardis, Hayes, and Fryling (2014) offered an interbehavioral interpretation that emphasizes the importance of analyzing the complex interbehavioral history between the perceiver and the target other.

Most of the behavioral work on perspective-taking has focused on the remediation of deficits in these abilities, based on the broad assumption that perspective-taking repertoires may be established or remediated through the acquisition of an appropriate learning history. Two studies have investigated the use of video modeling interventions to establish perspective-taking in children with ASD. Specifically, LeBlanc, et al. (2003) presented three children with a variation of the Sally-Anne Test. Whilst all three failed the task initially, the video modeling served to produce highly competent performances in all cases, although generalization to untrained tasks was recorded for only two of the children. Using a similar procedure again with three children, but including a number of training exemplars, Charlop-Christy and Daneshvar (2003) produced similar outcomes, but were more successful at promoting generalization to novel stimuli and novel responses. In a related study also using a variation of the Sally-Anne Test, and including prompts for training purposes, Gómez-Becerra, Martín, Chávez-Brown, and Greer (2007) presented the task to five children with ASD, five with Down Syndrome (DS), and five who were typically-developing, all aged between four and six years. Three of the typically-developing children passed without prompts, with the remaining two requiring prompts to pass, as did all five children with DS.

The five children with ASD all failed even with prompts. Further analyses of the data indicated that only those children with ASD or DS who had language deficits produced weak performances before or after prompting.

Developmental behavioral researchers have devoted considerable attention to the likely precursors to perspective-taking (Novak, 1996, 1998; Novak & Pelaez, 2004), with a particular focus on joint attention and social referencing (Moll & Meltzoff, 2011b; Slaughter & McConnell, 2003). *Joint attention*, as the name implies, involves tracking another's eye gaze or finger pointing in order to coordinate attending to a stimulus, such that the learner and the instructor have some element of shared experience regarding that stimulus (see also Lowenkron, 1998, for a relevant functional-analytic description of joint control). According to Dube, MacDonald, Mansfield, Holcomb, and Ahearn (2004), this joint stimulus orientation results from a relevant history of consequences, including solidarity play. Indeed, there is evidence that joint attention can be established when found to be deficient or absent. For example, MacDonald et al. (2006) investigated joint attention responding and initiation in 21 typically-developing children and 26 children with ASD, aged two to four years. When required to respond to joint attention involving gestures, both groups performed well, with some superiority observed with older age. However, when required to *initiate* joint attention, the children with ASD, especially the younger ones, showed considerably weaker performances than the typically-developing children. In a related remediation study of joint attention and its initiation, Whalen and Schreibman (2003) trained five children with ASD aged four years, using components of Discrete Trial Training (DTT) and Pivotal Response Training (PRT). Baseline performances indicated considerable impairments relative to typically-developing peers, especially in joint attention initiation. However, training facilitated significant improvements in all children on joint attention, and in four of the children on joint attention initiation, including generalization to novel settings and novel

adults. In a similar study, Gould, Tarbox, O'Hora, Noone, and Bergstrom (2011) evaluated the use of multiple exemplars of conditional discrimination training. During the baseline, all three children failed to demonstrate joint attention, but the interventions facilitated rapid acquisition of the target performances and generalization to untrained stimuli for all participants. However, generalization in the natural environment was much more limited. Hahs (2015) replicated this study, but failed to find generalization to untrained stimuli.

Social referencing involves orienting to another person's expression and then responding to a stimulus on the basis of that expression (Peláez-Nogueras & Gewirtz, 1997), with the expression thus functioning as a setting event (Peláez, 2009). For example, if a child discriminates a fearful expression on their mother's face as the child reaches towards a dog, the child may be less likely to touch the dog given this expression. Social referencing, therefore, enables learners to predict the potential reinforcement of stimuli or events without the need for direct contact with the stimulus. Peláez, Virues-Ortega, and Gewirtz (2012) investigated social referencing in which maternal facial expressions signaled either positive or negative consequences of the reaching behavior of 11 four- and five-month old babies. Whilst all of the infants failed the baseline, subsequent interventions established the mothers' joyful expressions as discriminative for infant reaching and fearful expressions as discriminative for not reacting, for all children.

Summary. In traditional behavior analysis, the ability to respond to one's own responding (i.e., acquire self-awareness) as an essential precursor to perspective-taking, is shaped through a history of interacting with other members of the social/verbal community, although empirical support for this interpretation of self-awareness has tended to come from research with nonhumans. Indeed, little behavior-analytic research has explicitly attempted to connect the concept of self (or self-awareness) with perspective-taking skills in humans. While some researchers have offered behavioral interpretations of ToM performances in

terms of equivalence relations and operant stimulus control, most research has focused on remediating deficits in perspective-taking through the provision of appropriate learning histories. The outcomes show that video modeling interventions have enabled children with ASD to pass the Sally-Anne Test, although generalization is more robust when training exemplars are included. Incorporating training prompts into the Sally-Anne Test has also produced positive outcomes, but appear to be necessary or less effective for participants with language deficits. Developmental behavioral researchers have devoted considerable attention to joint attention and social referencing as precursors to perspective-taking. There is evidence that joint attention responding and initiation can be established in children with ASD, although the latter (initiation) is more likely to be deficient and more difficult to establish, and generalization is not always observed. Interventions to establish social referencing have demonstrated positive outcomes in four- and five-month old babies. In general, as one might expect, there has been a far greater emphasis in behavioral psychology on prediction-and-influence of perspective-taking, which in a broad sense further complicates the literature in this area. That is, research from the mainstream literature has tended to produce relatively inconsistent results in attempting to tie deficits in perspective-taking to specific ages, populations, and syndromes. The fact that behavior-analytic research also shows that perspective-taking deficits are relatively amenable to change when targeted by behavioral interventions makes it even more difficult to draw firm conclusions about the very concept of perspective-taking. In turning to an area of behavior analysis that has concerned itself specifically with human language and cognition, RFT, we will find an account of perspective-taking that is unsurprisingly rooted in human language. As we shall see, this focus has recently generated a more process-oriented account of perspective-taking.

Relational Frame Theory: A Language-focused Behavior-analytic Approach to Self and Perspective-taking

Some behavioral researchers working under the rubric of RFT (see Hayes, Barnes-Holmes, & Roche, 2001 for a book-length treatment) have proposed that self-discrimination involves *verbal* processes that distinguish it functionally from the nonverbal self-discrimination observed with nonhumans. In other words, self-awareness requires a human to be "not simply behaving with regard to his behavior, but . . . also behaving verbally with regard to his behavior" (Hayes & Wilson, 1993, p. 297). According to RFT, this type of verbal self-discrimination and perspective-taking comprise repertoires of *derived relational responding*, which is the basis of language itself. In this section, we summarize the core concepts of RFT in order to provide the basis for the theory's approach to perspective-taking as derived relational responding.

Patterns of derived relational responding. At its most basic, RFT makes an important distinction between nonarbitrary and arbitrary relational responding. In simple terms, *nonarbitrary* relational responding involves relating one stimulus or event to another on the basis of a shared physical property. For example, you might say that two tennis balls are the same because they are the same shape, size, and/or color, although there may be other small physical properties on which the two balls differ. Nonarbitrary relational responding appears to be directly acquired through contingencies and is highly developed in nonhumans (see Giurfa, Zhang, Jenett, Menzel, & Srinivasan, 2001).

In contrast, arbitrary or derived relational responding is *not* based solely on physical stimulus properties, and is more likely to be emergent (i.e., derived) in terms of its acquisition. For example, if you train a verbally-able child that 'Tom is faster than David and David is faster than Ann', with no direct contact with these stimuli, they can then derive, in the absence of reinforcement or prompting, that 'Tom is faster than Ann' and that 'Ann is slower than Tom.' The technical term RFT uses to describe this type of relational behavior is *arbitrarily applicable relational responding* (AARR) and it appears, at the present time, to be

largely unique to verbally sophisticated humans (Brino, Campos, Galvão, & McIlvane, 2014; but see also Hughes & Barnes-Holmes, 2014). RFT researchers have investigated a number of different patterns of AARR, including responding in accordance with relations of coordination, distinction, opposition, comparison, hierarchy, and perspective-taking. These are summarized briefly below. In each case, we have provided an example of at least one study that has demonstrated the specific pattern of relational responding.

Responding in accordance with the relation of *coordination* appears to be the most basic form of AARR that infants learn (Lipkens, Hayes, & Hayes, 1993) at around 18-24 months (Luciano, Gómez-Becerra, & Rodríguez-Valverde, 2007). Consider the example, 'If A is the same as B and B is the same as C, then A and C are most likely the same.' O'Connor, Rafferty, Barnes-Holmes, and Barnes-Holmes (2009) successfully employed multiple exemplar training (MET) to establish word-picture and picture-word coordination relations in 15 children with ASD, as well as in three typically-developing children (see also Carr, Wilkinson, Blackman, & McIlvane, 2000).

Responding in accordance with the relation of *distinction* requires responding to arbitrary differences among stimuli, along a particular dimension, by applying a relational cue such as 'is different from' (Dixon & Zlomke, 2005; Roche & Barnes, 1996; Steele & Hayes, 1991). Consider the example, 'If A is different from B, then B is different from A.' Relations of distinction do not always specify the relevant dimension along which the stimuli differ and, of course, there are many ways in which this can occur. For example, you might tell someone that you are very different from your sister, with no need to say exactly how you differ. Dunne, Foody, Barnes-Holmes, Barnes-Holmes, and Murphy (2014) established contextual control for distinction responses with both nonarbitrary and arbitrary relations in two children with ASD.

Responding in accordance with the relation of *opposition* requires the abstraction of a particular dimension along which stimuli can be differentiated at either end of a continuum (Steele & Hayes, 1991). As a result, opposition relations likely involve a higher level of complexity than coordination and distinction relations, for example, because opposition relations *involve* coordination and/or distinction relations. For example, 'If A is opposite to B (hence A and B are also different) 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, while Dunne et al. (2014) established these relations in four children with ASD. Dymond, Roche, Forsyth, Whelan, and Rhoden (2007) also demonstrated the derived transformation of avoidance functions in adults in accordance with opposition relations (see also Whelan & Barnes-Holmes, 2004).

Responding in accordance with the relation of *comparison* requires responding to one event in terms of quantitative or qualitative relations along a specified dimension with another event. For example, 'If A is bigger than B and B is bigger than C', A is bigger than C and C is smaller than A. Responding on the basis of comparison relations has successfully been established in typically-developing children (Barnes-Holmes et al., 2004; Berens, & Hayes, 2007; Hayes, Stewart, & McElwee, 2016) and in children with ASD (Dunne et al., 2014; Gorham, Barnes-Holmes, Barnes-Holmes, & Berens, 2009). Vitale, Barnes-Holmes, Barnes-Holmes, and Campbell (2008) also showed some variation in comparison responding in adults between specified and unspecified relations.

Responding in accordance with *temporal* relations requires responding to the relationship between two events in terms of a specified temporal dimension, by applying a relational cue such as 'before/after' or 'now/then.' For example, 'If A occurs after B and B occurs after C', C most likely occurs before A and A occurs after C. RFT-based research

demonstrating patterns of temporal relational responding is limited, with only a few studies conducted with adults. Specifically, O'Hora, et al. (2008) found that successful completion of a temporal relations task predicted better performances on the Verbal Comprehension and Perceptual Organization indices of the Wechsler Abbreviated Scale of Intelligence-III (WAIS III) in an undergraduate sample. Similarly, O'Toole and Barnes-Holmes (2009) assessed flexibility in responding to temporal and comparison relations, using the Implicit Relational Assessment Procedure (IRAP). The results indicated that faster responding in accordance with temporal and comparison relations, as well as greater flexibility in these patterns, predicted higher scores on the Kaufman Brief Intelligence Test (K-BIT). Several studies have also assessed the implications of temporal relations for instructional control (Brassil, Hyland, O'Hora, & Stewart, 2019; Hyland, Smyth, O'Hora, & Leslie, 2014; McGreal, Hyland, O'Hora, & Hogan, 2016; O'Hora, Barnes-Holmes, Roche, & Smeets, 2004).

Responding in accordance with the relation of *hierarchy* appears to be even more complex and again contains some of the relations described above. For example, 'If B is a member of group A'; A is a class containing B and any other members of A are likely to be similar to B, at least to some extent. For example, apples and oranges are both members of the food group fruit, but they differ in many other ways. Several studies have investigated hierarchical relations in adults (e.g., Gil, Luciano, Ruiz, & Valdivia-Salas, 2012; Gil, Luciano, Ruiz, & Valdivia-Salas, 2014; Griffee & Dougher, 2002; Slattery & Stewart, 2014) and typically-developing children (Mulhern, Stewart, & McElwee, 2017). Some studies have also successfully trained hierarchical relational responding in typically-developing children aged five-six years (Mulhern, Stewart, & McElwee, 2018).

A small number of studies have explored the possible sequence in which the above repertoires of AARR develop naturally, because this may have important developmental and educational implications (e.g., Cassidy, Roche, & Hayes, 2011; Dixon, 2014). For example,

Dunne et al. (2014) assessed the repertoires in the following sequence with children with ASD: coordination, opposition, distinction, and comparison. Their outcomes showed that all 10 children demonstrated coordination relations: four demonstrated opposition relations; and two demonstrated distinction, comparison, and hierarchical relations, thus suggesting weaker performances as the relations became more complex. In addition, the number of training trials needed during the intervention phase to establish the target repertoires decreased steadily as more repertoires were established, thus implying that the earlier relational skills facilitated the latter.

In a subsequent study, Kent, Galvin, Barnes-Holmes, Murphy, and Barnes-Holmes (2017) directly compared two training sequences. Training Sequence A consisted of teaching coordination, distinction, comparison, opposition, and then hierarchical relations, while Training Sequence B switched the order of the comparison and opposition relations (i.e., coordination, distinction, opposition, comparison, and then hierarchy). The results indicated that participants who completed Training Sequence B (opposition before comparison) demonstrated significantly better performances on comparison relations than participants who completed Training Sequence A. This finding suggested that establishing opposition relations may facilitate the emergence of comparison relations.

The RFT approach to perspective-taking. As some of the findings above suggest, once these core patterns of AARR emerge, they likely provide the basis for more complex relational repertoires, such as that involved in perspective-taking. For RFT, perspective-taking is also AARR that becomes abstracted through learning to talk about your perspective in relation to others (McHugh, Barnes-Holmes, & Barnes-Holmes, 2004). Across multiple exemplars, this abstraction generates the constancy that characterizes your perspective and once the perspective-taking relations are established, they become an intrinsic feature of almost all of our verbal behavior (see Hayes et al., 2001). Imagine a very young child who is

asked "What did you have for lunch today?" while they are eating an evening meal with their family. If the child responded simply by referring to what a sibling is currently having for dinner, they may well be corrected with "No, that's what your brother is eating now, but what did you eat earlier today?" In effect, this kind of ongoing refinement of the three deictic relations allows the child to respond appropriately to questions about their own behavior in relation to others, as it occurs in specific times and specific places (e.g., McHugh, et al., 2004). Thus, 'having a perspective' is a continuous experience and an individual is always operating from the same 'self' perspective (Hayes, 1984).

For RFT, the core relations involved in perspective-taking are referred to as *deictic* (Hayes et al., 2001), and include responding from one's own perspective in relation to others, time, and place. Specifically, the *interpersonal* relations involve responding to *I* and *you*, the *spatial* relations involve responding to *here* and *there*, and the *temporal* relations involve responding to *now* and *then*. For RFT, the relational properties of I vs. you, here vs. there, and now vs. then become constants, against which environments that are continually changing in terms of time and space can be understood, categorized, and communicated about.

The original deictic relations protocol. Most of the empirical research on deictic relational responding has employed various iterations of a developmental protocol originally developed by Barnes-Holmes (2001)[1]. The original extensive 256-trial protocol targeted the three deictic relations (I-YOU, HERE-THERE, and NOW-THEN), as well as three levels of relational complexity, referred to as: simple, reversed, and double reversed relations. In an

[1] Guinther (2017) offered an experimental protocol for modeling perspective-taking that appears to require derived 'mental rotation' on behalf of typically-developing adult participants. More recently, Guinther (2018) extended the model to include false belief, but with mixed results (i.e., only two of four participants demonstrated false belief in the absence of direct training). As an aside, initially Guinther (2017) argued that the protocol developed by Barnes-Holmes (2001) and the derived 'mental rotation' model constituted competing accounts of perspective-taking. More recently, Guinther (2018) appears to recognize that the two approaches are RFT-consistent but are also different in so many ways that it is difficult to argue that one is somehow more precise or better than the other.

attempt to reflect a typical developmental sequence, the protocol targeted the interpersonal I-YOU relations first, followed by the spatial HERE-THERE relations, and finally the temporal NOW-THEN relations. Specifically, *Level 1* first targeted *simple I-YOU relations* (e.g., "I have a red brick and you have a green brick. Which brick do I have? Which brick do you have?"), followed by *reversed I-YOU relations* (e.g., "If I have a red brick and you have a green brick and if I was you and you were me. Which brick would I have? Which brick would you have?").

Level 2 targeted HERE-THERE relations, including I-YOU relations from Level 1. Again, *simple HERE-THERE relations* were assessed first (e.g., "I am sitting here on the blue chair and you are sitting there on the black chair. Where am I sitting? Where are you sitting?"), followed by *reversed HERE-THERE relations* (e.g., "I am sitting here on the blue chair and you are sitting there on the black chair. If here was there and there was here. Where would you be sitting? Where would I be sitting?"). Level 2 then combined the interpersonal and spatial relations in what was referred to as an *I-YOU/HERE-THERE double reversal* (e.g., "I am sitting here on the blue chair and you are sitting there on the black chair. If I was you and you were me and if here was there and there was here. Where would I be sitting? Where would you be sitting?").

Level 3 focused on the temporal relations and their relationship with interpersonal and spatial relations. Again, *simple NOW-THEN relations* were targeted first (e.g., "Yesterday I was watching television, today I am reading. What am I doing now? What was I doing then?"), followed by *reversed NOW-THEN relations* (e.g., "Yesterday I was watching television, today I am reading. If now was then and then was now. What was I doing then? What would I be doing now?"). It is notable from the examples above that even when presented in simple form, temporal relations do not combine I and YOU, instead only one is presented in any trial. This is because combining interpersonal and temporal relations leaves

some relations unspecified. For example, if I tell you that I was sleeping yesterday and my sister is working today, you cannot know what my sister was doing yesterday and what I am doing today. Similar to Level 2, Level 3 also assessed *HERE-THERE/NOW-THEN double reversals* (e.g., "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 then? Where would I be sitting now?").

Empirical research using the deictic relations protocol with typically-developing children. A large proportion of the research using the deictic relations protocol has presented it to typically-developing children (see Montoya-Rodríguez, Molina, & McHugh, 2017, for a review). The results of this body of research may be summarized as follows: (1) The data support the distinctions among the three types of deictic relations (McHugh, et al., 2004); (2) The deictic relations vary on a continuum of complexity from simple relations to reversed relations, and double reversed relations (McHugh et al.; Heagle & Rehfeldt, 2006); (3) There appears to be a developmental trend in which the interpersonal and simple relations emerge first (McHugh et al.); (4) Once established in typically-developing children, these perspective-taking repertoires can generalize to both new stimuli and real-world conversational topics (Heagle & Rehfeldt, 2006); (5) Perspective-taking repertories can be successfully established in more natural language-like contexts, such as within a children's story (Davlin, Rehfeldt, & Lovett, 2011); and (6) The establishment of the deictic relations may be enhanced when multiple exemplars of established cues for deictic responding are incorporated into the protocol (Montoya-Rodríguez, & Molina Cobos, 2018).

Empirical research using the deictic relations protocol with atypically-developing children. Similar to the mainstream ToM literature, a considerable number of studies on deictic relational responding in children have focused on investigating possible deficits associated with ASD. The findings that have been observed using the deictic relations

protocol may be summarized as follows: (1) Overall, children with ASD produce weaker performances than their typically-developing peers (Rehfeldt, Dillen, Ziomek, & Kowalchuk, 2007); (2) The performances of children with ASD can also be differentiated in terms of both relation type and level of complexity, and deficits can be remediated with direct training (Jackson, Mendoza, & Adams, 2014); (3) Deictic relational responding can be established using naturalistic variations of the original protocol, such as children's stories (Gilroy, Lorah, Dodgea, & Fiorello, 2015); and (4) The transformation of stimulus functions through deictic relations has been demonstrated in certain training contexts (Barron, Verkuylen, Belisle, Paliliunas, & Dixon, 2018; Belisle, Dixon, Stanley, Munoz, & Daar, 2016).

The use of the deictic protocol with typical adults. Several studies have used the original protocol to examine deictic relational responding in typical adults. McHugh et al. (2004) reported that adults (18-30 years) produced less errors overall than adolescents and children, and that adolescents made less errors than children. Interestingly however, even adults produced error rates ranging from 25% on reversed I-YOU relations to 50% on reversed NOW-THEN relations. In a replication study in the same paper, in which the protocol was presented in an automated rather than table-top format, very similar performances overall were observed.

The use of the deictic protocol with atypical adults. A number of studies have investigated deictic relational responding in various groups of adults, that may be referred to as atypical, either in terms of intellectual competence or clinical presentation. Gore, Barnes-Holmes, and Murphy (2010) investigated 24 adults with varying levels of intellectual disability and found that performances on the deictic protocol correlated with verbal ability, full-scale IQ, and performance IQ. Lovett and Rehfeldt (2014) successfully used MET with three adults with ASD to establish competent performances on the protocol and some level of generalization to natural social interactions. O'Neill and Weil (2014) presented the protocol to

three adults with mild-moderate intellectual disability and with schizophrenia. Baseline results indicated considerable deficits in responding across all three levels of complexity from 17% accuracy on double reversals to 50% on simple relations. After explicit training, significant improvements were observed on all tasks, with accuracy now ranging from 79% on double reversals to 96% on simple relations.

Villatte, Monestès, McHugh, Freixa, i Baqué, and Loas (2008) compared performances on the protocol within a nonclinical sample of college students who scored high versus low on social anhedonia. Overall, both groups performed very well, with minor weaknesses observed on the more complex trials. Where superiority in performance *was* observed in the low social anhedonia group, this occurred on reversed I-YOU and reversed HERE-THERE relations, I-YOU/HERE-THERE double reversals, and HERE-THERE/NOW-THEN double reversals. In a related study, Vilardaga, Estévez, Levin, and Hayes (2012) reported that performance on a modified version of the deictic protocol correlated with social anhedonia, empathy, and experiential avoidance.

Villatte, Monestès, McHugh, Freixa, i Baqué, and Loas (2010a) investigated performances on the protocol with 15 adults with and without schizophrenia. The sample with schizophrenia produced significantly more errors on all reversed relations, and weaker performances on double reversals. Contrary to previous findings, both groups performed better on double reversals than reversals.

Janssen et al. (2014) compared performances on the protocol between 13 adults with Social Anxiety Disorder (SAD) and 14 control participants. Similar to previous evidence, both groups produced their highest levels of accuracy on simple relations, with lowest on double reversals. Interestingly, while highest accuracies were observed on I-YOU relations, both groups emitted their next best performances on NOW-THEN relations, and their lowest accuracies on HERE-THERE relations. The two groups only differed significantly on

reversals, with the control group showing superiority in this regard. In a related study, Hendriks et al. (2016) compared the performances of 27 individuals with anxiety, eight with psychosis, and 23 control participants. The results showed that all groups produced their highest levels of accuracy on simple relations and the lowest on double reversals, with some evidence that the group with psychosis produced lowest accuracies overall, while the control group produced the highest level of accuracy.

Possible limitations to using the deictic protocol in adults and clinical samples. Although the deictic protocol has been used less often with adults than children, and has not been used extensively with clinical samples, several authors have raised concerns about using the tool with these samples (e.g., Hendriks et al., 2016). These concerns may be summarized as follows: (1) The protocol was explicitly designed for developmental purposes (i.e., use with young children) to establish deictic relations when they were found to be absent or deficient (see Barnes-Holmes, 2001); (2) Even typically-developing adults show deficits on specific deictic relations when these relations are not presented as they typically are in natural language (McHugh et al., 2004; Vitale et al., 2008); (3) RFT does not necessarily predict that psychological suffering involves *deficits* in relational responding; (4). It is *possible* that deficits or unexpected patterns of deictic relational responding *might* be observed in psychological suffering, but more meaningful effects would likely be obtained if the deictic relations were specific to the domain of interest (e.g., an individual's levels of anxiety relative to others).

Summary. Behavioral researchers working under the rubric of RFT have proposed a distinction between verbal self-discrimination as observed in humans and nonverbal self-discrimination observed with nonhumans. According to RFT, verbal self-discrimination and perspective-taking comprise repertoires of AARR. For RFT, perspective-taking is AARR that becomes abstracted across multiple exemplars of talking about your perspective in relation to

others. The core relations involved in perspective-taking are referred to as deictic relations, and include responding from one's own perspective in terms of interpersonal relations, spatial relations, and temporal relations. Most of the empirical research on deictic relational responding has employed various iterations of a developmental protocol. This research supports the distinctions among the three types of deictic relations, and the finding that these relations vary on a continuum of complexity from simple relations to reversed relations, and double reversed relations. In general, accuracies in performances on the deictic relational protocol increase as a function of age. However, even adults produce error patterns and, in some cases, adult performances are better on double reversals than reversals. Once established via MET, perspective-taking repertoires can generalize to both new stimuli and contexts. Studies assessing patterns of deictic relational responding in atypical populations have found that children with ASD produce somewhat weaker patterns than their peers. Results with atypical adults have found that performances on the deictic protocol correlate with verbal ability and IQ. Participants with a diagnosis of schizophrenia have been shown to produce significantly weaker results on reversed and double reversed relations than typically-developing counterparts. Overall several researchers have raised concerns about using the protocol to assess deictic relational repertoires in adult samples.

Exploring the putative relationship between performances on the deictic relations protocol and ToM tasks. A considerable number of the studies described above attempted to assess the relationship between children's performances on the deictic protocol and traditional ToM tasks in order to determine the potential functional overlap between the skills targeted by each. Specifically, with typically-developing children, Weil, Hayes, and Capurro (2011) reported that establishing competent performances on the protocol generalized to ToM tasks, although Jackson et al. (2014) reported that training on the protocol was *not* sufficient to improve weak performances on ToM tasks with atypically-developing children.

Four of the studies described in the earlier sections with adults from clinical samples have also attempted to assess the relationship between performances on the protocol and ToM tasks. With adults with mild-moderate intellectual disability and schizophrenia, O'Neill and Weil (2014) reported that training on the protocol significantly improved weak baseline performances on the Deceptive Container Task (Perner, Frith, Leslie, & Leekam, 1989) and the Hinting Task (Corcoran, Mercer, & Frith, 1995). Similarly, when Lovett and Rehfeldt (2014) used MET to establish deictic relational responding in adults with ASD, they saw improvements on the Theory of Mind Inventory (TOMI). Villatte et al. (2010a) found that performances on reversal trials by adults with and without schizophrenia significantly predicted accuracy on the ToM task. Finally, Hendriks et al. (2016) reported that with individuals with anxiety and others with psychosis, performance on the protocol was positively correlated with both the Faux-pas (Baron-Cohen, O'Riordan, Stone, Jones, & Plaisted, 1999) and the Strange Stories (Happé, 1995) tests (although these correlations were not retained when intelligence was controlled for). Taken together, there is evidence of a functional overlap between deictic relational responding as measured by the protocol and ToM with numerous samples.

Several studies have systematically adapted trials from the deictic protocol to create tasks that closely resemble the attribution of true and false beliefs as targeted by ToM measures, such as the Deceptive Container Task. Specifically, McHugh, Barnes-Holmes, Barnes-Holmes, and Stewart (2006) constructed trials that required participants from five different age groups to respond in accordance with the three deictic relations and, on some trials to respond in accordance with logical NOT. Consider a *true belief trial* with the following scenario and subsequent questions: "If you put the doll in the cookie jar and I am here. What would I think is in the cookie jar? What would you think is in the cookie jar?" Now consider *a false belief trial containing logical NOT* as follows: "If you put the doll in the

cookie jar and I am not here. What would you think is in the cookie jar? What would I think is in the cookie jar?". For RFT, responding correctly to the latter task involves responding in accordance with here-there, now-then, and logical not (i.e., I did NOT see inside THERE and THEN, so this is what I think is inside HERE and NOW). The results from McHugh et al. indicated that accuracy on both types of trial appeared to increase as a function of age, but there was no significant difference in accuracy rates when responding to true and false belief was compared, nor were differences recorded between these trial types for any age group.

In a related study, McHugh, Barnes-Holmes, Barnes-Holmes, Whelan, and Stewart (2007) compared responding to self versus other in adapted false belief trials, in terms of both accuracy and response latency. Consider the following *self-attribution false belief* trial: "If you put the pencils in the Smarties box and I am not there, would you think the Smarties box contains pencils?" Now consider an *other-attribution false belief trial*: "If I put the pencils in the Smarties box and you are not there, would I think the Smarties box contains pencils?" The results of the study indicated high accuracy overall in false belief responding, but significantly longer latencies on trials involving the perspective of other versus self.

Across two experiments, Villatte, Monestès, McHugh, Freixa, i Baqué, and Loas (2010b) used a similar adaptation of true and false belief trials as above and compared 15 control participants, 15 high in social anhedonia, 15 low in social anhedonia, and 15 with schizophrenia. The four trial types were as follows: *self-attribution true belief* (e.g., "If I put the pencils in the Smarties box and you are here, you would think the Smarties box contains …..?"); *self-attribution false belief* (e.g., "If I put the pencils in the Smarties box and you are not here, you would think the Smarties box contains….?"); *attribution-to-other true belief* (e.g., "If you put the pencils in the Smarties box and I am here, I would think the Smarties box contains….?"); and *attribution-to-other false belief* (e.g., "If you put the pencils in the Smarties box and I am not here, I would think the Smarties box contains ….?"). The results of

Experiment 1 indicated that participants with high social anhedonia were significantly less accurate than the low social anhedonia group on other-attributions. While latencies did not differ across groups, all were significantly faster on self- rather than other-attributions. Experiment 2 indicated that both groups showed longer latencies on other-attributions than self and on false beliefs versus true. Participants with schizophrenia were significantly less accurate than controls on self-attribution of false belief, but there was no difference on true belief. While the individuals diagnosed with schizophrenia also produced more errors on both types of other-attribution, this was not statistically significantly different from the performances of controls on other-attribution tasks.

In a related study, McHugh, Barnes-Holmes, Barnes-Holmes, Stewart, and Dymond (2007) constructed deictic trials that resembled ToM tasks for deception and presented them to five different age groups. There were four experimental trial types that, for example, presented a picture of a teddy on the screen above a picture of a toy box and a refrigerator, along with a trial specific question. Participants provided their response by placing the picture at the top of the screen on top of one of the pictures below. (1) *First-order Positive trials* included, for example, the question "If I have a teddy and I want you to find it, where should I put the teddy?" A correct response in this example would involve the participant placing the picture of the teddy on top of the picture of the toy box; (2) *First-order Negative trials* included for example, the question "If you have a teddy and you don't want me to find it, where should you hide it?" A correct response would involve the participant placing the picture of the teddy on top of the picture of the refrigerator; (3) *Second-order Positive trials* included, for example, the question "If I have a teddy and if you know that I know you're trying to hide it from me, where should you hide the teddy?" In this case, a correct response would involve the participant placing the picture of the teddy on top of the picture of the toy box; (4) *Second-order Negative trials* included, for example, the question "If I have a teddy

and if I know that you don't know I'm trying to hide it from you, where should I hide the teddy?" A correct response would involve the participant placing the picture of the teddy on top of the picture of the refrigerator. The results showed that in general overall accuracy appeared to improve with age. These differences in improvement were significant for all age groups except between late childhood and adolescence, and between adolescence and adulthood.

Summary. A considerable number of studies have assessed the relationship between performances on the deictic protocol and traditional ToM tasks, and found evidence of a functional overlap between deictic relational responding on the protocol and ToM with numerous samples. Several studies have systematically adapted trials from the deictic protocol to create tasks that closely resemble the attribution of true and false beliefs as targeted by traditional ToM tasks. The evidence indicates that accuracy on both types of trials increases as a function of age, but there are no differences in accuracy between true and false belief attribution. Related research has compared responding to self versus other in adapted false belief tasks and found no difference in overall accuracies, but significantly longer latencies on trials involving the perspective of other versus self. In studies with atypical samples, those with high social anhedonia have been found to perform significantly more poorly than controls on false belief attributions to others. Similarly, participants with a diagnosis of schizophrenia have performed significantly worse than controls on self-attributions of false belief.

The need for an alternative to the deictic protocol. Much of the work conducted in the area of deictic relational responding has focused on assessing the presence of these patterns of relational responding in a dichotomous manner. That is, participants were typically assessed for the presence of deictic relational responding, and if found to be deficient, these relations were trained and tested to determine if this produced predicted outcomes. However,

little research has focused on the relative strength of a pattern once it was observed and there have been recent calls for analyses that focus on the relative strength or persistence of derived relational responding, rather than simply its presence versus absence (e.g., Barnes-Holmes, Barnes-Holmes, Hussey, & Luciano, 2016). In an attempt to develop methodologies for assessing the relative strength of derived relational responding, researchers have explored alternative methodologies, such as the Implicit Relational Assessment Procedure (IRAP; e.g., Barnes-Holmes, Hayden, Barnes-Holmes, Stewart, & Boles, 2008).[2]

The IRAP requires participants to emit two opposing patterns of relational responding, and the ease with which one pattern may be emitted relative to the other provides a measure of response strength. Specifically, the procedure typically presents label and target stimuli (e.g., the label word "puppy" with the target word "pleasant") and requires participants to respond "True" (e.g., puppy-pleasant) or "False" (e.g., puppy-unpleasant) to the stimulus pairs. An IRAP typically comprises four trial types (e.g., *Puppy-Positive*, *Puppy-Negative*, *Spider-Positive*, and *Spider-Negative*) that are generally analyzed independently in terms of the difference in response latencies between responding that is deemed consistent versus inconsistent with a participant's verbal history. In general, response latencies are expected to be shorter during blocks of trials that require history-consistent versus history-inconsistent responding.

The body of empirical research employing the IRAP has grown considerably, with an increasing focus on clinically relevant phenomena (Vahey, Nicholson, & Barnes-Holmes, 2015). Using the IRAP to assess deictic relational responding, particularly in the clinical domain, would provide an alternative to the Barnes-Holmes (2001) protocol. A recent study in

[2] Although the IRAP was developed primarily as a behavioral assessment tool, more recently it has been adapted for training or educational purposes (e.g., Murphy, Lyons, Kelly, Barnes-Holmes, & Barnes-Holmes, 2019).

which the IRAP was used to target responding to self versus others seems particularly relevant (Barbero-Rubio, Lopez-Lopez, Luciano, & Eisenbeck, 2016).

The study presented participants with their own names and the name of the researcher as label stimuli, and statements pertaining to specific characteristics of the self versus other as targets (e.g., "is in front of the laptop"). There were two response options ("yes" and "no") on each trial. The four trial types in this study were referred to as: *I-I* (participant name-participant characteristics), *Other-Other* (researcher name-researcher characteristics), *I-Other* (participant name-researcher characteristics), and *Other-I* (researcher name-participant characteristics). In general, the pattern of IRAP effects reported by Barbero-Rubio et al. (2016) indicated that participants' response latencies showed significantly more rapid responding on the *I-I* trial type relative to the other three trial types during history-consistent blocks (i.e., responding "True" on *I-I* and *Other-Other* trial types, and responding "False" on *I-Other* and *Other-I* trial types). In addition, the difference in response latencies between consistent and inconsistent blocks for each trial type was in the predicted direction (i.e., shorter on history-consistent relative to history-inconsistent trials), and these differences were significant in terms of the normalized D_{IRAP}-scores.

In a systematic replication of the Barbero-Rubio et al. (2016) study, Kavanagh, Barnes-Holmes, Barnes-Holmes, McEnteggart, and Finn (2018) used a similar IRAP, but the study also included a control IRAP that did *not* require responding to self versus other. That is, instead of comparing self with other, the control IRAP compared responding between two separate others (i.e., the researcher and a picture of another unknown participant). In Experiment 1, the data from the IRAP showed significantly stronger responding on the *I-I* trial type versus *Other-Other*, but there was no difference in the control IRAP between *Researcher-Researcher* and *Other-Other*. Whilst a range of methodological differences between the two studies preclude systematic comparisons, both studies did show evidence of

differences in responding to self versus other, but no difference in responding to two others in the context of the control IRAP.

One possible concern that could be raised regarding the two studies involving the self- versus other-IRAPs described above is that differences that emerged between responding to self and other within the IRAP could be attributed to factors other than perspective-taking per se. For example, in the study by Kavanagh et al. (2018) a pattern known as the single trial type dominance effect (STTDE) emerged in Experiment 1. That is, the size of the D_{IRAP}-score for the *I-I* trial type was significantly larger than for the *Other-Other* trial type. Although this dominance effect could indicate a history of responding from one's own perspective more frequently than from another perspective, it does not necessarily indicate differences in the relative ability to take the perspective of self versus another (see Kavanagh et al. for a detailed discussion). To appreciate the argument we are making, other recent research has also reported a STTDE when shapes and colors were presented as categories within the IRAP (Finn, Barnes-Holmes, & McEnteggart, 2018). Specifically, larger D_{IRAP}-scores were shown on color-color than on shape-shape trial types and this effect appeared to be driven by a higher frequency of the use of color-related words in natural language over the use of shape-related words. Obviously, no perspective-taking was required when participants were simply asked to categorize colors as colors and shapes as shapes, and thus the same logic could be applied to a single IRAP that requires responding to self versus other (i.e., the effect could be the result of responding to self more frequently than to other in natural language, rather than an ability to perspective-take).

A second potential concern that could be raised regarding the two studies involving the self- versus other-IRAP pertains to the simple target phrases that specified characteristics of self and other (e.g., "is sitting down", "is the participant", "is in front of the computer"). As such, it could be argued that responding on the IRAP simply required deictic relational

responding but not perspective-taking. Indeed, perspective-taking would appear to require more complex target statements or relational networks that involve taking the perspective of self versus other. For example, such statements could take the form of "When event X happens, self or other thinks or feels Y." In principle, this sort of complex relational network requires that the participant responds to statements that coordinate with how the self responds to particular events, versus how they perceive others will respond to the same events. Such an IRAP, at least in terms of face validity, appears to target perspective-taking, as we generally understand it. Developing such an IRAP would necessarily involve inserting relatively complex statements or networks into the procedure. In doing so, the separation of the stimuli within an IRAP into labels and targets may be problematic because participants may simplify the task by responding to single words or subclauses within the labels and targets in such a way that fails to capture perspective-taking. One way of potentially avoiding this problem would be to employ a natural language format previously reported by Kavanagh, Hussey, McEnteggart, Barnes-Holmes, and Barnes-Holmes (2016). In that study, the IRAP combined the label and target stimuli to form statements that are more similar to natural language.

Based on this reasoning, more recent research by Kavanagh et al. (2019) involved a series of experiments employing two IRAPs to study deictic relational responding. The overarching purpose of these experiments was to develop IRAPs that would clearly differentiate responding from the perspective of self versus other. Using a natural language format, one IRAP targeted self-perspective and another targeted other-perspective. The self-focused IRAP required participants to respond to various statements about themselves. Specifically, each statement referred to an event (deemed positive or negative) and a positive or negative reaction to that event. The four trial types were referred to as: *Positive Event-Positive Reaction* (e.g., "I'm proud when I succeed in my exams"); *Positive Event-Negative Reaction* (e.g., "It frustrates me if I succeed in my exams"); *Negative Event-Positive Reaction*

(e.g., “Getting fines makes me happy”); *Negative Event-Negative Reaction* (e.g., “Getting a fine makes me angry”). The response options “yes” and “no” were presented at the bottom left- and right-hand corners on each trial. The other-focused IRAP was similar to the self-focused IRAP, but required participants to respond to various statements about others, rather than about themselves (e.g., “People will be proud if they succeed in their exams”).

Experiments 1 and 2 in the series focused on self versus other when the other was unspecified, whereas Experiments 3-6 focused on self versus other across differences in potentially key aspects of the other, such as similarity with, and difference from, self. The results from the first two experiments indicated that there were significant differences between the self- versus other-focused IRAPs, when the other remained unspecified. The remaining four experiments, however, indicated that when the other was specified there was limited evidence that performances on the two IRAPs differed significantly. A large number of correlational analyses between the IRAPs and a range of self-report measures yielded very few significant effects (and none at all after Bonferroni corrections). Finally, correlational analyses between the two IRAPs in each experiment were significant in some cases (Experiments 2, 3, and 5), but not others (Experiments 1, 4, and 6). Overall, the relatively small number of uncorrected correlations between the IRAPs and the explicit measures, and the complete absence of any corrected significant correlations, suggest that such effects should be taken with extreme caution. The fact that performances on the two IRAPs correlated in three of the experiments but not in the other three also calls for caution in interpreting these findings (i.e., it remains unclear whether the self- and other-focused IRAPs were tapping into similar or distinct response biases).

While the IRAPs produced predictable outcomes, in that all of the individual trial type effects were in accordance with common-sense assumptions (i.e., both self and other respond positively to positive events and negatively to negative events), it remains the case that the

IRAPs did not distinguish in a clear and consistent way between the perspective of self versus other. Although there may have been some sensitivity to self versus other, particularly when the other was unspecified (i.e., in Experiments 1 and 2), it is possible that the use of relatively complex statements in the (natural language) IRAPs potentially undermined or reduced the impact of deictic relational responding per se. That is, in presenting such complex stimuli or networks in the IRAP, participants tended to respond to the tasks as sense-making or problem-solving contexts, in which the self versus other had limited impact. The challenge going forward, therefore, is to develop IRAPs that maintain the deictic functions of self and other, in the context of perspective-taking rather than simple sense-making. However, meeting this challenge may not simply involve developing other or alternative IRAPs in a largely process-blind manner. Rather, it seems important to take a step back and begin to build a more process-oriented account of perspective-taking from within RFT itself. The remaining sections of the current article suggest one way forward in this regard.

An Alternative Strategy for Conceptualizing and Analyzing Perspective-taking Based on a Multi-Dimensional Multi-Level (MDML) Framework for RFT

The approach taken to studying perspective-taking within RFT has focused heavily on the three deictic relations (I-YOU, HERE-THERE, and NOW-THEN), and the development of the original protocol that involved targeting these relations. Specifically, the protocol asked participants to respond in accordance with these relations in simple and/or reversed form. More recent work on perspective-taking within RFT has employed the IRAP (see Barbero-Rubio et al., 2016; Kavanagh et al., 2018; Kavanagh et al., 2019) or has involved deriving spatial perspective-taking relations by exposing adult participants to a complex series of graduated ‘mental rotation’ tasks (see Guinther, 2017, 2018). In all of this work, however, there has been little if any effort to develop a technical, conceptual RFT-based analysis of tasks typically used by mainstream psychology to assess perspective-taking. For example, it

remains unclear exactly what relational repertoires seem to be required to complete the types of task that aim to assess what is described as false belief, such as the Deceptive Container Task or the Sally-Anne Test (see above). At this point, therefore, it may be useful to take a step back and consider a recent development in RFT that has attempted to systematize the increasing complexity in patterns of relational responding that have been identified within the theory. Having done so, we may be in a better position to then outline exactly what relational abilities are required for a child or individual to successfully complete false belief tasks. This is the general strategy we will adopt in the latter part of the current paper.

The Multi-Dimensional Multi-Level framework. In an effort to systematize the RFT account and emphasize the relevant behavioral dynamics involved in AARR (Barnes-Holmes, Barnes-Holmes, Luciano, & McEnteggart, 2017), a multi-dimensional multi-level framework has recently been proposed (see Table 1). According to this framework, AARR may be conceptualized as developing in a broad sense from; (i) mutual entailment, to (ii) simple networks involved in frames, to (iii) more complex networks involved in rules and instructions, to (iv) the relating of relations involved in analogical reasoning, and finally to (v) relating relational networks, which is typically involved in understanding and producing extended narratives, and advanced problem-solving. In identifying these as different levels, the MDML framework is not indicating that they are rigid or invariant "stages". Rather, lower levels are seen as containing patterns of AARR that may provide an important historical context for the patterns of AARR that occur in the levels above. In general, the different levels are based on a combination of well-established assumptions within RFT and, where possible, empirical evidence. The framework also conceptualizes each of these levels as having multiple dimensions: *coherence, complexity, derivation,* and *flexibility.* Each of the levels is seen as intersecting with each of the dimensions, yielding a framework that consists

of 20 units of analysis for conceptualizing and studying the dynamics of AARR in laboratory and in natural settings.

INSERT TABLE 1 HERE

A brief description of each of the four dimensions is as follows. *Coherence* refers to the extent to which specific patterns of AARR are generally consistent with other patterns of AARR. For example, the statement 'A car is larger than a truck' would typically be seen as lacking coherence with the relational networks that operate in the wider verbal community. Note, however, that such a statement may be seen as coherent in certain contexts (e.g., when playing a game of 'everything is opposite'). *Complexity* refers to the level of detail or density of a particular pattern of AARR. As a simple example, the mutually entailed relation of coordination may be seen as less complex than the mutually entailed relation of comparison because the former involves only one type of relation (e.g., if A is the *same as* B then B is the *same as* A), but the latter involves two types of relations (if A is *bigger than* B, then B is *smaller than* A).[3] *Derivation* refers to how well practiced a particular instance of AARR has become. Specifically, when a pattern of AARR is derived for the first time it is, by definition, highly derived (i.e., novel or emergent), and thus derivation reduces as that pattern becomes more practiced. *Flexibility* refers to the extent to which a given instance of AARR may be modified by current contextual variables. Imagine a young child who is asked to respond with the wrong answer to the question "Which is bigger, a car or a truck?" The easier this is achieved, the more flexible the AARR.

In a sense, the MDML framework simply makes explicit what basic researchers in RFT have been doing implicitly since the theory was first subjected to experimental analysis.

[3] Relational complexity (and indeed the other dimensions) may be defined along more than one dimension, such as number of relata, and/or frames, and/or contextual cues in a network. In some cases, therefore, identifying a single continuum of relational complexity (or some other dimension) may require appropriate multi-dimensional scaling (e.g., Borg & Groenen, 2005).

That is, whenever an RFT researcher conducts a lab-based study it often involves combining at least one of the levels with one or more of the dimensions of the MDML framework. Even in a simple study on equivalence relations, the researcher selects a level (e.g., mutual entailment or symmetry) and then specifies how many trials will be used to test for the entailed symmetry relations (e.g., 12), and how many trials must be correct to define the performance as mutual entailment (e.g., 10/12). In effect, the number of opportunities to *derive* the entailed relations must be specified (i.e., 12) and the number of responses that must *cohere* with the relations is also determined (i.e., 10). In effect, the level and two of the dimensions of the MDML framework have been invoked. If relations other than symmetry are introduced to the study, or programmed forms of contextual control are involved, then relational *complexity* is also manipulated. Furthermore, if the researcher attempts to change the test performances in some manner (e.g., by changing the baseline training), then relational *flexibility* in the original test performance is also assessed. As noted above, RFT and equivalence researchers have been doing this type of work for decades. Thus, the MDML framework simply makes these scientific behaviors more explicit by situating them in a framework that specifies 20 intersections between the widely recognized levels of AARR identified in RFT and the well-established dimensions along which the levels have been, or could be, studied.

The 20 intersections identified within the MDML framework specify the units of *experimental* analysis, not the levels or the dimensions *per se.* For example, although it is possible to state that mutual entailment is the bidirectional relation between two stimuli, mutual entailment can only be analyzed *experimentally* by specifying one or more of the dimensions. As noted above, the tested relation must *cohere* in some pre-specified manner with the trained relation (e.g., if A is taller than B, then B will be shorter than A), and the number of *derived* relational responses must be specified (e.g., a participant must produce at

least 10 out of 12 responses indicating that B is indeed shorter than A in the absence of programed reinforcement, prompting or other feedback).

A detailed treatment of the MDML framework has been provided elsewhere (e.g., Barnes-Holmes et al., 2017) and thus there is no need to work through all the details and subtleties here. The critical point is that RFT may be used to generate a conceptual framework that begins with a basic scientific unit of analysis, the mutually entailed derived stimulus relation, identifying at least some of the key dimensions along which mutual entailment may vary (e.g., coherence, complexity, derivation, and flexibility). In addition, the MDML framework emphasizes that more complex units of analysis may evolve from mutual entailment, such as the simple relational networks involved in relational frames, more complex networks involving combinations of frames, the relating of relational frames to relational frames, and ultimately the relating of entire complex relational networks to other complex relational networks. And in each case, these different levels of AARR may vary along the four dimensions listed above, and perhaps others that remain to be identified.

One of the purposes of the MDML is to provide a framework that outlines how the simpler units of analysis specified in RFT, such as mutual entailment connect to the more complex units, such as the relating of relational networks. Having outlined the MDML framework, we will use it to develop the beginnings of an RFT-based conceptual analysis of the basic false belief task (e.g., Deceptive Container Task and Sally-Anne Test).[4]

A conceptual functional analysis of the False Belief Task based on the MDML framework. The following is 'educated guess work' at providing a functional analysis, based on the MDML framework, of the AARR that is required to 'solve' a classic false belief task.

[4] A more complete conceptual analysis of perspective-taking, including visual and affective domains, would require referring to a very recent extension of the MDML framework, known as the hyper-dimensional, multi-level (HDML) framework (see Barnes-Holmes, 2018; Barnes-Holmes, McEnteggart, & Barnes-Holmes, in press). However, given our focus on the cognitive domain in the current article, we have limited our conceptual analysis to the MDML framework.

Where appropriate, the minimal levels of relational development specified within the MDML framework are indicated below. Specifically, we will argue that solving a false belief task involves the highest level of relational development (Level 5). We recognize that one could directly train correct responding on a false belief task through explicit reinforcement, direct instruction, and prompting, etc. However, obtaining correct responses that involve 'genuinely' understanding that others may believe something that is false if they have not seen what the self has seen would seem to require the relating of relational networks.

The critical relational precursors. Before presenting the full MDML-based model of false belief, it seems important to identify what we see as the key relational precursors and the levels of relational development at which they need to be observed. First, the three basic relational frames of coordination, distinction, and temporality would be required, thus involving Levels 1 and 2 of the MDML framework. It would be important that relational responding involved in these frames is relatively high in coherence and complexity, but relatively low in derivation and flexibility. More informally, (1) when events are related as coordinate, distinct or occurring in some temporal order, these patterns of relational responding should be consistent with many other instances of previous and current relevant patterns of such responding (high coherence); (2) the three classes of relational responding should be relatively sensitive to various forms of contextual control (high complexity); (3) each of the three classes should have relatively extended or protracted behavioral histories (low derivation); and (4) the three patterns should persist in the absence of supporting contextual variables, such as direct reinforcement, prompting, or instruction; and should also persist in contexts that could be seen as undermining the responding, such as modest levels of punishment (low flexibility).

In addition to the three basic relational frames discussed above, the core deictic relational frame of I-YOU, HERE-THERE, NOW-THEN would need to be firmly established

in the behavioral repertoire. Strictly speaking, as a frame this would be located at Level 2 of the MDML framework, but in ensuring that the frame was firmly established would likely have required that the basic framing participated in larger relational networks, thereby locating it at Level 3 at least. More informally, the 'I' would have been related to many other individuals (rather than only one other) in many different times and places. Technically speaking, this would involve ensuring again relatively high levels of coherence and complexity, with low levels of derivation and flexibility. For example, if I told someone that I was on a train at noon going from Dublin to Cork, this statement would *cohere* with the conclusion that I will arrive in Cork at approx. 3pm. If, however, I qualified that I would have to change at Mallow to complete the trip, the conclusion about the arrival time would be adjusted to approx. 3.30pm, which would require of course an increased level of *complexity* in the contextual control over the networking involved. Appropriate responding in this example would almost certainly involve low levels of derivation and flexibility. That is, there would be many broadly similar instances of informing listeners of where you are, where you are going, what time you expect to arrive, and any other qualifying conditions that would then allow both you and the listener to coordinate your activities.

The final critical relational precursor would require causal or if-then frames and appropriate transformations of function, involving the deictic relations specified above, thus again involving relational development at Levels 1, 2, and 3, at minimum, of the MDML framework. The specific causal relation and transformations of function could be described as 'seeing leads to knowing' or in other words 'if I see an event occur, then I know that it occurred.' Ideally, this particular if-then frame would network with the deictic frame in a complex network, so that I could derive 'if you and I see an event occur, then both you and I know that it occurred.' Again, it would be necessary for this type of complex networking to be relatively high in coherence and by definition high in complexity, and low in derivation

and flexibility. Indeed, these dimensional requirements could be seen as essential if a full-blown understanding of false belief is to be observed on relevant tasks.

Even with all of the foregoing precursors in place, false belief understanding appears to require relational responding that is clearly located at both Levels 4 and 5 of the MDML framework. To appreciate why this is the case, the reader should examine Figure 1, which provides a graphical representation of the suggested functional-analytic processes involved in responding correctly to the classic Unexpected Location (false belief) Task. The following bullet points should be read whilst examining the figure to assist in its interpretation.

INSERT FIGURE 1 HERE

- The left-hand side of the diagram indicates that initially (at Time 1) both the self and other observe a glove being placed into a box; based on this and the relational precursors described above, the self can conclude that both self and other know that there is a glove in the box.
- The right-hand side of the diagram indicates that subsequently (at Time 2) the self observes the glove in the box being replaced with a scarf when the other is not in the room; based on this and the relational precursors noted above, the self can conclude that only the self will know that there is a scarf (rather than a glove) in the box.
- The double-headed arrow linking the left and right sides of the diagram indicates that responding correctly to the false belief task requires that the self relates the two relational networks as distinct in terms of what the self and other know after Time 2. The critical point here is that if the self simply reported that the other *does not know* what is in the box after Time 2, that would indicate relating relations which is best located at Level 4 of the MDML framework. If, however, the self reports that the other thinks that the box contains a glove, that requires the relating of relations at Time 2 to

the relating of relations at Time 1. More informally, the self has to understand that what the other knew at Time 1 is what they still think at Time 2.

In deconstructing a false belief task using the MDML framework as we have done here, it clearly reveals what a complex and challenging task this appears to be and why young children struggle to solve it correctly. The individual differences in levels of coherence, complexity, derivation, and flexibility among the relational precursors discussed above could also help to explain, at least in part, why the literature contains such wide variation in the ages at which false belief tasks can be solved correctly, and why performances vary widely depending on the variation of the task that is presented. At this point, we should be clear that the current MDML interpretation of the false belief task remains highly speculative. Nevertheless, we present it here because it seems to suggest so many ways in which applied researchers and practitioners could approach the training and establishment of relatively robust false belief responding in individuals who find the task difficult.

Conclusions

The current article began with a broad review of the mainstream literature on perspective-taking. During the course of the review, perspective-taking was divided into visual, cognitive, and emotional domains, each of which has employed a wide variety of tasks and measures to assess perspective-taking abilities. A significant amount of this research has tended to focus on the development of the different types of perspective-taking with a particular emphasis on children with a diagnosis of ASD and adults with specific disorders, such as schizophrenia and BPD. In broad terms, groups with these diagnostic labels tend to perform poorly on perspective-taking tasks relative to typical controls, but the literature indicates that performances do vary widely depending on the nature of the tasks that are employed. In general, the mainstream literature on perspective-taking has tended to focus on identifying deficits and attempting to explain those deficits in terms of cognitive or cognitive-

neurophysiological mechanisms. Indeed, in some cases lack of perspective-taking is seen as helping to define a particular disorder in and of itself, such as in the concept of the 'autistic-mind.'

In contrast to the mainstream approach to perspective-taking, the behavior-analytic tradition has tended to focus on interventions for establishing or remediating repertoires that are deemed to be critical to perspective-taking. On balance, research in this area is somewhat limited, which is perhaps surprising given that behavior analysis has been so closely associated with developing treatment programs for ASD. One reason for the limited research may be that the very concept of perspective-taking pulls for 'mentalistic' thinking, with well-known descriptors, such as theory of mind. With that said, the current article does consider some of the key behavior-analytic studies that have sought to develop interventions that were designed to improve perspective-taking abilities.

Interestingly, there appears to have been a growing focus on perspective-taking within behavior analysis with the emergence of RFT. Given that the theory is presented as an account of human language and cognition, perhaps this increased attention to perspective-taking was inevitable. However, until relatively recently a systematic analysis of the key or core relational processes involved in perspective-taking was lacking. The perspective-taking protocol by Barnes-Holmes (2001) was the first attempt to develop an RFT-based analysis of perspective-taking in terms of the deictic relations, I-YOU, HERE-THERE, and NOW-THEN. Nevertheless, the protocol could be seen as more of an assessment tool, given that it focused on different levels of complexity (not to be confused with complexity as defined within the MDML framework) and how these correlated with different stages of development. In time, some researchers started to use the protocol as an intervention to improve perspective-taking skills. Although some success with the protocol was reported in the literature, the systematic deconstruction of perspective-taking as a complex relational activity,

which could vary along a range of contextual dimensions, was not developed, and this is what we have begun to develop here. Only future systematic research will clarify if our attempt to deconstruct specific types of perspective-taking in terms of the MDML framework, as we have done with a false belief task, will lead to improved functional assessments and analyses of perspective-taking in applied contexts.

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The MDML-based Analysis of a False Belief Task

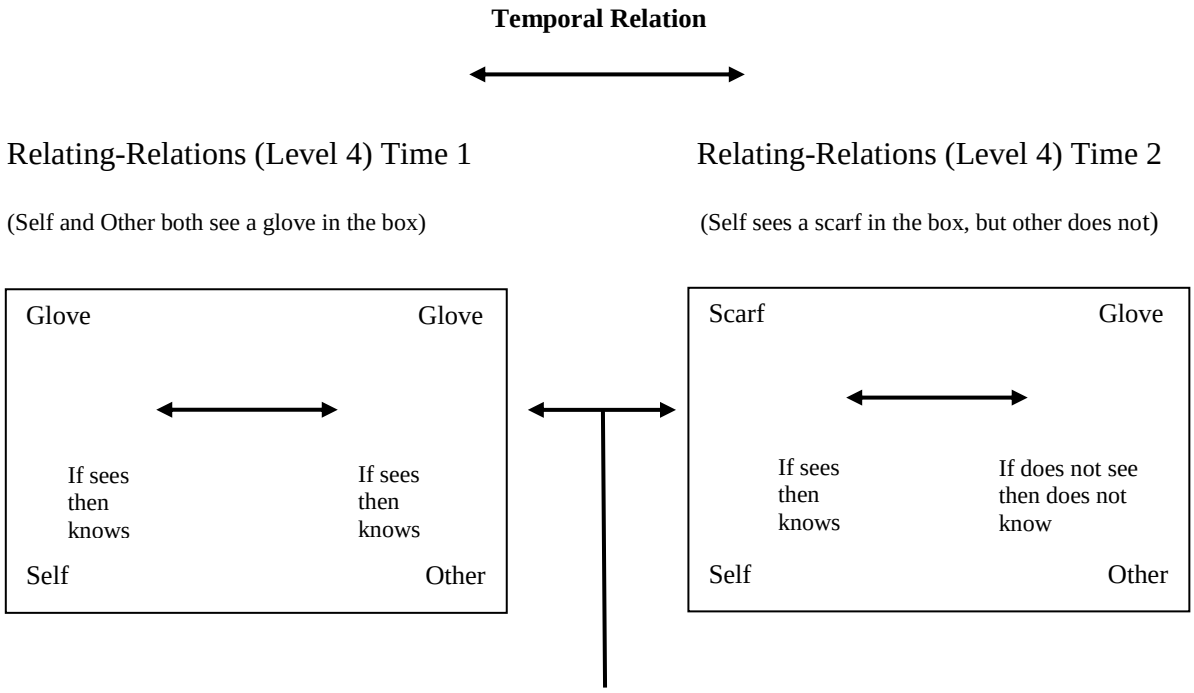

Fig. 1 Graphical representation of the suggested functional-analytic processes involved in responding correctly to a classical false belief task

Table 1

Overview of the Multi-Dimensional Multi-Level (MDML) Framework

LEVELS	**DIMENSIONS**			
	Coherence	**Complexity**	**Derivation**	**Flexibility**
Mutually Entailing	Coherence/Mutual Entailing	Complexity/Mutual Entailing	Derivation/Mutual Entailing	Flexibility/Mutual Entailing
Relational Framing	Coherence/Framing	Complexity/Framing	Derivation/Framing	Flexibility/Framing
Relational Networking	Coherence/Networking	Complexity/Networking	Derivation/Networking	Flexibility/Networking
Relating Relations	Coherence/Relating Relations	Complexity/Relating Relations	Derivation/Relating Relations	Flexibility/Relating Relations
Relating Relational Networks	Coherence/Relating Relational Networks	Complexity/Relating Relational Networks	Derivation/Relating Relational Networks	Flexibility/Relating Relational Networks