Naming, Story-Telling, and Problem-Solving

Critical Elements in the Development of Language and Cognition

Yvonne Barnes-Holmes and Dermot Barnes-Holmes

National University of Ireland, Maynooth

In the current article, we present the three pillars of Relational Frame Theory: relational frames, relational networks, and abstraction from and transformation of the nonarbitrary environment, with the examples of naming, story telling, and problem-solving, respectively. The main thesis of the current paper is that these processes are necessary for a complete behavioral account of the development of language and cognition because so much of human behavior is verbal, at least in part. The paper describes the overlap between the three pillars to illustrate the synergistic interaction in their development and the extent to which Relational Frame Theory is a developmental account of verbal behavior as a dynamical system. With a relatively limited array of interactive psychological processes, it is argued that Relational Frame Theory allows complex verbal events, such as story-telling and problem-solving, to be approached behaviorally and developmentally.

The study of language and cognition has played a key role in the mainstream literature in developmental psychology, whereas the behavior-analytic approach to development has been far less concerned with these two domains. Unlike traditional developmental researchers, behavioral psychologists in this field are likely to be less concerned with tracking common, qualitative, and cumulative changes across time (Chomsky, 1959; Piaget, 1967) than with identifying the basic behavioral processes that might give rise to these complex repertoires (e.g., Fischer, 1980). In the study of these basic processes, behavioral researchers have relied heavily upon the direct-contingency account of human verbal behavior presented by Skinner (1957). And, as is well known, this approach has often been criticized for not capturing the symbolic and emergent qualities that define human language and cognition (e.g., Chomsky, 1959; Hayes & Hayes, 1992).

Within behavior analysis, some researchers have pointed to the growing literature on derived stimulus relations as the basis of a new account of language and cognition, known as Relational Frame Theory (RFT: Hayes, Barnes-Holmes, & Roche, 2001a). The main advantages of this approach are that it retains its roots in the philosophical contextualism of behavior analysis and continues to draw on well-established behavioral principles, but also supplements the direct-contingency analyses that form the core of Skinner's *Verbal Behavior*. Relational Frame Theory, like any behavioral account, is inherently developmental in orientation and focuses on streams of organism-environment interactions. Because these interactions are considered in terms of both historical and current contexts, development or change is assumed and expected for the individual. According to RFT, this development involves three core theoretical concepts: relational frames, relational networks, and abstraction from and transformation of the nonarbitrary environment. Each of these pillars is implicit in the others and all are developing simultaneously, but what is barely seen at one level becomes dominant at another" (Hayes, Barnes-Holmes, & Roche, 2001b p. 112). Archetypal examples of these three pillars are naming, story telling, and problem-solving, respectively. In the present article, we describe these three examples and argue that the three pillars of RFT may be essential features of a coherent behavior-analytic account of the development of human language and cognition.

Relational Frames and Naming

Relating quite simply means to respond to one event in terms of another, and most living organisms appear to be capable of responding to relations among the physical or *nonarbitrary* properties of stimuli (e.g., responding to the larger or the duller of two stimuli, Reese, 1968). In addition, relational responding itself can be abstracted and brought under the contextual control of features other than the formal properties of the stimuli. The term *arbitrarily applicable* is used to describe this type of relational responding because in some contexts it is under the control of cues that can be modified entirely by social convention. For example, when playing a game with a child, you might say, "This time, more means less, and less means more," in which case, the relational functions are *applied* in an entirely *arbitrary* fashion. The term *relational frame* then refers to specific patterns of arbitrarily applicable relational responding.

In order for arbitrarily applicable relational responding to develop, the child must learn to discriminate between the relevant features of a task (i.e., responding to one event in terms of another based on the presence of a contextual cue) and the irrelevant features (e.g., the physical properties of the stimuli involved). The earliest social interactions of

children are dominated by this type of learning, of which naming (i.e., responding to the symmetrical relations between words and their referents) is a prime example.

A young child's early language history consists of a wealth of name-object and object-name interactions across a multitude of objects and names (e.g., edibles, toys, people, animals etc.). Across these interactions, symmetrical relations between the names of objects and actual objects are directly reinforced. For example, a mother may say, "Where's Teddy?" And then pick the teddy up and tickle the child with it (name-object relations). Similarly, she may ask, "What's this?" while holding up the teddy and may then say to the child, "It's Teddy" (object-name relations) and tickle the child again. Across time, symmetrical responding comes under the control of specific contextual cues such as "What's this called?" and the juxtaposition of objects and words. According to RFT, this type of history provides a basis for *generalized* symmetrical responding. Training in new name-object relations, therefore, will generate new or *derived* object-name relations (or vice versa) in appropriate contexts. If generalized symmetrical naming is possible, similar patterns with other kinds of relations should also develop. Relational Frame Theory uses a specific nomenclature to describe these performances.

Mutual entailment describes the bidirectional mutually entailed nature of arbitrary stimulus relations. For example, if A is related to B, B must be related to A. Although these relations are bidirectional, they are not always symmetrical. For example, if A is *larger* than B, then B is *smaller* than A (not the same as A). Arbitrarily applicable relational responding is brought to bear on a situation by contextual cues, such that if in a given context A is related in a characteristic way to B, then in that context, B will be related in another characteristic way to A.

Combinatorial entailment refers to a derived relation in which two or more stimulus relations (trained or derived) mutually combine. For example, if in a given context, A is related to B and A is related to C, then B and C will be combinatorially entailed in that context. For example, if good is the opposite of bad, and "maith" is the opposite of bad (as in the Irish language), then a derived combinatorial relation between good and "maith" is entailed. Combinatorially entailed relations must be specified explicitly, although the derived relations may be much less precise than the original relations. For example, if A is different than B and B is different than C, we cannot specify the precise relation between A and C or C and A (i.e., they may be the same or different). According to RFT, combinatorial entailment, with its specificity and complexity, probably emerges later in language development than mutual entailment (Lipkens, Hayes, & Hayes, 1993).

Transformation of stimulus function is the term used when the functions of a stimulus are altered in accordance with derived relations. Transformation of function is a defining characteristic of relational responding because it allows derived relations to have psychological content. For example, if a person is trained to select stimulus A as "more than" B, and if A is given a conditioned reinforcing function, then B should have a derived smaller reinforcing function because of its "less than" relation to A (Dougher, Auguston, Markham, Greenway, & Wulfert, 1994; Dymond & Barnes, 1995; Hayes, Brownstein, Devany, Kohlenberg, & Shelby, 1987). In order for derived relations to have appropriate psychological content, the transformation of stimulus functions must come under contextual control. For illustrative purposes, consider the bidirectional relations between the word "lemon" and an actual lemon (i.e., they participate in a frame of coordination). A number of stimulus functions are present in lemons, including the perceptual functions of taste (bitter), texture (rough), and sight (yellow). When instructed to "think of a lemon," most of us could easily come into contact with the functions of a lemon (we may even begin to salivate in response to the derived taste functions) even when no such object is present. In this example, the words "think of" act as a context in which the perceptual functions of lemons are elicited in accordance with the underlying relation. This example demonstrates the importance of contextual cues not only in establishing and indicating the particular conditions under which relational activity occurs, but also in specifying precisely which functions should be transformed.

In the early stages of language training, it is likely that inappropriate stimulus functions participating in derived relations will be transformed before the reinforcement contingencies establish appropriate contextual control. If, for example, a young child is told that an actor is a star, this may cause confusion, because the actor does not look like an actual star. Through differential reinforcement from the verbal community, however, the child will learn that in the context of saying someone is a star, the perceptual functions should not transfer to the person unless additional cues are offered (e.g., the words "his face looks like a star").

Let us summarize what we have said so far. A relational frame is a specific kind of arbitrarily applicable relational responding that has three sets of properties: (a) it shows the contextually controlled properties of mutual entailment, combinatorial entailment, and the transformation of functions; (b) it results from a history of relational responding relevant to the contextual cues involved; and (c) it is not based solely on direct training with regard to particular stimuli, nor solely on the nonarbitrary characteristics of either the stimuli or the relations among them. Developmentally, naming seems to provide an important basis for the development of relational frames in the behavioral repertoires of young children. For example, mutual entailment may occur between a name and an object (e.g., "car" and an actual car), combinatorial entailment may occur among two or more names and the same object ("car," "automobile" and an actual car), and the psychological functions of names may be transformed in the context of other words (e.g., "imagine the sound of a car").

From the perspective of RFT, therefore, naming provides the "entering wedge" into the world of human language and cognition. The derived relations made possible by a repertoire of naming allow for the establishment of much more complex derived stimulus relations, referred to

in the language of RFT as relational networks. Naming, of course, continues to develop (e.g., with a growth in vocabulary) as relational networks also emerge. These two repertoires, therefore, do not constitute sequential stages of development, although it seems highly implausible that relational networks could emerge without some prior repertoire of derived naming.

Relational Networks and Story Telling

The concept of a relational network provides a means of conceptualizing and studying the organization of larger language units commonly known as sentences, paragraphs, stories, and so on. Consider the simple sentence, "This is a cup," as an example of a relational network. The word "cup" participates in a frame of coordination with an actual cup. The phrase "This is a" may participate in a frame of coordination with other contextual cues that control the frame of coordination itself (e.g., "goes with"). The word order of the sentence establishes grammatical relational frames, enabling the listener to respond appropriately to the sentence. For example, "This is a cup" is not the same as "Is this a cup?" and each requires a different response from the listener. In certain contexts, however, the word "cup" may function in exactly the same way in "This is a cup" and "Is this a cup?" but this is determined by a range of contextual cues, such as the conversational context and the facial expression of the speaker. According to RFT, therefore, virtually any discrete event (e.g., words, grunts, or even a raised eyebrow) may function as part of a relational network if the historical and current context supports the relevant relational functions.

Relational networks can be more or less complete, depending on the extent to which the events in the network, and the network itself, serve as a context for relational activity. The simplest level of a complete relational network appears to correspond to what is commonly described as a sentence. At the level of a sentence, a network is said to be complete if terms (serving as contextual cues) set the occasion for adequate relational activity to specify a relation or relations between or among all of the events in the network (i.e., making the network complete).

Even larger language units (e.g., stories) can be approached from this perspective. Specifically, a relational network can be complete in a local sense (e.g., at the level of a sentence), but not in a larger sense because previous verbal material or the general verbal context indicate that a larger relational network is being formed in this instance but is not yet complete. For illustrative purposes, consider the following example. Imagine a parent says to a young child: "Let me tell you a story. Once upon a time there was a princess who lived in a castle with her wicked stepmother." If the parent then stopped abruptly, even a very young child would insist on hearing more. In this case, the child's history with larger relational networks or "stories" combine with cues (e.g., the phrase "Let me tell you a story") to establish a relational function. Although the statement "Once upon a time there was a princess who lived in a castle with her wicked stepmother" is a complete sentence because a relational context is fulfilled at this level, it is not a complete story because the larger relational network should specify what happened between the princess and her step-mother.

Even a very young child will attend for a long time to a good story because the development of the relational network establishes coherent and direct stimulus functions. In other words, the reinforcing value of stories is based *merely* on the properties of developing complex relational networks and transforming psychological functions in terms of these relations. For example, the child can "imagine" the events in the story in a similarly reinforcing manner as if these had actually occurred (e.g., feeling happy when the dwarves defeat the stepmother to save the princess).

The RFT account of story-telling, therefore, involves relating networks of stimulus relations. This process is central to the relational frame account of the development of language and cognition, because it appears to explain the generativity, richness, and complexity of these abilities, as commonly described. For instance, relating networks of stimulus relations is enormously efficient and generative. Hundreds or thousands of already-established stimulus relations in one domain can be brought to bear on another domain, thereby generating a wealth of derived relations.

Abstraction from and Transformation of the Nonarbitrary Environment and Problem-Solving

In a given instance, nonarbitrary stimulus relations may be indistinguishable from arbitrary relations applied to the nonarbitrary world. Consider, for example, two clear glass jars full of sweets. The jars both hold the same amount of sweets, but one is tall and thin while the other is short and broad (as typically presented during traditional tests of the Piagetian concept of conservation). A young child who is asked "Which has more?" will likely point to the taller jar. The child's pointing in this instance *looks like* a nonverbal event because of the prominent non-arbitrary differences between the two stimuli (i.e., the chosen jar is actually taller). Indeed, a well-trained nonhuman with an appropriate history of responding to differently sized objects and the nonarbitrary stimulus relations between them could probably accomplish this task (as a nonverbal response). Relating the two jars for the child, in this instance, may in fact be described as an arbitrarily applicable relational response that is not arbitrarily applied on this occasion. The relevant history that is brought to bear on this occasion involves both arbitrary training and nonarbitrary features of the environment. This example illustrates one way in which the nonarbitrary environment can become involved in arbitrarily applicable relational responding. Specifically, the nonarbitrary relations set the occasion for verbal or arbitrary relations but the former relations themselves do *not* enter into relational frames. For example, imagine a young boy presented with two spherical objects placed on a table in front of him. One of the objects is a large inflated balloon, while the other is a small baseball. When presented with these objects, the

young child may be able to respond correctly to the instruction "Which one is larger?" without the word "larger" participating in relational frames with the relevant formal dimension or other words. If this were the case, the child would not be able to respond to the question "What's another word for larger." The functions of the physical environment (i.e., "larger than") responsible for the relational responses are not transformed, and as such are not verbal.

Nevertheless, deriving the correct response in either of the examples above (i.e., the jars of sweets and the balloon/baseball examples) may still be verbal because it involves the application of a relational frame. Specifically, RFT employs the term *pragmatic verbal analysis* to refer to the verbal analysis of the nonarbitrary world when that analysis involves acting upon the world verbally, and having the world serve verbal functions as a result. Consider the child in the balloon/baseball example. In other contexts, "air" and "heavy" may participate in a relational frame of "difference" for the child (i.e., "air is not heavy"). If the child is subsequently asked: "Which one has more air in it?" and "Which one is heavier?" He may point to the balloon in response to the former question and to the baseball in response to the latter question. In this case, we might conclude that the child's original performance was regulated verbally by nonarbitrary features of the environment, and as such involved pragmatic verbal analysis. Similarly, a child who chooses the taller jar in the original example may be responding verbally if that response participates in a class with behaviors that are controlled in other contexts by arbitrary contextual cues (i.e., when a stimulus is arbitrarily designated as "larger" or "smaller than" another stimulus). According to RFT, therefore, much of what is considered nonarbitrary in human behavior is verbal in the sense that it involves pragmatic verbal analysis, because any nonarbitrary dimension that one can speak about meaningfully can function verbally.

Problem-solving is a common example of pragmatic verbal analysis. During this type of verbal behavior, complex "purposive" interactions with the natural environment that produce specific verbally-constructed consequences can be performed. In more traditional behavioral terms, problem-solving is said to alter the behavioral functions of the environment under the antecedent and consequential control of an apparent absence of effective action. In the language of RFT, this absence functions as an antecedent for relational activity that is itself oriented toward the establishment of such actions. Developmentally, this is a relatively sophisticated repertoire of cognitive skills, and thus it is not surprising that children do not demonstrate efficient problem-solving at a young age. For example, five-year-old children typically fail many of the problem-solving tasks that are taken to be measures of *executive function* in traditional cognitive psychology (Hughes, 1998; Perner & Lang, 2000).

According to RFT, all forms of problem-solving involve the discrimination of a problem state (i.e., the absence of effective action) and, to some degree, a discrimination of the problem solution. What differs across problems, however, may be the degree to which the solution to the problem is discriminated verbally. A *strategic problem* involves solutions that have been identified verbally to a large or complete extent. More informally, a good problem-solver has typically learned across exemplars to place the desired goal into a relational frame where it can be compared to existing verbal networks that specify the current situation and steps necessary to reach the verbally constructed outcome.

Traditional views of problem-solving correlate with this type of problem-solving because of the linear or step-like application of verbal relations. For instance, the following sequence is frequently described: Define Problem; Gather Information; Identify Possible Solutions; Select Plan; Carry out Plan; Test Outcome; Change Plan (see Reese, 1994). These common sense steps comprise domains in which verbal activity may occur, with each referring to the desired verbally constructed outcome. The step-like quality of strategic problem-solving does not result from the necessarily linear nature of verbal events themselves, but from the attempt to formulate heuristic strategies verbally. In other words, the step-like analysis of problem-solving is more prescriptive than descriptive.

Unlike strategic problem-solving, *evaluative* problem-solving applies when the lack of effective action is verbally accessible, but not adequate to constitute effective action. This type of problem-solving involves the use of relational frames to contact possible outcomes, so as to select among them. It is the verbal analog to reinforcer sampling, or forcing an animal to both sides of a concurrent chain, but in this case the "contact" is through the transformation of stimulus functions through a network of derived stimulus relations. For example, a child may choose between going to the mall and going to the movies by verbally listing each of the positive features of both activities to determine which might be preferred in this context. A broadly similar strategy may be adopted in adult life in the context of major life decisions, such as employment and careers, marriage, or religious practices. Once again, the problem may be more about the selection among possible consequences as it is the means of reaching consequences that are selected, and thus faced with problems of this kind, an adult may construct a list of pros and cons to try to abstract features of the situation that might be contacted.

Summary

We presented the three pillars of RFT: relational frames, relational networks, and abstraction from and transformation of the nonarbitrary environment. Archetypal examples of these pillars in terms of naming, story telling, and problem-solving, respectively were also presented. From the perspective of RFT, these processes are necessary for a complete behavioral account of the development of language and cognition because human behavior is so often verbal, at least in part. The RFT approach to development in these domains is more dynamical than stage-like because each pillar is implicit in the others and all are developing simultaneously. A history in one is likely to facilitate the on-going development of another. For example, many

going development of another. For example, many names are required to give stories breadth, and contextual control of different types of relational frames is required to give stories meaning, and to allow them to be compared. Precise naming skills are also required in order to problem-solve. Story-telling may also enhance problem-solving. For example, if the outcome of a story results from baiting a giant with food, a child may employ a similar strategy to get the dog out of the garden. Similarly, story-telling in turn will facilitate the expansion of existing relational networks.

These examples of the overlap between the three pillars of RFT illustrate the synergistic interaction in their development and the extent to which RFT is a developmental account. In this sense, therefore, RFT approaches the development of verbal behavior as a dynamical system. Based on a relatively small array of interactive psychological processes, RFT thereby allows even complex verbal events, such as story-telling and problem-solving, to be approached behaviorally. From this perspective most human actions are verbal, and any account of the development of language and cognition should pay close attention to this fact.

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Author's notes
Correspondence should be directed to Yvonne Barnes-Holmes at the Department of Psychology, National University of Ireland, Maynooth, Maynooth, Co. Kildare, Ireland (Email: Yvonne.Barnes-Holmes@may.ie).