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Relational Frame Theory: Implications for the Study of Human Language and Cognition

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Introduction

Stop for a moment and imagine a childhood version of yourself, standing in your parent's garden on a warm summer's day. In your left hand lies a small green acorn, and in the right is a watering can filled to the brim. You scoop a little earth from the ground, bury the acorn, cover it up and then splash some water over the soil. Every summer you return to the exact same spot and carefully tend to the seed, watching as it inches out of the ground and blooms into a small sapling and then a young tree. Now imagine many years later you return to your parent's garden and in the place of a seed stands a large oak whose roots are buried deep in the soil. You can see that its weather-worn trunk stretches up from the ground and reaches into the sky, and then splits into a dense tangle of branches, that each strike out in a different direction.

In many ways this metaphor reflects how researchers interested in Relational Frame Theory (RFT) have approached the study of human language and cognition over the past two decades. In place of an acorn, they have planted the seed of a simple idea (that the ability to frame events relationally is a learned operant behavior) and have provided the necessary conditions (rigorous empirical scrutiny) for that seed to flourish and bloom into a progressive research program. The roots of this work are buried in a philosophical framework (functional contextualism) that specifies the assumptions, goals and values of the researcher, and by implication, the principles, theories and methodologies that they draw upon. The weather-worn trunk reflects the transformation of the simple idea into an empirically grounded account (RFT) that describes how an advanced type of relational learning is acquired early on in our development and how that ability quickly grows in scale and complexity. For RFT researchers, this ability to frame events relationally is the common trunk from which many complex human behaviors spring forth. While these branches may certainly look different (given that they are characterized by different properties, types and combinations of relational frames) they are each extensions of the same behavioral 'trunk' or process. When conceptualized in this way, we see that RFT is a research enterprise whose roots (philosophy) ground and support its trunk (theory) which in turn splits into a variety of branches (basic and applied research).

If the learned ability to relationally frame is the functional 'seed' from which language and cognition grow, then this simple idea should give birth to research and application in domains where language and cognition are of known relevance. For instance, RFT should unlock new insights into analogical and metaphorical reasoning, rule-following, perspective-taking, thinking (fast and slow), problem-solving, and adapting in various ways to our social, physical and verbal worlds. At the same time, it should also provide the basis for new approaches to psychological development, language interventions and psychotherapy, not mention ways for dealing with the (problematic) behavior of social groups, organizations and societies. The handbook you are now reading is a testament to how RFT has met these challenges head-on over the past two decades and delivered on many fronts. While other chapters in this section focus their attention on those branches of RFT which are yielding the most fruit and are growing at the greatest speed (education, psychopathology) our aim is different: to take in the canopy as a whole and describe how much of the richness of human psychology may stem from a limited set of explanatory principles. Given the sheer scope of the RFT literature we do not intend to review every empirical finding but rather paint a picture of the theory in broad strokes, stopping to consider current themes and issues that are shaping research in this area (for book length treatments see Hayes, Barnes-Holmes, & Roche, 2001; Dymond & Roche, 2013; Rehfeldt & Barnes-Holmes, 2009; Torneke, 2010).

In Part I we consider how the ability to relationally frame sets the stage for the emergence of language and how the former's generative and flexible nature accounts for much of the latter's utility. This section will also highlight how relational framing rapidly increases in both scale and complexity, expanding from the relating of individual stimuli to the relating of relational networks to other networks. As we shall see, this leap in complexity gives rise to phenomena such as analogical and metaphorical reasoning, as well the ability to generate and follow rules or instructions. In Part II we turn our attention to the notion of 'cognition' and consider how different types and properties of relational framing play a role in perspective taking, intelligence and implicit cognition. We hope that our brief synopsis will not only set the stage for those topics considered in the following chapters, but showcase a living, breathing research enterprise that has come a long way in a very short period of time. In each section we highlight current issues and emergent themes in the RFT literature and offer suggestions for future research in this area. We also describe how this theory sometimes connects with, and at other times departs from, alternative approaches in psychological science. However, by specifying variables that facilitate prediction-and-influence, RFT seems to extend beyond alternative accounts, providing a comprehensive, theoretically unified, empirically grounded and practically applicable account of complex human behavior.[1]

Part I: RFT and Language

A "language" (from the Latin root lingua or "tongue") is often considered to be a "system of symbols and rules that enable us to communicate", "symbols being things that stand for other things" (words) while "rules specify how words are ordered to form sentences" (Harley, 2013,

[1] Although the current chapter separates language from cognition this is done purely in the service of communication. Indeed, it is important to recognise that the concepts of language and cognition are used to identify two broad domains in psychology but this should not be taken to indicate that RFT aims to distinguish functionally between the two. As a bottom-up functional-contextual account, the primary purpose of RFT is to provide an analytic-abstractive theory of the key behavioural processes involved in these broadly defined domains.

p.5). Although philosophers, psychologists and linguistics continue to debate the very definition of this phenomenon one thing is clear: from the cradle to the grave and nearly every day in-between, humans are bathed in a sea of language. From early childhood they swim in conversation and weave stories about the past, present and future. By adulthood they use written and spoken words to control their own and other people's behavior and to transmit information within and between generations. Throughout much of the past century scholars have sought to better understand the social, biological and neural factors that underpin this ability, as well as identify its core properties, structure and function. During this time language has been conceptualized and studied in a wide variety of ways, from functional (behavioral), mental (computational) and statistical perspectives (connectionist models), to biological (physiological methods) and anthropological (cultural and cross-cultural) approaches.

As we saw in Chapter X, early efforts within the behavior-analytic tradition to extrapolate from the learning principles identified in non-humans to the verbal behavior of our own species failed - amongst other things - to provide a satisfactory explanation for linguistic generativity or productivity (Skinner, 1957; Chomsky, 1959; although see Barnes-Holmes, Barnes-Holmes, and Cullinan, 2000). This contributed - in part - to the historical shift away from functional analyses of behavior-environment interactions and towards accounts interested in the mental mechanics of language. Researchers increasingly switched their focus to the mental level of analysis and began postulating hypothetical or 'computational' mechanisms to explain how language was acquired and used. Emphasis on historical and environmental factors took a back-seat to questions about the neural (Christiansen & Chater, 2008) and genetic architecture (Pinker & Jackendoff, 2005) that is assumed to realize and transmit these mechanisms within and between successive generations (see also Berwick, Friederici, Chomsky, & Bolhuis, 2013; Christiansen & Kirby, 2003). Although there are non-trivial differences across such accounts they typically conceptualize language *mechanistically* as being similar to a machine, composed of discrete parts that interact and are subject to specific operating conditions. At the same time, they often conceptualize language *mentalistically* as being mediated by a specific set of mental or computational processes which facilitate linguistic comprehension and production. This has resulted in an emphasis on the structural properties of language (morphology, syntax, and phonology) as well as the mental mechanisms and knowledge representations necessary for its development and operation (for a far more detailed treatment see Altman, 2001; Berwick et al., 2013; Chomsky, 2011; Harley, 2013; Traxler, 2012).

Language at the Functional Level of Analysis

Critically, and despite frequent suggestions to the contrary, the empirical and conceptual analysis of language within the behavior-analytic tradition did not flicker and die with Chomsky's critique of Skinner's work. Over the intervening years, research on rule-governed behavior, stimulus equivalence and derived stimulus relating pointed to possible behavioral processes that were missing from Skinner's direct contingency account, processes that seemed unique to, or at least largely elaborated in, our own species relative to others (see Chapter X). A new functional approach to language and cognition began to take shape, one that was philosophically and conceptually rooted in, and yet extended far beyond, Skinner's original account. This work did not, and could not, ape developments at the mental level of analysis due to its scientific goals, values and assumptions. Rather this work sought to better understand how the social and physical environment shapes and maintains *verbal behavior*[2]. Questions about the

[2] The reason for this is simple. If a researcher's analytic goal involves predicting the origins and properties of language, then universal grammars, connectionist models, mental schemata, or any other statistical, mental or non-mental variable (e.g., brain, genetics) can be used, so long as they are reliably related to that phenomenon. Yet if that same researcher wants to achieve both *prediction-and-influence* over verbal behavior, then appeals to such

mental mechanics of language were substituted for those that focused on those ongoing streams of organism-environment interactions, considered both historically and situationally, that would facilitate the prediction-and-influence of this phenomenon. For instance, what type of behavior are we talking about when we refer to 'verbal behavior' and what are the environmental factors of which it is a function? How can we account for its generativity, flexibility and symbolic nature in purely functional (non-mental) terms? Could a limited set of learning principles and behavioral processes really account for the movement from simple to increasingly complex verbal behavior in a coherent and parsimonious manner? Was this ability genetically hardwired or acquired through on-going interaction in and with the environment, and if the latter is true, then how precisely does it develop?

Language as RFT researchers see it. Drawing on over four decades of research, RFT has begun to offer answers to these and a host of related questions (see Dymond & Roche, 2013). According to this perspective, in order to understand verbal behavior we first need to understand a learned, generalized and contextually-controlled type of operant behavior known as arbitrarily applicable relational responding (AARR). This is because the former is argued to be an instance of the latter. As we discussed in Chapter X, *relating* refers to a generalized pattern of behavior that involves responding to at least one stimulus in terms of at least one other stimulus. Many different species can relate stimuli based on their formal or physical properties and these behaviors are defined as *non-arbitrarily applicable relational responses* or NAARR. Critically, however, humans display all the hallmarks of a more advanced type of relational behavior that

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explanations are ultimately insufficient. In order to exert influence over behavior the researcher must successfully manipulate events external to that behavior, and only contextual variables located in the environment can be directly manipulated (see Hayes & Brownstein, 1986). Consequently, from a CBS perspective, the scientific analysis of language is not complete until the causal variables external to verbal behavior have been identified – not because of some dogmatic adherence to a physical monism that excludes the non-physical, mental world, but rather as a pragmatic means of achieving its scientific goals (for more on CBS see Hayes, Barnes-Holmes, & Wilson, 2012).

allows for stimuli to be related regardless of their physical properties and in ways that were never reinforced in the past. These latter outcomes are defined as instances of AARR and demonstrate three core properties known as mutual entailment, combinatorial entailment and the transformation of function. There are many different patterns of AARR, or relational framing, and each is a type of operant behavior that is learned through ongoing interactions in and with the socio-verbal community.

The origins of verbal behavior. The earliest examples of such interactions begin in childhood and are designed to establish the most rudimentary form of AARR – namely – mutually entailed coordination relations between one stimulus (e.g., a word) and another (e.g., its referent). As we saw in Chapter X, this usually involves uttering the name of an object in the presence of an infant and then reinforcing orientating responses towards that item (i.e., hear word → look for object). At other times the object itself is presented to the child and appropriate auditory responses reinforced (i.e., see object → say word). Both of these interactions will take place in the presence of contextual cues, and in natural language interactions these cues typically take the form of questions such as '*What is this?*' or '*Where is the…?*'

In the language of RFT, bidirectional responding to an object and its name is being differentially reinforced in the presence of a contextual cue. Each and every day children encounter thousands of training exemplars with feedback for these and other relational responses. Although the stimuli, people and contexts involved in training bidirectional responding change across time, the functional relation between the object and its referent is always held constant: the child's relational responding is reinforced in both directions and in the presence of arbitrary contextual cues. "Eventually after a sufficient number of exemplars, the generalized response pattern of object-word symmetry is abstracted away from the topography of objects and brought under the control of contextual cues so that mutual entailment (i.e., being able to derive the untaught response when trained in only one direction) with any new word-object pair becomes possible" (Stewart & Roche, 2013, p.59). A child with this repertoire can now derive an untaught bidirectional relation from a trained relation, irrespective of the physical features of the word-object pair. For instance, presenting the child with a novel object (zebra) and relating that object to a word she has never encountered before ('zebra') in the presence of certain contextual cues will lead her to respond in a bidirectional manner. This occurs because the cues coupled with a history of unidirectional responding is highly predictive of reinforcement for bidirectional responding (e.g., she will point to the zebra when asked 'where is the zebra' and answer with 'zebra' when asked 'what is this?'). In the language of RFT, this bi-directional relation between an object and word represents an instance of mutually entailed coordination wherein a word is treated as functionally similar to its referent. In everyday language we could say that the child has learned how to name.

This history of MET sets the stage for more complex and varied types of relational responses to emerge and develop, such as the ability to relate mutually entailed relations to other mutually entailed relations (i.e. to combinatorially entail). For instance, once a history of reinforcement for bidirectional responding in the presence of arbitrary contextual cues is in place, pointing towards a picture of a flower (A) and saying '*this is a bloem*' will likely cause the child to emit a number of mutually entailed responses (e.g., asking '*What is that*?' will result in her saying the word *bloem* (B) while simply saying *'Where is the bloem'* will lead her to point towards the picture of the flower (A)). In addition, a second relation may also be established between the spoken word *bloem* (B) and a new stimulus (the written word BLOEM (C)) by uttering the spoken word (B) and then reinforcing orientating responses towards the written word

(C) (i.e., hear spoken word → look at written word). In many cases, caregivers will also orientate the child towards the written word (C) (e.g., by pointing to it) and then model or reinforce appropriate responses (see the written word → emit the spoken word). Once again, these relational responses will be trained in both directions in the presence of certain contextual cues across different situations, stimuli and populations. Following sufficient exemplars and training, the child will come to emit not only mutual but combinatorially entailed relations without any further reinforcement. Now when a new picture (A) is related to a spoken word (B) which is in turn related to a written word (C) the child will respond to those stimuli in ways that were never directly trained or instructed. For instance, she will act as if the picture is the same as the written word, the spoken word is the same as the picture and as if the written word is the same as the spoken word and picture. In the language of RFT, the child has been exposed to a set of contingencies that reinforce bidirectional responding to the arbitrary relation between *two or more* stimuli (i.e., she has learned how to combinatorially entail). In everyday language we could say that the child has learned how to treat pictures, written and spoken words as mutually substitutable stimuli that 'stand' for one another.

Expansion of linguistic abilities. The complexity of relational responding rapidly accelerates once children learn how to mutually and combinatorially entail relations between large numbers of stimuli in ways that extend above and beyond coordination. While the precise order and sequence in which relations are learned has yet to be empirically determined it appears that children initially learn how to AARR in accordance with sameness or coordination relations (Lipkens, Hayes & Hayes, 1993; Luciano, Gomez-Becerra, & Rodriguez-Valverde, 2007). Thereafter they quickly learn how to relate stimuli in a vast number of different ways, responding to objects and events on the basis of frames of distinction ('A is different to B'), opposition (‘A is opposite to B’), comparison (‘A is heavier than B’), hierarchy (‘A is part of B’), temporality (‘A comes after B’), causality (‘A causes B’), conditionality (‘A is a condition for B’), and deictics (‘A is mine and B is yours’) to name but a few. Research indicates that these frames are typically established via a similar history of MET as described above and appear to emerge in a logical and interdependent fashion, starting simple and growing in complexity (e.g., Barnes-Holmes, Barnes-Holmes, Smeets, Strand & Friman, 2004; Berens & Hayes, 2007; Carpentier, Smeets & Barnes-Holmes, 2003; Gorham, Barnes-Holmes, Barnes-Holmes & Berens, 2009; see also Rehfeldt & Barnes-Holmes, 2009).

The scale and complexity of these relations grows even further as (a) more and more stimuli come to be related via direct training or derivation and (b) children learn how to relate entire relations to other relations under contextual control. These ‘networks’ of relations are themselves comprised of multiple relational frames and continue to grow in complexity as children interact with the wider social-verbal community. To illustrate, consider only a fraction of the possible relations which surround a given word in everyday use, such as ‘laptop’. This stimulus is part of many hierarchical relations, such as the relational network ‘noun’, or ‘electronic devices’. Other terms are in a hierarchical relation with it, such as ‘hard-drive’ or ‘screen’. It enters into many comparisons: it is better than a calculator, bigger than a watch, heavier than a feather. It is the same as computer, but different to a house, and so on. “The participation of the word ‘laptop’ in these relations is part of the training required for the verbal community to use the stimulus ‘laptop’ in the way that it does. Even the simplest verbal concept quickly becomes the focus of a complex network of stimulus relations in natural language use” (Hayes et al., 2001, p.40).

In other words, as a child continues to interact with the socio-verbal community entire relations are combined in increasingly complex ways to form an elaborate and ever-growing network of related stimuli. According to RFT, the expansion of this network likely begins in infancy when we first learn to frame words and objects in coordination with one another and continues throughout the rest of our lives. "As children grow into adulthood, continued verbal interactions produce an increasingly complex and multi-relational network involving vast numbers of different objects and events and the relations between them…everything we encounter and think about, including ourselves, our thoughts and emotions, our prospects, other people, and our environment, becomes part of this elaborate verbal relational network" (Stewart & Roche, 2013, p.66)[3].

The Generative and Flexible Nature of Relational Framing

The ability to relationally frame is quite simply a game-changer. Learning how to relate stimuli and events in an arbitrarily applicable fashion equips humans with an extraordinarily efficient and generative means of interacting with the world around them. Once a sophisticated repertoire of framing is in place, any stimulus regardless of what it looks, smells, tastes, sounds or feels like can be related to any other stimulus in a near infinite number of ways. Arbitrary symbols such as written and spoken words, mathematical and scientific notation, pictures and images can be related to each other as well as physical objects in the environment, transforming the psychological properties of those stimuli. Indeed, the flick of a wrist, a grunt, raised eyebrow, frown or virtually any discrete event may become a 'verbal stimulus' when it participates in a relational network with other stimuli and has its functions altered as a result. Thus, from an RFT

[3] The concept of a relational network (and the relating of relational networks) also provides a way to approach the organization of larger language units in everyday terms, such as sentences, paragraphs, chapters, stories, trilogies, and so on. From an RFT perspective, human "language does not consist of isolated instances of utterances involving arbitrary applicability, mutual and combinatorial entailment, and transformation of stimulus function. Instead, each topographical unit (e.g., sentences, paragraphs, or chapters) contains multiple nested entailed relations and multiple possible functions, all of which differentially affect behavior" (Drossel, Waltz, & Hayes, 2007, p.17).

point of view, when we speak of the capacity for stimuli to 'stand for' or 'symbolize' other stimuli in the environment we are actually speaking of the participation of those stimuli in derived stimulus relations. It is this type of generalized contextually controlled operant which endows language with its characteristic symbolism and flexibility.

The generative implications of AARR are also spectacular. A single specified relation between two sets of related events might give rise to myriad derived relations in an instant. To illustrate, imagine you are informed that the word *money* is the same as *geld* which in turn is the same as *dinero*. From these two directly trained relations (*money-geld* and *geld-dinero*) you can derive four additional untrained relations (*money-dinero*; *dinero-money*; *geld-money* and *dinero-geld*). Now imagine a second scenario in which three more stimuli are related to one another (*argent*, *soldi* and *pengar*). Once again, four new relations will be derived, and when the first relation is related to the second, sixteen new relations can be derived between and among stimuli. Indeed, the generativity of AARR is such that by the time that eight stimulus relations are established, several thousand derived relations can emerge "because every stimulus and relationship between and among stimuli can be related one to the other in all directions" (Hayes, 2012). Put simply, the ratio of derived to trained relations seems to grow exponentially as humans learn to relate increasing numbers of stimuli in increasingly complex ways. This may help to explain how humans develop a repertoire of tens of thousands of inter-related verbal stimuli without the need for the socio-verbal community to directly reinforce those relations in all directions.[4]

At the same time, when stimuli participate in derived relations they can acquire entirely

[4] The well-documented 'language explosion' between the ages of 2 and 3 "seems like an obvious and salient example of the elaboration of the relational network. This typically occurs around the time that children have acquired the ability to frame in accordance with a few simple relations, allowing them to derive multiple novel relations amongst an expanding set of named objects and events" (Stewart & Roche, 2013, p.66).

new functions, or have their existing functions spontaneously modified or extinguished. For instance, establishing a coordination relation between the words *emergency*, *noodgeval* and *akut* may result in a transfer of function from the former to the latter, such that people will respond in broadly similar ways in the presence of these respective stimuli. They may shout *noodgeval* when threatened during a trip to Belgium, or quickly orientate towards someone screaming *akut* while in Sweden. However, learning that the word *veiligheid* is opposite to *emergency* which is in turn opposite to *säkerhet* will not occasion similar patterns of behavior as above. Rather these stimuli will acquire novel functions in accordance with the derived relations in which they participate (i.e., both words may be taken to mean “Safety”). Thus, from an RFT point of view, the transformation of function through derived stimulus relations may account for much of language’s productivity (i.e., how novel words, sentences, and solutions to problems are “generated” in the absence of direct reinforcement) (for more see Stewart, McElwee, & Sing, 2013).

Empirical links between derived stimulus relating and language. Evidence for a strong relationship between language and the ability to derive relations between stimuli has emerged on several fronts. First, verbally-trained humans appear to derive with remarkable ease and sophistication. Yet several decades of work suggests that their non-human (and arguably non-verbal) counterparts find it difficult to demonstrate even the most rudimentary properties of such behavior (Lionello-DeNolf, 2009; Hughes & Barnes-Holmes, 2014; Zental, Wasserman, & Urcuioli, 2014). Second, the capacity to derive relations develops and grows in complexity around the same time as children start to show evidence of language (Luciano et al., 2007), while brain-imaging studies indicate that relational responding produces similar patterns of neural activity as seen when humans perform linguistic tasks (Barnes-Holmes et al., 2005; Whelan, Cullinan, & O'Donovan, 2005). Third, individuals with linguistic deficits demonstrate impairments in their ability to derive relations between stimuli (Barnes, McCullagh, & Keenan, 1990) and providing remedial training in how to do so leads to corresponding improvements in linguistic skills (Murphy & Barnes-Holmes, 2010a, 2010b; Persicke, Tarbox, Ranick & St. Clair, 2012; Rosales & Rehfeldt, 2007; Walsh, Horgan, May, Dymond, & Whelan, 2014; see also Rehfeldt & Barnes-Holmes, 2009; Stewart et al., 2013). Finally, the fluency and flexibility of derived stimulus relating in normally developing populations consistently correlates with performance on other linguistic tasks (O'Hora et al., 2008; O'Toole & Barnes-Holmes, 2009; Whelan et al., 2005) while training designed to improve the former leads to corresponding improvements in the latter (e.g., Cassidy, Roche, & Hayes, 2011).

Critically, an empirical relationship does not indicate that derived stimulus relations depend upon language or that such relations are mediated by language, although some researchers have adopted this position for theoretical reasons (e.g., Horne & Lowe, 1996; Greer & Longano, 2010). Nor does it indicate that language depends upon derived stimulus relations, although others have gravitated towards this interpretation as well (see Sidman, 1994). Rather, when two dependent variables are correlated, one conservative strategy is to determine whether both variables are reflective of the same basic underlying psychological process. It could be that the correlation between linguistic ability and derived stimulus relations occurs because both are instances of the same general behavioral process (i.e., AARR). If the two do overlap at the level of behavioral process, then questions about human language may also be questions about derived stimulus relations, and vice-versa. This is the basic empirical and theoretical strategy that RFT researchers have adopted over the past twenty years (i.e., that the ability to 'language' and derived relations between stimuli are both instances of a learned, generalized and contextually-controlled type of operant behaviour known as arbitrarily applicable relational responding).

Summary. At its core, RFT argues that during our early development, we effectively 'learn how to language': we are provided with a history of learning which involves learning how to respond relationally to stimuli based on aspects of the context that specify the relation. Thus, when we speak of language or verbal behaviour we are actually referring to '*the action of framing events relationally*'. Stimuli such as spoken or written words, mathematical or scientific notation, as well as pictures and signs become 'verbal stimuli' when they participate in relational networks with contextual cues, the latter of which help establish the meaning or psychological functions of the stimuli for the language user. Likewise, a speaker is said to '*speak with meaning*' whenever they frame events relationally and produce sequences of verbal stimuli as a result. A listener is said to '*listen with understanding*' whenever they respond as a result of framing events relationally. Thus verbal meaning and understanding do not reflect the operation or outcome of some mediating mental event but rather constitute a type of contextually-controlled operant behavior.

Part II: From Simplicity to Complexity - Analogies, Metaphors, Rules and Instructions

So far we have offered a broad introduction to language from an RFT point view. We have defined this phenomenon as the act of relational framing, described how it is established during infancy and highlighted how its generativity and productivity arise from the ability to AARR. An important test for any psychological theory of language, however, is the extent to which is allows the researcher to predict and influence increasingly complex verbal behaviors, such as the ability to create and comprehend analogies, metaphors, rules or instructions. In what follows we demonstrate how RFT accommodates each of these phenomena by making just one small leap in conceptual complexity - namely - from the notion that stimuli can be related, to the idea that relations themselves can be related to other relations.

Analogical Reasoning

Analogies refer to the relating of two situations or analogs based on a common set of relationships that exist between and among their constituent elements. The core idea is that knowledge is transferred from a more familiar or better understood analog (termed the base) to a second analog (termed the target). “By ‘better understood’ we mean that the person has prior knowledge about functional relations within the source analog - beliefs that certain aspects of the source have causal, explanatory, or logical connections to other aspects…This asymmetry in initial knowledge provides the basis for analogical transfer (i.e., the source is used by the person to generate inferences about the target)” (Holyoak, 2012, p.234). To illustrate this more clearly, consider the analogy: ‘*Blizzard is to Snowflake as Army is to Solider*’. Here you transfer what you currently know about the source relation (Blizzards and Snowflakes) to the target relation (Army and Soldiers) by assessing the relationship within and between these two domains (i.e., that armies are comprised of soldiers in much the same way that blizzards are comprised of snowflakes). In this way, analogical reasoning represents a means by which existing knowledge about stimuli and events in one area can be used to guide behavior towards novel stimuli in new contexts.

The ability to generate and understand analogies is thought to be one of the most important and sophisticated aspects of human intelligence and the former is argued to be central to the development of the latter (e.g., Sternberg, 1977). Analogies are important vehicles for communicating in educational and scientific settings, they facilitate problem-solving (Barnett & Ceci, 2002), underpin creativity (Mayer, 1999), aid scientific discovery (Holyoak & Thagard, 1995), play a prominent role in certain psychotherapies (Hayes, Strosahl, & Wilson, 1999) and frequently predict academic success (Kuncel, Hezlett & Ones, 2004). According to RFT, analogical reasoning is a complex or 'higher-order' instance of AARR wherein entire stimulus relations are related to one another (Stewart**,** Barnes-Holmes, & Weil, 2009; Stewart, Barnes-Holmes, Hayes, & Lipkens, 2001). In other words, two relations are deemed to be analogous (i.e., related analogically) if the trained or derived relations in the 'base' relation are placed in a frame of coordination with the trained or derived relations in the 'target' relation.

To illustrate this more clearly, take a look at Figure 1. This relational network can be described in analogical terms as 'PhD students are to professors as apprentices are to carpenters' and denoted as A:B::C:D. In the language of RFT, this analogy consists of an overarching coordination relation between two other arbitrary coordination relations. On the one hand, a contextual cue ('*are to*') serves to establish that the words 'PhD students' and 'professors' are coordinated along some unspecified dimension. For many individuals this relation is likely based on the fact that students and professors are members of the same general class of stimuli known as 'academics' (although in principle this relation could also be based on other properties of the stimuli involved such as their occupational status, expertise, age, and so on). On the other hand, the above cue also serves to establish a second coordination relation between the words 'apprentice' and 'carpenter', and for many people, this relation is likely based on the fact that both are members of a general stimulus class known as 'tradesmen' (although once again this relation may be based on other stimulus properties such as their skill or age). Finally, another contextual cue ('as') serves to establish an overarching coordination relation between the two relations outlined above (i.e., 'PhD students are to professors' (coordination relation) 'as' (coordination relation) 'apprentices are to carpenters' (coordination relation)). This overarching relation specifies that the similarity between students and professors in the first relation is the same as the similarity between an apprentice and carpenter in the second relation (i.e., it involves an abstraction of a similarity between similarities).

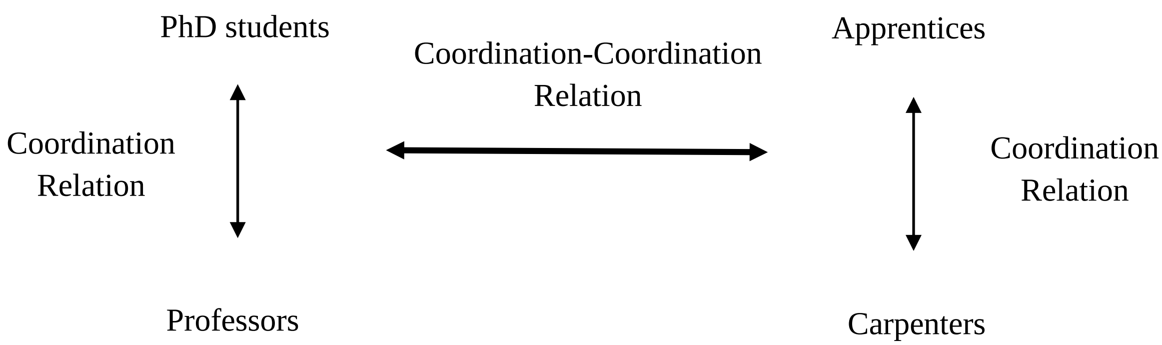

Figure 1. The analogy denoted as 'PhD students: professors :: apprentices : carpenters and the relations between and among those elements.

Several points are worth noting here. First, analogies do not require that stimuli within the first or second relation be related on the basis of coordination; they can also be related in a variety of different ways. For instance, the contextual cue 'is to' in the following analogies ('*dark is to light as laugh is to cry*', or '*spring is to season as august is to month*') specifies that stimuli are related in opposition or hierarchically with one another. Nevertheless, in most analogies, the former relation is nearly always framed in coordination with the latter relation via the contextual cue 'as'. Second, the contextual cue that controls how stimuli are related in the 'base' relation always controls how stimuli are related in the 'target' relation. Thus if the contextual cue specifies a distinction relation for the 'base' ('*baby is to adult*') it will do so for the 'target' (as '*puppy is to dog*'); if it specifies a hierarchical relation for the 'base' ('*stem is to flower*') it will do so for the 'target' (as '*trunk is to tree*') and so on. Third, the relations within analogies can often be traced back to the physical or non-arbitrary properties of the stimuli involved. Consider the following analogy: '*a planet is to a star as an electron is to an atomic* *nucleus*'. In this case, the arbitrary coordination relation between the words 'planet' and 'star' is based, to some extent, on the coordination of physical properties shared by the actual stimuli with which the words are coordinated (e.g., the former are usually smaller than and orbit the latter). Likewise, the arbitrary coordination relation between the words 'electron' and 'atomic nucleus' is based on the shared physical properties between these two stimuli (e.g., the former are usually smaller than and orbit the latter). Although the two coordination relations and the overarching coordination relation between them is entirely arbitrary in nature (there are no physical similarities shared by the words or between the words and the objects that they refer to), they can readily be traced back to shared non-arbitrary features. Put simply, the contextual cue ('is to') specifies that just as planets share some non-arbitrary properties with stars so do electrons with atomic nuclei. In this way, non-arbitrary stimulus features may influence the derivation of coordination relations (see Stewart, Barnes-Holmes, Roche, & Smeets, 2002). Finally, an individual's history of learning will influence the pattern of derived relations that will take place within a given analogy. In the above example, for instance, you might abstract the category (i.e., celestial and atomic particles) first and only abstract the non-arbitrary properties (e.g., size and shape) thereafter.

Accumulating evidence supports the notion that coordinate framing of derived relations provides a good model of analogical reasoning (e.g., Barnes, Hegarty, & Smeets, 1997; Barnes-Holmes et al., 2005; Carpentier et al., 2002; Carpentier, Smeets, Barnes-Holmes, & Stewart, 2004; Lipkens & Hayes, 2009; Ruiz & Luciano, 2011). Much of this work has focused on the history of learning that gives rise to the creation and solution of analogies in the laboratory. In a seminal study, Barnes et al. (1997) provided the first RFT model of analogical reasoning as the derivation of equivalence relations between equivalence relations or 'equivalence-equivalence' responding. In this experiment participants were exposed to a learning task designed to establish a number of coordination relations between arbitrary stimuli. A Matching-To-Sample (MTS) task presented a 'sample' stimulus in the middle of the screen (e.g., A1) and reinforced the selection of one of four 'comparison' stimuli at the bottom of the screen (e.g., B1, B2, B3, and B4). In this way participants learned via training that stimuli were related on the basis of coordination (e.g., A1-Same-B1) and distinction (e.g., A1 different from B2, B3, or B4). Thereafter, a test for mutual and combinatorial entailment was administered to see if derived stimulus relations emerged as expected. In the final section of the task participants were exposed to an 'analogy test' that was similar in many ways to the learning task they encountered before but with one key difference: this time the task was comprised of two different types of trials known as similar-similar or different-different trials. During the former the sample stimulus in the middle of the screen was always a compound of a combinatorially entailed relation of sameness (e.g., B1C1) while the comparison stimuli at the bottom of the screen were either a compound stimulus formed by a combinatorially entailed relation of sameness (B3C3) or distinction (A3C4). Different-different trials were similar but this time the sample stimulus was a combinatorially entailed relation of distinction. In the language of RFT, this 'analogy test' was designed to see if participants would relate two derived coordination or distinction relations to each other in accordance with a frame of coordination (i.e., relationally frame one relation as being coordinated with another relation). This is precisely what the authors' found, with adults as well as nine and twelve year old children readily passing the analogical test when provided with sufficient training (see also Pérez, García, & Gomez, 2011; Ruiz & Luciano, 2012).

Numerous studies have now extended this analysis by examining analogical framing in different age groups, with different measures, relations and domains. For instance, Carpentier and colleagues (2002, 2003) found that five-year old children, unlike their nine-year old and adult counterparts, experience considerable difficulties when exposed to a similar task as above and only demonstrated such performances when provided with extensive training. These results mirror the developmental divide observed in the analogical literature between children in early and late childhood (Sternberg & Rifkin, 1979) and suggest that the ability to create analogies emerges in parallel with the overall ability to frame events relationally. A number of RFT researchers have also sought to devise a more sophisticated means of experimentally establishing analogies using a task known as the Relational Evaluation Procedure (REP; Stewart, Barnes-Holmes & Roche, 2004).

In yet other research, relating derived relations, as a model of analogy, was measured using reaction times and event-related potentials (ERPs). This work demonstrated that analogical responses that were lower (similar-similar) relative to higher in complexity (different-different) were emitted with greater speed and were underpinned by different patterns of neural activity in the left-hemispheric prefrontal regions (Barnes-Holmes et al., 2005). Interestingly, this pattern of neural activity mirrors that seen elsewhere in the neurocognitive literature (Luo et al., 2003) and suggests that similar brain regions are recruited when people AARR in this way or solve analogies. More recently, Lipkens and Hayes (2009) demonstrated that the coordinated relating of opposition and comparative relations could also be used to engineer analogies in the laboratory. At the same time, they found that directly training an analogy between two relations allowed participants to derive a number of untrained analogies between novel events. Finally, Ruiz and Luciano (2011) extended the RFT model of analogy by training and testing “cross-domain” analogies which they defined as the relation of relations in separate relational networks. Whereas the work discussed thus far focused on within-domain analogies (‘*curing a stomach* *tumor is like curing a lung tumor*'), cross-domain analogies involve the transfer of knowledge from one domain to a completely unrelated domain ('*curing a stomach tumor is like capturing an enemy fortress*'). The authors found that such analogies could be established via a history of MET and that performance during their experimental procedure strongly correlated with that on a standard measure of analogical reasoning.

Summary and future directions. Taken together, the above work suggests that the ability to create and solve analogies arises from the coordinated relating of derived relations. This type of higher-order relational responding allows for entire classes of responses to impact other classes, providing one potential explanation for the generativity seen in human language and cognition. Although RFT researchers have made rapid strides in this domain many questions still need to be addressed. First, can transformations of functions through analogical frames be experimentally modelled (see Stewart, Barnes-Holmes, Roche, Smeets, 2002), and is it possible to engineer this type of relational responding where it was previously absent or weak? Work in this area has typically focused on establishing instances of analogical framing in the laboratory using adults and children who could already analogically frame (but see Carpentier, et al. 2002). A stronger demonstration would involve establishing analogical framing in cases where it was previously absent. Second, the role of non-arbitrary stimulus properties in analogical framing also requires attention (Stewart, Barrett, McHugh, Barnes-Holmes, & O'Hora, 2013) as does the role of analogical framing in psychopathology and psychotherapy (Foody et al., in press). Third, applied researchers will need to determine if the above work can be translated into educational and intellectual interventions that directly target and remediate deficits in analogical framing in normative and developmentally delayed populations (see Stewart et al., 2009; Persicke et al., 2012). Those same researchers could take such educational strategies one step further and determine whether advanced training in analogical framing actually promotes other types of behaviors such as creativity or intelligence. We will return to this issue latter in the chapter.

Metaphorical Reasoning

Metaphors represent a subclass of analogies that rapidly transfer a characteristic that is highly evident in one event (usually termed the 'vehicle') to a different event ('target'). They are like 'linguistic chauffeurs', who ferry information about a known domain to an unknown or less known domain, and as a result, change how we respond to the latter based on what we know about the former. Metaphors are woven into the very fabric of language and are essential for effective communication. For instance, we speak of relationships as "train-wreaks", political debates as taking place "in arenas" where "one side battles the other", exams as being "a walk in the park" or novel insights as requiring "thinking outside the box". Our parents are "dependable as a rock", "brothers are pig-headed" and even the world can be seen as a stage, "all the men and women merely players who have their exits and their entrances".

According to RFT, this 'rapid transfer of a characteristic' from the base to the target refers to the transformation of function that occurs when entire relations are related to other relations. Interestingly, metaphors seem to be characterized by a number of properties that distinguish them from their analogical counterparts. Foremost amongst these is the role that non-arbitrary or physical properties of stimuli (or the relationship between stimuli) play in analogies and metaphors. Analogies can, but need not be, based on the physical relations that exists between and among stimuli: RFT studies like those highlighted above indicate that people can analogically respond in ways that do not depend on the physical properties of the stimuli involved. However, the psychological effects of metaphors are mainly due to the physical properties of stimuli involved in the relating of relations (see Stewart & Barnes-Holmes, 2001, for a detailed discussion).

To illustrate, consider the metaphor: '*Surfing the Net'* which implies that using the internet is similar to surfing waves in the ocean. In the language of RFT, this metaphor involves two separate relational networks that are (a) framed in coordination with one another and which (b) involve a physical dimension or relation that (c) modifies and transforms the functions of stimuli participating in those relational networks. In the above example, we have specified two events (surfing waves of water and surfing information on the Internet) that participate in separate relational networks and which are characterized by a variety of psychological functions. The above statement serves to arbitrarily frame those stimuli as coordinated with one another. In many ways this metaphor is functionally similar to the type of analogies described previously: "surfing" (A) is to "water" (B) as "surfing" (C) is to "the Internet" (D). However, it is characterized by a number of properties that suggest a definition in terms of metaphor may be more apt. For instance, the focus on surfing is transferred from the domain of watersports where it is physically applicable, to that of the Internet where it is metaphorically applicable (i.e. a transformation of function from actual surfing to information retrieval). Stated more precisely, the coordinated relating of two relational networks leads to the functions of stimuli in the 'vehicle' relation (surfing in the ocean) being transformed in-line with the functions of the 'target' relation (surfing the Internet), which has a range of implications for understanding and dealing with the former. For example, through the metaphor a person may derive that just as surfing in the ocean is an enjoyable but effortful exercise so too is swimming through the vast ocean of information that exists on the Internet. In other words, the effectiveness of a metaphor depends, in large part, upon the discrimination of formal stimulus dimensions that provide the ground for the metaphor, such as the perceptual/functional similarity between surfing in the ocean and ‘surfing’ currents of information.

Analogies and metaphors also tend to differ in their directionality. At their most basic, both involve two events (A and B) that are related in the following fashion: ‘A is (like) B’. In the case of many analogies, the position of the A and B terms may be swapped and the result is still meaningful. For example, in the analogy ‘*An atom is like the solar system*’ swapping the order of A and B yields a valid and understandable analogy (*the solar system is like an atom*). In the language of RFT, analogies involve an overarching coordination relation between derived relations and reversing the order in which these relations are coordinated often yields broadly similar transformations of function. However, in the case of metaphor, if the A and B terms are swapped, the phrase loses it metaphorical quality: while the statement ‘*my father is a pig*’ makes sense the reverse does not (‘*a pig is my father*’). Metaphors such as this work because the A and B terms have a property in common that is obvious and stereotypical in the case of B (pigs) but not A (fathers). Furthermore, for the metaphor to work from a listener’s perspective, the father in question must possess, if only weakly, some of the functions of actual pigs, such as being slightly overweight, displaying poor eating habits and generally being quite messy. In the language of RFT, two relational networks are framed in coordination with one another (fathers and pigs), but comparative or hierarchical relations also seem to be involved in the transformation of functions that gives the metaphor its linguistic power. In the above metaphor we could consider “pig” as the super-ordinate category and its dominant properties (e.g., poor eating habits) as subordinate categories with which the target may be coordinated (my father eats like a pig). In other words, metaphors lead us to relate a target (father) and vehicle (pig) in a hierarchical fashion, and thus the direction of the metaphor is not readily reversible. In this way, the unidirectional, hierarchical relating of derived relations may be an important means of functionally distinguishing metaphors from analogies.

Future directions. Surprisingly, the distinction between *creating* versus *comprehending* metaphors, as well as the difference between metaphors and analogy has yet to be empirically modelled in the laboratory. Nor has metaphor been subjected to empirical scrutiny within the RFT literature since its original theoretical treatment well over a decade ago. This is despite the fact that RFT provides clear, testable predictions about the origins and properties of metaphorical reasoning, its relationship to analogical reasoning, not to mention technologies for establishing this ability where previously absent or weak (see Persicke et al., 2012). The same goes for functionally similar phenomena such as allegory, anecdote, simile, parable, story-telling and humor, which also seem to involve the relating of relations to other relations, but under different forms of contextual control (Stewart et al., 2001). Thus a rich, deep vein of research with seemingly wide-scale implications for many areas of psychological science has yet to be mined.

A functionally understood account of metaphor will not only convey theoretical benefits (by deepening our understanding of complex relational responding) but also offer practical value for those working in the applied wings of CBS. For many years now, clinicians and scholars have recognized that metaphors are effective tools for combatting human suffering (e.g., Hayes et al., 1999; Orsillo & Batten, 2005; McCurry & Hayes, 1992). Within the ACT literature, for example, metaphors have been argued to "promote the deliteralization of psychological content in a way that allows a person to experientially step out of their existing language system, and thus be less susceptible to the effects of 'cognitive fusion', wherein certain types of unhelpful transformations of functions occur (Foody et al., in press, p.14). To illustrate this more clearly, consider the following metaphor which is frequently used in clinical settings: "*struggling with anxiety is like struggling in quicksand*". In this case, two relations (struggling with anxiety versus struggling with quicksand) are coordinated via the contextual cue ‘is like’ which results in the transformation of functions (struggling in the context of a difficult situation) from the domain of quicksand where it is physically applicable, to that of anxiety where it is metaphorically applicable. “In other words, quicksand is the prototypical context in which the salience of struggling is highlighted and coordinating this with anxiety serves to highlight the futility of struggling there also, a fact that was not previously salient to the client. The salience of the futility of struggling is, therefore, only abstracted via the contextual cue for coordination between the two contexts” (Foody et al., in press, p.17).

An avalanche of ACT studies have emerged over the past decade and have drawn upon metaphors (amongst other clinical tools) to address a wide spectrum of psychological problems. If we are to better understand the effectiveness of existing (and create new) metaphors in clinical contexts then we will need to subject RFT’s account of this phenomenon to far closer empirical scrutiny. For instance, an experimental analysis of metaphor will need to be offered and the role of non-coordinate frames (causal, hierarchical, and comparative) accounted for. Given that metaphors play a critical role in experimental analogues of (McMullen et al., 2008) and acceptance-based interventions targeting psychopathology (e.g., Bach & Hayes, 2002; Twohig, Hayes, Masdua, 2006) these questions will need to be asked and answered soon. This work may require that we pay special attention to the role of deictic frames in particular. Clinical metaphors are usually employed to produce a shift in perspective in the client’s view of their own psychological suffering (e.g., seeing struggling with anxiety as the problem rather than the solution). The next logical step then is to explore the role of deictics and other relational frames in (clinical) metaphors. Other researchers could also consider how explicit training in the use of metaphors stimulates scientific creativity, educational outcomes, improves our capacity to solve social problems and make real-world decisions (Thibodeau & Boroditsky, 2011). Still others could examine how AARR gives rise to 'unstated metaphors'. For instance, 'when we say "I shot down his argument," or "He couldn't defend his position," or "She attacked my theory," we are alluding to an unstated metaphor that argument is war. Similarly, to say "Our marriage is at a crossroads," or "We've come a long way together," or "He decided to bail out of the relationship" is to assume metaphorically that love is a journey' (Pinker, 2006, p.2).

Summary. In short, analogies and metaphors are woven into the very fabric of language and RFT provides a functional account of their origins and properties. While several branches of this research literature have bloomed and flourished (analogy) others will need careful cultivation in the coming years (metaphor), especially given their practical utility in clinical and educational domains. Finally, the foregoing analysis highlights how the basic ideas of RFT can yield tangible benefits for those in the applied wing of CBS. This theory not only explains how metaphors acquire their psychological power but also suggests methods for developing effective clinical metaphors that can alter the way in which people frame events in the world around them.

Rules and Instructions

The ability to generate and apply rules to our own behavior (as well as that of others) is a fundamental avenue through which humans adapt to the world around them. Self or socially generated rules allow us to set and achieve goals (O'Hora & Maglieri, 2006), delay immediate gratification, and even deal with events before they occur (e.g., '*Mow my lawn next month and I will pay you afterwards*'; Doll, Jacobs, Sanfey, & Frank, 2009). Rules or instructions allow us to respond to consequences that are extremely abstract in nature (e.g., '*only honest people go to Heaven*') as well as indirectly profit from other people's experiences. For instance, a person can respond to the rule '*If you drink bleach, you will die*' without having to engage in the behavior of drinking bleach or of contacting the consequence of dying. More generally, rules such as moral principles, laws, commands, religious prescriptions, norms, and customs serve as the bedrock upon which many social and cultural groups are formed and function (Baumeister, 2008) while grammatical and syntactical rules provide the ‘scaffolding’ that binds language together (Hayes et al., 2001; McHugh & Reed, 2008).

Interestingly, this ability to generate and follow rules also has a dark-side. In some cases rules rapidly accelerate the rate at which we adapt to the world around us while in others they have precisely the opposite effect, undermining our sensitivity to changes in the wider world and producing undesirable consequences that could have otherwise been avoided (e.g., Hayes, Brownstein, Zettle, Rosenfarb, & Korn, 1986; Shimoff, Catania, & Matthews, 1981; also see Torneke, Luciano, & Valdivia Salas, 2008). For several years now, contextual behavioral scientists have argued that this capacity to become ‘locked into’ or ‘stuck’ in maladaptive patterns of rule-following plays a key role in psychopathology, from addiction (“*I need to smoke in order to cope*”), to self-harm (“*I always cut myself when I do poorly at school*”), as well as suicide (“*My pain will stop after I kill myself*”) and schizophrenia (see Hayes et al., 1999; Luoma, Kohlenberg, Hayes, Bunting, & Rye, 2008). In the domain of addiction, for example, it may be that gamblers following the rule “*My bad luck is bound to change*” continue to bet despite the aversive outcomes that result from following that rule (i.e., losing increasingly large sums of money; Dixon, Hayes, & Aban, 2000). Likewise, a person addicted to alcohol may emit the rule “*I will feel better after drinking*” and this may be effective in the short run. But when this rule persists over time, drinking continues, social and inter-personal problems fail to go away, and thoughts and feelings about poor life outcomes may actually increase (Törneke et al., 2008).

RFT and instructional control. Naturally, an RFT account of rule-following has the concept of AARR at its core. According to this perspective, rules or instructions represent complex networks of relations that serve to modify the psychological properties of stimuli in those networks (Barnes-Holmes et al., 2001; O'Hora & Barnes-Holmes, 2004; Törneke et al., 2008). In previous sections we described how relational frames are elaborated into relational networks that themselves are related and applied to the non-arbitrary environment. Rule-governed behavior is a subset of such behavior and refers to the coordination of behavior with a verbally specified contingency that often makes reference to antecedent, behavioral and consequential events.

To illustrate, imagine that you are about to hike through some mountains in southern Canada for the first time and a friend from the region warns you about a species of snake that lives in the area. He tells you that the stripes on this snake's back are red, yellow and black and that "*If red touches yellow then you're a dead fellow but if red touches black then you're okay Jack*". Several days later a snake with red and yellow stripes crosses your path and you start to sweat, experience fear and quickly walk in the opposite direction. RFT provides an analysis of how your behavior comes under instructional control by examining "the relational frames involved and the cues that occasion the derivation of those relations, as well as the psychological functions transformed through those relations and the cues that occasion those transformations of function" (Stewart, 2013, p.274). For instance, the instruction gains its psychological power because words like 'red', 'yellow', 'snake' and 'dead' participate in coordination relations with other stimuli and events (e.g., the word 'snake' with actual snakes, the word 'dead' with dead organisms and so on). But coordination relations are not enough. If the instruction consisted simply of 'snake, yellow, red, black, dead, ok, Jack' it would not make much sense - it would not specify that snake's with red/yellow stripes are the antecedent in the presence of which one should escape (the behavior), nor that avoiding death would be the consequence of doing so.

According to RFT, the person following the instruction must respond to the *relations between* the words contained in the statement, not merely those words themselves. In effect, it is the relating of words via relational cues which leads to stimuli acquiring new or changing their existing psychological properties. In the above example, conditional cues such as ‘If’, ‘Then’ and temporal cues such as ‘Before’ and ‘After’ specify the order of events and their contiguous relationship to one another. Interpersonal cues (‘you’) specify the individual towards whom the rule is directed. At the same time, functional cues such as ‘dead’ and ‘ok’ alter the functions of the snake such that the listener is more likely to avoid it in one context and disregard it in another. In other words, this relational network leads to a transformation of functions wherein the functions of the snake are altered depending on the relationship between the colors on its back. Once you hear the above instruction, you will likely avoid all contact with a red/yellow striped snake and readily approach or disregard his red and black striped cousin. According to RFT, people are said to ‘understand’ a rule or instruction whenever their behavior falls under the control of derived relations such as those outlined here. They can prescribe rules for themselves as well as others and identify whether they are following those rules by assessing the extent to which their behavior coordinates with that rule (for more see Barnes-Holmes et al., 2001; O’Hora & Barnes-Holmes, 2004).

If rule-following is an instance of AARR then we should be able to model such behavior in the laboratory; demonstrate that it develops over time; is amenable to change and is sensitive to its antecedents and consequences. We should also be able to establish this behavior where it was previously absent or weak. Over the past decade a number of studies have started to tackle these and related questions. For instance, we now know that instructional control can be experimentally modelled under laboratory conditions. Much of this work has involved the formation of relational cues meaning 'Same', 'Different', 'Before' and 'After'. During a subsequent 'instruction-following' test participants are presented with a number of trials that contain arbitrary stimuli (nonsense words and colored shapes) along with the aforementioned cues. On each trial, the contextual cues were used to establish coordination (e.g., *A1-Same-B1-Same-C1; A2-Same-B2-Same-C2; A3-Same-B3-Same-C3*) and temporal relations between stimuli (e.g., *C3-Before-C2-Before-C1*). Prior to the study participants were informed that each stimulus corresponds to a certain key on the keyboard and that they should press those keys based on what they see during a given trial. If RFT is correct, and instruction-following is a type of behavior that is under the control of derived stimulus relations, then participants should press the keys in the order specified by those relations (e.g., press the key corresponding to C3 before the key corresponding to C2 and so on). Furthermore, they should also do this for entirely novel sets of stimuli that were never differentially reinforced in the past and that bear no resemblance to one another. Results suggest that participants readily pass such a test (O'Hora, Barnes-Holmes, Roche, & Smeets, 2004), that responding in-line with such 'instructions' falls under the control of its antecedents and consequences (O'Hora, Barnes-Holmes, & Stewart, in press) and that instructed behavior may demonstrate the same functional properties as directly experienced and derived performances (Dymond, Schlund, Roche, De Houwer, & Freegard, 2012). Several researchers have begun to establish rule-following in populations where such an ability was previously absent (e.g., with developmentally delayed children; Tarbox, Zuckerman, Bishop, Olive, & O'Hora, 2011; see also Tarbox, Tarbox & O'Hora, 2009).

Pliance, Tracking and Augmenting. RFT researchers have also distinguished between three different kinds of contingencies that produce rule-following, labelled these contingencies plys, tracks and augmentals and linked them to variety of clinical phenomena (Törneke et al., 2008). Pliance is defined as rule-governed behavior under the control of a history of socially-mediated reinforcement for coordination between behavior and antecedent verbal stimuli (e.g., when a child cleans his or her bedroom after being told by a parent that "*You will only get pocket-money once your chores are complete*"). Tracking is defined as rule-governed behavior under the control of a history of coordination between the rule and the way the environment is arranged independently of the delivery of the rule (e.g., enjoying a clean room after being told that *"Cleaning your room will make you feel great"*). Finally, augmenting is defined as behavior that alters the degree to which stimuli in instructions function as reinforcers or punishers. These latter type of contingencies have been further sub-divided into two varieties. Motivative augmentals temporarily alter the degree to which previously established consequences function as reinforcers or punishers (e.g., *'wouldn't a tender steak and some crispy fries taste great right now?'*). Formative augmentals establish reinforcing or punitive functions for a stimulus in the first instance (e.g., *'do you want this slip of paper – it is last week's winning lottery ticket'*). A number of studies have sought to provide experimental analogs of these different types of instructions (Ju & Hayes, 2008; O'Hora et al., in press; Valdivia, Luciano, & Molina, 2006; Whelan & Barnes-Holmes, 2004) and show that they play an important role in phenomena such as depression (McAullife, Hughes & Barnes-Holmes, in press) and schizophrenia (Monestes, Villatte, Stewart, & Loas, in press).

Summary and future directions. Taken together, the above work reveals that rules and instructions exert a powerful influence over our current actions and future behavior. From an RFT perspective, when we use words like 'rules' and 'instructions' we are referring to relational networks that typically specify a temporal antecedent; the topography of a response; the appropriate context for the response; the type of consequences that will be contacted and when those consequences are delivered (e.g., '*If I study for my exams now I will be in with a good chance of getting a job later*'). They do so without the need for people to directly experience the events involved or even encounter the stimuli that they refer to[5]. Although the foregoing account of rule-governed behavior is well over twenty years old much work still remains to be done. First and foremost, some conceptual spring-cleaning seems in order. Non-technical terms such as 'rules' and 'instructions' may need to be jettisoned in favor of alternatives with less historical baggage. One possibility is that researchers refer to this class of behavior as 'complex relational regulation'. Although the complexity of the networks involved in such regulation can vary, many will usually involve transformations of functions in accordance with networks composed of co-ordination, conditional, temporal and deictic relations. The advantage of this definition is that it avoids the use of terms (rules and instructions), which are used in numerous ways both inside and outside of behavioral psychology. Adopting the concept of 'complex relational regulation', however, simply encourages the researcher to distinguish between more or less complex forms of verbal regulation (for a related discussion see Barnes-Holmes et al., 2001; O'Hora & Barnes-Holmes, 2004).

Second, a systematic experimental analysis of the current and historical factors that serve to establish, maintain and modify this type of behavior is sorely needed. The same goes for the origins of complex relational regulation in infancy and the potential role that other relational frames (spatial and hierarchy) play in this process. Few interventions exist for establishing this repertoire in people who do not already display it and only a handful of studies have sought to

[5] Although rules may be seen as involving relatively complex relational networks, relational networks are not always necessarily rules. For example, metaphors, analogies, stories and jokes also appear to involve relational networks, but strictly speaking may not necessarily function as rules.

remediate this ability where previously weak or absent. Researchers will need to identify how verbal regulation transitions from the basic to complex forms seen typically in adults, such as the ability to derive rules that specify long-delayed (e.g., death) or highly abstract consequences (e.g., going to heaven or hell) (see Tarbox et al., 2009). Third, future work will need to focus on the potential factors that increase or decrease the probability of rule-following. RFT researchers have long argued that rules may be stated and understood and yet not followed because (a) the behavior specified by the rule is not in the behavioral repertoire of the listener, (b) the rule-giver lacks credibility or (c) authority and ability to mediate reinforcement. The plausibility of the rule may also be called into question because it is contradictory or incoherent with the individual's prior learning history. These and other moderators such as the accuracy, type and source of the rule as well as the role of relational complexity, derivation and coherence in their formation, persistence and change will need to be subjected to closer inspection in the coming years.

Fourth, concepts like plys, tracks and augmentals, while certainly popular in the CBS literature, are not strictly speaking technical terms for RFT and have often enjoyed more theoretical than empirical support. Future work will need to provide more precise functional analyses of these different types of verbal stimuli, demonstrate that they actually give rise to functionally distinct outcomes and determine their role in different social, clinical and cognitive phenomena. Take, for example, the clinical domain. If plys and tracks can decrease our sensitivity to reinforcement contingencies, and thus by implication, increase our likelihood of certain psychopathologies, would training flexibility in deploying and discarding such rules serve to undermine human suffering? Fifth, RFT and ACT researchers have focused more on the *maladaptive* role that rules play in everyday life and less on their *adaptive* role in goal-setting, motivation, persuasion, morality, delayed gratification and social cognition (although see O'Hora

& Maglieri, 2006). Thus greater attention should be paid to the positive consequences of this type of behavior.

Conclusion

In the preceding section we focused our attention on those areas of RFT that have made the greatest strides in the domain of language since Hayes et al.'s seminal text in 2001. The intervening years have served to further solidify the relationship between AARR and language, with research supporting the former's role in analogical and metaphorical reasoning as well as instructional control. Nearly fifteen years on we can confidently say that RFT has taken significant steps towards a naturalistic, functional-analytic account of human language. Evidence indicates that we have identified the environmental regularities and history of learning necessary to predict and influence the development and change of verbal behavior with relative precision, scope and depth. These variables have allowed us to devise interventions that can remediate linguistic deficits in developmentally-delayed populations or accelerate those same abilities in their typically-developing counterparts (see Chapter Z). This program of research has also stimulated new insight into the powerful role that language plays in human suffering and the need for psychotherapeutic approaches that target how one frames events relationally (see Chapter W).

However we have only begun to scratch the surface of where an RFT approach to language may eventually take us. For instance, while the theory has had much to say on issues such as (generative) grammar, allegory, anecdotes, parables, story-telling and humor, these topics still await empirical scrutiny. The same goes for other important classes of verbal behavior such as persuasion, rhetoric and logic (Roche, Barnes-Holmes, Barnes-Holmes, Stewart, & O'Hora, 2002). At the same time, RFT has made clear, testable assumptions about language development, from the probability of speech errors and novel utterances, to the relationship between verbal comprehension and production. This is also true for child-directed speech, degenerate stimulus input and the role of AARR in U-shaped grammatical development (e.g., Cullinan & Vitale, 2009; Hayes et al., 2001; McHugh & Reed, 2008; Stewart et al., 2013). A functional analysis of these and related topics would not only cement our understanding of verbal behavior but also provide further evidence that RFT can adequately account for the generative and productive nature of human language. Finally, complex relational regulation represents a novel intellectual country that RFT researchers are only starting to explore. Charting this new domain will require methodological innovation that enables researchers to better generate and manipulate relational networks, capture their impact on behavior and remediate such abilities in educational and developmental contexts.

Part III: RFT and Human Cognition

The philosophical and conceptual swing from the functional to mental level of analysis during the 1960's was not limited to the domain of language. With the advent of cognitive psychology, researchers began to draw upon a different philosophical framework (mental mechanism), with its own root (computer or neural net) and causal metaphors (links-in-a-chain). The result was a focus on the action of mental mechanisms which were suggested to be independent from, and yet instantiated by, physical systems in the environment (e.g., computers or brains). These mental processes and representations became an explanatory intermediary between environment and behavior, invoked in order to understand phenomena such as learning, perceiving, recognizing and remembering, reasoning, decision making, problem-solving, feeling, attending, and being creative. Collectively, these behaviors were repackaged under the rubric of 'cognition' which referred "to all the processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used…cognition is involved in everything a human being might possibly do…every psychological phenomenon is a cognitive phenomenon" (Neisser 1967, p.4). Behavior was now treated as an indication, manifestation, or expression of physiological and/or neurological processes taking place inside the person or mediating mental processes such as expectations, desires, intentions, attributions, attitudes and feelings which took place somewhere "outside of the physical world in which information is represented and processed independently of the physical system in which it is implemented" (De Houwer, 2011, p.202). These mental events were assumed to operate on environmental input (bottom-up processing), were said to be influenced by other mental events such as knowledge and expectation (top-down processing), or some combination of the two. Approached in this way, the purpose of psychological science became twofold. The goal of research was to identify the basic mental processes which mediate between input (environment) and output (behavior) in order to better predict the behavioral effect of interest. The second was to identify the operating conditions that were both necessary and sufficient for those mental processes to successfully function (e.g., Bargh & Ferguson, 2000)[6].

Cognition at the functional level of analysis. Shifting to the functional level of analysis requires that we adopt a strikingly different perspective, one in which cognition is conceptualized *as* behavior. The metaphor of an information processing machine or neural net is set to the side along with questions about the mental mechanisms and operating conditions which mediate between environment and behavior. Instead of searching for mechanisms or processes that underlie perception, attention and memory, decision making, emotion and thought, the question

[6] The above account is a drastic oversimplification of research at the mental level of analysis. For a more detailed and carefully considered treatment see Brysbaert & Rastle, 2009; Eysenck & Keane, 2013; Miller, 2003; also see Chiesa, 1994; 1998; De Houwer, 2011).

becomes 'what are the functional relations between behavior and environment that give rise to, sustain or undermine those actions which people refer to as involving thinking, remembering, attending, being creative or intelligent?'. Although it is true that early behaviorists focused exclusively on *public* behaviors and excluded *private events* from legitimate analysis, this is not the case for their contemporary counterparts, who arrange behavior along a single continuum from public (e.g., ticking a box that indicates a particular dislike) to private (e.g., thinking or feeling that I do not like a particular person without saying so out loud). By referring to cognitive phenomena like thinking, remembering and reasoning as behaviors, functional researchers seek to emphasize that (a) it is the task of psychology to predict-and-influence these events and that (b) public or private events can only be influenced by manipulating the environment external to that behavior. In other words, CBS views both public and private behaviors, and possible interactions between the two, as dependent variables (i.e., outcomes for which we must find a cause) and environmental regularities external to the behavior(s) of interest as independent variables (i.e., the causes of behavior). This strategy of treating private events as behavior - and thus as a dependent variable - is adopted in order to achieve CBS's central goal of prediction-and-influence (for an excellent discussion see Hayes & Brownstein, 1986).

Cognition as the RFT researcher sees it. This conceptualization of (public vs. private) behavior, combined with a focus on environmental moderators rather than mental mediators, has led to the popular misconception that functional researchers are disinterested in - or incapable of - dealing with psychological phenomena such as language or cognition (e.g., Bargh & Ferguson, 2000). Yet nothing could be further from the truth. Functional accounts have sought to provide a naturalistic explanation for the emergence and development of phenomena such as self and perspective taking, implicit cognition and intelligence. RFT, for example, argues that cognition is not a mental event that mediates between environment and behavior; rather it is a behavioral event (AARR), and as such, there is no reason that the study of cognition cannot be carried out at the functional level of analysis. Put simply, arbitrarily applicable relational responses are what “minds” are full of, and when we speak of ‘cognitive’ phenomena we are referring to complex instances of relational framing that are more or less evident under different environmental conditions. It is to this topic that we now turn.

Self and Perspective Taking

The ‘self’ represents one of the most ubiquitous and enduring concepts in psychological science. Since the earliest days of the discipline researchers have appealed to the notion of ‘self’ as a causal or explanatory factor when accounting for complex human behavior. For instance, we are said to ‘self-determine’ and ‘self-regulate’ (Deci & Ryan, 1985), have a host of ‘self-perceptions’ (Laird, 2007), and act in ways that are either ‘self-enhancing’ or ‘self-defeating’ (Sedikides & Gregg, 2008). Our ‘self-beliefs’, ‘self-esteem’ and ‘self-concepts’ are argued to shape our thoughts and feelings (Greenwald & Farnham, 2000) while our ‘self-discipline’, ‘self-control’ and ‘self-efficacy’ influence how we behave towards ourselves and others (Zimmerman, 2000). The self plays an important role in psychodynamics, humanism and positive psychology as well as in several psychotherapeutic approaches including ACT (Hayes et al., 1999). Much of this work has been conducted at the mental level of analysis, and as such, the self has usually been conceptualized as a mediating mental agent or motivational force which makes decisions and causes action (see Baumeister, 2010).

Self-Discrimination. Interestingly, and despite its non-technical status, researchers operating at the functional level of analysis have also referred to the ‘self’, often describing behavior as being under ‘self-control’, or as being ‘self-monitored’, ‘self-reinforced’ or ‘selfdiscriminated'. However, rather than posit the self as a mediating mental mechanism, these researchers have sought to better understand the wider class of 'self-related' behaviors and their environmental determinants. Early work in this area focused on the idea that self-awareness involves responding to one's own responding. For instance, Skinner (1974) argued that "there is a difference between behaving and reporting that one is behaving or reporting the causes of one's behavior" (p.34-35). Thus he defined self or self-awareness functionally and argued that it emerges from a history of reinforcement or punishment for accurately labeling controlling environmental antecedents or consequences of one's behavior or physiology (for more see Lattal, 2012).

RFT expands upon this account in several key ways. Foremost amongst these is that it distinguishes between two fundamentally different types of self-discrimination. The first is displayed by many different organisms and involves simply behaving with regards to the individual organism's own behavior. This can be observed in the laboratory by exposing non-humans to reinforcement schedules that generate different patterns of responding and then administering a second task which requires them to correctly discriminate between those different behaviors (e.g., Reynolds & Catania, 1962; Shimp, 1983). These experiments suggest that even organisms without the ability to AARR can discriminate their own behavior when contingencies are appropriately arranged. The second type of self-discrimination is grounded in the ability to AARR and involves behaving *verbally* with regard to our own behavior. According to this perspective, the ability to frame events relationally "serves to transform the highly limited forms of self-awareness seen with non-humans into an extremely complex form of behavior requiring a separate and special treatment in its own right" (Stewart, 2013, p.274). To illustrate, consider the work of Dymond and Barnes (1994). In their study participants were taught three different coordination relations and were then trained to emit two (time-based) self-discrimination responses. That is, if they did not make a response within a certain time-frame then choosing a stimulus from the first coordination relation was reinforced. If they made at least one response within a given time-frame choosing a stimulus from the second coordination relation was reinforced. The authors found that the self-discrimination functions established during training for one stimulus transferred to the other stimuli in those derived relations (see also Dymond & Barnes, 1995, 1996). In other words, the authors found that the self-discriminations made by humans were of a fundamentally different kind to those seen in the non-human literature. Their work suggest that humans do not simply discriminate that they are behaving like many other organisms but rather relationally frame with regard to their own behavior (i.e., they are ‘verbally’ self-aware). This study, in addition to others, indicates that there is an important functional difference between AARR and non-AARR based self-knowledge. Organisms with the ability to AARR can frame one aspect of their own behavior with another, in much the same way that a stimulus can be related to another stimulus or event. In other words, not only can humans relate A as being ‘better/worse than’ B, A as coming ‘before/after’ B and so on, but they can also frame their own behavior in this very same way (e.g., ‘*my colleagues are all better than me*’, ‘*I’m the worst friend ever*’ or ‘*I really should have finished studying before taking a break*’).

RFT therefore extends beyond earlier behavioral accounts in two important ways: it (a) functionally defines what it means to verbally self-discriminate and (b) provides a detailed account of the learning history necessary to establish such a repertoire (e.g., Barnes-Holmes et al., 2001; McHugh & Stewart, 2012; Stewart, 2013). From this perspective, it is the learned ability to respond in-line with deictic frames which provides the foundation for verbal self-discrimination. As we saw in Chapter X, deictic frames are comprised of temporal (NOW-THEN), spatial (HERE-THERE) and interpersonal (I-YOU) relations and their development is somewhat unique. Whereas coordination, distinction and comparative relations emerge based on what people learn about stimuli that are physically similar, dissimilar or quantitatively different along some dimension, deictics are not abstracted from a non-arbitrary or physical referent. Rather they emerge based on the invariance of the speaker's perspective across time and context. In their early interactions with the socio-verbal community, children learn to ask and answer questions like '*What are you doing here?*', '*What am I doing now?*', '*What will you do there?*' with regard to a variety of stimuli, situations and settings. It is the constant division between the speaker (I-YOU) who is always HERE and NOW and the to-be-related stimuli which are THERE and THEN that provides the environmental consistency upon which deictic relations are abstracted and arbitrarily applied (for a more detailed treatment see Barnes-Holmes, Barnes-Holmes, & Cullinan, 2001; McHugh, Barnes-Holmes, & Barnes-Holmes, 2009).

Perspective Taking. RFT proposes that these deictic frames constitute the functional 'seed' from which human self (discrimination) and perspective-taking skills grow and flourish. Perspective taking refers to inferences about our own and other people's desires and beliefs, as well as the use of these inferences to interpret and predict behavior (Baron-Cohen, Lombardo, Tager-Flusberg, & Cohen, 2013; McHugh & Stewart, 2012). Typically developing children show early signs of perspective-taking in infancy, and by around five years, demonstrate evidence that they understand another person's actions and motivations (Baron-Cohen et al., 2013). In contrast, children with autism spectrum disorders (ASD) show severe deficits in their ability to understand and predict events from the perspective of another (e.g., Baron-Cohen, 2000). Although many researchers have approached perspective-taking at the mental level of analysis (often in terms of

'Theory of Mind' or ToM; see Doherty, 2012), others argue that this ability can be understood functionally as an instance of deictic framing. In other words, the abstraction of an individual's perspective of the world, and that of others, requires a combination of a sufficiently well-developed relational repertoire and an extensive history of multiple exemplars that take advantage of that repertoire (McHugh, Stewart, & Hooper, 2012).

Empirical support for this account has been obtained on three separate fronts. First, developmental studies with typically-developing and developmentally delayed children suggest that deictic frames are pre-requisites for successful perspective-taking. Much of this work has shown that deictic frames tend to be fairly well established in the behavior of children above (but not below) five years of age, the same age at which children demonstrate reasonably reliable perspective-taking skills in the ToM literature (McHugh, Barnes-Holmes, & Barnes-Holmes, 2004; McHugh, Barnes-Holmes, Barnes-Holmes, & Stewart, 2006; McHugh, Barnes-Holmes, Barnes-Holmes, Stewart, & Dymond, 2007). Second, a number of studies have assessed the deictic framing abilities of different populations and sought to remediate deficits where present. For instance, several authors have found that children with autism spectrum disorder (ASD) - a population who regularly show deficits in perspective-taking abilities - also show deficits in deictic framing (e.g., Rehfeldt, Dillen, Ziomek & Kowalchuk, 2007) and that training in the latter produces improvements in the former (e.g., Weil, Hayes & Capurro, 2011; see also Gould, Tarbox, O'Hora, Noone, & Bergstrom, 2011; Heagle & Rehfeldt, 2006). Third, there is a small but growing body of research on the relationship between deictic frames and the self, with some studies focusing on the therapeutic implications of this relationship, and others on the role of perspective-taking in clinical (schizophrenia) and subclinical (social anhedonia) populations. For example, individuals with known perspective-taking difficulties, such as those diagnosed with social anhedonia (Villatte, Monestès, McHugh, Freixa i Baqué, & Loas, 2008), or schizophrenia (Villatte, Monestès, McHugh, Freixa i Baqué, & Loas, 2010) also perform poorly on deictic framing tasks that involve interpersonal relations. This also seems to be true for those suffering from social anxiety disorder (Janssen et al., 2014). It may well be that perspective-taking deficits in these areas can be remediated by providing a history of learning in-line with RFT's suggestions (for preliminary evidence in this regard see O'Neill & Weil, 2014)[7].

Summary. In short, RFT connects with, but extends beyond, traditional behavior-analytic accounts of self. It agrees with the Skinnerian view that self-discrimination is an important class of behavior that is functionally different for organisms with and without verbal abilities. What is innovative about RFT then is not the general direction it takes but the specifics it offers. It articulates that verbal self-discrimination involves the learned ability to deictically frame with regard to one's own behavior and outlines the history of learning necessary to produce such performances. At the same time, it also connects with cognitive and developmental approaches to the self which highlight the importance of the subjective 'I' (e.g., James, 1891), the gradual development of perspective-taking skills in childhood (e.g., Baron-Cohen et al., 2000) and the importance of social contingencies in shaping self-awareness or a 'reflexive consciousness' (Baumeister, 2010). Once again it extends beyond these approaches by highlighting that the subjective 'I' emerges in-line with the development of perspective-taking, the latter of which is based on the ability to respond in accordance with temporal, spatial and interpersonal (deictic) relations. Indeed, RFT proposes that once deictic frames become part of an individual's behavioral repertoire they become an inherent property of most events for that

[7] It is worth noting that perspective taking and ToM are not explicitly connected with the self in the wider psychological literature. It is only in the context of the bottom up explanation provided by RFT that the development of perspective-taking is seen as critical to the construction of self (see Stewart, 2013).

person. Once deictics are in place, people can relationally frame their thoughts, feelings, actions, sensations, memories and ideas in different ways. For example, they can relate events that took place in the past or will take place in the future (THERE and THEN) from the perspective of an 'I' that is HERE and NOW. They can also frame events in the present (HERE and NOW) with an 'I' that is also HERE and NOW. And, they can recognize that they always relate events from the perspective of an 'I' that is located HERE and NOW about events that occur THERE and THEN.

Thus research stemming from RFT not only mirrors that seen within the psychological literature on self and perspective-taking, but the inductive, behavioral foundations of this approach lead to new conceptual and empirical insights as well as methods for establishing and remediating these abilities where previously weak or absent. This account highlights the environmental regularities and history of learning that give rise the sense of self. It draws attention to the important role that relational framing and (social) reinforcement play in the discrimination of self from the environment, self from others and self from psychological content or context. In doing so, it provides the necessary information to remediate "self-related problems, whether in respect of the delayed development of self and perspective-taking in autistic or normative populations…or of self-related psychotherapeutic problems as treated by clinicians using Acceptance Commitment Therapy" (Stewart, 2013, p.281).

Future directions. While the future is notoriously difficult to predict, we believe that a number of questions and issues about deictics will shape RFT research over much of the coming years. First, if deficits in deictic framing are evident in developmentally delayed (ASD), subclinical (social anhedonia) and clinical populations (schizophrenia) then the next logical step is to examine whether interventions that directly target the former lead to corresponding improvements in the latter. Once again, this will require new methodologies which can not only assess an individual's ability to deictically frame at increasing levels of complexity but also target stimuli and events that participate in deictic frames during the individual's day-to-day life (e.g. relations such as '*I think you are going to hurt me*' or '*You are always looking at me even when I'm not watching*'). Second, the majority of existing RFT work has tended to focus on the role that deictic frames play in perspective-taking, self, deception and false belief. Future work could expand this analysis even further by clarifying their role in metaphorical reasoning (Foody et al., in press), self-rules (see Chapter Z), delayed gratification, social stereotyping and prejudice as well as persuasion and rhetoric (Roche et al., 2002). It could also attempt to explain why stimuli that are deictically framed are often remembered more accurately (Greenwald & Banaji, 1989) and evaluated more positively (Nuttin, 1987) or examine how the use of these frames differs when verbal communities emphasize independence (Western societies) or interdependence (Asian societies) (Markus & Kitayama, 1991). Third, the 'three selves' that have been discussed in the ACT/RFT literature (Hayes, 1995; Hayes et al., 2001) represent middle level concepts that lack the precision, scope and depth of more technical terms found in RFT. While recognizing their pragmatic utility in the clinical context it is important to realize that because the 'three selves' have not been wrought out of the fires of experimental research, it will be difficult if not impossible to submit them to experimental (functional) analyses like those conducted with concepts like entailment and derived transformation of function (see Foody et al., 2012). Finally, deictic frames may provide a useful means to distinguish the elaborate sense of 'self' displayed by humans and the more limited forms of self-discriminative behavior seen elsewhere in the animal kingdom.

Implicit Cognition

A substantial body of evidence indicates that people often behave in two qualitatively different and potentially conflicting ways (for reviews see Banaji & Heiphetz, 2010; Nosek, Hawkins, & Frazier, 2011; Payne & Gawronski, 2010). On the one hand, and consistent with our intuitive beliefs about behavior, we can respond to stimuli in the environment in a non-automatic fashion. These ‘explicit’ responses are argued to be controlled, “intentional, made with awareness and require cognitive resources” (Nosek, 2007, p.65). On the other hand, our history of interacting with the social, verbal and physical environment can also give rise to automatic or ‘implicit’ responses that are emitted quickly without our awareness, intention and/or control. What is interesting about these ‘automatic’ behaviors is that, although they unfold in the blink of an eye, they often predict the way people will subsequently act, from their voting intentions in upcoming elections (Friese, Smith, Plischke, Bluemke, & Nosek, 2012), the foods and brand products they will approach and consume (Gregg & Klymowsky, 2013), their likelihood of attempting suicide in the following six months (Nock et al., 2010), or breaking up with their romantic partner (Lee, Rogge, & Reis, 2010). Likewise, automatic behaviors also predict the quality and quantity of interactions with members of other racial (McConnell & Leibold, 2001) or social groups (Agerström & Rooth, 2011) in ways that self-report questionnaires often fail to capture.

Whereas ‘non-automatic’ behaviors are typically captured via direct measurement procedures like questionnaires, interviews, and focus groups, their automatic counterparts are registered using indirect procedures, the most popular of which include semantic and evaluative priming (Fazio, Jackson, Dunton, & Williams, 1995; Wittenbrink, Judd, & Park, 1997), the Affective Misattribution Procedure (AMP; Payne, Cheng, Govorun, & Stewart, 2005) as well as the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) and its secondgeneration variants. Indirect procedures have been adopted by researchers from nearly every corner of psychological science and have had a powerful impact on empirical and theoretical output due to their practical value in predicting human behavior.

Mental level of analysis. Unsurprisingly, the study of implicit cognition has been dominated by researchers operating at the mental level of analysis (for a discussion see Hughes, Barnes-Holmes, & De Houwer, 2011; Hughes, Barnes-Holmes, & Vahey, 2012). In-line with their scientific goals, cognitive and social psychologists have attempted to explain why automatic responding corresponds, conflicts and predicts non-automatic behavior by appealing to some set of mediating mental mechanisms. Although there are non-trivial differences across mental models of implicit cognition, the assumption that associations (Fazio, 2007), propositions (De Houwer, in press), dual-process models involving reflective-impulsive systems (Strack & Deutsch, 2004), associations *and* propositions (Gawronski & Bodenhausen, 2011), or multiple interactive memory systems (Amodio & Ratner, 2011) mediate between environment and behavior is foundational. In other words, mental theories are primarily concerned with how mental constructs are formed, activated and changed as well as their influence on automatic and controlled behavior.

Functional level of analysis. Unsurprisingly, RFT researchers have approached this topic with a different set of scientific goals in mind. These researchers have sought to identify the environmental and historical regularities that give rise to different classes of behaviors, such as those captured by direct and indirect procedures. This analysis has been formalized in an RFT-inspired account known as the Relational Elaboration and Coherence (REC) model (see Hughes et al., 2012). At the core of this model reside two simple ideas: (a) that explicit and implicit cognition represent instances of the learned and contextually controlled ability to frame events relationally and that (b) these relational responses can vary in their *complexity* and history of *derivation*. Relational complexity refers to the fact that stimuli can be related to one another in a vast number of ways, from simple mutually entailed relations between single stimuli to combinatorial relations involving multiple stimuli, to the relating of relations to other relations as well as the complex relating of entire relational networks to other networks. The REC model draws attention to this fact and arranges relational responding along a ‘complexity’ continuum from high to low. At the same time, relations not only vary in their complexity but also in the degree to which they have been previously derived. Derivation refers to the finding that once a set of stimulus relations have been directly trained (e.g., A-B and B-C), a number of novel and untrained relations tend to emerge (e.g., A-C and C-B). The REC model defines the first time a person derives the relation between A and C as a ‘high derivation’ response given that the history of deriving that particular response is minimal. As a person encounters an ever increasing number of opportunities to derive, their responding may increasingly be defined as involving ‘lower’ levels of derivation. The REC model draws attention to this fact and arranges relational responding along a ‘derivation’ continuum from high to low (see Figure 3)[8].

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[8] The descriptive terms *brief and immediate relational responding* (BIRRs) versus *extended and elaborated relational responding* (EERRs) have been used to distinguish between the types of responses that were typically targeted by indirect and direct procedures, respectively. However, the terms BIRRs and EERRs are descriptive, whereas the concepts of derivation and complexity point to variables that may be involved in producing these two broadly defined patterns of behavior. In the current chapter we will continue to use these descriptive labels, while recognising their limited explanatory value.

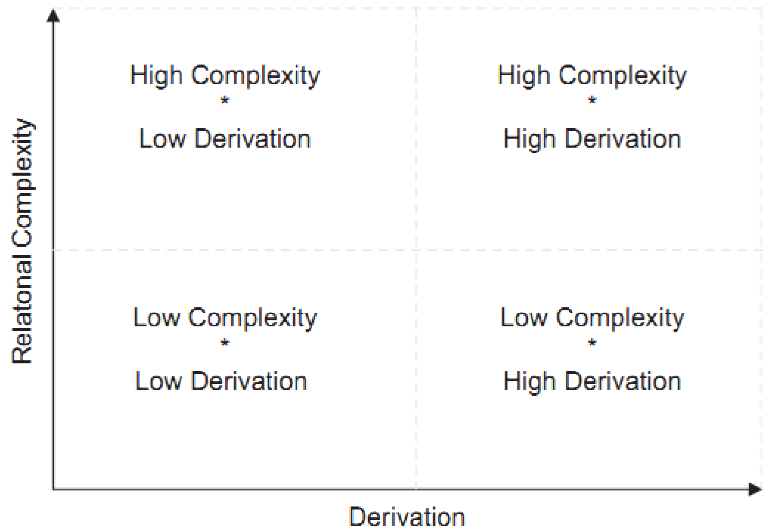

Figure 3. Relational responding carved into four different categories as a function of the complexity and level of derivation that characterize the response.

Arranging relational responses along these inter-related continua affords a number of useful advantages. First, it highlights that 'automatic' and 'non-automatic' thoughts, feelings and actions are instances of the same overarching class of behavior (AARR) that varies in *degree* rather than in *kind*. From a REC perspective, when researchers use terms such as 'implicit cognition' or 'automatic responding' they are referring to relational responses that are typically characterized by lower levels of complexity and derivation. Likewise, terms such as 'explicit cognition' or 'non-automatic responding' typically refer to responses that are characterized by higher levels of complexity and derivation. In other words, the REC model equips functionally-orientated researchers with a nomenclature that is not imported from either the lay community or the mental level of analysis. Instead it employs terms that are directly rooted in a bottom-up functional theory that coherently connects basic concepts to complex behavioral phenomena (i.e., it is philosophically and conceptually consistent with CBS and RFT). Adopting this approach lowers the likelihood that the functional and mental levels of analysis will be conflated and provides insight into the possible functional origins, properties and conditions necessary to observe these classes of behavior.

Second, the idea that relational responses vary in their complexity and history of derivation is consistent with the general trend of evidence in the RFT literature. We now know that relational responses, like all behaviors, unfold across time, and that (all things being equal) more complex responses take additional time and are emitted with lower accuracy relative to their less complex counterparts. As the number and type of relations increase the speed and accuracy of responding decreases relative to relations that are at lower levels of complexity (e.g., Barnes-Holmes et al., 2005). At the same time, the extent to which a response has been derived in the past will also influence its probability of being emitted quickly (Roche, Linehan, Ward, Dymond, & Rehfeldt, 2004) and accurately in the future (Healy Barnes-Holmes, & Smeets, 2000). Thus it appears that the complexity of a relational response, as well as the degree to which it has been derived in the past, influences the probability that it will be emitted with speed and accuracy in the future.

Third, given that relational responses vary in their complexity and derivation, and that lower complexity/derivation responses are emitted with greater speed and accuracy than their high complexity/derivation counterparts, it follows that different experimental procedures will be more or less sensitive to certain types of responses depending on how they are designed. Consider, for example, indirect tasks like the IAT or priming. Broadly speaking, these measures compare the speed with which people relate stimuli from two different classes with a common response key in ways that are either consistent (*Spiders-Bad*) or inconsistent (*Spiders-Good*) with the individual’s prior learning history. In the language of RFT, these tasks (a) establish a higher-order coordination relation between two stimulus classes based on a shared response function and then (b) compare the speed with which these coordination-based responses are emitted when people have to respond in history consistent versus inconsistent ways (O'Toole, Barnes-Holmes, & Smyth, 2007). The key point here is that by arranging the measurement context to primarily target coordination relations, the IAT and priming tasks are restricted in the complexity of the relational responses that they can capture. In other words, when viewed through the lens of the IAT and priming measures, implicit cognition seems to involve low complexity/derivation *coordination* relations between stimuli (e.g., *Black People-Same-Good*; *White-Same-Bad*), which at the mental level of analysis, has been interpreted as evidence for the automatic activation of mental associations in memory (Hughes et al., 2011).

Critically, however, the REC model argues that the behaviors targeted by indirect procedures are relational in nature. Given a sufficient history of learning, and a measurement context capable of capturing those relations, the behavioral effects obtained on indirect procedures should reflect other relational responses above and beyond coordination. In principle, low complexity/derivation responses can involve any relationship between stimuli, such as opposition, hierarchy, comparative or deictic relations. Although the speed and accuracy of these responses will presumably vary in accordance with the levels of complexity and derivation of the targeted relation, there is no *a priori* reason why any type of relational response should not be emitted quickly and accurately. One implication of viewing implicit cognition in this way is that an indirect procedure capable of targeting stimulus relations at differing levels of complexity is not only possible but quickly becomes necessary. RFT researchers have offered the Implicit Relational Assessment Procedure (IRAP) as one such task (Barnes-Holmes, Barnes-Holmes, Stewart, & Boles, 2010; although also see O'Reilly, Roche, Ruiz, Ryan, & Campion, 2013).

Simply put, the IRAP was designed to target pre-existing relational response biases by placing an individual's learning history into competition with a response contingency deemed inconsistent with that history of responding. To illustrate, consider the work of Nicholson and Barnes-Holmes (2012) who examined low complexity/derivation responding towards disgusting stimuli. Participants completed two separate IRAPs: one targeting so-called "disgust propensity" when confronted with revolting items (e.g., "I'm disgusted") and a second assessing so-called "disgust sensitivity" to the same stimuli (e.g., "I need to look away"). In either case, the IRAP presented a label stimulus (e.g., 'I am disgusted') at the top of the computer screen, a target stimulus (e.g., picture of a disgusting image) in the middle of the screen and two relational response options ('True' and 'False') at the bottom of the screen. During half of the trials participants were required to respond as if pleasant images were positive and disgusting images were negative. On the other half of the trials they are required to produce the opposite response pattern (pleasant images--negative and disgusting images--positive). The difference in time taken to respond in one way versus the other – defined as the IRAP effect – indicated the strength or probability of pre-existing relational response biases. In the Nicholson and Barnes-Holmes study, the authors found that performance on the two IRAPs predicted entirely different outcomes on self-report and behavioral choice tasks. In other words, different patterns of (rapidly emitted) relational responding towards the same target stimuli predicted how people would act towards other stimuli at a future point in time (see also Remue, De Houwer, Barnes-Holmes, Vanderhasselt, & De Raedt, 2013).

Like the IAT and priming measures, the IRAP can target simple (coordination) relations between stimuli that have been derived many times in the past, and in such cases, the latter tends to produce similar outcomes to the former (e.g., Barnes-Holmes, Murtagh, Barnes-Holmes, & Stewart, 2010). However, and consistent with the REC model's predictions, a rapidly expanding

IRAP literature suggests that the measure can also capture more complex relational responses which are, nevertheless, highly derived and emitted in the order of milliseconds. Not only are these latter responses emitted quickly and accurately but they often predict self-reported and real-world behaviors with greater sophistication than responses towards relations at lower levels of complexity (Roddy, Stewart, & Barnes-Holmes, 2010, 2011). In other words, when viewed through the lens of the IRAP, implicit cognition reflects relational responding that is certainly at low levels of derivation but not necessarily restricted to coordination relations. Rather relational responses which unfold in the blink of an eye can also vary in their respective complexity (e.g., '*I'm a worthless person*'; '*I want to be successful*'), which at the mental level of analysis, fits more readily with the idea of automatically activated propositions in memory (De Houwer, in press). These more complex responses can predict a person's sexual orientation (Timmins, Barnes-Holmes, & Cullen, 2014), their likelihood of staying in a drug rehabilitation program (Carpenter, Martinez, Vadhan, Barnes-Holmes, & Nunes, 2012), of interacting with feared stimuli in the environment (Nicholson & Barnes-Holmes, 2012), or professionally burning out when working with developmentally-delayed children (Kelly & Barnes-Holmes, 2013). They typically converge with those obtained from self-report tasks when people are not motivated to self-present or modify their behavior to concord with social expectations (e.g., Vahey, Barnes-Holmes, Barnes-Holmes, & Stewart, 2009). They also diverge from self-report data in "psychologically sensitive" domains, especially where racial, religious and social groups are concerned (for a recent review of the IRAP literature see Hughes & Barnes-Holmes, 2013)[9].

Summary. Functional and mental models of implicit cognition are similar insofar as they

[9] The REC model appeals to a third property of derived relational responding (i.e., relational coherence) in order to explain why BIRRs can either converge or diverge from EERRs in different contexts (for a detailed treatment of coherence in this context see Hughes et al., 2012; Hughes & Barnes-Holmes, 2013).

both agree that thoughts, feelings and actions can unfold quickly, in ways that sometimes lack self-discrimination (awareness), and which take place in the presence of other demanding tasks (efficient) or competing verbal contingencies (intentional). They also agree that these ‘automatic’ responses can come to exert a powerful influence over our more elaborate and carefully considered behaviors. However, the former deviates from the latter by defining implicit and explicit cognition *functionally* as instances of AARR which vary in their respective levels of complexity and derivation. Researchers at these two levels also differ in their assumptions about the origins and properties of, as well as relationship between, explicit and implicit cognition. The REC model draws upon three conceptual tools (relational coherence, complexity and derivation) as well as a methodological one (the IRAP) in order to account for thinking, both fast and slow. Unlike the notion of mental associations or propositions, these concepts simply refer to properties of the same behavioral process (AARR) that become more or less prevalent in different (measurement) contexts.

Future directions. Although the REC model is consistent with findings in the RFT literature, and those pointing to the impact of relational information on implicit measures in cognitive science (see De Houwer, in press), a number of questions still need to be addressed. First, a detailed experimental analysis of relational complexity and derivation, as well as their interaction, is clearly needed. This also applies to relational coherence and self-discrimination (‘awareness’), both as topics in and of themselves as well as their interaction with the above two factors. Second, while a small number of studies have provided experimental evidence for the development of BIRRs (e.g., Hughes & Barnes-Holmes, 2011; O’Reilly et al., 2013; O’Toole, Barnes-Holmes, & Smyth, 2007) a systematic exploration of the learning histories and current contextual variables critical to establishing, maintaining, and changing such behaviors is clearly needed. So too is an analysis of how levels of complexity and derivation impact upon an individual's behavior across the lifespan. While pragmatic considerations can interfere with the collection of data in infants, we argue that a developmental understanding of implicit cognition is certainly worth the effort (Banaji & Heiphetz, 2010; see also Rabelo, Bortoloti, & Souza, 2014). Third, we have only begun to scratch the surface when it comes to the role that complexity and derivation play in clinical, social, health and forensic domains. Future work could determine whether the world of implicit cognition, as viewed through the lens of procedures such as the IRAP, allow us to better understand, predict and influence real-world behaviors such as close-relationships, judgment and decision making, job-hiring situations, consumer behaviors as well as law, public policy, and organizational practices. Finally, and like all definitions, the parsing of relational responses based on complexity and derivation is a matter of convention; not fixed or absolute but rather flexible to further modification in-line with empirical findings. It may well be that other properties of AARR allow us to develop a more sophisticated functional treatment of implicit cognition than that offered here. Although the REC model requires in-depth empirical scrutiny, we believe that it provides RFT researchers with an opportunity to participate fully in the study of implicit cognition alongside our contemporaries in social and cognitive psychology.

Intelligence

The study of individual differences is populated with a wide spectrum of contrasting definitions and theories about the origins and properties of 'intelligence' (for a detailed treatment see Sternberg & Kaufman, 2011). For some, intelligence involves 'language and the capacity to develop and transmit culture, to think, to reason, test hypotheses, and understand rules' (Mackintosh, 2011, p.1). For others, it represents the ability to adapt to the physical, social and verbal environment "in which one finds oneself. If that environment is suboptimal, it involves the ability to shape the environment to make it more suitable for one's skills and desires; and if that environment still does not work, it involves the ability to select a different environment, to the extent that one is able" (Sternberg, 2014a. p.176). Theories of intelligence sometimes decompose this phenomenon into composite elements such as problem-solving abilities, verbal intelligence and social competence (Sternberg, 1985) or define it in terms of a psychometrically identified general intelligence factor known as 'g' (Jensen, 1998). Still others advocate for a multiplicity of intelligences (Gardner, 2006). These various ways of conceptualizing and studying intelligence are themselves guided by different metaphorical ways of viewing the mind, from geographic (psychometric methods), and computational perspectives (information-processing methods), to biological (physiological methods) and anthropological (cultural and cross-cultural) (see Sternberg & Kaufman, 2011). While some authors have attempted to identify the mental mechanics of intelligence others have looked to the brain, nervous system (Deary, 2000), genetics (Plomin, 2012) and their interaction for answers. What is clear is that intelligence is operationalized and valued in different ways in different cultures, such that characteristics which lead to successful adaptation in one culture may not do so in another (Sternberg, 2004). Finally, the steady rise in intelligence test scores over the past century (Flynn, 2007) and their sensitivity to educational and programmed interventions has led researchers to question the view of intelligence as an invariant trait that is static across the lifetime of the individual. Instead growing consensus suggests that it can be systematically modified (see Sternberg, 2014a, 2014b), with researchers differing in how much of an increase they think is actually possible.

Intelligence at the functional level. Switching to the functional level of analysis requires that we conceptualize and approach the study of intelligence in a fundamentally different light. Intelligence is no longer considered a mental mechanism that individuals 'possess' and which mediates their actions but is simply a descriptive term for a measurable quality of some class or group of behaviors that tend to occur in a given context (e.g., analogical reasoning, spatial orientation and mathematical skills) (see Williams, Myerson, & Hale, 2008). Viewing intelligence as behavior causes researchers to shift their attention away from questions about the structure or qualities of some mental mechanism or psychometric construct and towards the functional determinants of that behavior. Stated more precisely, functionally-orientated researchers are interested in the types of behavior (and contexts in which they occur) that cause psychologists and society to use terms such as intelligence as well as the current and historical regularities of which intelligent behavior is a function. Thus understanding ‘intelligence’ at the functional level means being able to specify the environment-behavior relations that establish, maintain and sensitize that subclass of behaviors commonly referred to as ‘intelligent’. Addressing these and related questions has enormous practical utility insofar as it brings researchers one step closer to designing technologies that can enhance the fluency, sensitivity and flexibility of intellectual behavior in developmentally delayed and normally developing populations.

RFT and intelligence. This is precisely the approach that RFT researchers have taken over the past decade (see Barnes-Holmes, Barnes-Holmes, & Cullinan, 2001; Cassidy, Roche, O’Hora, 2010; O’Toole, Murphy, Barnes-Holmes, & O’Connor, 2009; Roche, Cassidy, & Stewart, 2013; Stewart, Tarbox, Roche, O’Hora, 2013). The core idea underlying much of this work is a simple but bold one: that AARR represents the basic functional ‘building block’ of those cognitive and linguistic skills (e.g., deductive and inductive reasoning, communication, etc.) that underpin intelligent behavior. Stated more precisely, intellectual performances involve the ability to elaborate entire networks of derived stimulus relations *fluently* and *flexibly*, to bring those relational responses under increasingly subtle forms of contextual control, to transform stimulus functions through entire networks, and to abstract features of the natural environment that will support and sustain relational responding.

Evidence in support of this claim has emerged on two separate fronts. We now know that the fluency and flexibility with which people derive at increasing levels of complexity predicts their performance on intelligence tests. O'Hora, Pelaez and Barnes-Holmes (2005) found that performance on a complex relational task involving temporal, coordination and distinction relating predicted outcomes on the Wechsler Adult Intelligence Scale (WAIS-III). Specifically, participants who successfully completed a learning task designed to establish arbitrary relational cues, and who could then use those cues to form derived stimulus relations showed evidence of superior outcomes on the Vocabulary and Arithmetic subscales of the WAIS-III relative to their counterparts who failed that same task. In a follow-up study, O'Hora and colleagues (2008) found that performance on a temporal relating task was predictive of participant's Full Scale, Verbal and Performance IQ. Similar to before, participants who passed a task designed to establish arbitrary stimuli as relational cues, and who could use those cues to frame events temporally showed evidence of superior outcomes on the Verbal Comprehension and Perceptual Organization factors of the WAIS-III relative to their counterparts who failed to do so. O'Toole and Barnes-Holmes (2009) employed an IRAP to test the fluency (speed and accuracy) with which participants could frame events temporally, in coordination and distinction with one another in ways that were either consistent or inconsistent with their prior learning history (e.g., '*Spring comes before Summer*' vs. '*Marriage comes before Engagement*'). Results indicated that fluency in reversing previously established relations correlated with IQ as measured by the Kaufman Brief Intelligence Test (K-BIT). People who produced higher IQ scores on the K-BIT were also ‘relationally flexible’ insofar as they were faster to respond in history-consistent and inconsistent ways on the IRAP. Their ‘relationally rigid’ counterparts who experienced greater difficulty in reversing previously established relations scored lower on that same test. Finally, Gore, Barnes-Holmes and Murphy (2010) exposed a number of adults with varying levels of intellectual disability to standard measures of language and IQ, as well as to an adaptation of a deictic framing protocol (McHugh, el al., 2004). They found that the degree to which participants could deictically frame at increasing levels of complexity correlated with verbal ability, full-scale IQ and performance IQ on the Wechsler Abbreviated Scale of Intelligence (WASI-III). Taken together, these studies suggest that the fluency and flexibility of relational responding represent important predictors of intelligent (linguistic and cognitive) behavior.

While the above findings are certainly consistent with the idea that relational framing constitutes the core functional process underlying intellectual behaviors, a more robust test of this assumption requires that the fluency and flexibility of relational responding be directly targeted and corresponding changes in intellectual performance observed. In other words, if intelligent behavior is an instance of AARR, and if AARR is itself a type of generalized operant behavior, then promoting relational flexibility (and undermining rigidity) should enhance behaviors that are generally deemed as ‘intelligent’.

As we saw in Chapter X, MET interventions can be used to establish or improve a variety of relational frames where previously absent or weak in adults and children. Thus one possibility would be to expose participants to an intelligence test before and after MET designed to enhance relational framing skills so that corresponding changes in intellectual performance could be ascertained. This is the very strategy that Cassidy et al., (2011) adopted in their recent study. They recruited a group of educationally typical and sub-typical children and then exposed them to a simple conditional discrimination task which trained and tested coordination responding towards the same set of stimuli. Thereafter half of the participants received ‘advanced’ MET that established relational fluency in coordination, comparative and opposition relating while the other half were exposed to the same training and testing as before. IQ tests were administered (a) at baseline, (b) following the conditional discrimination phase (after 3 months) and (c) after MET was completed (after 2 years). The authors found that training fluency in establishing and responding to multiple stimulus relations produced corresponding improvements in full and subscale IQ. Whereas fluency in coordination relating across multiple exemplars proved to be relatively beneficial, training relational fluency at higher levels of complexity led to the largest improvements in post-test IQ scores. Interestingly, follow-up testing indicated that these rises in IQ scores were still present almost four years later, suggesting that relational training and testing “successfully targeted skills that were of enduring importance in the ongoing intellectual and educational activities of the children” (Roche et al., 2013, p.290). Although these initial findings require intensive and systematic replication, they provide the first step towards a functional analysis of the relationship between AARR and intellectual behavior. They also hint at the power of MET as a procedure for improving the flexibility and fluency of relational framing.

Summary. Attempting to kick-start intellectual development and boost educational achievement in typically developing and educationally deficient populations is an ambitious goal to say the least. Yet research at the functional level may provide the theoretical and methodological tools to make this goal a reality. RFT contributes to the study of intelligence by providing a functional definition of this phenomenon, which in turn leads to clear, testable predictions about its origins and properties. The key idea here is that AARR represents the fundamental ‘building block’ of intelligence and that *fluent* and *flexible* relational framing underpins the skills and abilities needed to succeed in educational contexts. RFT also suggests that by directly targeting relational framing, and building fluency and flexibility in those repertoires, intellectual performance and educational attainment may be enhanced.

Future directions. Taking a step back, it should be evident that this line of research is very much in its infancy and that many conceptual and empirical challenges will require attention in the road ahead. Foremost amongst these, concerns our understanding of AARR itself: limited work has been conducted on several types of framing (spatial, temporal, logical and hierarchical) while little or no work has been carried out on others (conditionality). Nor do we know how relational frames interact with, and support each other, throughout intellectual development. Although early indications point to the importance of establishing fluency across a variety of frames and exemplars (Cassidy et al., 2010), we do not know which frames or combination of frames are more or less important for different intellectual skills and abilities. At the same time, existing procedures for training fluent and flexible framing will need to be refined and the moderating impact of biological (diet, sleep, genetics), social (family structure, social skills) and psychological (motivation, self-discipline) factors examined before these protocols are rolled-out to educational and applied contexts. Existing work has almost exclusively focused on a handful of frames (e.g., coordination, temporal and comparison) and their relationship to performance on standardized intelligence tests. Future interventions will need to determine the optimum order, sequence and content of training needed to promote intellectual abilities across a variety of populations (children, teenagers, adults) and examine whether training in additional frames (hierarchical, deictic and conditional) leads to even greater gains than those seen so far.

When carrying out this work researchers should also incorporate a wider range of outcomes measures. In nearly every study to date accuracy has been used as the main dependent measure of relational responding. Yet the acquisition *rate* at which contextual cues and stimulus relations are established or modified and the *speed* with which history-consistent responses are reversed may refine our understanding of intellectual behavior to a greater degree than accuracy-based measures alone. Thus alternative properties of relational responding will need to be considered and new measures for capturing such performances devised. For instance, RFT-inspired protocols such as the Training and Assessment of Relational Precursors and Abilities (TARPA) and PEAK relational training system (Dixon, et al., 2014), seem to provide systematic means to assess and train the key skills implicated in flexible relational responding (see Moran, Stewart, McElwee, & Ming, 2014). Early work also suggests that the IRAP can assess the flexibility of relational responding at various levels of complexity (O'Toole & Barnes-Holmes, 2009). Researchers could draw upon the IRAP in order to identify instances of relational rigidity that could benefit from flexibility training (via the TARPA or PEAK) or assess the impact of other MET procedures designed to enhance relational framing skills. If relational flexibility is indeed a core feature of human intelligence, then it follows that rigidity, the antithesis of flexibility, is likely to be detrimental to intelligence. Finally, the majority of research to date has correlated relational performances with standardized measures of intelligence. Future work could examine whether more sophisticated framing abilities lead to other outcomes above and beyond improved intelligence scores, such as scholastic achievement, career success, or improved health and longevity. Addressing these and related issues will provide stronger evidence that an RFT approach to intellectual development makes a genuine difference in the lives of others.

Part IV: Conclusion

In their original book length treatment of RFT back in 2001, Hayes and colleagues suggested that while the theory certainly seemed to be a generative one, we would not know if it was truly progressive and pragmatically useful until it increased our ability to predict and influence human language and cognition with precision, scope and depth. Even a cursory glance through the current chapter (and those elsewhere in this handbook) will serve to reinforce how RFT met this challenge head-on and delivered on several important fronts. Evidence indicates that we have identified the environmental regularities and history of learning necessary to predict and influence ‘cognitive’ phenomena such as self (discrimination) and perspective-taking, intelligence as well as thinking fast and slow. This approach has equipped researchers with variables that have fed the engines of application in order to change the world in a positive and intentional way. For instance, with a better understanding of deictic framing came technologies that enabled us to establish or enhance perspective-taking skills in developmentally-delayed and (sub) clinical populations where previously weak or absent. With an appreciation for different properties of relational framing came procedures designed to capture events which unfolded in the blink of an eye, and to use those responses for predicting clinical, social and health-related behaviors. Information about the fluency and flexibility of relational framing also pointed to possible strategies for cultivating and enhancing human potential.

Two points are worth noting before we bring this chapter to a close. First, we only managed to capture a thin slice of the conceptual and empirical forces currently shaping the RFT literature. Ongoing work has also implicated AARR in a host of other complex human behaviors, from the development of false memories (Guinther & Dougher, 2010, 2014), and maintenance of auditory hallucinations (Monestes et al., in press), to the search for meaning and sense making (Quinones & Hayes, 2014), problem-solving (Stewart et al., 2013), motivation (Ju & Hayes, 2008) and emotion (Barnes-Holmes & Hughes, 2013). Refining our functional understanding of these and related domains may provide input for a range of applications that change the world in other positive and useful ways. Second, while we have made progress over the past decade, there is still much work that needs to be done. For instance, the contribution of AARR to (a) the stability and change of behavior within and between individuals across time and context (personality; Harrington, Fink, Dougher, 2001), (b) how an individual's thoughts, feelings and actions vary as a function of the social context (group cohesion, stereotyping, prejudice; Roche et al., 2002), (c) financial or organizational decision making (behavioral economics; Quinones, Hayes, & Hayes, 2000) and (d) the ability for others to modify our behavior via persuasion or rhetoric has yet to be subjected to systematic empirical scrutiny. The same goes for topics such as pragmatic verbal analysis (or 'thinking'), problem-solving, emotional and moral development, close relationships and many other aspects of human psychological life. Delving into the RFT literature reveals a deep, rich vein of theoretical assumptions about these and related areas that - in many cases - have yet to be empirically mined. Transforming these ideas into generative, progressive and pragmatically useful programs of research will require equal parts ingenuity and methodological innovation.

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