

# Criticizing the Tendency for Evolutionary Psychologists to Adopt Cognitive Paradigms When Discussing Language

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## ABSTRACT

Relational Frame Theory (RFT) has opened previously unreceptive areas of empirical behavioral research and illuminated fundamental aspects of human language and cognition. We may gain additional insight into the function of language by understanding the specific contingencies in our environment that have been instrumental in its evolution and development. Evolutionary psychology may help to illuminate the effects of verbal behavior in naturally and sexually selected environments, allowing researchers a better understanding of how and why we form complex relations.

*Key Words:* RFT, language, human cognition, evolution and development of language, evolutionary psychology, natural selection, sexual selection, formation of complex relations.

## RESUMEN

La Teoría del Marco Relacional ha abierto áreas de investigación empírica hasta ahora poco receptivas a un enfoque conductual, a la par que ha arrojado luz sobre aspectos fundamentales del lenguaje y la cognición humanos. Podemos obtener un conocimiento aún mayor acerca de las funciones del lenguaje si llegamos a entender las contingencias específicas en nuestro ambiente que han tenido un papel instrumental en la evolución y desarrollo de estas capacidades. La psicología *evolucionista* puede ayudar a entender los efectos de la conducta verbal en medios seleccionados natural y sexualmente, permitiendo así a los investigadores un mejor entendimiento de cómo y por qué formamos relaciones complejas.

*Palabras clave:* RFT, lenguaje, cognición humana, evolución y desarrollo del lenguaje, psicología evolucionista, selección natural, selección sexual, formación de relaciones complejas.

## AN EVOLUTIONARY PERSPECTIVE ON RELATIONAL FRAME THEORY

Relational Frame Theory (RFT) is an ambitious account of language and cognition that is conceptually and empirically accessible in ways that other psychological theories of language have not been. In a relatively short time, it has opened previously unreceptive areas of empirical behavioral research and illuminated fundamental aspects of human

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cognition. And, while RFT has stirred up some controversy among behavior analysts (Boelens, 1996; Burgos, 2003; Sidman, 1994; Galizio, 2003), it has also piqued the interest of researchers outside behavior analysis.

Evolutionary psychologists have also investigated many of the issues and behavioral data addressed by RFT and incorporated them into their work on human cognition and language. Unfortunately, most of these integrations have come from a mechanistic and mentalistic perspective, which is incompatible with the functional, contextual approach that characterizes RFT. An example of this is Dickins' 2003 article, *General Symbol Machines: The First Stage in the Evolution of Symbolic Communication*. Dickins examines the role of arbitrary relational responding, associative learning, and stimulus equivalence in the evolution of human language and cognition. As the title makes clear, the author uses these concepts to propose cognitive devices and hypothetical mental computational mechanisms, relying on the conceptual framework established by Chomsky. The General Symbol Machine (GSM) that Dickins advocates is similar to Chomsky's inborn Language Acquisition Device (LAD) but is used in an attempt to explain broader categories of relational responding, not just language.

While evolutionary psychologists often adopt the Chomskian approach to language and cognition, there are some glaring disjunctions between the mechanism and mentalism of Chomsky's theory and the functionalism and selectionism of evolutionary theory. In Chomsky's approach, LADs did not evolve through traditional Darwinian principles, and "the relationship between words and the world is intrinsic, fixed, and determined" (Devereux, Rosenwasser, & Hantula, 1997). Given this fundamental difference in the two perspectives, it could be argued that the Chomskian approach is not the best match for evolution-based theories of language and cognition. Nor is it compatible with RFT, which is antithetic to the concept of fixed or determined relationships between words and the world.

Because evolutionary explanations of language frequently have their basis in Chomskian principles, they are unable to satisfy the empirical, methodological, and philosophical preferences of behavior analysis. Mental and mechanical explanations may allow for the prediction of behavior, but they do not directly allow for its control or influence. The scientific goal of behavioral influence requires the specification of the determinants of these behavioral processes not in terms of hypothetical cognitive structures but in terms of the controlling contexts and functions of verbal behaviors (Dougher & Hayes, 2000). It is our contention that by using a larger evolutionary framework to examine RFT, we may gain some insight into the specific functions and environmental contingencies that have been instrumental in the development of language.

Relational Frame Theory provides a functional, contextual perspective for studying verbal behavior. In this approach a "language" is a conventional set of words and rules for combining them. "Words" are stimuli that function within relational frames, and the "rules" for combining them are contextual cues that disambiguate derived relational responses and the transformation of stimulus functions. So "cognition" becomes relating and is, therefore, a behavioral event (Hayes et al., 2001, p. 145). Verbal behavior, therefore, is a specific set of behaviors derived from the larger class of relational responding that comprises all cognition.

Behavior analytic explanations of language have been criticized and ignored because of the common assumption that principles derived largely from rats and pigeons are insufficient to explain anything as complex as human language and cognition (Hayes et al., 2001, p. 145). The long-standing rationale for the behavioral approach has been that the principles of behavior identified with animal populations are applicable to humans. This strategy has been hugely successful in some domains and has yielded a number of principles that transfer from nonhuman to human populations. However, it has been less successful in explaining verbal behavior.

One area in which traditional behavior analysis has been found wanting is in its attempts to explain linguistic behavior. As Hayes et. al write, “arbitrary applicable relational responding occurs readily, even with human infants and with difficulty or not at all with nonhumans. After thirty years of behavior analytic research on derived stimulus relations, that statement is still true” (p. 145). There appears to be a qualitative difference between human and animal abilities in this regard. A complete theory of language and human cognition cannot be derived from studying nonhumans, but the foundations for language and cognition were established in our evolutionary ancestors.

Just as contingencies in our environment and our individual life histories shape our behavior, so has our ancestral environment shaped our evolution. Patterns of genes, which influence behavior, are selected for and against, shaping populations in different ways. Human behavior has been shaped by direct environmental contingencies as well as a verbally constructed world (Hayes et al., 2001, p. 49). Primates, our closest relatives, have been shown to differentially respond to a number of vocal stimuli. However, as Hayes et. al (2001) point out, “all primates may run or hide when they hear cries of danger... but even a single individual could have a significant behavioral advantage over others if in similar contexts a weaker cry of danger is ‘heard’ through the derivation of a bi-directional relation. As this small difference gains prevalence in a gene pool, a group of listeners capable of deriving bi-directional relations could be created” (p. 146). Once started, the behavioral advantages of evolving verbal communities would translate into improved reproductive success and through the process of natural and sexual selection, a social species of primate would be thrown into a “self-amplifying loop of language and culture [causing] a full blown social/verbal community to explode on the scene with verbal reasoning, planning, problem-solving, written language, religion, philosophy, sense of self, literature, science, technology and so on” (p. 146).

Any theory of language and cognition must explain how such a system arose. What conditions gave rise to such a complex and qualitatively unique system? Consistent with the pre-analytic assumptions of behavior analysis, it could be argued that useful information concerning the ultimate (as opposed to proximate) causes of verbal behavior may be found in the relatively new field of Evolutionary Psychology.

An appreciation for the evolutionary forces that have shaped current human behavior is not new to behavior analysis. Skinner (1981) states that human behavior is the product of both contingencies of survival dictated by natural selection and contingencies of reinforcement on an individual and cultural level. We contend that Relational Frame Theory, the study of language, verbal behavior, and cognition is a logical starting point for integrating behavior analysis and evolutionary psychology. Evolutionary psychology

can benefit from behavior analytic concepts and techniques that emphasize the behavior of individuals from a long-term, contextual, and functional perspective. Conversely, behavior analysis could benefit from an evolutionary understanding of the determinants and effects of behavior in naturally and sexually selected environments.

We are not advocating the wholesale importation of evolutionary theories of language into a behavioral approach. First, the predominant approaches to evolutionary psychology are primarily cognitive and mentalistic and have their own goals, assumptions, and root metaphors. Many of these theories are simply incompatible with or irrelevant from a behaviorist perspective. Secondly, many evolutionary explanations of behavior have are post-hoc, “just so stories” that fail to capture the richness and complexity of human cognition and language. Many of the criticisms that have been leveled at behaviorists who have tried to deduce the principles of language from nonhuman behavior have been applied to evolutionary psychologists.

However, where we think evolutionary psychology can advance our understanding of language is by expanding our understanding of the function of language and the context in which it evolved. Language need not be thought of simply as a tool for survival, a basic defensive mechanism or an instrument for communicating mundane, pragmatic information. Instead, our capacities for language, art, music, humor, creativity, and all things requiring the creation of “precise, complex, subtle, or abstract” relational networks, may be a by-product of the complex and vitally important competition for mates (Miller, 2000).

There has recently been a renaissance of an idea in evolutionary psychology that had been overlooked by biologists and anthropologists for over a century after it was proposed: sexual selection. Sexual selection is a counterpart to natural selection. Just as healthy, strong, and fast individuals were more likely to survive in our ancestral past, individuals who were intelligent, handsome, and had resources or skills were more often selected as mates. Sexual selection is a dynamic, self-referential system in which genes select traits, and are themselves selected, resulting in an extremely quick, and unpredictable evolution of traits (Miller, 2000). Sexual selection is driven by sexual choice, primarily females choosing which male mates based on a set of traits. These traits may or may not be advantageous from a natural selection standpoint, but become the focus of sexual selection because they are fitness indicators i.e., physical manifestations of underlying genetic quality (low mutation load or high intelligence, for example). Examining sexual selection lets us look at behavior, not just genes. It allows us to keep the analyses (evolutionary and behavioral) at the level of behavior and keeps us from falling into the trap of biological reductionism.

What follows is a brief introduction to mainstream evolutionary psychology, the evolution of language, and a case for incorporating a behavioral approach into evolutionary theory.

#### EVOLUTIONARY PSYCHOLOGY

Evolutionary psychology has its roots in a number of scientific and philosophical approaches to the study of human behavior. Sociobiology, evolutionary biology, human

behavioral ecology, behavioral genetics, and cultural and physical anthropology, as well as social psychology, have all influenced modern evolutionary psychology. Naturally, there are areas where this rather diverse array of fields correspond and areas where they disagree. Generally, evolutionary psychologists have adopted one approach or another based on their particular area of interest within evolutionary psychology or their educational background. As it is still a relatively new field, few psychologists have been directly trained as evolutionary psychologists and the field mirrors the eclecticism found in its pioneers.

Most current evolutionary psychology follows “a specific interpretation of evolution represented, for example, by the work of Buss, Symons, and Tooby and Cosmides” (Caporael, 2001). There are a few axioms that form the basis of the field. First, it asserts that humans are the products of evolution by natural and sexual selection. Second, just as the body has evolved physical structures, organs, the brain has evolved cognitive structures to aid survival and reproduction. Using the body as a model for the brain, it is a fair guess that the brain, too, is composed of one or more functional parts, each of which is also specialized to facilitate the survival and reproduction of the organism. Third, there are physical and psychological differences among all individuals and these differences are heritable (the differences are to some degree genetic and can be passed on to your offspring) and influence behavior. Fourth, evolution by natural and sexual selection is currently accepted as the only process whereby entities can acquire functional properties. Human brains should perform precisely those functions that facilitated survival and reproduction in the past. Whether they currently do so will depend on how closely the present environment resembles the past.

A good example of this process can be found with unconditioned stimuli. Behavioral psychologists have long known that humans are more easily conditioned to respond to some stimuli than others. Many people are afraid of snakes and spiders, but few people fear cars. An evolutionary explanation of fear of snakes and spiders would posit that over the last 200,000 years, humans regularly encountered spiders and snakes that were potentially deadly. Only over the last 100 years have humans regularly encountered automobiles, which can also be deadly. While 200,000 years is long enough for selection to favor individuals who were afraid of and avoided snakes and spiders, 100 years is not long enough to select for individuals who are afraid of cars. We can predict that humans may well possess an innate aversion to spiders and snakes, but not to automobiles—even though cars currently kill far more people than spiders or snakes. The major lesson of evolutionary psychology, then, is that by examining the environment of our ancestors, how it affected survival and reproduction, we can gain some understanding of some current behaviors.

Evolutionary Psychology works on two levels simultaneously. One is the ultimate level—which states that human behavior, respondent and operant, has been shaped by evolutionary pressures to survive and reproduce. Individuals are predisposed to react to contexts in ways that were adaptive for their ancestors, from whom they inherited their genes. At the proximate level, cognitive mechanisms are said to cause behavior at the current moment. Individuals are said to have information processing mechanisms that comprise the mind and allow us to interact with the environment. This approach is

exemplified by the work of evolutionary psychologists Leda Cosmides and John Tooby. Purportedly, evolutionary psychologists choose cognitive psychology as the basis for explaining proximate causes of behavior because of the “descriptive precision made possible by cognitive science” (Barkow, Cosmides & Tooby 1995). Given the functional, selectionist character of evolutionary explanations, it could be argued that behavior analysis may be a better approach to understanding the proximate causes of behavior and is more consistent with the functional approach evolutionary psychology employs to understand ultimate causes.

The ultimate causes of behavior are usually “cognitively impenetrable.” That is, we are often controlled by reinforcers without any knowledge of the ultimate reason why they are reinforcing. Further, evolutionary psychology describes ultimate causes of behavior from a contextualistic, functionalistic, non-mentalistic, and monistic perspective but then adopts a cognitive model for proximate causes, which is mechanistic, structuralistic, dualistic, and mentalistic. Some researchers are critical of proximate, evolutionary explanations of behavior because they do not seem to flow directly from the ultimate causes of behavior, possibly because of this disjunction (Siegert, 2002).

The advantage of a behavior analytic approach to describing proximate causes in evolutionary psychology is that it is compatible with the contextualistic, functionalistic, non-mentalistic, and monistic perspective of ultimate causes and proximate causes of behavior. Therefore, behavior can be described in a coherent, consistent framework that allows researchers to shift between ultimate and proximate levels of analysis while avoiding the pitfalls of reductionism. Also, incorporating idiographic approaches into evolutionary psychology may allow an even more precise understanding of the interaction between ultimate causes, proximate causes, and an individual’s life history in predicting behavior. A tenet of evolutionary psychology is that an individual will strive to maximize his (or her) fitness in a particular environment by comparing his own fitness with those around him and adjusting his behavior accordingly. Gangestad and Simpson (2000) suggest “that men with features signaling genetic benefits to offspring” are preferred by women as short-term mates. These differences, in turn, affect “his willingness to help in child-rearing. It is these circumstances and the cues that signal them that underlie the variation in short- and long-term mating strategies between and within the sexes” (p. 573). Examining aggregate data on male mating patterns that ignores differences in genetic fitness may have overlooked such a finding. Evolutionary psychologists employing only nomothetic methods have probably missed many such interesting and informative individual differences. The more we know about an individual, the more precisely we can predict their future behavior in a range of environments and the more influence we may be able to exert over it.

Incorporating a behavior analytic approach would allow for *prediction and control* (influence) of behaviors which may help to allay concerns that all evolutionary explanations are post hoc descriptions of behavior that offer no real understanding.

#### LANGUAGE

Although more has been written about the evolution of language than the evolution

of any other human mental ability (Miller, 2000), theories about its development have been hampered to a large extent because most evolutionary accounts of language see it as evolving only through natural selection. Intuitively, language seems to function as a trait that confers survival benefits on those who use it-- putting them far ahead of non-language users. Some anthropologists (Holden, 1999; Balter, 2001) claim that Neanderthals' inability to use language, for physical or psychological reasons, may have rendered them unable to compete with early humans, thus contributing to their extinction. If language were so important for survival, however, it would make sense that other species should have developed it, especially other social animals, such as apes and monkeys. As Dunbar (1996) writes, "other species bark and scream, grunt and wail, but none speak." These simple sounds have been sufficient for frightening predators or intimidating rivals and increasing general fitness, but there has been no selective environmental pressure to develop language to the extent it has been developed in humans.

### SEXUAL SELECTION AND LANGUAGE

This adherence to the belief that all human behaviors could be explained as pragmatic solutions to environmental problems has been a problem for an evolutionary perspective. Natural selection theories of the evolution of language are insufficient explanations of what is an extremely ornate, complex, altruistic, and costly trait. The massive size of the human vocabulary, around 60,000 words acquired at a rate of 10 words a day for a child's first 18 years (Dunbar, 1996), the complexity of grammatical structures, and the sheer physical cost of developing and maintaining a brain which is nine times as large as would be predicted for a mammal our size and which consumes 10 times the energy, pound for pound, of the rest of our body (Dunbar, 1996), is evidence for the role of sexual selection in the development of language. Language is too excessive and too costly to be purely adaptive from a natural selection perspective.

Mate selection is extremely important for all animals. The better your mate, the higher the chance of your genes surviving into future generations. In humans, both males and females should seek to optimize their mating strategies so as to secure a mate that will provide high quality genes as well as support and resources for the offspring to enhance the probability that they will mature to reproductive age themselves (Simpson, Gangestad, & Christensen, 1999). The reintroduction of sexual selection as a driving force in human evolution allows for explanations of such complex, uniquely human behaviors as art, music, humor and language (Miller, 2000).

So, what characteristics should women look for in males? Mate selection strategies and criteria differ depending on the goals of a particular individual. When individuals are interested in short term mating, mating that consists of a few sexual encounters over a relatively short period of time, Weiderman and Dubois suggest that both men and women will put a relatively high value on physical attractiveness. Additionally, men will seek women who are not looking to acquire their resources, that is, a low investment opportunity to reproduce. Women, on the other hand, will also value financial resources and generosity, in a short-term situation.

More informative for our consideration of sexual selection pressures on the evolution of language, however, are the factors that shape an individual's selection of long-term mates. According to Buss and Schmitt (1993), "more than 90% of all people in all societies marry at some point in their lives." Given that long-term mating is so prevalent cross culturally it should provide insight into general categories important for mate selection. When selecting a long-term partner, traits such as physical attractiveness, financial resources, and sexual experience give way to traits such as kindness, intelligence, and generosity (Miller, 2000). The best way to judge a mate for these characteristics is through communication.

If individuals are judging potential mates on these characteristics, there is obviously a great amount of pressure to develop fitness indicators that are capable of displaying these qualities as well as developing a reliable means of judging the validity of related cues. The most reliable indicators of high genetic quality are traits that are difficult to fake because they carry a high associated cost for producing and maintaining them (Johnstone & Grafen, 1993). This "handicap principle" suggests that costly indicators should be the most reliable cues to underlying health because the very fact that they are hard to produce makes them difficult for a less healthy individual to fake. The human brain is an extremely costly organ to develop and maintain, and an individual's linguistic ability is an extremely complex adaptation that is most likely the result of a large number of genes acting together (Plomin & Philip, 2002). Whenever there are a large number of genes working in concert, even a few mutations can disrupt development. If things are functioning well that is a good sign of underlying health.

Linguistic abilities are highly correlated with general cognitive ability. General cognitive or intellectual ability is referred to as the "g factor" which is, highly heritable (Plomin & Philip, 2002). Studies on monozygotic and dizygotic twins have demonstrated that the heritability of linguistic ability is substantial (Stromswold, 2001). If this g-factor "could be construed as mental fitness" (Miller, 2000) then it would be highly advantageous to be able to judge a potential mate's g-factor relative to your own intelligence and that of other potential mates. It seems that people actually do select partners based on their linguistic ability. The correlation for language ability between spouses is greater than .50 (Stromswold, 2001).

By judging other individual's linguistic facility we not only assess reliable indicators of underlying intelligence and health, we also gain information about other characteristics, such as a potential mates' generosity and willingness to commit resources to the relationship and offspring. Language, therefore, serves two primary functions in mate choice. First, it is a means for comparing potential mate's behaviors, propensities, and personalities with regard to commitment, resources and interpersonal skills. Second, it can serve as a proxy for assessing traits that are themselves not directly observable, such as intelligence and good genes.

There are other means of assessing an individual's intelligence, such as creativity, artistic ability, or musical ability. So, why should language be such an important factor? The importance of language resides in its universality, which establishes it as a baseline metric against which all individuals can be judged. When trying to select between a painter and a musician, for example, it might be very difficult to differentiate underlying



intelligence. Success and talent in different domains can render direct comparisons difficult or impossible. By using language as an overarching standard we can compare notably different fitness indicators.

The importance of verbal courtship has often been overlooked or dismissed as insufficient for the development of such a complicated human behavior as human language (Miller, 2000). From an evolutionary perspective, the most important choices individuals will ever make involve their mating partners. Choosing a physically sick or mentally unstable mate, especially as a long-term partner, could be disastrous for an individual's genes. A failure to reproduce sends all of an individual's genes and related traits to the evolutionary waste-basket. There is no second chance. Conversely, choosing a healthy, intelligent, fertile mate who will provide good genes and resources for raising children will greatly enhance the survival and multiplication of those genes and traits.

Language abilities have developed to the extent that they have as an adaptation to sexual selection pressures. Although we begin developing language extremely early in life, linguistic fluidity parallels the development of other sexual characteristics-- it blossoms as we approach sexual maturity (Miller, 2000). As we begin searching for mates and establishing the criteria that we will use to judge potential future mates (and simultaneously learning to present ourselves in the best possible light) we begin to recognize and display characteristics important for sexual relationships and reproduction. This development is both physical and psychological. The depth, complexity, associated costs and effort poured into communication gives other individuals unparalleled access to, "someone's personality, past, plans hopes, fears, and ideals" (Miller, 2000) and is the most important, comprehensive and incisive tool at our disposal for finding the best possible mate we can.

Individuals would not advertise their fitness through language if it were falling on deaf ears. If individuals were uninterested in discriminating between articulate, meaningful speech and incoherent babbling, then it wouldn't be necessary for humans to develop language beyond a minimal, functional level. It would be irrelevant as a sexually selected cue. From a female's perspective, it becomes important to be able to analyze a male's linguistic ability in order to detect fraudulent cues about health, intelligence, kindness, or any other sexually desirable trait.

#### RELATIONAL FRAME THEORY

Relational Frame Theory is an ideal perspective for examining language as a generalized indicator of intelligence. Linguistic abilities tend to remain consistent across different tests of vocabulary, reading comprehension, the generation and comprehension of analogies and metaphors, and verbal problem-solving (Hayes et al., 2001). Vocabulary size should be correlated with increasingly elaborate networks of verbal content and more subtle and abstract relational repertoires. Reading comprehension and the use of more conceptual or theoretical verbal constructs that stretch relational frames (analogies, puns, jokes) require individuals to be verbally flexible, to extend networks in logical but novel ways, and to think abstractly (Hayes et al., 2001). Barnes-Holmes et al. (2001) write that, "solving analogies requires a range of relational skills that simultaneously

assess for the amount of verbal content acquired and the range, speed, flexibility, and subtlety of contextual control over relational responding. All of these skills are central to the cultural dimension of intelligence" ( p.161). The idea that this g-factor underlies not just verbal behavior but is at the core of relational responding is consistent with the idea that linguistic abilities could be reliable indicators of heritable mental fitness. Additionally, relational responding may be instrumental in navigating the complex social networks necessary for social status, survival and reproduction.

#### LANGUAGE, GROUP SIZE, AND NORMATIVE SOCIAL BEHAVIOR

Other possible selection pressures influencing the evolution of language are increasing group size, social stratification, and reliance on complex social networks for protection from predators and rivals, as well as access to resources. Dunbar (2003) suggests that as group size increases among social primates so does brain size and social complexity. These changes may have promoted the evolution of language and general relational responding. In larger social communities, successful individuals would be those who are socially sophisticated and able to navigate the complex web of allies and enemies. This may establish the context in which it would be beneficial to form many of the relational frames (such as distinction, comparison, and hierarchical relations). Social primates need to consider not only the individual they are interacting with but also that individual's family and supporters. Distinctions made on the basis of size, attractiveness, speed and strength are helpful, but when these decisions must be made in a sophisticated hierarchy more precise distinctions must be made (Hayes et al., 2001, p. 36). Individual's who can form relations such as "A is stronger than B but B is weaker than C" can pick their battles, allocate their resources, and manipulate social relations in ways that other individuals cannot (Hayes et al., 2001, p. 36). The ability to form deictic relational frames allows individuals to substitute I for YOU, HERE-THERE, and NOW-THEN and to consider situations from another perspective. It is clearly important for a social species.

The ability of individuals to form complex relational frames is an advantage in social species and complex environments. Roche, Barnes-Holmes, Barnes-Holmes, and Hayes (2001) write that RFT could be instrumental in understanding traditional areas of social psychology such as normative social behavior, group cohesion, prejudice, persuasion and rhetoric, and sexual attractiveness. All of these areas are integral to evolutionary psychology.

#### REINTERPRETING EVOLUTIONARY EXPLANATIONS OF LANGUAGE

Evolutionary psychologists, drawing on work done by social psychologists, economists, and anthropologists, have long understood the importance of social interactions in the development of our species. Cosmides and Tooby (1992) argue that there have been specific selective pressures for individuals to evolve mechanisms for social exchange. One fundamental consideration of evolutionary psychological theories, absent in many other approaches, is the consideration of costs and benefits. Evolutionary theorists

assume that all physical and psychological development burdens us with increased costs in terms of developmental time or resources. Individuals must choose how to spend their time and energy. They must decide how much time to spend looking for a mate and how much time to spend looking for food. Decisions about whether to begin reproducing or to spend additional time in somatic growth and development are based on environmental factors as well as the individual's life history. For example, a high fitness male may choose to invest his time and energy in mating effort, forgoing costly parenting effort because he will have many opportunities to mate and because the environment is hospitable enough to ensure many of his offspring will survive. This means that the most successful individuals will be those who invest the appropriate amount of resources in the skills and traits that are essential for their environment. As far as behavioral and cognitive adaptations, "the properties of an adaptation can be used to identify the class of problems, at the correct level of specificity or generality, that the adaptation was designed to solve" (Cosmides & Tooby, 1992, p. 243). Along these lines they set out to empirically prove that humans have developed "mechanisms" to solve social and interpersonal problems but not necessarily more general or abstract problems. This claim is based on their observations of college students' relative ability to solve Wason selection tasks that were either abstract or socially relevant.

Wason selection tasks present the participant with a rule in the form of *If P then Q*. For example, the statement "If you attend a conference, then you pay the registration fee" follows the *if P (you attend a conference) then Q (you pay the registration fee)* format. Next, participants are presented with four cards with different information about each situation written on both sides. One side contains information about *P* and the other side contains information about *Q*. They are asked to select only the cards necessary to find a violation of the rule.

The cards for the above rule would be:

Attended conference	Did not attend	Paid registration	Did not pay registration
(P)	(not-P)	(Q)	(not-Q)

In order to see if a violation of the rule has occurred it is necessary to turn over the cards corresponding to *P* and *not-Q*, "Attended conference" and "Did not pay registration". The two other cards, *not-P* and *Q* do not offer any information relevant to the violation of the rule. If you did not attend the conference, then it does not matter if you paid the registration or not. And if you paid the registration, then you may or may not have attended. Either way, no rules were violated. However, if you turn over the card corresponding to "Attended conference" and it indicates that you have not paid for registration, then you have directly violated the rule. Similarly, if you did not pay to register, then you should expect the *not-Q* card to show that you did not attend the conference.

There is a large and persuasive body of evidence to suggest that people are only able to solve abstract logical problems, which involve conditional hypotheses in the

form of *If P then Q*, about 25% of the time (Cosmides & Tooby, 1992). By making the content of these problems socially relevant, particularly pertaining to social exchange, contracts, and cheater detection, individuals are far more adept at deriving successful solutions. Cosmides & Tooby concluded that this finding demonstrates an evolved cognitive mechanism related to complex social relations.

Examples of the problems given by Cosmides and Tooby are:

1. "If a person has a 'D' rating then his documents must be marked code 3"

(If                      p                      then                      Q)

The Cards they are allowed to chose from are:

D	F	3	7
(P)	(not-P)	(Q)	(not-Q)

2. In its crackdown against drunk drivers, Massachusetts law enforcement officials are revoking liquor licenses left and right. You are a bouncer in a Boston Bar, and you'll lose your job unless you enforce the following law:

"If a person is drinking beer, then he must be over 20 years old"

(If                      p                      then                      Q)

The cards they were presented with were:

Drinking beer	Drinking coke	25 years old	16 years old
(P)	(not-P)	(Q)	(not-Q)

The correct answer is always to pick *P* and *not-Q*. For the first problem the participant should pick cards D (*P*), and 7 (*not-Q*). This was selected less than 25% of the time by college students, however. When the situation was changed to reflect a socially relevant problem, however, the correct cards were selected over 75% of the time. These two problems only differ in terms of their propositional content, the logical format is exactly the same.

The authors argue that individuals' ability to solve problems set in a social context but not the abstract problems is evidence for an evolved social contract algorithm specifically to deal with cheater detection (Cosmides & Tooby, 1992). They write, "the social environment need not provide all of the (hypothetical) properties needed to construct a social exchange psychology from a set of content-free mental procedures because the evolved architecture of the human mind already contains content-specific mechanisms that will cause [such a] psychology to reliably develop" ( p. 278). Implicit knowledge, they argue, allows individuals to make sense of the environment around them by functioning as a foundation for learning and has developed to solve problems of evolutionary significance and not a general ability in formal or propositional logic.

Behavioral approaches, including RFT, are adverse to such explanations and focus instead on, "the role of organism-environment interactions as opposed to inherent organismic capabilities" (Hayes et al., 2001, p. 159, emphasis added). These two approaches are not necessarily diametrically opposed, however. The RFT perspective agrees that logical reasoning "does not provide an explanation for relational framing" (Hayes et al., 2001, p. 191). Instead, RFT address both "logical and illogical reasoning" through an individual's history and the functions of the contextual cues in the conditional

proposition (Hayes et al., 2001, p. 192). This is not to say that there are not environmental stimuli that are biologically potentiated. Simply knowing what the stimuli and contexts are, however, is not sufficient. We must understand the relationship between an individual, their life history, ontology, phylogeny, and the environment.

In the *Relational Frame Theory* chapter “Education,” Barnes-Holmes, Barnes-Holmes, and Cullinan, examine the logical errors people make when reasoning about conditional propositions similar to the Wason selection tasks used by Cosmides and Tooby. Barnes-Holmes et al point out the common errors that even many “verbally sophisticated individuals” make: failing to make the modus tollens deduction, denying the antecedent, affirming the consequent, or denying the consequent. They present an example of an abstract problem that people often answer incorrectly (by denying the antecedent):

If there is a square then there is a circle  
There is not a square

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Therefore, there is not a circle

Logically, however, there could be a circle. A relational frame explanation of such an “illogical” answer is that, for most English speakers, the words “if” and “then” are usually used to “specify a contingent relationship, sometimes of a temporal quality, between two events, in which the latter event is entirely contingent or dependent on the former” (Hayes et al., 2001, p. 192). For the majority of contingencies in an individual’s history, rewards or punishments are completely dictated by behavior. People do not expect to receive their paychecks if they fail to show up for work or to go to jail even though they committed no crime (although the possibilities exist, and, on rare occasions happen). The if-then nature of the statement is functionally equivalent to complete dependency on the satisfaction of the “if” term. The statement takes on a bidirectional significance that is not implied in the strictest sense of the statement, which is unidirectional, because it has functioned that way in the past.

Cosmides and Tooby’s finding that changing the context in which a problem was situated can determine when an individual’s response makes sense within RFT. Barnes-Holmes et al. write, “from the RFT perspective, this type of research suggests that multiple relational functions have been established in the verbal histories of most English speakers, and that it is possible to actualize these various functions (and suppress others) by manipulating the current context of the reasoning task” (Hayes et al., 2001, p. 193). If individuals’ ability to solve Wason selection tasks, or any other logical problems, improves when it is situated in a social context, then it may be that we have evolved biological predispositions to solve such problems or that through experience, individuals learn how to solve social problems (as opposed to novel or abstract problems). It may also be a combination of the two. Because individuals are immersed in a social environment since birth, social stimuli should be particularly salient. Additionally, individuals who have little prepotentiation or derive no pleasure from social situations, such as individuals with autism or schizoid personality disorders, may never learn

complex social relations, regardless of their history, because such situations are not reinforcing.

Contingencies of reinforcement are differentially potentiated across species and individuals in any one species. Given human phylogeny, we may expect social problems (contexts) to be highly potentiated because they have been instrumental in both our survival and reproduction. Setting problems in a social context may act as a setting event, a potentiating variable or as an establishing operation. Harrington, Fink, and Dougher (2001) write, "human learning depends importantly on evolved biological predispositions. There clearly are highly potent unconditioned reinforcers and unconditioned stimuli whose effects clearly appear to be innate" (p. 10). Perhaps individuals are prepared to pay special attention to social problems, spend more energy forming relational networks between social concepts, and develop more intricate and sophisticated relations because of the gravity of social problems. There need not be hardwired algorithms for solving the enormous number of potential social problems people face on a given day but instead an underlying motivation to *learn* how to solve such problems. When adults are then asked to solve Wason selection tasks with a social context, the problems are easily mapped onto well-defined, robust relational frames that are able to easily accommodate relatively simple problems. Similar abstract problems, however, have no analogous established relational networks and individuals may attempt to solve them through step-by-step logical reasoning.

If the ability to form complex relational frames evolved to solve pragmatic problems, to navigate intricate social networks, and as a fitness indicator for attracting mates, we should find that it is intricately connected with other abilities and traits. If we learn to solve social problems more easily than abstract problems because such situations are prepotentiated, individual differences in the salience of such contingencies of reinforcement may impact an individual's ability to solve logical problems.

An individual who is highly introverted may perform less well on a task set in a social context than an extraverted individual for whom such a situation would be highly potentiated. Individuals with Asperger's Syndrome, for example, may have the ability to solve socially relevant logical problems, but may not be motivated to do so. The development of relational frames are shaped by an individual's ontogeny and we may be able to understand an individual's behavior if we understand that history.

Additionally, if the ability to form relational frames is fundamental to intelligence and language then we may find that it correlates with cues of underlying genetic fitness important for mate selection. It may be possible to show that an individual's ability to form complex derived stimulus relations is correlated with measures of fluctuating asymmetry, perceived attractiveness, or mate value. If relational responding is, to some degree, the product of sexual selection then we may have a better understanding of why particular stimuli are prepotentiated, how individual differences influence the salience of contingencies of reinforcement in our environment, and how we form relations.

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