A BEHAVIORAL GENETIC AND EVOLUTIONARY PSYCHOLOGY PERSPECTIVE ON DECISION-MAKING

Richard Sejean

A Thesis
In
The John Molson School of Business

Presented in Partial Fulfilment of the Requirements
for the Degree of Master of Science in Administration (Marketing) at
Concordia University
Montreal, Quebec, Canada

November 2006

Your file Votre référence
ISBN: 978-0-494-28984-6
Our file Notre référence
ISBN: 978-0-494-28984-6

ABSTRACT

A Behavioral Genetic and Evolutionary Psychology Perspective on Decision-Making

Richard Sejean

This thesis investigates the genetic and evolutionary bases of how decisions are made. Specifically, Study 1 examined the genetic underpinnings of decision-making styles by contrasting the relative similarities of monozygotic and dizygotic co-twins along the general decision-making style and maximizing scales. The results suggest that the extents to which individuals exhibited rational, intuitive, spontaneous and maximizing decision styles were significantly affected by genetics. While the hypotheses pertaining to the dependent and avoidant styles enjoyed directional support, the results were not statistically significant. In Study 2, the predecisional choice processes of monozygotic and dizygotic co-twins were examined in light of the amount, selectivity and pattern of information processing exhibited as twins independently solved a computerized decision-making task. The results suggest that while the amounts of information processed predecisionally were influenced by innate elements of subjects' decision-making personalities, the selectivity and pattern components of the choice process were seemingly adaptive to characteristics of the problem at hand. Finally, in providing a Darwinian analysis of the information search process underlying mate choice, Study 3 sought to demonstrate the evolutionary bases of the mind's adapted cognitive policies. To this end, subjects were asked to find a short-term mate via a computerized mate selection task. In line with evolutionary predictions, individuals tended to deliberate more extensively prior to choosing versus rejecting potential mates. Moreover, females tended to evaluate more candidates than males before identifying a winning suitor and devote more search effort to the task overall. Additional findings and implications are reported in the thesis.

ACKNOWLEDGMENTS

First, I would like to thank my supervisor, Professor Gad Saad, for opening up his infinite vault of ideas to me. Working with him has been an extremely memorable and enriching experience. I would also like to thank Dr. Lynn Cherkas and the entire team at the St-Thomas' Hospital Twin Research Unit (UK) for making the twin-studies conducted in this thesis possible.

Additionally, I would like to thank Dr. Bianca Grohmann and Dr. Onur Bodur for providing me with their invaluable feedback. My appreciation also goes out to the administrative staff of the M.Sc. program, most notably to Heather Thomson, and to the internal M.Sc. grant that helped fund this thesis.

To Patrick Garon-Sayegh, Mario Prsa, Costa Piplakis, John Vongas and Eric Stenstrom, thanks for being there for me throughout the various stages of this journey. To my parents, Ilsa and Georges, my brothers Joe and Phil, and my sister Laura, thank you for your endless support.

Most importantly, thank you Gorana for helping me run my studies, for traveling with me to international conferences, and most of all, for putting up with me and helping me become a better person.

Finally, my thanks go out to any eventual readers of this thesis. I hope you will enjoy reading it as much as I enjoyed writing it.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Chapter 1

INTRODUCTION

Making decisions is central to the human condition. In the words of Thomas Jefferson: "without the possibility of choice, and the exercise of choice, a man is not a man but a member, an instrument, a thing" (as cited in Iyengar and Lepper, 1999, p. 349). What is more, the unique approach each decision-maker takes when making his or her choices is among a person's most life-shaping characteristics: "it is in your moments of decision that your destiny is shaped" (Robbins, 1991, p.40). Choosing which brands to buy, where to vacation, which applicant to hire, even which parking space to occupy, are just some of the many problems we all face on an almost daily basis. Though we all make such decisions, we do so in very special ways.

In the past several decades, luminaries like Herbert Simon, Amos Tversky, Daniel Kahneman and Richard Thaler have revolutionized our understanding of the human decision-making process (see Payne, Bettman and Johnson, 1993 for a seminal review). Prior to their contributions – and to those of nameless others since – decision-making was thought to follow a set of prescriptive axioms, which did more to describe how the choice process *should* unfold rather than how it actually does. In identifying countless violations of the tenets of rational choice theory (i.e., the leading decision theory at the time) the field of behavioral decision research surfaced as a much-improved means of describing the intricacies of human choice. Though in recent years our understanding of the human decision-making process has been furthered considerably, most decision-scientists have focused on studying how the decision process adapts to the task and contextual characteristics of the problem at hand (e.g., Payne, Bettman and Johnson, 1993) or on identifying the decisional consequences of individual differences acquired through learning and experience (e.g., Brucks, 1985). While some have explored the workings of more stable decision-making qualities (e.g., Scott and Bruce, 1995; Schwartz et al., 2002), none has provided more than speculative origins for these. In other words, while individuals have been found to possess their own characteristic decision-making styles (i.e., decision-making predisposition), it remains unclear whether general approaches to choice are due to environmental or genetic factors.

By focusing specifically on tracing the expression of psychological traits back to their roots, the field of behavioral genetics has flourished, bringing the heritability of a wide variety of psychological measures to the forefront of the nature-versus-nurture debate. Individual differences in everything from IQ and personality to pathological conditions like alcoholism and gambling have all been found to bear underlying genetic components (for reviews see Plomin and McClearns, 1993; Bouchard, 1998). However, despite this impressive and diverse array of inquiries, virtually no attempts have focused on exploring the genetic underpinnings of decision-making specifically.

Advances in the decision-sciences have yielded a handful of psychological inventories that can be used to profile individuals' decision-making styles (e.g., the General Decision-Making Style measure). In addition, process-tracing methodologies have been developed which enable researchers to analyze the cognitive procedures that lead up to the implementation of a choice (e.g., Mouselab). Using both of these approaches, this thesis seeks to shed light on the nature of the traits and behaviors that comprise individuals' approaches to choice by contrasting the relative similarities of monozygotic (MZ, identical) and dizygotic (DZ, fraternal) co-twins along relevant measures (i.e., via a behavioral genetic/twin-study paradigm).

"Whereas behavioral geneticists study variations within a species, evolutionary psychologists or sociobiologists attempt to delineate species-typical proclivities or instincts and to understand the relevant evolutionary developments that took place in the Pleistocene epoch and were adaptive in the lives of tribal hunter-gatherers"(Bouchard et al., 1990, p.228). Accordingly, as a second focus this thesis seeks to provide an evolutionary psychology (EP) analysis of the mind's evolved decision-making policies by examining the predecisional cognitive processes of individuals as they solve one of evolution's most illustrious decision-problems: that of choosing a mate. To this end, a novel information search framework and process-tracing interface are empirically tested.

Chapter 2

LITERATURE REVIEW

This thesis has two main objectives. The first involves establishing the innateness of individuals' approaches to choice. To this end, Studies 1 and 2 report findings wherein the relative similarities of MZ and DZ co-twins were contrasted along self-reported and process-tracing measures. While Study 1 focused on examining the genetic underpinnings of decision-making styles, Study 2 sought to shine a behavioral genetic light on key facets of the predecisional choice process. The thesis's second objective entails providing a Darwinian analysis of the mind's evolved decision-making strategies. As it would have been impossible to study the entire range of cognitive adaptations in a single undertaking, Study 3 focused on demonstrating the fit between key evolutionary principles and the search processes underlying mate choice specifically.

The literature review begins by providing a description of the various traits and behaviors that define individuals' approaches to choice, followed by an explanation of the behavioral genetic means via which their innateness can be inferred. Next, the chapter will present a breakdown of the Darwinian process underlying the genotyping of the mind's evolved cognitive strategies, placing particular emphasis on the area of adapted mate search. By bridging the gap between the psychological and biological sciences, a richer understanding of the human decision-making process is sought.

Establishing the Innateness of Individual Approaches to Choice:

A Behavioral Genetic Inquiry

Mapping individual approaches to choice

Decision-scientists have devised various means by which individuals' approaches to choice can be mapped. In particular, Scott and Bruce (1995) have developed the general decision-making style (GDMS) measure, a multi-item questionnaire used to directly assess individuals' decision-making proclivities. Similarly, Schwartz et al. (2002) have developed the maximizing (MAX) scale, a multi-item measure used to assess the characteristic levels of optimality sought from peoples' decision outcomes. While both of these allow for individuals' approaches to choice to be mapped along relevant traits, adopting a process-tracing method yields equally meaningful insight into the cognitive procedures that underlie the predecisional choice process (Payne, Bettman and Johnson, 1993). The following section begins by describing general decision-making style and maximizing in greater depth, and proceeds by providing a detailed portrayal of the process-tracing approach.

General Decision-Making Style and Maximizing

The manners with which individuals make their decisions can in part be described by their a priori general decision-making styles (see Scott and Bruce, 1995 for a complete review). Driver (1979) has defined decision-making style as a habitual pattern used by individuals in their decision-making endeavors. Others have contributed to this definition, specifying that decision-making style can be further characterized by both the amount of information gathered when making a decision (Driver, Brousseau and Hunsaker, 1990), and the manner with which sense is made of the data collected (Hunt et al., 1989; McKenny and Keen, 1974; Mitroff, 1983). In 1995, Scott and Bruce developed a comprehensive instrument to capture individual differences in general decision-making style, yielding a five-approach taxonomy (i.e., rational, intuitive, avoidant, dependent and spontaneous). In support of the existing literature, the authors found that individuals use a combination of styles when making their decisions (revealed by correlations among the instrument's subscales) (cf. Driver, Brousseau and Hunsaker, 1990), and that though decision-making is a context-dependent activity (Payne, Bettman and Johnson, 1993), decision-makers are predisposed to the manners by which they make their decisions in general.

Another important feature of a person's general approach to making decisions relates to the motivations underlying his or her choice-process. In particular, Schwartz et al. (2002) claim that individuals are predisposed to the levels of optimality sought from their decision-outcomes. However, the idea that individual choice-processes are driven by different motives is fairly new. Under rational choice theory (which assumes that individuals have access to complete information when making their decisions) the only rational objective is to seek the outcome from which a maximum level of utility can be derived (Von Neumann and Morgenstern, 1944). Alternatively, Simon (1955, 1956, 1957) has proposed a decision-rule based on what he calls satisficing. "Simon's alternative to rational choice theory questions not only the processes by which options are assessed and choices made, but also the motives that underlie choice" (Schwartz et al., 2002, p.1178). Whereas maximizing is motivated by a need to achieve the optimal outcome, satisficing is instead driven by the desire to reach an option that is simply good enough. As it is now well established, given the complexity of the decision world and the cognitive limitations of the human mind, decision-makers cannot simply maximize their decision-outcomes without factoring-in the associated costs. Decision-makers must hence adapt their strategies in function of an effort-accuracy trade-off (Payne, Bettman and Johnson, 1993). Among the many task and contextual variables that can potentially influence one's decision to either maximize or satisfice, Schwartz et al. (2002) suggest that individuals exhibit predisposed levels of maximizing motives in general. Of interest, maximizing has been shown to negatively affect feelings of wellness and satisfaction, and even contribute to depression, in spite of the fact that on average, maximizers enjoy objectively superior decision-outcomes than satisficers (Schwartz et al., 2002; Iyengar, Wells and Schwartz, 2006).

Process-tracing approach: capturing the predecisional choice process

While individuals' approaches to choice have typically been examined via relevant traits (using self-reported measures), some researchers have proposed that when studying decision-making, data should be collected as actual choices are being made (Ford et al., 1989). Jasper and Shapiro (2003) provide three key reasons as to why decision-making should be studied in this manner. Namely, these are: (1) to evaluate decision-making theories based on the fit between the search patterns they imply and those observed, (2) to uncover how certain moderating variables affect the actual decision-making process, and (3) to gain practical insight as to how particular decision-problems are solved. For example, Laroche, Kim and Matsui (2003) demonstrate how understanding the cognitive processes that underlie consideration set formation (i.e., which alternatives are considered when making a choice) can have clear and meaningful implications for marketing practitioners. By identifying the specific decision-heuristics used during consideration set formation, the authors propose that managers can identify their products' salient attributes and ensure that their brands meet the required cut-offs on each of these.

Researchers have been successful at capturing the cognitive processes leading up to choice using one of three process-tracing approaches: (1) using introspection and verbal protocol analysis, (2) by means of eye-movement tracing, and (3) via computerized interfaces. The first method requires subjects to verbally describe their thought processes as they solve a particular decision-problem. Though introspection and verbal protocol analyses enable researchers to uncover both quantitative and qualitative components of decision-making, many of the cognitive processes leading up to choice are unconscious and hence cannot be captured using this approach. Moreover, to a great extent, the quality of the data collected using introspection and verbal protocol analyses is directly contingent upon the verbal skills of each individual subject (Payne, Bettman and Johnson, 1993). Eye-movements tracing is a more sophisticated means of monitoring information acquisition behavior. Using this approach, the cognitive processes underlying choice are inferred from subjects' gaze as they visually acquire the information needed to solve a designated problem (Russo and Dosher, 1983). However, this method is marred with several limitations, including the complexity of the equipment required, its costliness, and the difficulty inherent to analyzing the collected data (Payne, Bettman and Johnson, 1993; Russo, 1978). In response to the high costs and complexity of the eye-movement monitoring approach, and the biases inherent to introspection and verbal protocol analyses, decision-scientists have developed a variety of computerized process-tracing tools (e.g., Mouselab, see Payne, Bettman and Johnson, 1993; MouseTrace, see Jasper and Shapiro, 2003; DSMAC see Saad, 1998). This approach allows researchers to represent a decision-problem via a computer-interface and monitor key behaviors as they occur in real-time (e.g., extent of information search prior to implementing a choice). Several varieties of programs exist, each of which is suited to studying a particular type of decision problem. For example, DSMAC (Dynamic Sequential Multi-Attribute Choice) is specifically suited to studying attribute-based sequential search behavior (i.e., binary choice) (Saad, 1998). Using a process-tracing approach, researchers are able to cue several aspects of the predecisional cognitive processes. In particular, these include metrics related to the amount of predecisional processing, the selectivity of predecisional processing, and the pattern of predecisional processing (Payne, Bettman and Johnson, 1993). Each of these is discussed in greater detail in Chapter 4.

Summary

In summary, researchers have devised various means by which individuals' approaches to choice can be profiled. Though, for the most part, cognitive psychologists have relied on the assumption that a decision-making style is simply a "learnt, habitual response pattern exhibited by an individual when confronted with a decision situation" (Scott and Bruce, 1995, p.820). While learnt and experiential factors are important moderators of a person's predecisional choice process (e.g., Brucks, 1985), is it not possible that individuals possess innate decision-making proclivities as well? Recently, Pinker (2002) has proposed behavioral genetics – the study of how the genes affect behavior – as a bridge between human biology and psychology. By adopting this perspective, this thesis seeks to explore the genetic underpinnings of individuals' approaches to choice. Accordingly, the literature review proceeds by describing key methods by which the genetic bases of psychological traits can be assessed, providing examples of related studies from the behavioral genetics literature.

Establishing the genetic basis of psychological traits

For almost every trait in our bodies, there exists a great deal of variation between members of the species as a whole. Historically, the idea that not only are one's physical, but also psychological, traits encoded in the genes has had intuitive appeal. Remarking on the heritable patterns of behavior among dogs, Francis Galton, cousin of Charles Darwin, made such a claim long before the gene was even identified as a unit of inheritance (Clark and Grunstein, 2000). Despite the promise of this idea, several questions had puzzled Galton and his contemporaries. Namely, these included how to provide empirical evidence for the heritability of psychological traits, and how to disentangle the genetic from the environmental influences on behavior? However, in an 1875 article published in the journal *Inquiries into Human Faculty and its Development*, Galton reported a breakthrough: "I have ...[sought] some new method by which it would be possible to weigh in just scales the effects of Nature and Nurture, and to ascertain their respective shares in framing the disposition and intellectual ability of men. The life-history of twins supplies what I wanted" (p.155). Since Galton's time, behavioral geneticists have further developed specific types of studies to thusly infer the heritability of psychological traits.

Most recently, a handful of business scholars have attempted to apply behavioral genetic principles and methods in their areas of specialty. For example, Ilies, Arvey and Bouchard (2006) provided a strong case for adopting a behavioral genetic approach in the management sciences, emphasizing the relevance of genetically rooted traits (i.e., general cognitive ability and personality), attitudes (i.e., job satisfaction), values and interests (i.e., perceived work climate and vocational interests), affective qualities (i.e., moodiness) and behaviors (i.e., job switching, leadership and performance) to management scholars and practitioners alike (for other papers that have applied behavioral genetics thinking in the management sciences see also Arvey et al., 2006 and Ilies, Gerhardt and Le, 2004). Similarly, in applying a behavioral genetic approach in the area of consumer research, Perry (1973) examined the extent to which the consumption of alcohol, cigarettes and coffee was influenced by an underlying genetic component. In closing, the author writes: "what this study suggests is that heredity is a variable worth examining in connection with attempts to understand and explain consumer behavior" (p.379). Before discussing the specific means by which this thesis seeks to bridge the gap between the behavioral genetic- and decision-sciences, a description of the key methods used by behavioral geneticists is provided below. Namely, these include: (1) family studies, (2) twin studies, and (3) adoption studies (Pinker, 2002; Weiten, 2002).

Family studies

The rational behind family studies goes as follows: if a given trait is genetically based, then individuals with higher degrees of genetic relatedness should exhibit more resemblance than individuals with lower degrees of genetic relatedness along relevant measures. For example, individuals who on average share 50% of their genes with each parent should be more similar to each of them than they are to their first cousins, with whom they share only 12.5% percent of the genes that vary between individuals.

Family studies typically examine trait similarity between relatives at four different degrees of relatedness: between first-degree relatives, who on average share 50% of the genes that vary between individuals in common (e.g., brothers and sisters); between second-degree relatives, who on average share 25% of the genes that vary between individuals in common (e.g., half-brothers and half-sisters); between third-degree relatives, who on average share 12.5% of the genes that vary between individuals in common (e.g., first cousins); and between fourth-degree relatives, who on average 6.25% of the genes that vary between individuals in common (e.g., second cousins). In addition, the comparative similarities of related and unrelated individuals, who on average share 0% of the genes that vary between individuals, are sometimes assessed providing a baseline reference of trait variability (see Weiten, 2002 for complete review; see also Gottesman, 1991 and Gottesman, 1993 for examples of family studies that have examined the influence of heredity on schizophrenia in particular).

Though family studies can reveal whether or not a trait runs in a family, they cannot determine whether or not the increased resemblance among more related family members is due to genetic or environmental components of development as closer relatives are also more likely to live together than distant ones. Accordingly, As Weiten (2002) writes: "family studies can offer useful insights about the *possible* impact of heredity, but they cannot provide *definitive* evidence" (p.80, words italicized for emphasis).

Twin studies

In twin studies, researchers gauge the influence of the genes on the development of psychological traits by contrasting the relative similarities of MZ and DZ co-twins along suited measures. Whereas DZ co-twins share 50% of the genes that vary between individuals (no more than any non-twin brothers and sisters, making them first-degree relatives), their MZ counterparts share exactly 100% of their genetic makeup. Twins studies are better able to isolate the genetic component of psychological development than the family approach. Since siblings are typically reared in the same environment (sharing relatives, neighbors, teachers, peers etc), twin studies are not limited by the bias that closer relatives are likely to share increasingly similar environments than their more distant counterparts; a confound inherent to family studies. Any significantly greater similarity found among pairs of MZ as compared to DZ co-twins on the trait under scrutiny can thusly be attributed to the genes (Pinker, 2002; see Plomin and McClearns, 1993 for a complete review). For example, in contrasting the relative similarities of MZ and DZ twins along measures of cognitive ability, McGue et al. (1993) reports significantly greater similarities related MZ as compared to DZ twins, inferring cognitive ability to be affected by genetics. Similarly, in demonstrating that MZ co-twins were significantly greater than their DZ counterparts along measures of extraversion, Loehlin (1992) inferred this dimension of personality to be shaped by the genes.

Some have warned that the twin methodology can provide inflated estimates of heritability (Laland and Brown, 2002). For example, according to Otto, Christiansen and Feldman (1995) researchers must consider the fact that parents, peers, neighbors and teachers might treat MZ co-twins more similarly than their DZ counterparts (i.e., providing the former with a more similar developmental environment than the latter). However, other varieties of the twin-study paradigm that focus on contrasting the similarity of MZ co-twins reared apart have addressed this specific issue (e.g., Bouchard et al., 1990; Tellegen et al., 1988). "The results come out roughly the same no matter what or how it's measured. Identical twins reared apart are highly similar; identical twins reared together are more similar than fraternal twins reared together" (Pinker, 2002, p.374).

Adoption studies

Another method used to assess the influence of the genes on the development of psychological traits is the adoption study. Two types of adoption studies exist, each of which provides slightly different understanding of how the genes and the environment affect the development of psychological traits. The first type of adoption study involves comparing the similarity of related siblings (who share overlap in 50% of their genes and most of their environment) and adoptive siblings (who share no genetic overlap and most of their developmental environment). The second type of adoption study involves contrasting the relative similarities of adopted children and their adoptive parents, and adopted children and their biological parents. "If adopted children resemble their biological parents on a trait, even though they were not raised by them, genetic factors probably influence that trait. In contrast, if adopted children resemble their adoptive parents, even though they inherited no genes from them, environmental factors probably influence the trait" (Weiten, 2002, p.81). For example, McGue et al. (1993) used an adoption-study approach to explore how the genes and the environment influence intelligence specifically. In finding IQ scores to be as similar between adopted children and both their adoptive and biological parents, McGue et al. (1993) highlight the importance of both the genes and the environment in shaping human development (cf. Bouchard, 1998).

Summary

Individuals differ with respect to key aspects of their general approaches to choice. While cognitive psychologists have identified several means by which such differences can be mapped, little (if anything) is know about the nature of the underlying traits and behaviors. Often, these have simply been assumed as being the products of learning and experience (Scott and Bruce, 1995). On the other hand, behavioral geneticists have provided strong evidence that: "the mind, like the body, is significantly influenced by the genes" (Marcus, 2004, p.79), uncovering innate components to a variety of human qualities (e.g., general intelligence). While it has been established that the genes influence general cognitive abilities like IQ and reading skills to a significant degree, nothing is known about the genetic roots of decision-making styles. By studying individuals' approaches to choice from a behavioral genetic perspective (i.e., adopting a twin-study approach), this thesis seeks to by bridge this gap. However, while behavioral genetic methods "can help explain what makes people different, [...] they cannot explain what people have in common" (Pinker, 2002, p.377). Accordingly, before proceeding to the empirical portions of this thesis, an evolutionary psychology perspective on the mind's more common cognitive structures is provided below.

The evolutionary psychology of decision-making:

On the nature of evolved decision-making processes

Evolutionary psychologists propose that the mind has evolved specialized cognitive tools (i.e., decision heuristics) geared to producing adaptive behavior when solving recurring problems of genetic life-and-death implications (Tooby and Cosmides, 1992; Gigerenzer and Todd, 1999). Evolutionary psychologists hence lend implicit support to the inheritance of psycho-behavioral traits (including those related to decision-making), with DNA as the biological means by which strategies favored by natural selection are transmitted to future generations. While thus far the literature review has presented the theoretical material needed to study the nature of individuals' approaches to choice, the remaining sections will provide an evolutionary psychology explanation of the development of the mind's evolved decision-making strategies focusing specifically on the area of human mate selection. Accordingly, the chapter will proceed by explaining Darwin's (1859) theory of evolution by means of natural selection and discuss how it has been applied to the understanding of human psychology. Next, a breakdown of the search process underlying mate choice will be provided along with a description of the epistemic lenses under which it has been studied in EP. Subsequently, the literature review will proceed by discussing various contingencies of sexual strategy (e.g., biological sex), describing the evolutionary contexts in which the corresponding behaviors would have been adaptive.

Natural Selection, Evolutionary Psychology and Human Mate Selection

Darwin's theory of evolution by means of natural selection describes the process by which life on earth evolves (i.e., the process by which adaptive qualities become fixed in the genotypes of successful species). Natural selection is governed by three major principles: (1) variation, (2) differential fitness, and (3) inheritance (Darwin, 1859). To illustrate, consider the following example: By and large, all human beings are born with an opposable digit on each hand. However, long before this adaptive trait was included in the genotype of the species, early hominid ancestors were forced to endure the ecological challenges of their environments without it. Then, for some reason, either due to a replication error in the genetic code (i.e., random mutation) or the coming together of two distinct gene pools (i.e., genetic recombination), some individuals were born with opposable thumbs while others, alas, were not (i.e., variation). Over generations, individuals with and without the adaptive grip were forced to compete with each other for scarce resources. This process persisted until at some point, in light of their superior ability to meet the survival and reproductive challenges of their environments (i.e., differential fitness), coupled with the fact that the genes for opposable thumbs could be passed on from parent to child (i.e., inheritance), only those that possessed the adaptive trait remained.

Evolutionary psychologists propose that similarly, cognitive adaptations to vital challenges of the environment of evolutionary adaptedness surfaced, providing some individuals with differential fitness over others. As a result, the mind is said to have evolved a collection of highly specialized decision-making strategies, triggered by cuing features of the adaptive domain at hand (i.e., domain-specific cognitive adaptations) (Tooby and Cosmides, 1992; Gigerenzer and Todd, 1999; see also Barrett, Dunbar and Lycett, 2002 for a comprehensive review). The task of choosing a mate is among evolution's most vital decision-problems. Consequently mate selection is among the most studied domains in evolutionary psychology. However, while researchers have investigated a wide variety of sexual behaviors and strategies (see Buss, 2002a for a complete review), few have endeavored to study the cognitive processes that underlie mate choice specifically (Eba, 1998; Todd and Miller, 1999). This thesis in part seeks to fill this gap. Accordingly, the following paragraphs provide a detailed account of the search process underlying mate choice, discussing the distinct means by which it has been studied by evolutionary psychologists (e.g., Todd and Miller, 1999). The literature review will then proceed by describing the key factors surrounding the development of human sexual strategies, focusing on those that relate to mate search specifically.

Mate search

In mate choice, humans are constantly evaluating potential suitors (Frank, 1988) (albeit to varying degrees). The information search processes underlying mate choice have been studied in two distinct manners. Namely, these include the trait-based and candidate-based approaches. While the trait-based approach focuses on how potential suitors are evaluated (i.e., within-candidate evaluations), the candidate-based approach focuses on how extensively the mate pool is examined in order for a winning suitor to be found (i.e., how many candidates are considered before a choice is implemented). Specifically, in trait-based sequential-sampling, individuals iteratively acquire attribute information on two competing suitors until a desired threshold of cumulative discrimination is reached (Eba, 1998). In alternative-based sequential-sampling (Todd and Miller, 1999), individuals holistically evaluate one prospective mate at a time until a fitting candidate is found. While empirically, both approaches have been considered independently, some have suggested combining the two to yield a more comprehensive understanding of the human mate selection process (Saad and Sejean, 2006a; Saad, 2006, personal communication; Lippman and McCardle, 1991). The subsequent paragraphs provide a review of the existing studies that have explored mate search via the trait- and candidate-based approaches discussed above. A unified mate search model is proposed and subsequently tested in Chapter 5.

Candidate-based

A person can spend a lifetime sequentially evaluating suitors (i.e., dating) without ever having encountered them all. A key decision in the search process underlying mate choice hence becomes when to stop evaluating additional candidates and commit to a single one. Accordingly, Todd and Miller (1999) have proposed that in the context of mate selection, human being have evolved adaptive satisficing strategies. By means of computer simulations, the authors report policies that *could* have evolved in light of the ecological constraints of the Pleistocene epoch and the notion of bounded rationality (which describes the all-pervasive effort-accuracy tradeoff driving information search as being adaptive to evolutionary concerns). While the resulting models provide insight into possible mate selection strategies, they have yet to be validated via human testing. Moreover, whereas the candidate-based approach to studying mate search focuses on how broadly potential suitors are sought (i.e., the number of candidates evaluated before terminating the search process), it offers little insight into the specifics of how individual suitors are appraised (e.g., how extensively the chosen suitor was examined).

Trait-based

In focusing specifically on the mechanics of how potential mates are appraised, Eba (1998) asked mate seekers to choose between two available suitors, evaluating them along any number of relevant traits (e.g., intelligence, attractiveness etc), via a computer-interface. Analyses were then conducted with respect to the sex of the participant and the temporal context of the proposed encounter (i.e., short-term versus long-term). The authors report findings wherein subjects employed search procedures that were consistent with evolutionary predictions. For example, as predicted by Buss and Schmitt's (1993) sexual strategies theory, males seeking a long-term mate reportedly devoted more effort to the underlying search process than those seeking a mate for a short-term affair. Moreover, given that in human mate selection a poor choice is typically more costly than a poor rejection, subjects were found to require less convincing prior to rejecting versus selecting mates (sexual strategies theory is described in greater detail below; the effort-accuracy tradeoff inherent to choices versus rejections is further discussed in Chapter 5).

Summary

Examining mate search from either an exclusively candidate-based or an exclusively trait-based perspective fails to account for many of the intricacies proper to the task of seeking a mate. Specifically, in human mate choice, mate seekers must typically evaluate a single candidate at a time along any number of defining attributes from within an unknown pool of potential suitors before making a decision to either reject or accept the given suitor. To account for these particularities, this thesis sought to combine both candidate-based and trait-based approaches into a mega sampling framework. By adopting this unified approach, both the trait- and candidate-based components of mate choice can be studied in light the idiosyncratic problem-structure of the decision at hand (see Chapter 5 for a complete description of the unified mate search model).

Determinants of human mate choice

While ultimately, humans mate for the same reasons (i.e., to perpetuate their genes into future generations), the strategic means by which they do so is influenced by several factors. Most notably, these include: biological sex (Trivers, 1972) and the anticipated temporal context of the encounter (Buss and Schmitt, 1993; Kenrick et al., 1990). Given the critical importance of these parameters, each is discussed in the paragraphs below.

Sex

Trivers' (1972) parental investment theory states that in the mating market, the sex that bears the greater burden of parental investment will be more sexually selective and coy. In humans, relative to males, females face inherently higher levels of minimal investment (and associated risk) related to reproduction and parenting. For instance, the minimal parental investment required from females demands a significant commitment of nine months gestation; for males, this period is considerably shorter involving a single act of sexual intercourse. Consequently, whereas a woman can only spread her genes nine-months at a time, a man can potentially do so several times a day! Moreover, whereas in theory, a man can reproduce throughout his entire lifetime, the average woman has a much shorter window of opportunity (currently ranging from twenty to twenty-five years). In addition, while it may be beneficial for males to engage in unrestricted sexual encounters with multiple partners, doing so offers females only a minute probability of reaping a genetic payoff, as they are only fertile during a brief period of their menstrual cycle. As the minimum costs of parental investment required from females are far greater than those related to males, the former are typically more selective in seeking a mate, requiring higher levels of accuracy from their choices (temporal context is discussed as a moderator of this sex-difference in the following paragraph). Incidentally, males have not always profited from their limited roles in human reproduction. While females know for sure whether or not they've parented a child (satisfying their Darwinian imperatives), long before the advent of DNA paternity testing, men were forced to endure the risk of their parental effort and resources being invested in another man's child (i.e., being cuckolded). In response, as the female mind has evolved strict mate-selection policies, its male counterpart has developed various cuckoldry avoidance mechanisms expressed through sexual jealousy (e.g., Buss et al., 1992), mate guarding (e.g., Buss, 2002b), and in some extreme instances: homicide (e.g., Wilson and Daly, 1992).

Temporal context

Buss and Schmidt (1993) and Kenrick et al. (1990) have further specified the relationship between mate-selection strategy and sex by discussing its sensitivity to the anticipated temporal context of the affair (i.e., short-term vs. long-term mating contexts). While the cost-benefit ratio associated with mating is especially uneven between the sexes in cases of short-term encounters, male and female prospects face increasingly similar risks and opportunity costs when committing to a long-term partner (i.e., locking themselves into a monogamous relationship). In partial support, based on the extent to which two competing suitors were evaluated by subjects as a measure of strategic selectivity, Eba (1998) reported that: "males searching for a long-term mate *were* more selective than males searching for a short-term mate. However, females searching for long- and short-term mates *did not* differ in their selectivity" (p. 81, italic added for emphasis).

Summary

In the first part of this chapter, it was proposed that both the traits and behaviors that comprise individuals' approaches to choice likely bear an underlying genetic component. Accordingly, Studies 1 and 2 were conducted to assess the innateness of related traits and behaviors via self-reported and process-tracing measures respectively. In the second part, it was proposed that throughout human evolution, the mind has developed specialized cognitive adaptations. Accordingly, Study 3 was conducted to analyze the evolved search processes underlying mate choice in light of surrounding adaptive factors (e.g., the biological sex of the mate seeker). By bridging the gap between the biological and psychological sciences, this thesis aims to provide a richer understanding of the human decision-making process.

Chapter 3

STUDY 1

Cognitive psychologists have identified several traits along which individuals' approaches to choice can be mapped (e.g., Scott and Bruce, 1995; Schwartz et al., 2002). However, these have almost exclusively been regarded as products of learning and experience (Scott and Bruce, 1995; Driver, 1979). The aim of Study 1 was to shed additional light on the matter by exploring the innateness of decision-making styles using a twin-study approach. To this end, the relative similarities of MZ and DZ co-twins were compared along key general decision-making traits (i.e., general decision-making style and maximizing). Though experiential factors clearly affect how decisions are made (e.g., Brucks, 1985), do people possess innate approaches to choice in general as well? Herein lays the inquiry of Study 1.

RESEARCH QUESTIONS AND HYPOTHESES

If individuals' approaches to choice are in fact rooted in the genes, it should follow that MZ co-twins (who share 100% of their genes in common) be more similar than their DZ counterparts (who on average share 50% of the genes that vary between individuals) along related traits. Accordingly, the current study reports findings wherein the relative similarities of MZ and DZ co-twins were contrasted along measures of general decision-making style (GDMS) (Scott and Bruce, 1995) and maximizing (MAX) (Schwartz et al., 2002). Hypotheses related to each of these measures are stated below.

Twin-zygosity and intra-sibling differences in GDMS & MAX

In 1995, Scott and Bruce developed the GDMS measure, a 25-item inventory used to assess individuals along a set of five basic decision-making sub-styles (i.e., rational, intuitive, spontaneous, dependent and avoidant). In 2002, Schwartz et al. introduced the MAX scale, a 13-item inventory used to position individuals along a satisficing-maximizing continuum (see Chapter 2 for a more detailed description of each of these). In Study 1, differences between siblings were computed along the various subscales of the GDMS measure and along the MAX scale. In addition, a summary measure of the various intra-sibling differences reported along the subscales of the GDMS was computed; intra-sibling differences were then compared along the summary measure with respect to twin-zygosity[1]. In running the analyses, it was predicted that DZ twins would exhibit greater intra-sibling differences than their MZ counterparts. Accordingly, the following set of hypotheses was posited:

Summary of differences along the General Decision-Making Style measure

H1: DZ co-twins will be more different than their MZ counterparts along the sub-styles of the GDMS measure (overall).

Sub-styles of General Decision-Making

H1a: DZ co-twins will be more different than their MZ counterparts along the rational subscale of the GDMS measure.

H1b: DZ co-twins will be more different than their MZ counterparts along the intuitive subscale of the GDMS measure.

---

[1] Please note that this measure was intended to provide a summary of the overall intra-sibling differences reported along the various subscales of the GDMS measure. For a more statistically sound evaluation of the genetic underpinning of decision-making styles, please refer to the set of sub-style-related analyses.

H1c: DZ co-twins will be more different than their MZ counterparts along the dependent subscale of the GDMS measure.

H1d: DZ co-twins will be more different than their MZ counterparts along the avoidant subscale of the GDMS measure.

H1e: DZ co-twins will be more different than their MZ counterparts along the spontaneous subscale of the GDMS measure.

Maximizing

H2: DZ co-twins will be more different than their MZ counterparts along the maximizing scale.

METHODOLOGY

Participants

Study 1 consisted of 100 twin-pairs (or 200 individual twins) pooled from two samples. Participants from the first sample were amassed from the 2005 Montreal twin parade. Twenty-two pairs of MZ twins and six pairs of DZ twins from this sample completed the GDMS scale (see Appendix A). Twins from the second sample were recruited from the St-Thomas' hospital twin registry in the UK. Thirty pairs of MZ twins and forty-two pairs of DZ twins from the UK sample completed the GDMS scale; twenty-seven pairs of MZ and forty pairs of DZ twins from this sample completed the maximizing scale (see Appendix B). Sample splits are listed in Table 1 below.

Table 1: Sample splits

	General Decision Making Style		Maximizing	
	MZ	DZ	MZ	DZ
Canadian Sample	22 pairs	6 pairs	--	--
United Kingdom Sample	30 pairs	42 pairs	27 pairs	40 pairs
TOTAL[2]	**52 pairs**	**48 pairs**	**27 pairs**	**40 pairs**

Procedure

Montreal twins sample

Pairs of twins were randomly approached following an outdoor parade and asked to independently fill a brief 2-page questionnaire comprised of the GDMS scale.

UK twins sample

Pairs of twins, scheduled for various studies at the St-Thomas' hospital, were asked to fill out a slightly more elaborate questionnaire comprised of both the GDMS and maximizing scales. Again, siblings were asked to answer their booklets independently.

RESULTS

Confirming the five-factor model of GDMS

A factor analysis was performed on the GDMS dataset via a maximum likelihood (ML) extraction method using SPSS 13.0. Costello and Osborne (2005) recommend using ML because it allows for the fit of the proposed model to be assessed via an associated Chi-square statistic (see Also

[2] Additional analyses performed on the UK sample only mirrored those related to the pooled sample.

Fabrigar et al., 1999). The Chi-square statistic associated with the five-factor model was $\chi^2(185)$ = 189.87 (with 185 degrees of freedom), yielding a p-value of 0.39 ($p > 0.2$). As the related null hypothesis postulates that the proposed model indeed fits as well as a perfect model (Lattin, Carroll and Green, 2003), the five-factor model was confirmed, explaining 55.67% of the total variability in the data (see Loo, 2000 and Spicer & Sadler-Smith, 2005 for further support of the five-factor GDMS structure; see also scree-plot in Appendix C). Following the extraction of the five factors, a varimax rotation was performed to determine whether or not the items would load as expected. The items loaded on the expected factors with the exception of one. As depicted in Appendix C, item 25, which was originally expected to load on the spontaneous decision-making style, loaded on the somewhat related intuitive decision-making factor. For this reason, item 25 was included as an indicator of intuitive decision-making style and dropped from the spontaneous style's item set.

Data transformations

In Study 1, each data-point corresponds to a difference between two observations (i.e., intra-sibling difference). The datasets were consequentially bound by zero at the lower end, making them slightly right-skewed, while including zero-values. The datasets were hence normalized using a square-root transformation (see Osborne, 2002 for a complete description of data transformation protocols). While this process allowed for the ensuing t-tests to be performed, interpreting the post-transformational data can be a daunting task at best (Osborne, 2002). Accordingly, the ranges and means discussed below refer to the data in its original form. The associated t-statistics and p-values, however, pertain to analyses conducted on the normalized data.

Method of analysis

As alluded to above, mean differences in the relative similarities of MZ and DZ co-twin were compared along the various metrics by way of t-tests. In particular, results are reported below as they relate to intra-sibling differences in the summary measure of decision-making style dissimilarity (i.e., across the various subscales of the GDMS measure), intra-sibling differences in each of the various sub-styles of the GDMS measure, and intra-sibling differences reported along the maximizing scale. To account for uneven MZ and DZ sample-sizes, unequal variances were assumed when running the corresponding t-tests. A synthesis and explanation of the reported findings is provided in the discussion section.

Summary measure of general decision-making style

In comparing the aggregated intra-sibling differences of MZ and DZ co-twins reported along each subscale of the GDMS measure, it was hypothesized that the mean related to DZ co-twins would be significantly greater than the one corresponding to their MZ counterparts. The associated results are reported in Table 2 below.

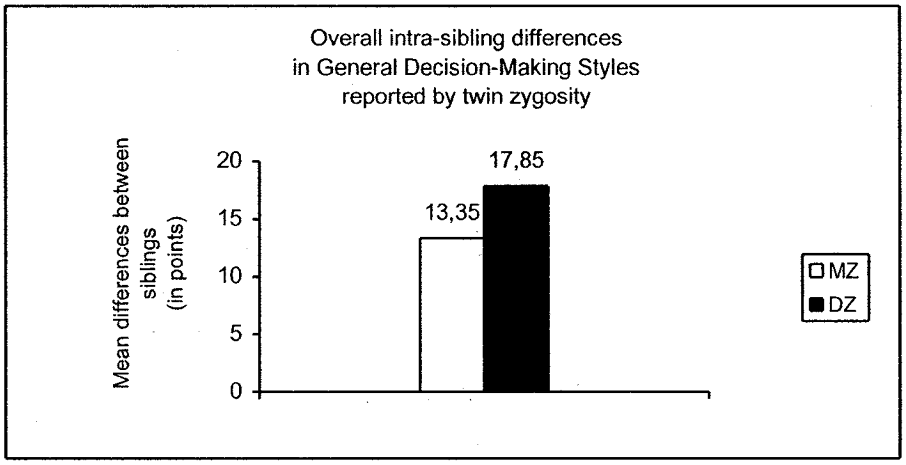
Table 2: Overall intra-sibling differences in general decision-making styles

	MZ *N=52 pairs*	*DZ* *N=48 pairs*	*t-value*	*df*	*p-value*	*Status*
Mean aggregated GDMS differences (in points)	13.35	17.85	-3.78	92	<0.001	Supported

Results correspond to a one-sided t-test

As depicted in Table 2, the mean related to DZ co-twins (17.85 units) was indeed significantly greater than the one pertaining to their MZ counterparts (13.35 units) ($t(92) = -3.78$, $p < 0.001$). The contention that GDMS would reveal an innate component along this metric was hence supported (see Figure 1 below).

Figure 1: GDMS overall Results



Sub-scales of general decision-making style

In comparing the mean intra-sibling differences of MZ and DZ co-twins along each of the sub-styles of the GDMS measure it was hypothesized that those related to DZ co-twins would be significantly greater than the ones corresponding to their MZ counterparts. The related findings are reported in Table 3 below.

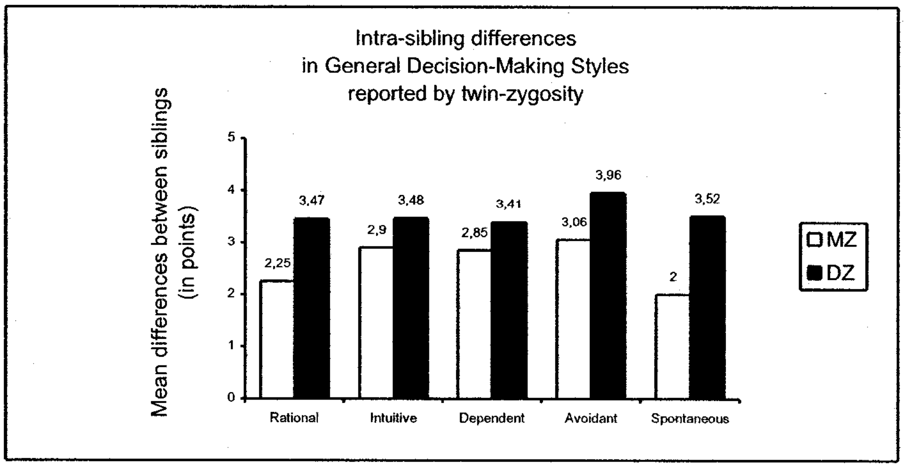
Table 3: Intra-sibling differences along each sub-style of general decision-making

	Cronbach's alpha	*MZ N=52 pairs*	*DZ N=48 pairs*	*t-value*	*df*	*p-value*	*Status*
Rational	0.78	2.25	3.47	-3.14	97	0.001	Supported
Intuitive	0.73	2.90	3.48	-2.15	88	0.017	Supported
Dependent	0.81	2.85	3.41	-0.83	95	0.204	Not Supported
Avoidant	0.76	3.06	3.96	-1.00	88	0.159	Not Supported
Spontaneous	0.82	2.00	3.52	-2.54	96	0.006	Supported

Results correspond to one-sided t-tests

As depicted in Table 3 above, all of the subscale-related hypotheses enjoyed directional support; three out of five of these were statistically significant. In particular, intra-sibling differences reported along the measure of rational decision-making style ranged from 0 to 12.5 points. As predicted, the mean pertaining to DZ co-twins (3.47 points) was significantly greater than that of their MZ counterparts (2.25 points) (t (97) = -3.14, p <0.005). Intra-sibling differences reported along the measure of intuitive decision-making style ranged from 0 to 12 points. Again, the mean related to DZ co-twins (3.48 points) was significantly greater than that of their MZ counterparts (2.90 points) (t (88) = -2.15, p <0.05). Finally, intra-sibling differences reported along the measure of spontaneous decision-making style ranged from 0 to 11 points. Yet again, in comparing the related mean intra-sibling differences, that related to DZ co-twins (3.52 points) was significantly greater than the one corresponding to their MZ counterparts (2.00 points) (t (96) = -2.54, p < 0.01). While all the subscale-related hypotheses enjoyed directional support (see Figure 2 below), those pertaining to the dependent and avoidant decision-making styles were not statistically significant (p>0.1) (intra-sibling differences ranged from 0 to 14 and from 0 to 12 for the dependent and avoidant decision-making styles respectively; see Table 3 for a depiction of the related means and statistics). As a possible explanation, the development of these styles is perhaps more contingent upon environmental factors. A more detailed discussion on this is provided in the following section.

Figure 2: GDMS subscale Results



Maximizing

In comparing the intra-sibling differences of MZ and DZ co-twins along the maximizing scale, it was hypothesized that the mean related to DZ co-twins would be significantly greater than that of their MZ counterparts. The results are reported in Table 4 below.

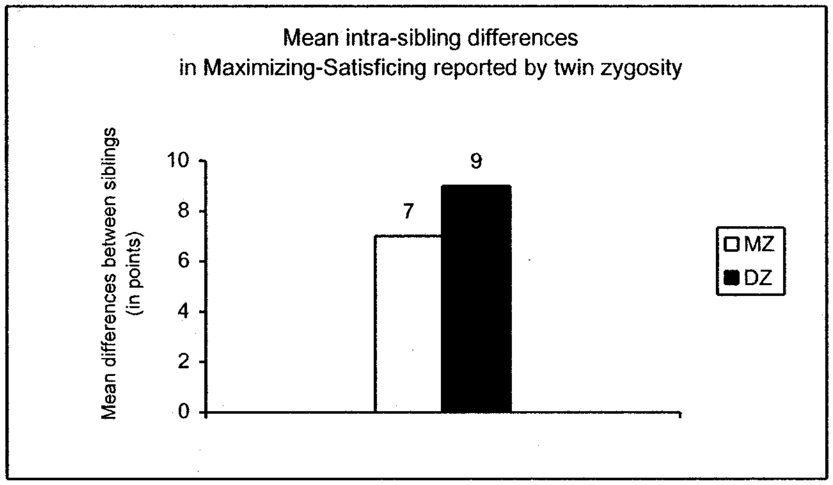
Table 4: Intra-sibling differences in maximizing

	Cronbach's alpha	*MZ N=27 pairs*	*DZ N=40 pairs*	*t-value*	*df*	*p-value*	*Status*
Maximizing	0.67	7.00	9.00	-1.71	56	0.046	Supported

Results correspond to a one-sided t-test

Intra-sibling differences reported on the maximizing scale ranged from 0 to 24 points. As predicted, in comparing the related means, that corresponding to DZ co-twins (9.00 units) was significantly greater than the one pertaining to their MZ counterparts (7.00 units) (t (56) = -1.71, p < 0.05) (see Figure 3 below). While the maximizing scale's reliability score (Cronbach's alpha = 0.67) was below the standard 0.7 minimum (Nunnally, 1978), the iterative removal of any single item from the scale failed to improve its reliability. In such cases, one can apply Devellis' (1991) rules of thumb wherein he proposes that scores between 0.65 and 0.7 are minimally acceptable. This issue is further addressed in the limitations section.

Figure 3: Maximizing results



DISCUSSION

Decision-makers vary with respect to key aspects of their characteristic approaches to choice. Though related traits have been identified in the cognitive psychology literature (Scott and Bruce, 1995; Schwartz et al., 2002), prior to this study, little (if anything) was known about their particular origins. In most cases, they were simply assumed to be the products of learning and experience (Scott and Bruce, 1995; Driver, 1979). In contrasting the relative similarities of MZ and DZ co-twins along measures of decision-making style, Study 1 provides compelling evidence that many of the traits that comprise individuals' approaches to choice, however, bear a significant innate component.

While all hypotheses enjoyed directional support, the effect of zygosity on the dependent and avoidant decision-making styles was not statistically significant. Perhaps these aspects of general decision-making style are simply more sensitive to developmental factors. For example, it is possible that while a genetic predisposition for relying on the support of others when making decisions may exist, the reality of having to make choices autonomously forces an a priori dependent decision-maker to adapt his or her decision-making style to the landscape of his or her decision environment (the notions of developmental plasticity and adaptability to the environment are discussed in Chapters 4 and 6). Moreover, it is worth mentioning that both the dependent and avoidant decision-making styles are likely linked to self-confidence (i.e., the trust one has in his or her own ability to make choices in an autonomous and timely manner). As conventional wisdom proclaims, self-confidence is earned, not given. Lending empirical support, Ruefenacht et al. (2002) reported that in dogs, self-confidence is mainly a product of environmental and experiential factors, not genetic relatedness. If the dependent and avoidant decision-making styles were in fact linked to one's acquired self-confidence, it would make sense that they be less affected by his or her genetic predispositions.

Another noteworthy point of discussion relates to the genetic underpinnings of maximizing. Among the most vital contributions arising from Schwartz et al.'s (2002) work is the negative relationship reported between maximizing and feelings of well-being and life-satisfaction. Because maximizers by definition tend to seek optimality from their decision-outcomes, they are more prone to experiencing disappointment and regret. As a result, maximizers often to feel worse than satisficers, despite the fact that on average they tend to enjoy objectively superior decision-outcomes (see also Iyengar, Wells and Schwartz, 2005). By revealing a genetic component to the tendency to either maximize or satisfice, the twins-related findings imply a possible link between genetics and peoples' general levels of happiness, and ultimately psychological health (see

Schwartz et al., 2002 for a discussion linking maximizing to depression). This claim is supported in the relevant literature-streams wherein states of psychological wellness have been linked to the genes (e.g., see Gottesman, 1991, 1993 for a evidence of the genetic basis of schizophrenia).

Limitations

Study 1 was subject to minor limitations. Firstly, while the GDMS measure used on the United Kingdom sample included all 25 items of the GDMS scale (courtesy of Bruce in a personal communiqué), the measure completed by members of the Canadian sample was comprised of the 24 items published in Scott and Bruce's (1995) article. As per the personal communiqué with Bruce (2005, personal communication), the inconsistency between the two was apparently the result of a publishing oversight. In Study 1, this discrepancy was remedied by replacing missing values with their corresponding subject-specific factor-means (i.e., with the mean of the affected factor).

A second limitation of Study 1 was the low Cronbach's alpha for the maximizing scale (0.67), rating below the suggested minimum of 0.7 (Nunnally, 1978). It is worth noting that the iterative removal of any single item from the scale failed to improve its reliability. In such cases, as Devellis (1991) proposes, the criteria can be relaxed slightly, and scores between 0.65 and 0.7 can be considered to be minimally acceptable. Moreover, as Schwartz et al. (2002) report similarly low reliabilities in the paper that introduced the scale, it is unlikely that the low reliability exhibited in Study 1 was due to any idiosyncratic features of the sample used therein.

As an additional noteworthy limitation, the specific twin-study flavor used in Study 1 involved contrasting the relative similarities of MZ and DZ co-twins reared together. However, some have warned that MZ siblings might share more similar developmental experiences than their DZ counterparts. For example, it is possible that in looking more alike, MZ co-twins are treated more similarly by their parents, peers, teachers etc. than their DZ counterparts (Otto, Christiansen and Feldman, 1995). While the results typically come out the same across twin-study implementations (Pinker, 2002), future researchers might consider reproducing Study 1's findings using a different behavioral generic approach (e.g., by examining the relative similarities of MZ co-twins reared apart).

Conclusion

In conclusion, Study 1 yielded findings wherein several of the traits that underlie individuals' approaches to choice were reportedly influenced by genetic factors. In particular, MZ co-twins were found to be significantly more similar than their DZ counterparts along several measures general decision-making style and maximizing. However, not all of the findings enjoyed statistical significance. In particular, MZ co-twins were not significantly more similar than their DZ counterparts with regards to the dependent and avoidant components of their general decision-making styles. This pattern of findings suggests that while genetic predispositions are important factors in influencing the development of human traits, they are by no means deterministic. Moreover, while certain aspects of individuals' approaches to choice are relatively fixed in the genes, others imply more plasticity (i.e., adaptability to the environment). In summary, Study 1 provided evidence that several decision-making traits are indeed rooted in the genes. What remains to be seen is whether or not key facets of the cognitive process underlying decision-making (i.e., predecisional information search behaviors) are similarly ingrained. Herein lays the focus of Study 2.

SUMMARY OF FINDINGS

GENERAL DECISION-MAKING STYLE	
H1: DZ co-twins will be more different than their MZ counterparts along the sub-styles of the GDMS measure (summary measure).	Supported
H1a: DZ co-twins will be more different than their MZ counterparts along the rational subscale of the GDMS measure.	Supported
H1b: DZ co-twins will be more different than their MZ counterparts along the intuitive subscale of the GDMS measure.	Supported
H1c: DZ co-twins will be more different than their MZ counterparts along the dependent subscale of the GDMS measure.	Not Supported
H1d: DZ co-twins will be more different than their MZ counterparts along the avoidant subscale of the GDMS measure.	Not Supported
H1e: DZ co-twins will be more different than their MZ counterparts along the spontaneous subscale of the GDMS measure.	Supported
MAXIMIZING	
H2: DZ co-twins will be more different than their MZ counterparts along the maximizing scale.	Supported

Chapter 4

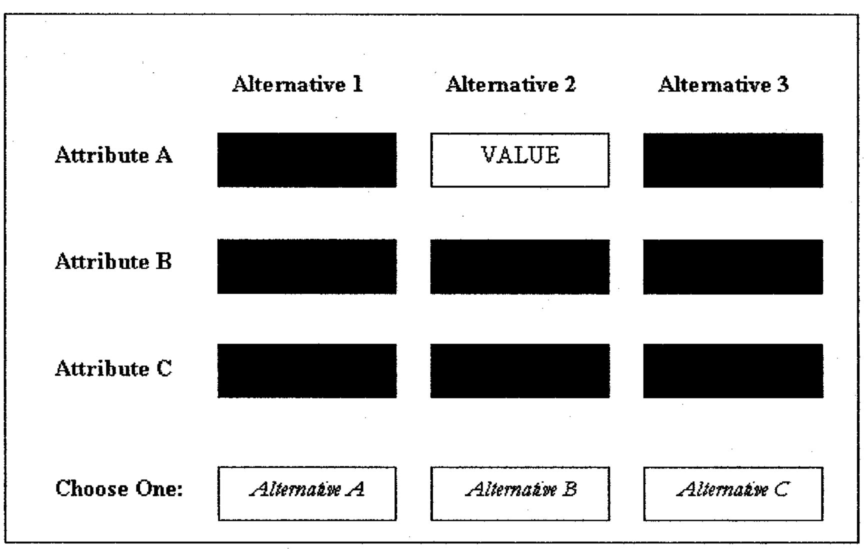
STUDY 2

If the genes are in part responsible for one's general decision-making styles, are more implicit aspects of a person's choice process rooted in DNA as well? If so, it should follow that given their greater genetic overlap, MZ co-twins behave more similarly than their DZ counterparts when making actual decisions. In Study 2, the cognitive processes underlying the choices made by MZ and DZ co-twins were captured along key process-tracing measures as siblings independently solved a computerized decision-making task. The relative similarities of MZ and DZ co-twins were subsequently contrasted, inferring the innateness of essential facets of the predecisional choice process. Chapter 4 begins by providing a description of the process-tracing approach employed in Study 2 (including a depiction of the information display format and various process-tracing metrics employed therein), and proceeds by positing the related research questions and hypotheses. Subsequently, the chapter provides a detailed report of the decision-making task presented in the study, discussing the surrounding methodological considerations and procedures. A synopsis of the findings and a related discussion follow directly thereafter.

The computer-interface

For the purpose of Study 2, a computerized decision-making task was developed using Mouselab, a process-tracing application development platform (see Payne, Bettman and Johnson, 1993 for a detailed description). In completing the task, subjects were asked to select a winning alternative from a predefined set of available options. As depicted in Figure 4, alternatives were listed on a computer screen along their defining attributes in a matrix (or tabular) format with each column corresponding to an alternative and each row pertaining to a given attribute. While traditionally, rows correspond to alternatives and columns pertain to attributes, a transposed configuration was chosen to accommodate for the way Mouselab applications elicit chosen outcomes (i.e., at the bottom of the screen aligned with the columns). A matrix schema was employed to allow for several key search metrics to be computed (these are discussed in the following section). The specific dimensions of the information display matrix presented in Study 2, along with the exact context and stimulus space proposed therein, are discussed in the methodology section.

Figure 4: Sample information display matrix



As depicted in Figure 4, units of information were displayed in cells at the intersection of the corresponding alternative and attribute areas. These were initially hidden to subjects, enclosed within an opaque outer-layer or "box". A single unit could be viewed at a time by clicking in the appropriate location with the mouse. Once subjects felt that they had sufficiently evaluated the available options, they were instructed to select a winning alternative by clicking in the appropriate selection-box at the bottom of the screen (the experimental procedure is discussed in greater detail in the methodology section).

Measures

As subjects acquired information, several process-tracing measures were recorded. Specifically, for each unit requested, the application recorded the identifier of the box (used to breakdown its associated alternative and attribute properties), the time at which the box was opened, the time at which the box was closed, and a message field denoting the type of operation made (i.e., whether a box was opened, closed or a choice was made). From these basic measures, several more complex metrics were computed. In particular, these included metrics related to: (1) the amount of processing, (2) the selectivity of processing, and (3) the pattern of processing exhibited predecisionally. Each of these is addressed in the following paragraphs, along with the associated research questions and hypotheses.

RESEARCH QUESTIONS AND HYPOTHESES

Amount of processing

As Payne, Bettman and Johnson (1993) state, the amount of processing a person dedicates to solving a decision-problem is an important facet of his or her choice-process. Accordingly, the authors propose three complimentary measures related to: (1) the total amount of information acquired predecisionally (i.e., the total number of times that information boxes were opened before a final decision-outcome was reached), (2) the total amount of time spent processing information (i.e., the total amount of time during which information boxes were open), and (3) the average amount of time spent per unit of information processed. In stating the specific hypotheses, the computation of intra-sibling differences along each of these is discussed in the paragraphs below.

Total amount of information processed

With regards to this metric, the amount of information acquired predecisionally was first computed for each subject as the total number of times information boxes were opened before a winning option was chosen (Payne, Bettman and Johnson, 1993). The related intra-sibling differences were subsequently computer along two complimentary measures. The first involved calculating the absolute difference between the total numbers of times information boxes were opened by each sibling. The second involved computing a similarity proportion for each pair of twins by dividing the number of cells acquired by the less extensive information searcher by that of his or her more exigent co-twin. The difference between 50 and 100 cells is much more impressive than the difference between 300 and 350 despite the fact that in both cases the absolute difference is 50. In the latter case both individuals share a high extent of information search; in the former, they do not. In contrasting the results of MZ and DZ co-twins along both of these metrics, the following hypotheses were proposed:

Intra-sibling differences

H3a: DZ co-twins will be more different than their MZ counterparts with respect to the number of times information boxes were opened predecisionally.

Intra-sibling similarities

H3b: MZ co-twins will acquire more similar proportions of predecisional information than their DZ counterparts.

Total amount of time spent processing information

With regards to this metric, intra-sibling differences were computed as the absolute difference in the total amounts of time each sibling spent processing information before committing to a winning option. In contrasting the results of MZ and DZ co-twins along the ensuing metric, the following hypothesis was proposed:

H3c: DZ co-twins will be more different than their MZ counterparts with respect to the total amount of time spent processing information predecisionally.

Average amount of time spent processing each unit of information

With regards to this metric, intra-sibling differences were computed as the difference in the total amount of time each sibling spent processing information before committing to a winning option divided by the corresponding numbers of times that information boxes were opened predecisionally. In contrasting the results of MZ and DZ co-twins along the ensuing metric, the following hypothesis was proposed:

H3d: DZ co-twins will be more different than their MZ counterparts with respect to the average amount of time spent processing each unit of predecisional information.

Selectivity of processing

The second set of process-tracing metrics examined in Study 2 relates to the selectivity of the cognitive strategy preceding the implementation of a choice. As Payne, Bettman and Johnson (1993) write: "a central distinction among strategies is the extent to which they make tradeoffs among attributes. Decision strategies (such as weighted additive) that make tradeoffs are called compensatory strategies, whereas strategies (such as lexicographic) that do not make tradeoffs are called non-compensatory" (p. 29). Non-compensatory strategies are typically less effortful and entail more selective processing. Payne, Bettman and Johnson (1993) propose that the consistency of processing across alternatives and attributes are indicators of processing selectivity (i.e., whether a compensatory or non-compensatory decision strategy was opted for). Specifically, they state: "more compensatory decision rules [...] imply a pattern of information acquisition that is consistent (low in variance) across alternatives and attributes; in contrast, non-compensatory strategies [...] imply more variance in processing" (p.155). Payne, Bettman and Johnson (1993) suggest computing processing selectivity (i.e., processing consistency across alternatives and attributes) as the variance in the proportions of time spent evaluating each alternative (and each attribute) individually. To illustrate, consider the following example.

Assessing the consistency of evaluative processing across alternatives:

Proportions of processing for each alternative:

- Twin 1: 50% of processing on alternative 1, 25% on alternative 2, 10% on alternative 3, 10% on alternative 4, 5% on alternative 5, and 0% on alternative 6.
- Twin 2: 80% of processing on alternative 1, 20% on alternative 2, and 0% on the four remaining alternatives

To calculate the net metric of similarity:

1. Compute the variances in the proportions related to Twins 1 and 2
2. Compute the absolute difference between the two variances

In other words:

- Let Var1 = Variance of (0.5, 0.25, 0.10, 0.10, 0.05, 0)
- Let Var2 = Variance of (0.80, 0.20, 0, 0, 0, 0)
- Net metric of similarity = Var1 - Var2

The same logic was used to compute the variance in the proportions of time spent on each attribute. In contrasting the relative similarities of MZ and DZ co-twins along these metrics, the following hypotheses were posited:

Processing consistency across alternatives

H4a: DZ co-twins will be more different than their MZ counterparts in terms of the processing consistency displayed across alternatives.

Processing consistency across attributes:

H4b: DZ co-twins will be more different than their MZ counterparts in terms of the processing consistency displayed across attributes

Pattern of processing

The final measure of cognitive processing examined in Study 2 relates to the pattern of information search preceding a decision (i.e., whether processing was more alternative- or attribute-based). Specifically, processing pattern can be assessed by comparing the $(n + 1)^{th}$ unit of information acquired to the n^{th} unit of information acquired. If both are within the same alternative, the sequence is recorded as an alternative-based transition. If both are within the same attribute, the sequence is recorded as an attribute-based transition. Payne (1976) has proposed the following measure to capture the decision-maker's pattern of processing:

$$\frac{(\text{Alternative-based transitions} - \text{Attribute-based transitions})}{(\text{Alternative-based transitions} + \text{Attribute-based transitions})}$$

Ratios closer to +1 are indicative of an alternative-based processing pattern; those closer to –1 are indicative of an attribute-based processing pattern. In contrasting the intra-sibling differences related to MZ and DZ co-twins, it is hypothesized that:

> H5: DZ co-twins will be more different than their MZ counterparts in terms of their information processing patterns.

METHODOLOGY

For the purpose of Study 2, a process-tracing task was developed using Mouselab. The following sections provide a description of the pre-experimental configuration of the task and a detailed report of the subsequent experimental procedure.

Pre-experimental task design and configuration

The key activities involved in configuring the decision-making task employed in Study 2 were: (1) choosing the problem context, and (2) defining the stimulus space accordingly (i.e., generating alternatives). The reasoning behind the stimuli choices and the surrounding problem-context was as follows: as a requirement, the chosen decision-situation needed to provide subjects with a general decision-making task that was not so common that they would likely have common or established processing strategies (i.e., to capture individual differences), yet familiar enough that they would understand how to inform themselves in order to complete the task (i.e., to avoid random choice processes). These criteria were established to elicit individual differences in the cognitive processes leading up to a choice being made. As a result, the context of choosing a hotel for a 2-week vacation was selected.

In defining the stimulus space (i.e., information display matrix), each hotel was described along 7 key attributes. Namely, these were: (1) Cleanliness, (2) fun, (3) location, (4) restaurant, (5) security, (6) service, and (7) weather. These attributes and their corresponding scale-levels were derived from a review of hotel descriptions listed on various travel websites (e.g., www.hostelworld.com, www.hotels.com, expedia.com). Attributes and their scales are listed below:

Attribute names and scales [3]

Cleanliness: Poor – Fair – Good – Very Good
Fun: Dull – Fun – Very Fun
Location: Poor – Nice – Very Nice
Restaurant: 2 stars – 3 stars – 4 stars
Security: Poor – Fair – Good – Very Good
Service: Poor – Fair – Good – Very Good
Weather: Rainy – Showers – Cloudy – Windy – Sunny

Each hotel's profile was generated using a randomizing function. Specifically, for each hotel a random number generator was used to assign an integer value to each of its attributes (with 1 corresponding to the lowest attribute level and subsequent integers corresponding to the remaining levels in increasing order of anticipated preference). To illustrate, consider the following example. As depicted in the list above, the cleanliness attribute was comprised of four distinct levels. To configure a given hotel's standing along the cleanliness attribute, a random number generator was prompted to produce an integer between 1 and 4. Provided the integer returned were "3", the hotel would be assigned the value "good" along the cleanliness attribute.

[3] Note that this scale does not pass the criteria of being mutually exclusive and mutually exhaustive. This, however, does not in any way harm the twins-related findings.

Experimental procedure

Study 2 was comprised of 132 individual twins (27 MZ twin-pairs and 39 DZ twin-pairs) originating from the UK sample[4] described in Study 1. In participating, subjects were asked complete a computerized decision-making task involving the selection of a vacation resort from among six hotels, each of which was defined along the seven attributes listed on the previous page. These particular dimensions were selected to offer subjects a sizable amount of information, while respecting Mouselab's display boundaries. Subjects were informed that in informing themselves, though hotel features were listed alphabetically, they were not required to open boxes in any particular order. Moreover, subjects were instructed to only open as many boxes as was needed to make a choice among the available options. The task ended when subjects committed to their final choice and clicked in the confirmation area at the bottom of the screen.

The study was conducted in multiple sessions over a six-month period at the St-Thomas' hospital genetic epidemiology and twin research unit. Sessions were run on four computers and took approximately 10 to 15 minutes to complete (including instructions and demonstration screens). Several screens were designed to introduce subjects to the task. Subjects were first shown a prototype information display matrix with all the cells open, familiarizing them with the task's data structure. Next, subjects were shown a demo screen with all the cells closed, and asked to acquire information and make a choice. Data from this screen was discarded as it was designed solely for trial purposes. After having navigated past these screens, subjects were presented with the actual task.

[4] The discrepancy between the number of MZ and DZ twin participants arises from the fact that at the time of the study, the UK twins-lab had been focussing on collecting data pertaining to DZ co-twins for the purposes of other projects.

RESULTS

Method of analysis

Mean differences in the relative similarities of MZ and DZ co-twins were assessed via a series of t-tests. In order to account for uneven cell sizes pertaining to MZ and DZ subject data, unequal variances were assumed when running the corresponding analyses. With regards to the intra-sibling-related analyses, datasets were normalized using a square-root transformation prior to analyses (cf. Chapter 3). Where data-points corresponded to proportions (i.e., H3b), the datasets were normalized using the arcsine transformation before being analyzed (see Osborne, 2002 for a complete description of data transformation protocols). As in Study 1, while this process allowed for the desired t-tests to be performed, interpreting the post-transformational data can be a daunting task (Osborne, 2002). Accordingly, the means discussed below refer to the data in its original form. The associated t-statistics and p-values, however, pertain to analyses conducted on the normalized data. A synthesis and an explanation of the reported findings are provided in the discussion section.

Amount of cognitive processing

It was hypothesized that DZ co-twins would exhibit greater intra-sibling differences than their MZ counterparts along the various metrics related to the amount of processing preceding the implementation of a choice. The associated results are presented in Table 5 below.

Table 5: Amount of processing with regards to twin zygosity

Mean intra-sibling differences in:	*MZ N=27 pairs*	*DZ N=39 pairs*	*t-value*	*df*	*p-value*	*Status*
Amounts of information processed (in units of information processed)	13.70	26.67	-3.34	59	<0.001	Supported
Proportions of information processed (similarity index)	0.68	0.55	2.08	55	0.02	Supported
Differences in total time spent processing information (in seconds)	15.37	27.97	-1.99	64	0.03	Supported
Differences in average time spent on each unit of information (in seconds)	1.26	1.54	-0.30	60	0.38	Not supported

Results pertain to one-sided t-tests

As depicted in Table 5, the amounts of processing preceding the implementation of a choice were seemingly influenced by genetic factors. In particular, the mean intra-sibling differences in the amounts of information processed predecisionally related to DZ co-twins (26.67 units) was significantly greater than that corresponding to their MZ counterparts (13.70 units) ($t(59) = -3.34$, $p < 0.001$). In comparing the related similarity indexes, as predicted, that related to MZ co-twins (0.68) was significantly greater than the one corresponding to their DZ counterparts (0.55) ($t(55) = 2.08$, $p < 0.05$). With regards to the temporal metrics, DZ co-twins were significantly more different than their MZ counterparts in terms of how much time they spent processing information predecisionally, (27.97 vs. 15.37 seconds respectively) ($t(64) = -1.99$, $p < 0.05$). However, in comparing the average amounts time spent processing each unit of predecisional information, no significant differences were found between DZ and MZ co-twins ($p > 0.2$) (see Table 5 for related means and statistics). Perhaps while the total amount of time spent processing units of information was a good indicator of the amount of processing devoted to the predecisional choice process, the average amount of time spent on each unit was more related to processing speed. In either case, this first set of analyses provides strong evidence that the amount of processing individuals devoted to solving the proposed decision-problem was influenced by genetic factors.

Selectivity of cognitive processing

It was hypothesized that DZ co-twins would exhibit greater intra-sibling differences than their MZ counterparts along metrics of processing consistency across alternatives and across attributes. The results associated with each of these are presented in Table 6 below.

Table 6: Mean intra-sibling differences in processing selectivity

Mean intra-sibling differences in:	*MZ N=27 pairs*	*DZ N=39 pairs*	*t-value*	*df*	*p-value*	*Status*
Processing consistency across alternatives (in variances across alternatives)	0.03	0.02	0.54	48	0.30	Not supported
Processing consistency across attributes (in variances across attributes)	0.02	0.02	-0.61	64	0.27	Not supported

Results pertain to one-sided t-tests

As depicted in Table 6, intra-sibling differences reported along the alternative- and attribute-based processing selectivity metrics were quite similar between DZ and MZ co-twins. Hence, the related hypotheses were not supported ($p > 0.2$). Of interest, variances in the proportions of time spent evaluating each alternative ($M = 0.02$) and each attribute ($M = 0.02$) were small across subjects, irrespective of genetic relatedness. This suggests that most individuals made use of equally selective processing strategies, in particular opting for a more compensatory approach (i.e., small variances entail more consistency; consistency entails the use of more compensatory strategies). Hence, while the amounts of information acquired predecisionally were reportedly linked to genetic factors, processing selectivity was more sensitive to the specific characteristics of the problem at hand (i.e., task and context variables) (Payne, Bettman and Johnson, 1993). This claim is further developed in the discussion section.

Pattern of cognitive processing

It was hypothesized that DZ co-twins would exhibit greater intra-sibling differences than their MZ counterparts along the processing pattern metric described earlier. The associated results are presented in Table 7.

Table 7: Mean intra-sibling differences in processing pattern

MZ *N=26 pairs*	*DZ* *N=38 pairs*	*t-value*	*df*	*p-value*	*Status*
0.52	0.47	0.88	60	0.19	Not supported

Results pertain to a one-sided t-test

As depicted in Table 7, MZ and DZ co-twins were equally similar with respect their processing patterns. In comparing the related means, that related to DZ co-twins (0.52) did not differ significantly from the one corresponding to their MZ counterparts (0.47) ($p > 0.1$). In addition, as with processing selectivity, the mostly positive pattern metrics revealed across subjects ($M = 0.26$) suggests that individuals tended to adapt their processing patterns similarly, evaluating alternatives holistically (versus heuristically) prior to identifying a winning option. This finding supports the contention that subjects employed a more compensatory decision strategy in completing the task, as compensatory strategies are associated with a more alternative/holistic-based evaluation patterns (i.e., positive pattern metrics) (Payne, Bettman and Johnson, 1993). It would hence appear that like processing selectivity, processing pattern was adaptive to the characteristics of the decision-problem at hand. A related discussion is provided below.

DISCUSSION

Study 2 reports findings wherein MZ co-twins tended to dedicate more similar amounts of processing to their predecisional information search than their DZ counterparts. The latter highlights two important findings: (1) in support of the existing literature, individuals displayed idiosyncratic information needs (Cacioppo and Petty, 1982), and (2) individual differences in the amounts of processing engaged in predecisionally were significantly influenced by genetics. This finding was expected as the amounts of search preceding an individual's decisions are likely linked to innate elements of his or her personality (e.g., Verplanken, Hazenberg and Palenewen, 1992). On the other hand, virtually no individual differences were revealed along the various measures of processing similarity and processing pattern. While the amount of information processed predecisionally was reportedly linked to genetic factors, the type of decision-strategy applied was seemingly more sensitive to the characteristics of the problem at hand (cf. Payne, Bettman and Johnson, 1993). This claim fits within the adaptive decision-making framework proposed by Payne, Bettman and Johnson (1993), wherein decision-makers are said to adapt their strategies to the given problem's task and contextual parameters. Interestingly, the adaptive mechanism by which the mind assesses the decision-problem's defining features and triggers an adaptive strategy accordingly is likely itself an adaptation (in an evolutionary sense) and hence genetic in nature. This possibility is further explored in the thesis' final chapter.

Limitations and directions for future research

Study 2 was subject to minor limitations. First, Study 2 sought to infer the innateness of various aspects of the predecisional choice process via data gathered from the completion of a single decision-making task (i.e., hotel selection task). It would however have been of value to assess the stability of the extracted processes across a greater variety of decision problem domains, varying not only in terms of the proposed situation (e.g., selecting a hotel) but also with regards to the problem's task and context variables (e.g., dimensions of the information display matrix). This would have allowed for commonalities in the manners with which individuals adapt their decision-making strategies to the parameters of the task at hand to be further explored. Future research should consider exploring the genetic underpinnings of the predecisional choice process in a greater variety of decision tasks and contexts. Moreover, it may have been a good idea to control for subject-specific travel experience during the experiment, as expertise has been shown to affect the decision-making process (e.g., Brucks, 1985). However, as there is no reason to assume that intra-sibling differences in travel experience would systematically bias the results of one type of twin more than the other, this omission did not likely pose a significant problem. As an additional point of interest, in Study 2 subjects' information search processes were elicited via a classic information display board (IDB) paradigm (i.e., matrix presentation format). While this allowed for the computation of several powerful metrics (i.e., amount of processing, selectivity of processing, and pattern of processing) to be performed, future research might consider studying the innateness of additional information behaviors using alternative choice models (e.g., adopting a sequential multi-attribute choice approach). Finally, as proposed in Study 1, future researchers should seek to replicate this study's findings via additional behavioral genetic methods (e.g., by contrasting the similarities of MZ co-twins reared apart).

Conclusion

By means of two distinct approaches (i.e., via self-reported and process-tracing measures), the behavioral genetic component of this thesis reported several of the traits and behaviors that comprise individual approaches to choice as being influenced by genetics. Specifically, the extents to which individuals exhibited rational, intuitive and spontaneous decision-making styles, and sought to maximize the outcomes of their choices, were reportedly defined within a greater set of innate predispositions. Similarly, the amounts of processing exhibited predecisionally were seemingly linked to the genes. While reported levels of these traits and behaviors presumably boar a direct genetic foundation, Studies 1 and 2 suggest that many other features of individuals' approaches are more sensitive characteristics of the given decision-problem, regulated by an evolved domain-general mechanism "geared to producing adaptive behavior in environments whose contours cannot be predicted and are not recurring" (MacDonald, 1991, p.11, italics added). As a result, it was proposed that adaptive decision-making (as defined by Payne, Bettman and Johnson, 1993) is likely itself an adaptation, albeit one along which individuals do not differ significantly.

SUMMARY OF FINDINGS

Hypothesis	Result
AMOUNT OF PROCESSING	
H3a: DZ co-twins will be more different than their MZ counterparts with respect to the number of times information boxes were opened predecisionally.	Supported
H3b: MZ co-twins will acquire more similar proportions of predecisional information than their DZ counterparts.	Supported
H3c: DZ co-twins will be more different than their MZ counterparts with respect to the total amount of time spent processing information predecisionally.	Supported
H3d: DZ co-twins will be more different than their MZ counterparts with respect to the average amount of time spent processing each unit of predecisional information.	Not Supported
SELECTIVITY OF PROCESSING	
H4a: DZ co-twins will be more different than their MZ counterparts in terms of the processing consistency displayed across alternatives.	Not Supported
H4b: DZ co-twins will be more different than their MZ counterparts in terms of the processing consistency displayed across attributes	Not Supported
PATTERN OF PROCESSING	
H5: DZ co-twins will be more different than their MZ counterparts in terms of their information processing patterns.	Not Supported

Chapter 5

STUDY 3

> "The aim of EP is to identify the selection pressures that have shaped the human psyche over the course of evolutionary time, and then test whether our psychological mechanisms actually show the features one would expect if they were designed to solve these particular adaptive problems (for example, choosing mates or detecting cheats)."
>
> (Barrett, Dunbar and Lycett, 2002, p.10).

While Studies 1 and 2 focused on exploring the innateness of individual approaches to choice, the purpose of Study 3 was to provide an EP analysis of the mind's evolved decision-making strategies. As it would have been impossible to do so across the full gamut of evolutionary domains, Study 3 focused on exploring evolved decision-making policies within the specific context of human mate selection. To this end, participants were asked to search for a short-term mate via a computerized process-tracing interface. The extracted search processes were subsequently examined in light of evolutionary predictions along various search metrics. This chapter begins by providing a description of the framework and measures used to explore mate search in Study 3, followed by a detailed account of the related research questions and hypotheses. Next, the experimental task and procedures are discussed, followed by a presentation of the ensuing findings and a related discussion.

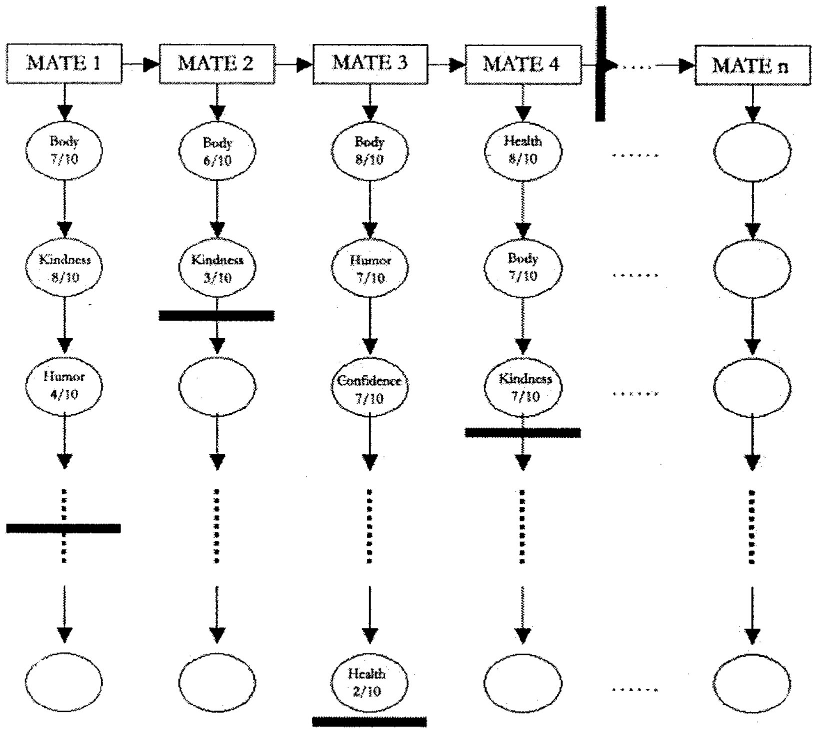
SEQUENTIAL CHOICE

In the previous study, all of the information needed for participants to solve the given decision-problem was simultaneously available. Subjects simply had to decide on which units of information to sample prior to implementing a choice. However, in many real-world situations (e.g., choosing a parking space, hiring a secretary, seeking a mate), individuals must sequentially evaluate alternatives one at a time, with neither the awareness of how many exist nor the knowledge of the alternative-set's qualitative distribution. Moreover, in many cases, once a particular option is forgone, it can no longer be chosen at a future point in time (i.e., backtracking is not possible). Hence, whether one chooses to select or reject a given option, the person must contend with the uncertainty of what could have been.

A unified sequential mate search model

The task of choosing a mate is among evolution's most notorious sequential choice problems (Todd and Miller, 1999). The search process underlying mate choice can be described along two dimensions: the first relates to the breadth of search (i.e., the number of candidates evaluated); the second relates to its depth (i.e., the amount of search dedicated to each candidate). While in the literature, both dimensions have been considered independently (e.g., Todd and Miller, 1999; Eba, 1998; see also Chapter 2 for a summary of studies that have examined mate search via these two approaches), the current study sought to examine the cognitive process underlying mate choice from a more unified perspective (see Figure 5 below). In particular, Study 3 explored mate search from both a candidate- and trait-based perspective. While the candidate-based analyses sought to provide insight into the thoroughness (or breadth) of search for a winning suitor from within a pool of possible candidates, the trait-based analyses sought to describe how extensively each potential mate was evaluated before being either chosen or rejected by the mate-seeker.

Figure 5: A unified search model



In Figure 5, each rectangular box corresponds to a possible candidate (or alternative) evaluated in sequence (i.e., one by one without the possibility of backtracking); each oval area denotes a unit of information (i.e., attribute-value) processed along the corresponding candidate. Mates are evaluated one at a time until a decision can be made to either select or reject a given candidate (denoted by the horizontal bar); the vertical bar indicates the decision to commit to a winning suitor. The search metrics, interface and stimuli are discussed in subsequent sections.

Search metrics

As depicted above, the unified framework provides insight into several distinct characteristics of the search process. Namely, these include: (1) the number of alternative candidates evaluated (i.e., the number of alternatives preceding the vertical bar), (2) the amount of processing dedicated to the chosen candidate (i.e., the units of information processed along the final/chosen alternative), (3) the amount of processing dedicated to rejected candidates (the total or average units of information processed along the alternatives excluding the final/chosen one), and (4) the total amount of search preceding mate choice (i.e., total units of information processed during the task).

Search interface

To collect the various search metrics described above, a computerized mate selection task was developed using Visual Basic 6.0. In completing the task, subjects were asked to sequentially evaluate potential mates until a winning one was found (the number of candidates evaluated relates to the breadth dimension of search). In particular, subjects evaluated candidates one by one along any number of their defining attributes (e.g., intelligence, attractiveness) via a computer interface (see Appendix D – Figure 6 for a screenshot of the mate selection task's interface), allowing for a single attribute value to be viewed at a time (the units of information processed during candidate evaluations relates to the depth dimension of search). Subjects sequentially evaluated candidates as extensively as needed until a decision could be reached to either choose the current suitor (terminating the search process) or continue searching for a superior mate (permanently eliminating the current candidate). Additional details surrounding the configuration of the task (i.e., identifying relevant attributes, generating a pool of potential suitors, setting the order in which candidates are evaluated etc.) are discussed in the methodology section.

Search moderators

> "In exploring mate choice, there are two general issues to consider. First there are general principles that underpin and guide mate choice: these are often considered to be human universals in that, given the nature of the Darwinian process, they apply to everyone. However, individuals' decisions in this, as in every other aspect of real life, are contingent."
> (Barrett, Dunbar and Lycett, 2002, p.93)

Study 3 sought to investigate mate search in light of the universal principle that in mate selection, a poor choice is more costly then an overly prudent rejection, as well as according to several subspecies contingencies. Namely, these included the biological sex, sociosexuality (Simpson and Gangestad, 1991), need for cognition (Cacioppo and Petty, 1982) and maximizing (Schwartz et al., 2002) tendencies of the mate seeker (each of these is discussed in greater detail in the following paragraphs). As the purpose of Study 3 was to emphasize inter-group differences along the extracted search metrics (e.g., sex-differences), the mate selection task was specified as having a short-term context (see Buss and Schmitt, 1993 for a seminal review paper concerning the effects of temporal context on sex-differences in reproductive strategy; see also Chapter 2). Research questions and hypotheses pertaining to each of the proposed determinants of search are stated below.

RESEARCH QUESTIONS AND HYPOTHESES

Choices versus mate rejections in mate search

In human mate selection, the costs of making an inaccurate choice exceed those of making an inaccurate rejection. While in the former case, the risks range from pregnancy and abandonment for females to a wide range of opportunity costs for males, in the latter, individuals can always search for another desirable mate. Accordingly, it was hypothesized that in mate choice, individuals would devote greater amounts of effort to selecting versus rejecting a particular short-term mate. Accordingly, the following hypothesis was posited:

> H6: Individuals will devote greater amounts of search effort prior to selecting versus rejecting a potential short-term mate.

Sex-differences in mate search

In short-term mate choice, the female-related costs of making indiscriminate mating decisions far exceed those related to males (Buss and Schmitt, 1993). While in for females, the minimal cost of parental investment include an eight month period of gestation, that related to males involves a single act of sexual intercourse. As a result, it was predicted that females would devote greater extents of search to finding a short-term mate than males (i.e., evaluating a greater number of candidates, dedicating greater amounts of processing to evaluating chosen candidates and devoting greater amounts of search to the task overall) while being more discriminating in their approach (i.e., dedicating less amounts of processing to rejecting unworthy suitors). In light of the previously described search metrics, the following hypotheses were stated:

> H7a: Females will devote more search effort to completing the short-term mate selection task than males.
>
> H7b: Females will evaluate more candidates than males before identifying a winning short-term mate.
>
> H7c: Females will evaluate their chosen short-term mates more extensively than males.
>
> H7d: Females will devote less search effort to rejecting unworthy candidates than males.

Sociosexuality and mate search

Sociosexual orientation describes individual differences in a person's tendency to prefer either unrestricted (i.e., not requiring love) or restricted (i.e., commitment-oriented) sex (Simpson and Gangestad, 1991). While evolutionary psychologists have linked sociosexual orientation to various behaviors (e.g., infidelity), little is know about the effects of this individual difference trait on the cognitive processes underlying mate search. As low-SOI individuals are by definition less likely to engage in short-term sexual encounters than their high-SOI counterparts, it was thought that between the two groups, the former would display more selective mate choice policies (i.e., dedicating greater amounts of search to the task overall, evaluating a greater number of candidates, dedicating greater amounts of processing to evaluating chosen candidates, dedicating less amounts of processing before rejecting unworthy candidates) than the latter. Accordingly, it was hypothesized that:

> H8a: Low-SOI individuals will devote more search effort to completing the short-term mate selection task than their high-SOI counterparts.
>
> H8b: Low-SOI individuals will evaluate more candidates than their high-SOI counterparts before identifying a winning short-term mate.
>
> H8c: Low-SOI individuals will evaluate their chosen short-term mates more extensively than their high-SOI counterparts.
>
> H8d: Low-SOI individuals will devote less search effort to rejecting unworthy candidates than their high-SOI counterparts.

Need for cognition and mate search

Cognitive psychologists have linked extents of predecisional search to underlying cognitive traits (see Beatty and Smith, 1987 for a review). Among these, strong links have been reported with regards to need for cognition (a trait describing individual differences in the tendency to engage in and enjoy effortful thinking) and the extents of search exhibited prior to implementing a choice. In particular, Verplanken, Hazenberg and Palenewen (1992) have demonstrated that individuals with high levels of need for cognition tend to devote more effort to predecisional information search than their low-need for cognition counterparts. Accordingly, it was hypothesized that in seeking a short-term mate, high-NFC individuals would display greater amounts of search along each of the various metrics examined in Study 3. In particular, it was hypothesized that:

> H9a: High-NFC individuals will devote more search effort to completing the short-term mate selection task than their low-NFC counterparts.
>
> H9b: High-SOI individuals will evaluate more candidates than their low-NFC counterparts before identifying a winning short-term mate.
>
> H9c: High-NFC individuals will evaluate their chosen short-term mates more extensively than their low-NFC counterparts.
>
> H9d: High-NFC individuals will devote more search effort to rejecting unworthy candidates than their low-NFC counterparts.

Maximizing and mate search

Among the many factors that can affect the extents of search preceding individuals' choices, people have been shown to differ in the extents of optimality sought their decisions' outcomes (see Chapter 2 for a more complete discussion on individual differences in the motives that drive the choice process). Recently, maximizing has been identified as a trait relating to individual differences in the motives underlying the manners by which choices are made (Schwartz et al., 2002). In particular, high-maximizers seek the best possible decision-outcomes; low-maximizers desire an option that is good enough. Accordingly, it was hypothesized that relative to their low maximizing counterparts, high-maximizers would display greater amounts of search to finding their optimal mate.

Along the various search metrics, it was hence hypothesized that:

> H10a: High-MAX individuals will devote more search effort to completing the short-term mate selection task than their low-MAX counterparts.

H10b: High-SOI individuals will evaluate more candidates than their low-MAX counterparts before identifying a winning short-term mate.

H10c: High-MAX individuals will evaluate their chosen short-term mates more extensively than their low-MAX counterparts.

H10d: High-MAX individuals will devote more search effort to rejecting unworthy candidates than their low-MAX counterparts.

METHODOLOGY

Study 3 was comprised of two major tasks. Namely, these involved: (1) the completion of a computerized mate-selection task (used to trace subjects' predecisional choice processes and compute the relevant search metrics), and (2) the completion of a post-experimental questionnaire (used to assess subjects along the various search moderators). Methodological considerations relating to both of these are described below. An account of the experimental procedure follows directly thereafter.

Computerized mate selection task

The mate selection task was described earlier. The following paragraphs will hence focus on describing the activities surrounding the task's pre-experimental configuration (i.e., how the task was designed).

Task configuration

The configuration of the mate selection task can be broken down into two main activities: (1) generating the set of potential mates (i.e., defining the various mates along their defining attributes), and (2) setting the sequence in which mates were presented to subjects one at a time. A detailed account of each of these activities is provided below.

Generating the set of alternatives

Generating the set of alternatives involved: (1) identifying the attributes and scales along which potential suitors were defined, and (2) creating candidate-profiles accordingly.

Identifying relevant attributes and their scales

In the mate selection task, potential suitors were defined along 24 attributes based on Eba's (1998) exhaustive list of mate selection criteria. In particular, these attributes described candidates according to their ability to provide resources (i.e., income, occupation, intelligence, and ambitiousness), willingness to provide resources (i.e., shows affection, kindness, seeks commitment, shows emotional support, moral character), ability and willingness to provide protection (i.e., physical strength, height, self-confidence, and assertiveness), physical attractiveness (i.e., facial beauty, physique, healthiness and fashion sense), and fidelity and promiscuity (i.e., sexual experience, sexual fidelity, sex drive). In addition, similarity of interests, sense of humor, social skills and exciting personality were included to account for individual preferences. All attributes were defined on a scale ranging from 1 to 10, with 10 being the best possible score and 1 being the worst. This allowed subjects to construct their own representations of how each attribute characterized a given candidate (e.g., a 9/10 attractiveness might imply blond hair to one person, and brown to another). It is worth noting that Eba's (1998) original list included 25 attributes. For the purpose of Study 3, the attribute "age" was dropped, as it was would have been difficult for subjects to represent candidates' ages along a scale from 1 to 10. In addition, as Eba's study examined mate selection in both short- and long-term contexts, her study included the attribute "number of children desired". Since Study 3 focused exclusively on unrestricted, short-term encounters, this attribute was dropped and replaced with "sex drive".

Generating alternatives

For the purpose of Study 3, 40 candidate profiles were generated using a randomizing function. Specifically, for each suitor, an integer from 1 to 10 was randomly assigned to each of its twenty-four defining attributes. The number 40 was chosen to provide subjects with a sufficient number of candidates to make a choice.

Setting the sequence of evaluation

Setting the order in which subjects were exposed to the programmed candidates required: (1) computing a subject-specific measure of expected preference for each candidate, and (2) defining the order in which candidates would be encountered via these.

Computing subject-specific preferences rankings

Subject-specific preferences were anticipated to affect the perceived desirability of each candidate. As subjects were to evaluate candidates in a particular sequence, a special procedure was employed to control against the introduction of eventual order of presentation effects. In particular, this involved basing the order in which candidates would be presented to participants on a subject-specific rank of expected preference (i.e., attributing a subject-specific rank to each candidate). This approach was employed instead of random ordering alternatives to ensure that the elicited behaviors reflected differences in search strategies across individuals and not the idiosyncratic order in which each subject was exposed to the various candidates. To assess the expected preference of each candidate, attribute importance weights were elicited from each subject using a Q-Sort procedure at the beginning of the task (e.g., Eba, 1998; Saad and Russo, 1996) (see Appendix E – Figures 7 - 11 for screenshots and an explanation of the attribute importance weight elicitation procedure). For each participant, candidates were then ranked by the application in order of expected preference according to a weighted sum of each programmed candidate's attribute values and the indicated attribute importance weights. Candidates were subsequently presented to subjects using their relative ranks as a sequence index, standardizing the task across subjects. In this manner, all subjects evaluated the available candidates in the same relative order of expected preference (based on each candidate's subject-specific ranking). For example, if the task were designed such that subjects would be exposed to their 9th most preferred candidate followed by their 3rd most preferred candidate, this order would hold true across subjects (even if the particular suitors corresponding to these ranking differed between them). The process by which the order of presentation was configured across subjects is described below.

Establishing the order of candidate evaluations

Defining the order in which alternatives were presented to subjects (via their subject-specific preference rankings) involved several steps. First, the forty alternatives were segmented into five categories of expected preference: (1) the most preferred group (i.e., alternatives ranked 1 through 4 in terms of relative preference), (2) the second most preferred group (i.e., alternatives ranked 5 through 12), (3) the third most preferred group (i.e., alternatives ranked 13 through 28), (4) the fourth most preferred group (i.e., alternatives ranked 29 through 36), and (5) the fifth most preferred group (i.e., alternatives ranked 37 through 40). For each subject, the first- and fifth-most preferred groups were dropped from the candidate pool (to exclude "extreme" candidates), leaving 32 available candidates to choose from. Among these, the majority belonged to the middle most preferred group. This was intended to encourage a variety of stopping points as for example, it was thought that an excess of highly appealing candidates would likely lead to early stopping point. Next, the remaining 32 alternatives were clustered into 3 segments of 8 mates such that each segment was comprised of 2 alternatives from the second most preferred group, 4 alternatives from the third most preferred group, and 2 alternatives from the forth most preferred groups. This was done to minimize the probability of encountering a string of very good or very poor suitors. Within each segment, alternatives were randomly ordered. The resulting sequence was then specified in the program, serving the means by which alternatives were presented to subjects during the task.

Survey instrument

Following the computerized mate selection task, subjects were asked to complete a post-experimental questionnaire. The questionnaire was comprised of four sections, assessing subjects along measures of sociosexual orientation (Simpson and Gangestad, 1991), need-for-cognition (Cacioppo, Petty and Kao, 1984), maximizing (Schwartz et al., 2002), and a host of personal and demographic variables (i.e., sex, age, ethnicity, sexual orientation, relationship status, and self-perceived overall mating value) (see Appendix F).

Experimental procedure

Study 3 was comprised of sixty subjects (32 males and 28 females) recruited from the Concordia University campus. Experimental sessions were conducted during scheduled one-hour sessions in a computer lab at Concordia University. Specifically, the lab was configured with 5 rows of 2 to 3 computers each, providing several feet of separation between the stations such that participants were unable to observe others' behaviors. In addition, participants were instructed to focus solely on their screens and if they had any questions, to simply raise their hands. Finally, there was a station at the front of the lab from which the examiner had a panoramic view of the room. From this position, the examiner ensured that the task ran smoothly and confidentially. At the beginning of each session, subjects were provided a thorough, scripted demonstration of the mate selection task, and were encouraged to ask questions. In addition, subjects were given an attribute guide (modified from Eba, 1998), in which the definition of each attribute was listed in alphabetical order (see Appendix G). Subjects first completed the computerized mate-selection task, followed by the post-experimental questionnaire.

RESULTS

Method of analyses

Study 3 looked at the effects of several search moderators on the cognitive process underlying mate search. To this end, a series of t-tests was performed to compare the means (along the various search metrics) of the groups under study. While this involved comparing the results of established groups for the analyses pertaining to choices vs. rejections and male vs. female mate choice process, those pertaining to SOI, NFC and MAX, involved dichotomizing subjects into low and high groups via media-splits along the relevant scales (this process is discussed in greater detail in the sections related to each search moderator). To account for uneven cell sizes, the t-tests were performed assuming unequal variances. In addition, a series of stepwise regression analyses was conducted to assess the relative impact of each of the various search moderators (i.e., sex, SOI, NFC, MAX) on each of the relevant search metrics (e.g., number of candidates evaluated). The following section begins by reporting the results pertaining to the mean comparisons, and subsequently proceeds by presenting those related to the series of stepwise regressions. The chapter concludes by providing a synopsis of the findings and a related discussion.

Mean comparisons between groups

Choices versus Rejections

In human mate selection, the costs of making inaccurate choices exceed those of making inaccurate rejections. Accordingly, it was hypothesized that choices would entail greater amounts of search effort than rejections. The associated results are listed in Table 8 below.

Table 8: Search effort preceding choices and rejections (in units of information processed predecisionally)

Choices *N=60*	*Rejections* *N=52*	*t-value*	*df*	*p-value*	*Status*
18.15	12.85	3.02	102	0.002	Supported

Results pertain to a one-sided t-test

In comparing the mean amounts of processing dedicated to choices and rejections[5], as predicted, that related to the former (18.15 units) was significantly greater than the corresponding one for the latter (12.85 units) ($t(102) = 3.02$, $p < 0.005$). This finding is congruent with similar analyses conducted by Eba (1998), wherein using a strictly trait-based approach, choices were also found to imply greater extents of predecisional effort than rejections. As predicted, the relative accuracy required from choices (for adaptive reasons) seemingly counterbalanced the incremental search costs.

[5] Each observation pertains to the average amount of search preceding rejections per candidate. Eight candidates did not provide any rejection data.

Sex-differences in mate search

In short-term mate choice, the costs related to females making poor mating decisions far exceed those corresponding to males. Accordingly, it was hypothesized that females would display more selective mate choice strategies than their male counterparts. The related findings are listed in Table 9 below.

Table 9: Mean amounts of processing dedicated to short-term mate search reported by sex

Search metric	*Male* *N=32*	*Female* *N=28*	*t-value*	*df*	*p-value*	*Status*
Total extent of search (in units of information processed)	87.78	148	-2.34	44	0.01	Supported
Number of candidates evaluated	7.28	11.89	-2.36	47	0.01	Supported
Amount of predecisional processing preceding choice (in units of information processed)	18.53	17.71	0.28	56	0.39	Not Supported
	N=26	*N=26*				
Amount of predecisional processing preceding rejections (in average units processed per rejection)	12.96	12.73	0.11	43	0.46	Not supported

Results pertain to one-sided t-tests

As depicted in Table 9 above, the analyses yielded several significant findings. As predicted, females tended to devote more total effort to finding a short-term mate (148 units) than males (87.78 units) ($t(44) = -2.34$, $p = 0.01$). Moreover, relative to males, females tended to evaluate a significantly greater number of candidates before committing to a winning suitor ($t(47) = -2.36$, $p = 0.01$). Both of these findings were congruent with evolutionary theory (Trivers, 1972; Buss and Schmitt, 1993) and an effort-accuracy framework. In spite of these confirmed predictions, male and female subjects however did not differ significantly in terms of the amounts of search exhibited during their within-candidate evaluations, both for choices ($p>0.2$) and rejections ($p>0.2$). This finding was not completely unexpected as in conducting a similar analysis (albeit strictly from a trait-based perspective), Eba (1998) reported that likewise, males and females searching for a short-term mate did not differ significantly in terms of the amounts of predecisional effort displayed. These findings are further developed in the discussion section.

Sociosexual orientation index (SOI) and mate search

As low-SOI individuals are by definition less likely to engage in short-term mating encounters than their high-SOI counterparts, it was predicted that the former would display more selective mate choice policies than the latter. To test this claim, subjects were dichotomized into two groups according to their scores on Simpson and Gangestad's (1991) SOI scale (Cronbach's alpha = 0.71) based on a median-split of the reported scores[6]. Accordingly, subjects with scores below the median of 47 were placed in the low-SOI group (N = 28, M = 26.16); subjects with scores above 47 were placed in the high-SOI group (N = 28, M = 96.4). T-tests were subsequently run to compare the means of both groups along the various search metrics. Associated results are reported in Table 10 below.

Table 10: Amount of processing dedicated to mate search reported by SOI

Search metric	*Low SOI N=28*	*High-SOI N=28*	*t-value*	*df*	*p-value*	*Status*
Total extent of search (in units of information processed)	133.11	93.86	1.50	42	0.07	Supported
Number of candidates evaluated	10.54	7.89	1.35	54	0.09	Supported
Amount of predecisional processing preceding choice (in units of information processed)	17.29	19.39	-0.69	53	0.25	Not Supported
Amount of predecisional processing preceding rejections (in average units processed per rejection)	N=24 12.26	N=24 13.76	-0.7	42	0.24	Not supported

Results pertain to one-sided t-tests

[6] Three subjects did not complete the SOI measure. In addition, the SOI of a single subject corresponded to the median value and was hence excluded from the analyses.

While none of the SOI-related analyses enjoyed strong statistical support (yielding p-values greater than 0.05 across the board), the results pertaining to the total extent of search and the number of candidates evaluated were marginally significant ($p<0.1$). In particular, as predicted members of the low-SOI group tended to devote greater amounts of processing effort to finding a short-term mate (133.11 units vs. 93.86 units) and evaluate a greater number of candidates before committing to a winning suitor (10.54 candidates vs. 7.89 candidates). In addition, low-SOI subjects tended to devote less effort to making rejections then their high-SOI counterparts (12.26 vs. 13.76 units processed) (i.e., suggesting the application of a more selective mate choice strategy). While it was originally thought that subject from the low-SOI group would devote more predecisional processing to evaluating their winning suitors than their high-SOI counterparts, the results pointed to the contrary (i.e., 17.29 vs. 19.39 units processed by members of the low- and high-SOI groups respectively). As a possible explanation for this, as Brucks (1985) states, in many cases: "knowledge allows one to ask more questions and increases the benefit/cost ratio of doing so" (p.4). In the context of short-term mating, members from the high-SOI group can be viewed as experts (or at least knowledgeable) in the consumption of short-term mating encounters. As each unit of information is acquired at a greater cost to the novice than it is to the expert, though low-SOI subjects may have requested information fewer times before committing to a winning suitor than their high-SOI counterparts, their search processes may have entailed greater investments of effort (even if this was not reflected in the amounts of predecisional search in terms of the units of information processed). This possibility must however be interpreted with caution as the associated results were not statistically significant ($p>0.2$).

Need for cognition and mate search

Individuals with high levels of need for cognition (NFC) are more prone to engaging in and deriving pleasure from effortful thought. Moreover, NFC has been reported to positively affect the extent of search one is likely to engage in predecisionally (Verplanken, Hazenberg and Palenewen, 1992). Accordingly, it was hypothesized that high-NFC individuals would devote greater extents of search to seeking a short-term mate along each of the various search metrics. To test this claim, subjects were divided into two groups according to their scores on Cacioppo, Petty and Kao's (1984) NFC scale (Cronbach's alpha = 0.84), based on a median-split[7]. In particular, subjects with scores below the median of 67 were placed in the low-NFC group (N = 28, M = 56.43); those with scores above it were placed in its high-NFC counterpart (N = 25, M = 74.44). Subsequently, t-tests were run to compare the means of both groups along the various search metrics. Results are listed in Table 11 below.

Table 11: Amount of processing dedicated to mate search reported by NFC

Search metric	*Low-NFC N=28*	*High-NFC N=25*	*t-value*	*df*	*p-value*	*Status*
Total extent of search (in units of information processed)	90.61	138.36	-1.66	39	0.05	Supported
Number of candidates evaluated	6.79	10.44	-1.86	42	0.03	Supported
Amount of predecisional processing preceding choice (in units processed)	17.61	19.76	-0.69	51	0.25	Not supported
Amount of predecisional processing preceding rejections (in average units processed per rejection)	N=24 13.84	N=21 13.19	0.29	42	0.39	Not supported

Results pertain to one-sided t-tests

[7] Three subjects did not provide usable NFC-related data. In addition, the NFC results of four subjects corresponded to the median value and were hence excluded from the analyses.

In examining the results listed in Table 11, several important findings can be observed. As predicted, subjects from the high-NFC group tended to exhibit greater extents of search effort in completing the mate choice task (138.36 units) than their low-NFC counterparts (90.61 units) ($t(39) = -1.66, p < 0.1$). In addition, relative to their low-NFC counterparts, high-NFC subjects tended to evaluate significantly more candidates before committing to a winning suitor (10.44 vs. 6.79 candidates) ($t(42) = -1.86, p < 0.05$). These findings further evince the fact that high-NFC subjects prefer complex to simple problems (Cacioppo and Petty, 1982). While NFC significantly influenced the number of candidates evaluated during the task (and to a less significant degree, the total amount of processing dedicated therein) it did not appear to affect the extent to which alternatives were evaluated ($p > 0.2$). These results are further explored in the discussion section.

Maximizing and mate search

Individuals differ with respect to the levels of optimality sought from the outcomes of their decisions. While low-maximizers desire an option that is good enough, high-maximizers seek optimality. In exploring the effects of maximizing on mate search, subjects were divided into two groups according to their scores on Schwartz et al.'s (2002) maximizing scale (Cronbach's alpha = 0.66) via a median-split dichotomization process[8]. In particular, subjects with scores below the median of 59 were placed in the low-maximizing group (N = 28, M = 51.04), while those with scores above 59 were placed in the high-maximizing group (N = 27, M = 66.78). Accordingly, t-tests were run to compare the means of both groups along the various search metrics. Associated results are listed in Table 12 below.

[8] One subject did not complete the maximizing scale. In addition the maximizing results of four subjects corresponded to the median value and were hence excluded from the analyses.

Table 12: Amount of processing dedicated to mate search reported by MAX

Search metric	*LowMAX N=28*	*High-MAX N=27*	*t-value*	*df*	*p-value*	*Status*
Total extent of search (in units of information processed)	110.86	104.37	0.24	51	0.41	Not supported
Number of candidates evaluated	9.11	7.44	0.97	52	0.17	Not supported
Amount of predecisional processing preceding choice (in units processed)	18.21	18.85	-0.21	53	0.42	Not supported
Amount of predecisional processing preceding rejections (in average units processed per rejection)	N=25 12.82	N=22 13.26	-0.20	44	0.42	Not supported

Results pertain to one-sided t-tests

As depicted in Table 12 above, none of the hypotheses enjoyed significant support. In particular, high- and low-maximizers tended to evaluate candidates to similar extents (both in choosing and rejecting potential mates). Moreover, the mean number of candidates evaluated related to high-maximizers (7.44 candidates) was greater than that corresponding to their low-maximizing counterparts (9.11 candidates) and high-maximizers tended to devote less of total search effort overall (104.37 vs. 110.86 units). While unexpected, these finding may be rooted in the fact that high-maximizers are more prone to experiencing regret than their low-maximizing counterparts (Schwartz et al., 2002). Perhaps limiting the size of one's accumulated consideration-set (i.e., the set of previously considered, though currently unavailable, options) was used as a regret-aversion tactic. This claim must however be interpreted with caution as the corresponding results were not statistically significant ($p > 0.1$). This possibility is however further explored in the discussion section.

Stepwise regression analyses

As a final set of analyses, a series of stepwise regressions was conducted to establish the relative impact of sex, SOI, NFC and MAX on each of the search metrics investigated in Study 3[9]. The associated results are presented below.

Tests for multi-collinearity

Multi-collinearity issues are often of concern when multiple psychometric measurements are used in regression analyses. Collinearity diagnostics were hence performed for each of the variables in the models discussed below. Variance inflation factors (VIF) were <1.3 and tolerances were >0.8 indicating that multi-collinearity was not a problem for the models presented below.

Total extent of search

In analyzing the power of sex, SOI, NFC and MAX in explaining the total extent of search devoted to the mate selection task, a stepwise regression analysis yielded a significant model ($F_{1,53}=4.95$, $p=0.03$) with a single predictor variable, namely: sex ($\beta=58.68$, $t=2.23$, $p=0.03$). This finding was congruent with those of the related mean comparisons, where sex also yielded significant effects ($p<0.05$) on the total extents of search devoted to the mate selection task. This finding highlights the power of sex-specific adaptive challenges in driving the evolution sex-specific mate search strategies.

[9] Five subjects were excluded from the regression analyses (e.g., providing incomplete measures).

Number of candidates evaluated

In analyzing the power of sex, SOI, NFC and MAX in explaining the number of candidates evaluated before a choice was made, a stepwise regression analysis yielded a significant model ($F_{2, 52}$ =4.70, p=0.01) with two predictor variables. Namely, these were: sex (β=4.73, t=2.49, p=0.02) and NFC (β=0.19, t=2.12, p=0.04). This finding was also congruent with those corresponding to the mean comparisons, which revealed that sex and NFC both significantly affected the number of candidates evaluated before a winning suitor was selected ($p<0.05$). While both sex and NFC were found to be significant predictors of the number of candidates considered during the task, the impact of sex was greater than that of NFC. This was not unexpected as sex-specific adaptive challenges would have been especially powerful in driving the evolution sex-specific mate search strategies.

Amount of search dedicated to winning suitor

In line with the mean comparison analyses, no significant predictors were identified for the amounts of search dedicated to evaluating winning suitors.

Amount of search preceding rejections

In line with the mean comparison analyses, no significant predictors were identified for the amounts of search dedicated to evaluating rejected candidates.

DISCUSSION

In providing an EP analysis of the search process underlying mate choice, Study 3 yielded several important findings. Firstly, Study 3 reported findings wherein the extents of processing devoted to the mate selection task were predictably contingent upon the adaptive levels of accuracy sought from the mate seekers in light of the surrounding evolutionary context. This was revealed as mate choices involved more effort than mate rejections and as females exhibited more effortful strategies than males in terms of both the overall effort dedicated to the task and the number of candidates evaluated therein. In both cases, the adaptive levels of accuracy sought entailed corresponding levels of cognitive expenditure. It is however worth noting that in line with previous findings (i.e., Eba, 1998), males and females did not differ significantly with regards to the amounts of processing devoted to their within-candidate evaluations. This perhaps indicates that though males and females exhibited different levels of selectivity in terms of which candidate they chose (i.e., revealed by sex-differences in the number of candidates evaluated before a winner was found), they were equally rigorous in assessing which was worthy and which was not (i.e., revealed by sex-similar extents of search afforded to candidate evaluations). Alternatively, it is possible that attribute-values were simply too easily acquirable via the interface. While the decision to either choose or reject a given candidate entailed meaningful implications (e.g., each rejection involved an increased investment of time, not to mention the related opportunity cost), acquiring attribute-values simply involved a click of the mouse (i.e., cost-free). This possibility is further addressed in the limitations section.

While several of the hypotheses related to the effects of sociosexual orientation on the various search metrics were directionally supported, none enjoyed strong statistical supported (i.e., $p<0.05$) (two however enjoyed marginal significance ($p<0.1$)). Perhaps this lack of strong statistical findings can be explained by the fact that while one's sociosexual orientation may express a legitimate mating preference (e.g., the specific traits sought in a prospective mate), it does not diminish the adaptive levels of accuracy required from one's mating decisions. In other words, while several aspects of mate selection may be linked to sociosexual orientation (e.g., whether or not one feels that sex without love is acceptable), the effort-accuracy tradeoff governing the mate search process continues to operate mostly in function of one's evolved adaptive concerns (e.g., sex-specific levels of minimal parental investment).

In investigating the effects of need for cognition on mate search, as predicted high-NFC subjects tended to deliberate more extensively before finding a mate relative to the low-NFC counterparts (in terms of both the total extent of processing dedicated to the task and the number of candidates evaluated predecisionally). This finding fits with the existing literature on need for cognition (e.g., Verplanken, Hazenberg and Palenewen, 1992). In particular, the number of candidates evaluated predecisionally is a clear indicator of a problem's complexity (Payne, Bettman and Johnson, 1993), and by very definition high-NFC individuals tend to prefer complex to simple problems (Cacioppo and Petty, 1982). However, as with the sex-related analyses, both low- and high-NFC subjects tended to evaluate candidates to similar extents. This was true in both cases of choices and rejections. Again this finding possibly reflects the fact that attribute-based information was too easily acquirable via the interface.

Finally, none of the analyses related to the maximizing scale yielded statistically significant results. While most hypotheses were supported from a directional perspective, subjects from the high-maximizing group tended to evaluate fewer candidates before committing to a winning suitor than their low-maximizing counterparts. Perhaps limiting the number of candidates evaluated was a regret-aversion tactic. In support, Schwartz et al. (2002) claim that added options are often a mixed blessing (see also Iyengar & Lepper, 2000; Iyengar & Lepper, 1999), and that such is especially true for high-maximizers who have a greater propensity for feeling regret. It is hence possible that in navigating through the sequential choice task (in which candidate backtracking was not possible), high-maximizers evaluated fewer candidates to avoid regretting their final decisions (i.e., having forgone fewer superior candidates).

It is worth noting that the maximizing-related hypotheses were tested via Schwartz et al.'s (2002) 13-item composite maximizing scale. This approach mirrored that used by Schwartz et al. (2002) in the paper that defined 13-item measure as the "maximizing-scale". Specifically, in studying the relationships between maximizing and various proposed correlates (e.g., perfectionism, regret, etc.), Schwartz et al. (2002) based their analyses on the 13-item composite maximizing scale. However, to extract additional information from the maximizing-related data, the authors have suggested grouping items related to: (1) being open to better jobs, songs on the radio, television shows, relationships, liking lists that rank things, and fantasizing about alternatives to reality, (2) shopping for a friend, renting videos, shopping for clothing and writing several drafts of letters so as to word things just right, and (3) items related to having high standards, both for oneself and for things in general. As in Study 3 none of the maximizing-related hypotheses were significant along the composite maximizing scale, additional analyses were conducted along each of the latter components to see if any additional information could be extracted. While the majority of the component-based analyses failed to yield significant findings, two results related to the third component of maximizing in particular (i.e., relating to having high standards) were statistically significant ($p<0.05$). In particular, subjects with high standards for themselves (N=22; M=18.55) tended to devote significantly greater amounts of processing to evaluating their chosen and rejected candidates than subjects with comparatively low standards (N=28; M=13.29) ($p<0.05$)[10]. More precisely, the mean extent of processing preceding the choice of a winning suitor related to

[10] Subjects were divided into low and high groups based on a median-split. One subject did not complete the maximizing scale; the score of nine subjects corresponded to the median value.

subjects from the high standards group (20.67 units) was significantly greater than that corresponding to their counterparts from the low standards group (15.18 units) ($p = 0.04$). In addition, the mean extent of processing preceding the rejections of potential suitors related to subjects from the high standards group (15.56 units) was significantly greater than that corresponding to their counterparts from the low standards group (10.92 units) ($p = 0.02$). While it makes sense that individuals with higher standards would require more convincing (i.e., information search) prior to committing to a winning candidate, it is less clear why they would also require more convincing prior to rejecting an unworthy suitor. This finding is likely also related to the fact that high-maximizers are more prone to experiencing regret as a result of their decisions. Consequentially, high-maximizers might engage in effortful thought when making decisions (whether these lead to the choice or rejection of a given option) to ensure that they are making the best possible decision, especially in cases where choices and rejections are final.

Limitations and directions for future research

Study 3 was subject to minor limitations. First, as Study 3 sought to emphasize differences between the groups being analyzed (e.g., men and women), mate search was examined in light of a short-term mating context (Buss and Schmidt, 1993). However, to achieve a more complete understanding of sequential search in the context of human mate selection, future research might consider expanding the scope to provide insight related to both short- and long-term temporal conditions. Second, while every effort was made to recreate the decision-problem architecture of human mate choice (e.g., candidates encountered one at a time, candidate backtracking not permitted etc), actual mate search involves search costs. Implementing these appropriately (e.g., by attaching a temporal cost to each unit of information acquired as proposed by Saad, 1998) might increase the realism of the extracted search processes. Moreover, while individuals are increasing seeking mates using computer interfaces (e.g., via the internet), the task presented in Study 3 may have lacked a certain level of ecological validity. For example, while mate seekers may use a score system in describing potential mates to their friends, these ratings are usually based on the previous processing of more tangible cues (e.g., a picture). Future research should certainly focus on defining candidates via more realistic stimuli (e.g., pictures, vocal tracks etc.). As an additional area for future research, little is known about the implications of mutual choice (as discussed by Todd and Miller, 1999) on mate search. It would be interesting to study how individuals adapt their search policies to the prospect of their being accepted or rejected. Finally, while Study 3 provided a link between information search in the context of human mate choice and evolution it did not account for the possible impact of socialization, specifically as it possibly related to the sex-differences reported therein. Other EP treatises have demonstrated the stability of evolved sex-differences across cultures (e.g., Brown, 1991; Buss et al., 1990). Nonetheless, many aspects of human mating are adaptive to features of the socio-cultural environment at hand (e.g., sex-ratio). In light of such variations, future research might consider running Study 3 in different types of cultures (e.g., cultures with polygamous mating systems).

Summary

In summary, Study 3 provided evidence that the mind has evolved specialized cognitive strategies geared to producing adaptive behavior in evolutionarily relevant problem-domains. In particular, Study 3 focused on demonstrating the adaptive fit between the search-processes underlying mate choice (as cued via process-tracing metrics) and the evolutionary contexts that would have favored their development. In so doing, the extents of effort dedicated to finding a mate were found to be predictably sensitive to the adaptive levels of accuracy required from individuals' decisions. For example, given that in short-term mating contexts, the costs/risks associated with females' making inaccurate decisions are far greater than those corresponding to males, the former were found to devote more total effort to finding a short-term mate (evaluating a greater number of potential suitors) than the latter. Additionally, Study 3 sought to explore the effects of one's general cognitive proclivities in a domain-specific context. On the matter, the findings suggested that while NFC perhaps describes a more pervasive preference for complex to simple problems (i.e., transcending decision-contexts and domains), maximizing refers to one's desire to make a decision that will not be regretted later on. Though more research is needed on this topic, Study 3's evolutionary-based findings, coupled with the behavioral genetic insights provided by Studies 1 and 2, plead a strong case for adopting a Darwinian approach to the study of decision-making.

SUMMARY OF FINDINGS

Hypothesis	Result
Choices versus Rejections and Mate Search	
H6: Individuals will devote greater amounts of search effort prior to selecting versus rejecting a potential short-term mate.	Supported
Sex-differences and Mate Search	
H7a: Females will devote more search effort to completing the short-term mate selection task than males.	Supported
H7b: Females will evaluate more candidates than males before identifying a winning short-term mate.	Supported
H7c: Females will evaluate their chosen short-term mates more extensively than males.	Not supported
H7d: Females will devote less search effort to rejecting unworthy candidates than males.	Not supported
Sociosexuality and Mate Search	
H8a: Low-SOI individuals will devote more search effort to completing the short-term mate selection task than their high-SOI counterparts.	Weakly supported
H8b: Low-SOI individuals will evaluate more candidates than their high-SOI counterparts before identifying a winning short-term mate.	Weakly supported
H8c: Low-SOI individuals will evaluate their chosen short-term mates more extensively than their high-SOI counterparts.	Not supported
H8d: Low-SOI individuals will devote less search effort to rejecting unworthy candidates than their high-SOI counterparts.	Not supported
Need for Cognition and Mate Search	
H9a: High-NFC individuals will devote more search effort to completing the short-term mate selection task than their low-NFC counterparts.	Supported
H9b: High-SOI individuals will evaluate more candidates than their low-NFC counterparts before identifying a winning short-term mate.	Supported
H9c: High-NFC individuals will evaluate their chosen short-term mates more extensively than their low-NFC counterparts.	Not supported
H9d: High-NFC individuals will devote more search effort to rejecting unworthy candidates than their low-NFC counterparts.	Not supported
Maximizing[11] and Mate Search	
H10a: High-MAX individuals will devote more search effort to completing the short-term mate selection task than their low-MAX counterparts.	Not supported
H10b: High-SOI individuals will evaluate more candidates than their low-MAX counterparts before identifying a winning short-term mate.	Not supported
H10c: High-MAX individuals will evaluate their chosen short-term mates more extensively than their low-MAX counterparts.	Not supported
H10d: High-MAX individuals will devote more search effort to rejecting unworthy candidates than their low-MAX counterparts.	Not supported

[11] While the findings stemming from the composite maximizing scale did not enjoy statistical support, having high standards – a component of maximizing – was significantly related to the amount of processing dedicated to evaluating both chosen and rejected candidates. In particular, subjects with high standards tended to devote significantly more effort to search along the trait-based metrics related to choices and rejections than their low-standard counterparts ($p < 0.05$).

Chapter 6

GENERAL DISCUSSION

Psychologists have long sought to understand the different factors that affect the human decision-making process. Though the freedom to make choices has typically been regarded as a quintessential human ability, few have focused on studying the nature of Man's individual and species-wide decision-making faculties. By adopting both behavioral genetic and evolutionary psychology perspectives, the purpose of this thesis was to fill this gap. To this end, Studies 1 and 2 made use of a twin-study paradigm to examine the genetic underpinnings of the traits and behaviors that comprise individuals' approaches to choice (Saad & Sejean, 2006a). Subsequently, by demonstrating the fit between human information search behaviors and the evolutionary contexts in which these would have been adaptive, Study 3 sought to provide a Darwinian analysis of the cognitive processes that underlie mate choice in particular (Saad & Sejean, 2006b). In so doing, Study 3 involved testing a novel sequential sampling framework and a related process-tracing interface for the first time (Saad and Sejean, 2006c). A succinct review of the major findings, and implications and opportunities for future research, related to each of these areas is provided below.

A Behavioral Genetic Perspective on Decision-Making

All human beings make decisions, albeit adopting slightly different approaches. Some people deliberate extensively before reaching their verdicts (i.e., rational decision-makers); others can implement a choice in the blink of an eye (i.e., intuitive decision-makers). The first purpose of this thesis involved examining the nature of such individual differences using a twin-study paradigm.

In particular, Studies 1 and 2 focused on exploring the genetic underpinnings of the traits and behaviors that underlie individuals' choice processes. In summary, Study 1 reported findings wherein MZ co-twins were significantly more similar than their DZ counterparts along measures of rational, intuitive and spontaneous decision-making styles, as well as along the maximizing scale and a metric of overall general decision-making style similarity. While MZ co-twins were also found to share greater degrees of similarity than their DZ counterparts with regards the dependent and avoidant decision-making styles, differences between the two groups were not statistically significant (implying the impact of environmental factors). Study 2 reported findings wherein MZ co-twins tended to devote significantly more similar amounts of processing to solving the designated decision-problem than their DZ counterparts. This finding fit with reports that the amount of search a person engages in predecisionally is linked to innate elements of his or her personality (e.g., Verplanken, Hazenberg and Palenewen, 1992). While it was originally expected that the genes would similarly influence the selectivity and pattern components of the predecisional choice process, the latter were apparently more sensitive to characteristics of the decision-problem at hand (cf. Payne, Bettman and Johnson, 1993).

The reported pattern of findings suggests that many of the traits and behaviors that comprise individuals' approaches to choice are influenced by genetics. For instance, the extent to which a person's choices are based on intuition is an innate feature of his or her decision-making personality. Other aspects of the predecisional choice process (e.g., processing selectivity), however, are presumably more adaptive to the parameters of the specific problem at hand (i.e., the decisional environment). While displayed levels of processing selectivity and processing pattern were reportedly not fixed in the genes, they were seemingly regulated by an adaptive cognitive mechanism, which is itself likely an adaptation (i.e., genetic in nature). Specifically, throughout human evolution, the ability to behave adaptively in environments whose surrounding could not be predicted beforehand would have provided some individuals with differential fitness over others (MacDonald, 1991). Accordingly, the mind is said to have evolved a set of domain-general cognitive traits (e.g., general intelligence) and mechanisms (e.g., learning) (Kanazawa, 2004; Segal and MacDonald, 1998). It is hence proposed that adaptability to features a given decision-problem is made possible by an evolved domain-general cognitive mechanism, which in line with the behavioral decision theory, applies decision strategies in function of the problem's task and context parameters and an all-pervasive effort-accuracy tradeoff (Payne, Bettman and Johnson, 1993). This claim illustrates the explanatory power of examining decision-making under an evolutionary lens.

Implications and directions for future research

The implications of these findings are widespread and prescribe an entire onset of marketing-related studies. Illustrating the applicability of behavioral genetic thinking in the area of consumer research, Perry (1973) made use of a twin-study paradigm to examine the effects of heritability on the consumption of several goods (e.g., cigarettes and alcohol), in light of their intuitive links to innate elements of their consumers' personalities (e.g., anxiety and dependency). Similarly, future researchers might consider exploring the relationship between genetics and various other consumption behaviors (e.g., impulsive shopping) with links to individuals' innate decision-making styles (e.g., spontaneity, intuitiveness etc.). In addition, future research is needed to examine the influence of one's nature on consumer-related attitudes (e.g., materialism) and behaviors (e.g., philanthropy) independently of decision-making styles.

From a more applied perspective, "if genetic structures associated with particular behavioral traits continue to be identified in the future, organizations might use genetic information for screening and selection (Arvey et al., 1994)" (Ilies, Arvey and Bouchard, 2006, p.134). Similarly, if the traits and behaviors that underlie individual approaches to choice can someday be mapped along their related genes, marketing practitioners might use genetic information to personalize the informational content and persuasive appeals of their communication efforts (i.e., market segmentation via biometrically acquired genetic information). For example, in targeting consumers with inherently more rational decision-making styles, advertisers might place more emphasis on the logical reasons for purchasing their brands. Similarly, in targeting dependent decision-makers, marketers may wish to include a greater number of testimonials in crafting their persuasive appeals. This point (i.e., using biometric information to optimize advertising efficiency), however, raises a number of ethical considerations and additional deliberation on the topic is clearly advised.

An Evolutionary Psychology Perspective on Decision-Making

> "Like the genes that build the body, the genes that build the brain are a product of evolution" (Marcus, 2004, p.111).

Many within the decision-sciences have ignored the pivotal role of evolution in studying the workings of the human mind. The purpose of Study 3 was to fill this gap by providing an evolutionary psychology analysis of how the mind solves one of evolution's most illustrious decision-problems: that of choosing a mate. In summary, Study 3 reported findings wherein various search behaviors (captured via a computerized mate-selection task) were consistent with evolutionary predictions. For instance, in evaluating candidates for a short-term mating affair, subjects tended to dedicate significantly more effort to evaluating chosen versus rejected candidates. This finding was predicted as in the context of short-term mate selection, inaccurate choices are more costly than inaccurate rejections. In addition, in line with Trivers' (1972) parental investment theory and Buss and Schmitt's (1993) sexual strategies theory, females displayed more selectivity in seeking a short-term mate than males along several of the search metrics examined in Study 3.

As an additional focus, Study 3 sought to examine the effects of NFC and maximizing on the search process underlying mate choice. While such general cognitive proclivities have clear theoretical links to predecisional information search in domain-general contexts (i.e., contexts for which the mind has not evolved any specialized strategies), little is known about their impact in domain-specific situations like mate choice. Nonetheless, as mate choice is subsumed within a greater set of problems involving sequential search, it was predicted that NFC and maximizing would indeed affect the mate search process. The related findings provided mixed results. While NFC was apparently linked to search in the context of human mate selection (with regards to the number of candidates evaluated), maximizing (as cued by the composite scale) was not. However, in running additional analyses along components of maximizing, having high standards for one's self and in general was reportedly linked to the extent to which candidates were evaluated. The mixed findings suggest that further research is needed to more specifically examine the influence of general cognitive proclivities across decision-domains.

As an additional contribution, Study 3 introduced a novel framework for studying sequential mate search. According the Todd (2000), when solving domain-specific problems (e.g., mate search) the mind has adapted fast and frugal means of taking advantage of the specific way information is structured in the environment. Moreover, several researchers have noted that the manner in which information is formatted and structured in a given choice-task can have profound effects on the subsequent decision-making behavior (Bettman and Kakkar, 1977; Russo, 1977). Hence, especially when studying domain-specific issues, every effort must be made to represent the information structure of the problem at hand as accurately as possible. As discussed earlier, mate search has traditionally been studied via two distinct approaches (i.e., trait- and candidate-based). Despite the independent insights provided by these, the task of choosing a mate is perhaps best described by a combination of the two. By unifying alternative-based and attribute-based sequential-sampling frameworks (Saad, 2006, personal communication; Lippman & McCardle, 1991), Study 3 sought to provide a more accurate representation of the knowledge environment surrounding mate choice. To highlight the additional insight provided by the unified model, consider the following. In reference to her own research which studied mate search using a strictly trait-based approach, Eba (1998) stated: "while this research provided several promising results (e.g., number of rejections, mate preferences), the findings also yielded some unfavorable results. Specifically, there was no evidence to show that males and females differed in the degree of effort exerted in searching for a mate" (p.155). Similarly, Study 3 found that males and females did not differ significantly in terms of the effort devoted to seeking a mate along the trait-based metrics. However, with regards to other facets of search (e.g., candidate-based metrics), the evolutionary predictions were confirmed (i.e., males and females were found to be significantly different in terms of the number of candidates evaluated predecisionally and the total amount of processing afforded to the mate choice task).

Implications and directions for future research

The evolutionary psychology component of this thesis marked one of a limited (albeit growing) number of attempts to bridge the gap between the fields of consumer behavior and evolutionary psychology (e.g., Saad and Gill, 2000; Colarelli and Dettmann, 2003; Saad, 2006, 2007). As a broad implication, Study 3's findings suggest that evolutionary forces have indeed shaped the workings of the mind, further evincing the legitimacy of adopting a Darwinian approach to the study of consumer psychology. In particular, the area of consumption investigated in Study 3 involved 'shopping' for a mate. While mate selection has earned the attention of consumer behavior scholars in recent years (e.g., Hitsch, Hortacsu and Ariely, 2005), the cognitive search processes underlying mate choice have gone relatively unstudied. This is surprising as information search is a common topic within the fields of mate selection and consumer research. In providing an evolutionary analysis of the search process underlying mate search, this thesis provides key insight into how humans inform themselves when making decisions.

From a more applied perspective, the mating-related findings provided by Study 3 can be used to help the plethora of matchmaking service providers (most notably those that have recently surfaced on the Internet) better tailor their offerings to suit their clients' adaptively oriented needs (i.e., evolved human nature). For example, in light of the finding that females tended to evaluate a greater number of candidates than males before committing to a winning suitor, online dating services may choose to adjust their information display formats accordingly (e.g., showing more candidates per screen to female vs. male members). In addition, Study 3 attempted to link the search processes underlying mate choice to several individual difference traits (e.g., NFC). While the related findings yielded mixed results, tailoring the mate search experience to idiosyncratic aspects of each member's personality (perhaps via a battery of pre-search psychological assessments) is clearly the next step in personalized matchmaking. Though some service providers advertise using such practices to match individuals more accurately (e.g., eHarmony.com), none of these have considered matching the very search process of finding a mate to their members' idiosyncratic search proclivities (e.g., NFC). As a related application, Study 3 showed that individuals with low levels of need for cognition tended to evaluate fewer alternatives than their high-NFC counterparts. Accordingly, online service providers might increase customer satisfaction by restricting the number of suggested candidates to only the best ones for their low-NFC members, while including a greater number of candidates of varying levels of quality for their high-NFC counterparts. Further research is needed to more directly address the means by which human-computer interactions (including navigational flow, search routines, proposed option-sets, information presentation formats, etc.) can be tailored to fit the cognitive proclivities of each individual user in contexts other than those involving mate choice.

Conclusion

In summary, this thesis reports findings related to four major areas: (1) identifying the genetic underpinnings of decision-making predispositions, based on established psychometric scales (i.e., general decision-making style and maximizing-satisficing), (2) revealing the innateness of specific aspects of the cognitive process underlying choice based on the evaluation of actual behavior (i.e., using a computerized process-tracing tool), (3) demonstrating the evolutionary origins of decision-making adaptations (i.e., using a novel process-tracing interface), and (4) testing a unified approach for studying sequential-sampling. In so doing, the thesis integrated major themes from the fields of behavioral decision research, genetics and evolutionary psychology. While the findings provide compelling evidence for the Darwinian process by which human decision-making faculties evolved, future research is needed to reveal the mind's full variety of adaptive expressions, and see how these interact with both cultural and environmental factors.

REFERENCES

Arvey R.D., McCall B., Bouchard T.J. Jr., Taubman P. (1994). Genetic Influences on Job Satisfaction and Work Values, *Personality and Individual Differences*, 17, 21-33.

Arvey, R.D., Rotundo, M., Johnson, W., Zhang, Z., & McGue, M. (2006). The determinants of leadership role occupancy: Genetic and personality factors. *Leadership Quarterly*, 17, 1-20.

Barrett, Louise, Robin Dunbar, and John Lycett. (2002). *Human Evolutionary Psychology.* Princeton: Princeton University Press.

Beatty, Sharon E., and Scott M. Smith. (1987). External search effort: An investigation across several product categories. *Journal of Consumer Research*, 14 (1), 83-95.

Bettman, J.R., & Kakkar, P. (1977). Effects of information presentation format on consumer information acquisition strategies. *Journal of Consumer Research*, 3, 233-240

Bouchard, T.J. (1998). Genetic and environmental influences on adult intelligence and special mental abilities. *Human Biology*, 70, 257-279.

Bouchard, T.J., Lykken, D.T., McGue, M., Segal, N.L., Tellegen, A. (1990). *Science*, 250, 4978, p 223(6)

Brown, D.E. (1991). *Human universals.* New York: McGraw-Hill

Brucks, M. (1985). The effects of product class knowledge on information search behavior. *Journal of Consumer Research*, 12, 1-16.

Buss, D. M., & Schmitt, D. P. (1993). Sexual Strategies Theory: An evolutionary perspective on human mating. *Psychological Review*, 100, 204-232.

Buss, D. M., Abbott, M., Angleitner, A., Asherian, A., Biaggio, A., Blanco-Villasenor, A., et al. (1990). International preferences in selecting mates: A study of 37 cultures. *Journal of Cross-Cultural Psychology*, 21, 5-47.

Buss, D.M. (2002a). Human Mating Strategies. *Samfundsokonomen*, 4, 47-58.

Buss, D.M. (2002b). Human Mate Guarding. *Neuroendocrinology Letter* Special Issue, 23: 23-29.

Buss, D.M., Larsen, R.J., Westen, D. and Semmelroth, J. (1992), Sex differences in jealousy: Evolution, physiology and psychology. *Psychological Science*, 3: 251-255.

Cacioppo, J. T., & Petty, R. E. (1982). The need for cognition. *Journal of Personality and Social Psychology*, 42, 116-131.

Cacioppo, J. T., Petty, R. E., & Kao, C. E. (1984). The efficient assessment of need for cognition. *Journal of Personality Assessment*, 48, 306-307.

Clark, W. and Grunstein, M. (2000). Are we hardwired? *The role of genes in human behavior*. New York: Oxford University Press.

Colarelli, S. M., & Dettmann, J. R. (2003). Intuitive evolutionary perspectives in marketing. *Psychology and Marketing*, 20, 837-865.

Costello, Anna B. & Jason Osborne (2005). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Practical Assessment Research & Evaluation*, 10(7).

Darwin, C. (1859). *On the Origin of Species*. London: John Murray.

DeVellis, Robert F. 1991. *Scale Development: Theory and Applications*. Newbury Park, CA: SAGE Publications.

Driver, M. J. (1979). Individual decision making and creativity. In S. Kerr (Ed.), *Organizational Behavior*. Columbus, Ohio: Grid Publishing, Inc., 59-91.

Driver, M.J., Brousseau, K.E., & Hunsaker, P.L. (1990) *The dynamic decision-maker*. New York: Harper & Row.

Eba, A. (1998). *An Evolutionary Approach to Studying Search Behavior in the Context of Human Mate Selection*. Unpublished master's thesis, Concordia University.

Fabrigar, L. R., Wegener, D. T., MacCullum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods*, 4, 272-299.

Ford, J. Kevin, Neal Schmitt, Susan L. Schechtman, Brian M. Hults, and M. L. Doherty. (1989). Process Tracing Methods: Contributions, Problems, and Neglected Research Questions. *Organizational Behavior and Human Decision Processes* 43(1): 75-117.

Frank, R.H. (1988). *Passion within reason: The strategic role of emotions*. New York, NY: W.W.Norton & Company.

Galton, F. (1875). History of Twins. *Inquiries into Human Faculty and its Development*, 155-173.

Gigerenzer, G., and Todd, P.M. (1999). Fast and frugal heuristics: The adaptive toolbox. In G. Gigerenzer, P.M. Todd, and the ABC Research Group, *Simple heuristics that make us smart*. New York: Oxford University Press.

Gottesman, I.I. (1991). *Schizophrenia genesis: the origins of madness*. New York: Freeman.

Gottesman, I.I. (1993). Origins of schizophrenia: Past as prologue. In R. Plomin & G.E. McClearns (Eds.), *Nature, nurture and psychology.* Washington, DC: American Psychological Association.

Hitsch, G.J., Hortacsu, A., Ariely, D. (2005). What makes you click: an empirical analysis of online dating, *Meeting Papers of Society for Economic Dynamics*, No. 207.

Hunt, R.G., Krzystofiak, F.J., Meindl, J.R., & Yousry, A.M. (1989). Cognitive style and decision making. *Organizational Behavior and Human Decision Processes*, 44, 436-453

Ilies, R., Arvey, R. & Bouchard, T.J. Jr. (2006). Darwinism, behavioral genetics, and organizational behavior: a review and agenda for future research. *Journal of Organizational Behavior*, 27, 121-141.

Ilies, R., Gerhardt, M., & Le, H. (2004). Individual differences in leadership emergence: integrating meta-analytic findings and behavioral genetics estimates. *International Journal of Selection and Assessment*, 12 , 207 –219.

Iyengar, S. S., & Lepper, M. R. (2000). When choice is demotivating: Can one desire too much of a good thing? *Journal of Personality and Social Psychology*, 79, 995-1006.

Iyengar, S. S., & Lepper, M. R. (1999). Rethinking the value of choice: A cultural perspective on intrinsic motivation. *Journal of Personality and Social Psychology*, 76, 349-366.

Iyengar, S., Wells, R., Schwartz, B. (2006). Doing Bettern but feeling Worse: Looking for the "Best" Job Undermines Satisfaction. *Psychological Science*, 2: 143-150.

Jasper, J.D. & Shapiro, J. (2002). MouseTrace: A better mousetrap for catching decision processes. *Behavior Research Methods, Instruments, and Computers*, 34, 364-374.

Kanazawa, Satoshi. (2004). General Intelligence as a Domain-Specific Adaptation. *Psychological Review* 111: 512-523.

Kenrick, D.T., Sadalla, E.K., Groth, G., & Trost, M.R. (1990). Evolution, traits, and the stages of human courtship: Qualifying the parental investment model. *Journal of Psychology*, 58(1), 97-116.

Laland, K. N., & Brown, G. R. (2002). *Sense and Nonsense.* Oxford: OUP.

Laroche, M., Kim, C. and Matsui, T. (2003). Which decision heuristics are used in consideration set formation? *Journal of Consumer Marketing*, 20 (3), 192-209.

Lattin, J.M., Carroll, J.D., Green, P.E. (2003). *Analyzing Multivariate* Data. Toronto: Brooks/Cole, Thomson Learning, Inc.

Lippman, S.A., & McCardle, K.F. (1991). Uncertain search: A model of search among technologies of uncertain values. *Management Science*, 37(11): 1474–1490, 1991.

Loehlin, J.C. (1992). *Genes and environment in personality development.* Newbury Park,CA:Sage Publications, Inc.

Loo, R. (2000). A Psychometric Evaluation of the General Decision-Making Style Inventory. *Personality and Individual Differences*, 29, 895-905.

MacDonald, K. B. (1991). A perspective on Darwinian psychology: The importance of domain-general mechanisms, plasticity, and individual differences. *Ethology and Sociobiology*, 12, 449-480.

Marcus, G. (2004). *The Birth of the Mind: How a Tiny Number of Genes Creates the Complexities of Human Thought.* NY: Basic Books.

McGue, M., Bouchard, T.J., Jr., Iacono, W.G., & Lykken, D.T. (1993). Behavioral genetics of cognitive ability: A life-span perspective. In R. Plomin & G.E. McClearns (Eds.), *Nature, nurture and psychology.* Washington, DC: American Psychological Association.

McKenney, J., & Keen, P. (1974). How managers' minds work. *Harvard Business Review*, 52, 79-90.

Mitroff, I.I. (1983). *Stakeholders of the organizational mind.* San Francisco: Jossey-Bass.

Nunnally, J. C. (1978). *Psychometric theory (2nd ed.).* New York: McGraw-Hill.

Osborne, Jason (2002). Notes on the use of data transformations. *Practical Assessment, Research & Evaluation*, 8(6).

Otto, Sarah P, Freddy B Christiansen and Marcus Feldman. (1995). Genetic and cultural inheritance of continuous traits, *Technical Report 64*, University of California, Berkeley.

Payne, J. W., Bettman, J. R., & Johnson, E. J. (1993). *The Adaptive Decision Maker*, Cambridge University Press.

Payne, J.W. (1976). Task complexity and contingent processing in decision making: An information search and protocol analysis. *Organizational Behavior and Human Performance*, 16, 366-387

Perry,A. (1973). Heredity, personality traits, product attitude, and product consumption – An exploratory study. *Journal of Marketing Research*, 10: 376–9.

Pinker, Steven (2002). *The Blank Slate: The Modern Denial of Human Nature.* New York: Viking Penguin.

Plomin, R. & McClearns, G.E. (1993). *Nature, nurture and psychology.* Washington, DC: American Psychological Association.

Robbins, T. (1991). *Awaken The Giant Within.* Sound Ideas.

Ruefenacht, S., Gebhardt-Henrich, S., Miyake, T. & Gaillard, C. (2002). A behaviour test on German Shepherd dogs: heritability of seven different traits. *Applied Animal Behaviour Science*, 79, 113-132.

Russo, J. Edward and Barbara A. Dosher. (1983). Strategies for Multiattribute Binary Choice. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 9, 676-696

Russo, J.E. (1977). The value of unit price information. *Journal of Marketing Research*, 14, 193-201

Russo, J.E. (1978). Eye fixations can save the world: Critical evaluation and comparison between eye fixations and other information processing methodologies. In H.K. Hunt (Ed.), *Advances in Consumer Research* (Vol.5, pp. 561-570). Ann Arbor, MI: Association for Consumer Research.

Saad, G. & Sejean, R. A Process-Tracing Tool for Studying Attribute-Based and Alternative-Based Sequential Sampling. International Meeting of the Psychometric Society, Montreal, Canada, June 2006.

Saad, G. & Sejean, R. A Unified Sequential Mate Choice Model. Human Behavior and Evolution Society, Philadelphia, PA, June 2006.

Saad, G. & Sejean, R. The Genetic Underpinnings of Decision-Making Styles: A Twin Study. Behavioral Decision Research in Management, Santa Monica, LA, June 2006.

Saad, G. (1998). The experimenter module of the DSMAC (Dynamic Sequential Multi Attribute Choice) interface. *Behavior, Research, Methods, Instruments & Computers*, 30(2), 250-254.

Saad, G. (2006). Applying evolutionary psychology in understanding the Darwinian roots of consumption phenomena. *Managerial and Decision Economics*, 27(2-3): 189.

Saad, G. (2007). *The Evolutionary Bases of Consumption*. Mahwah, NJ: Lawrence Erlbaum.

Saad, G. and Gill, T. (2000), Applications of Evolutionary Psychology in Marketing, *Psychology & Marketing*, Vol. 17(12), 1005-1034.

Saad, Gad and J. Edward Russo (1996). Stopping Criteria in Sequential Choice. *Organizational Behavior and Human Decision Processes*, 67(3), 258-270.

Schwartz, B., Ward, A., Monterosso, J., Lyubomirsky, S., White, K., & Lehman, D. (2002). Maximizing versus satisficing: Happiness is a matter of choice. *Journal of Personality and Social Psychology*, 83, 1178-1197.

Scott, S. G., & Bruce, R. A. (1995). Decision-making style: the development and assessment of a new measure. *Educational and Psychological Measurement*, 55(5), 818 - 831.

Segal, N., & MacDonald, K. B. (1998). Behavior Genetics and Evolutionary Psychology: A Unified Perspective on Personality Research. *Human Biology* 70, 157-182.

Simon, H. A. (1955). A behavioral model of rational choice. *Quarterly Journal of Economics*, 59, 99–118.

Simon, H. A. (1956). Rational choice and the structure of the environment. *Psychological Review*, 63, 129–138.

Simon, H. A. (1957). *Models of man, social and rational: Mathematical essays on rational human behavior.* New York: Wiley.

Simpson, J.A., & Gangestad, S.W. (1991). Individual differences in sociosexuality: Evidence for convergent and discriminant validity. *Journal of Personality and Social Psychology,* 60, 870-883.

Spicer, D.P., & Sadler-Smith, E. (2005). An examination of the general decision-making style questionnaire in two UK samples. *Journal of Managerial Psychology,* 2(2), 137-149(13)

Tellegen, A., Lykken, D.T., Bouchard, T.J.,Jr., Wilcox, K.J., Segal,N.L., &Rich,S. (1988). Personality similarity in twins reared apart and together. *Journal of Personality and Social Psychology,* 54, 1031 .1039.

Todd, P.M. 2000. The ecological rationality of mechanisms evolved to make up minds. *American Behavioral Scientist,* 43: 940—956.

Todd, P.M., and Miller, G.F. (1999). From pride and prejudice to persuasion: Satisficing in mate search. In G. Gigerenzer, P.M., Todd, & the ABC Research Group (Eds.), *Simple Heuristics That Make Us Smart,* (pp. 287-308), New York: Oxford University Press.

Tooby, J., & Cosmides, L. (1992). The psychological foundation of culture. In J.H. Barkow, L. Cosmides, & J. Tooby (Eds.), *the adapted mind: Evolutionary psychology and the generation of culture,* 19-136, New York, NY: Oxford University Press.

Trivers, R. (1972). Parental investment and sexual selection, In B.G. Campbell (Ed.), *Sexual Selection and Descent of Man:* 1871-1971, (pp. 136-179), Chicago, Il: Aldine.

Verplanken, B., Hazenberg, P.T., & Palenewen, G.R. (1992). Need for cognition and external information search effort. *Journal of Research in Personality,* 26, 128-136.

Von Neumann, J., & Morgenstern, O. (1944). *Theory of games and economic behavior.* Princeton, NJ: Princeton University Press.

Weiten, W. (2002). *Psychology: Themes and variations (briefer ed) (5th ed).* Wadsworth / Thomson.

Wilson, M., Daly, M. (1992). Who kills whom in spouse killings? On the exceptional sex ratio of spousal homicides in the United States. *Criminology,* 30: 189-215.

Appendix A: GDMS scale

Listed below are statements describing how individuals go about making important decisions.

Please indicate the extent to which you agree or disagree with each statement.

(Listed items were shuffled in the actual questionnaire)

		Strongly disagree 1	Somewhat disagree 2	Neither agree nor disagree 3	Somewhat agree 4	Strongly agree 5
a.	I plan my important decisions carefully.	[1]	[2]	[3]	[4]	[5]
b.	I double-check my information sources to be sure I have the right facts before making decisions.	[1] [1]	[2] [2]	[3] [3]	[4] [4]	[5] [5]
c.	I make decisions in a logical and systematic way.	[1]	[2]	[3]	[4]	[5]
d.	My decision making requires careful thought.	[1]	[2]	[3]	[4]	[5]
e.	When making a decision, I consider various options in terms of a specific goal.	[1]	[2]	[3]	[4]	[5]
f.	When making decisions, I rely upon my instincts.	[1]	[2]	[3]	[4]	[5]
g.	When I make decisions, I tend to rely on my intuition.	[1]	[2]	[3]	[4]	[5]
h.	I generally make decisions which feel right to me.	[1]	[2]	[3]	[4]	[5]
i.	When I make a decision, it is more important for me to feel the decision is right than to have a rational reason for it.	[1]	[2]	[3]	[4]	[5]
j.	When I make a decision, I trust my inner feelings and reactions.	[1]	[2]	[3]	[4]	[5]
k.	I often need the assistance of other people when making important decisions.	[1]	[2]	[3]	[4]	[5]
l.	I rarely make important decisions without consulting other people.	[1]	[2]	[3]	[4]	[5]
m.	If I have the support of others, it is easier for me to make important decisions.	[1]	[2]	[3]	[4]	[5]
n.	I use the advice of other people in making my important decisions.	[1]	[2]	[3]	[4]	[5]
o.	I like to have someone to steer me in the right direction when I am faced with important decisions.	[1]	[2]	[3]	[4]	[5]
p.	I avoid making important decisions until the pressure is on.	[1]	[2]	[3]	[4]	[5]
q.	I postpone decision making whenever possible.	[1]	[2]	[3]	[4]	[5]

Appendix A (Cont.)

r.	I often procrastinate when it comes to making important decisions.	[1]	[2]	[3]	[4]	[5]
s.	I generally make important decisions at the last minute.	[1]	[2]	[3]	[4]	[5]
t.	I put off making many decisions because thinking about them makes me uneasy.	[1]	[2]	[3]	[4]	[5]
u.	I generally make snap decisions.	[1]	[2]	[3]	[4]	[5]
v.	I often make decisions on the spur of the moment.	[1]	[2]	[3]	[4]	[5]
w.	I make quick decisions.	[1]	[2]	[3]	[4]	[5]
x.	I often make impulsive decisions.	[1]	[2]	[3]	[4]	[5]
y.	When making decisions, I do what seems natural at the moment.	[1]	[2]	[3]	[4]	[5]

Appendix B: Maximizing scale

Please indicate the extent to which you agree or disagree with each of the following statements.

Completely Disagree	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Completely agree
[1]	[2]	[3]	[4]	[5]	[6]	[7]

Whenever I'm faced with a choice, I try to imagine what all the other possibilities are, even the ones that aren't present at the moment.

[1] [2] [3] [4] [5] [6] [7]

No matter how satisfied I am with my job, it's only right for me to be on the lookout for better opportunities.

[1] [2] [3] [4] [5] [6] [7]

When I am in the car listening to the radio, I often check other stations to see if something better is playing, even if I am relatively satisfied with what I'm listening to.

[1] [2] [3] [4] [5] [6] [7]

When I watch TV, I channel surf, often scanning through the available options even while attempting to watch one program.

[1] [2] [3] [4] [5] [6] [7]

I treat relationships like clothing: I expect to try a lot on before finding the perfect fit.

[1] [2] [3] [4] [5] [6] [7]

I often find it difficult to shop for a gift for a friend.

[1] [2] [3] [4] [5] [6] [7]

Renting videos is really difficult. I'm always struggling to find the best one.

[1] [2] [3] [4] [5] [6] [7]

When shopping, I have a hard time finding clothing that I really love.

[1] [2] [3] [4] [5] [6] [7]

I'm a big fan of lists that attempt to rank things (the best movies, the best singers, the best athletes, the best novels etc.).

[1] [2] [3] [4] [5] [6] [7]

I find that writing is very difficult, even if it's just writing a letter to a friend, because it's so hard to word things just right. I often do several drafts of even simple things.

[1] [2] [3] [4] [5] [6] [7]

No matter what I do, I have the highest standards for myself.

[1] [2] [3] [4] [5] [6] [7]

Appendix B (Cont.)

I never settle for second best.

[1] [2] [3] [4] [5] [6] [7]

I often fantasize about living in ways that are quite different from my actual life.

[1] [2] [3] [4] [5] [6] [7]

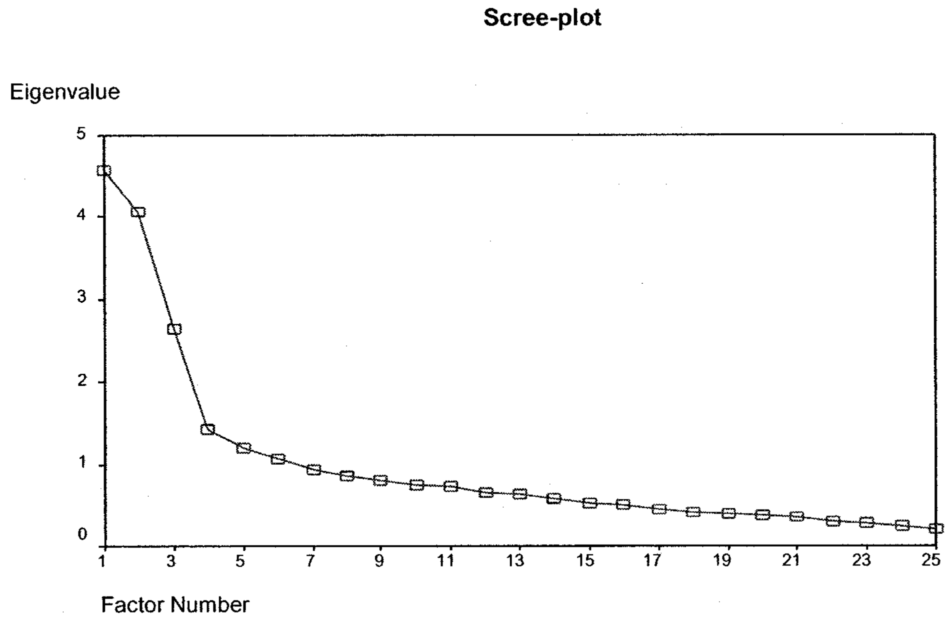
Appendix C: GDMS factor loadings matrix and scree-plot

Rotated Factor Matrix

	Factor				
	Dependent	Intuitive	Spontaneous	Rational	Avoidant
ITEM 1				.530	
ITEM 2				.515	
ITEM 3				.578	
ITEM 4				.557	
ITEM 5				.577	
ITEM 6		.739			
ITEM 7		.776			
ITEM 8		.329			
ITEM 9		.410			
ITEM 10		.602			
ITEM 11	.833				
ITEM 12	.556				
ITEM 13	.537				
ITEM 14	.724				
ITEM 15	.631				
ITEM 16					.620
ITEM 17					.644
ITEM 18					.504
ITEM 19					.491
ITEM 20					.527
ITEM 21			.777		
ITEM 22			.652		
ITEM 23			.613		
ITEM 24			.660		
ITEM 25		.464			

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 7 iterations. Strongest factor loading depicted for each item. Mean replacement option enabled for missing values.

Appendix C (Cont.)



Appendix D: Mate selection information acquisition screen

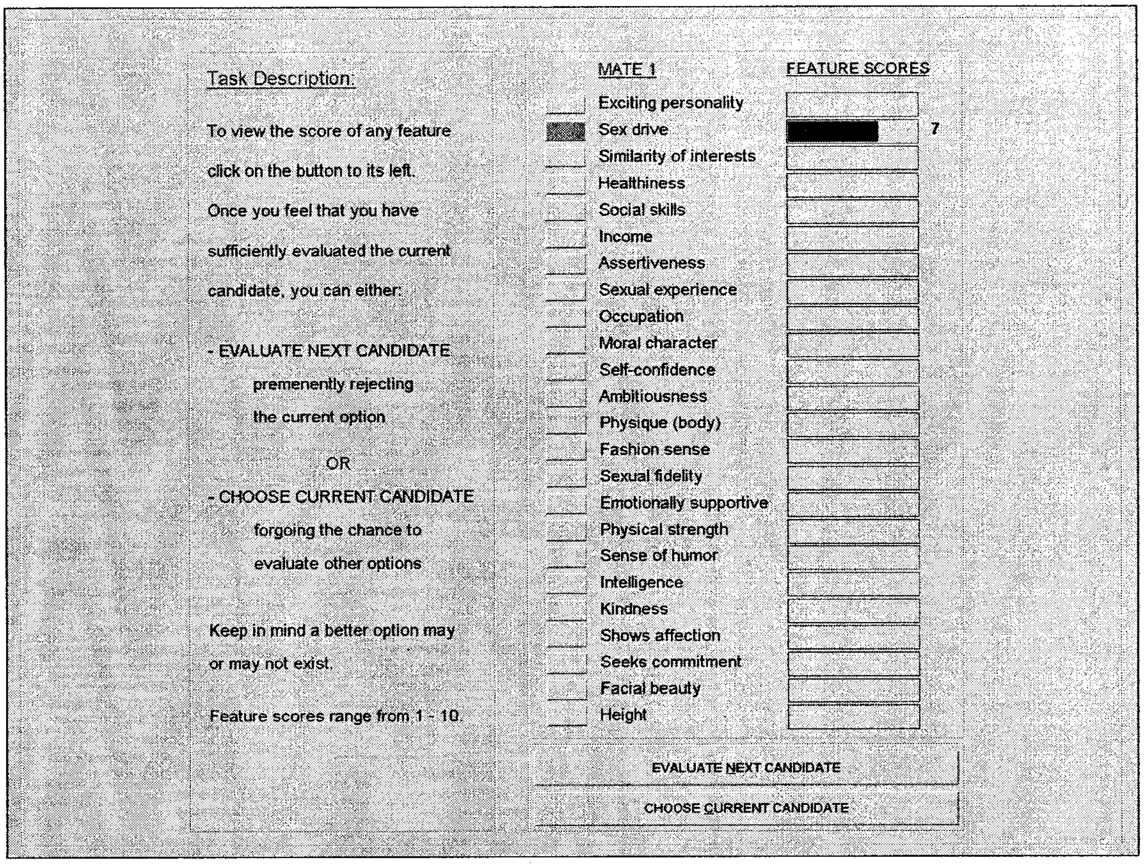


Figure 6: Information acquisition screen. Subjects were able to view attribute scores for each candidate one at a time via the information acquisition screen (all attributes ratings were defined on a scale from 1 to 10, with 10 being the best possible score and 1 being the worst). In evaluating any given candidate, subjects were instructed to acquire as much information as they needed by sliding the mouse in the appropriate area from within a randomly ordered list of features and clicking (the order in which attributes were listed was randomized for each candidate evaluated). Following the sufficient appraisal of the any viewed candidate, subjects were asked to either select the current suitor (forgoing the chance to search for a better option), or reject it and continue their search for a better option. In opting for the former, subjects cued the end of the mate selection task. In opting for the latter, the information acquisition screen was refreshed for the next suitor and task was repeated.

Appendix E: Attribute importance weight elicitation screens

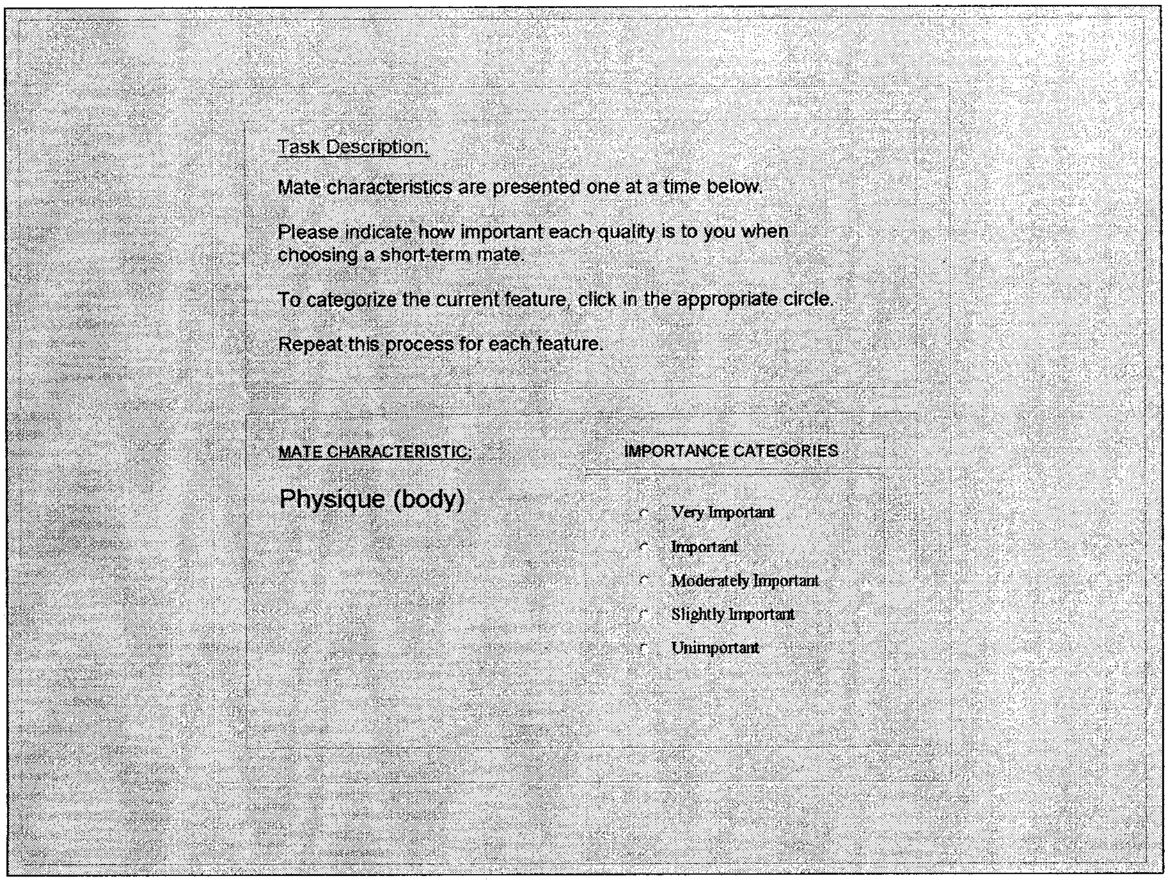


Figure 7: Categorizing of attributes. The computerized mate selection task began by eliciting subjects' attribute importance rankings and weights using a Q-Sort procedure. For this purpose, attribute names were first listed on the computer screen one at a time, at which point subjects were asked to assign each of them to one of five importance categories (i.e., unimportant, slightly important, moderately important, important and very important).

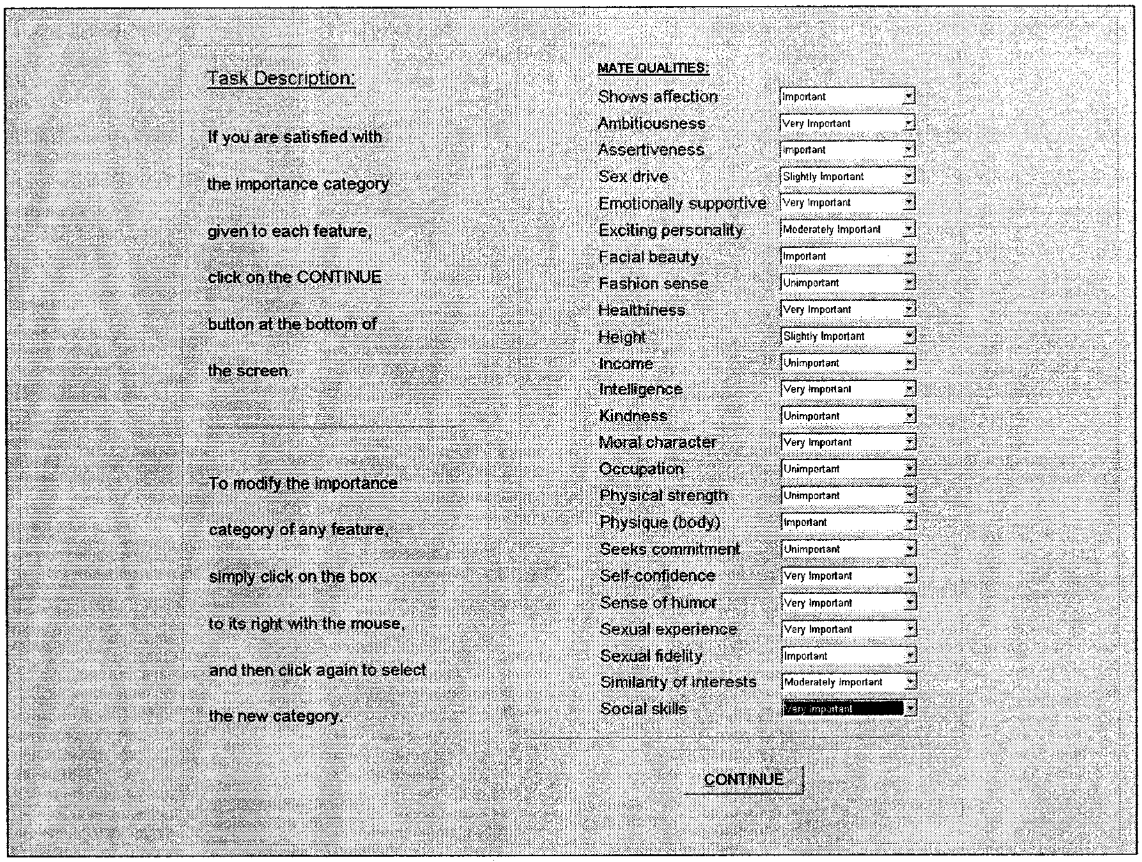


Figure 8: Confirmation of attribute categories. On this screen, subjects were shown a listing of the 24 attributes along with their designated importance categories, and asked to confirm their proper classification.

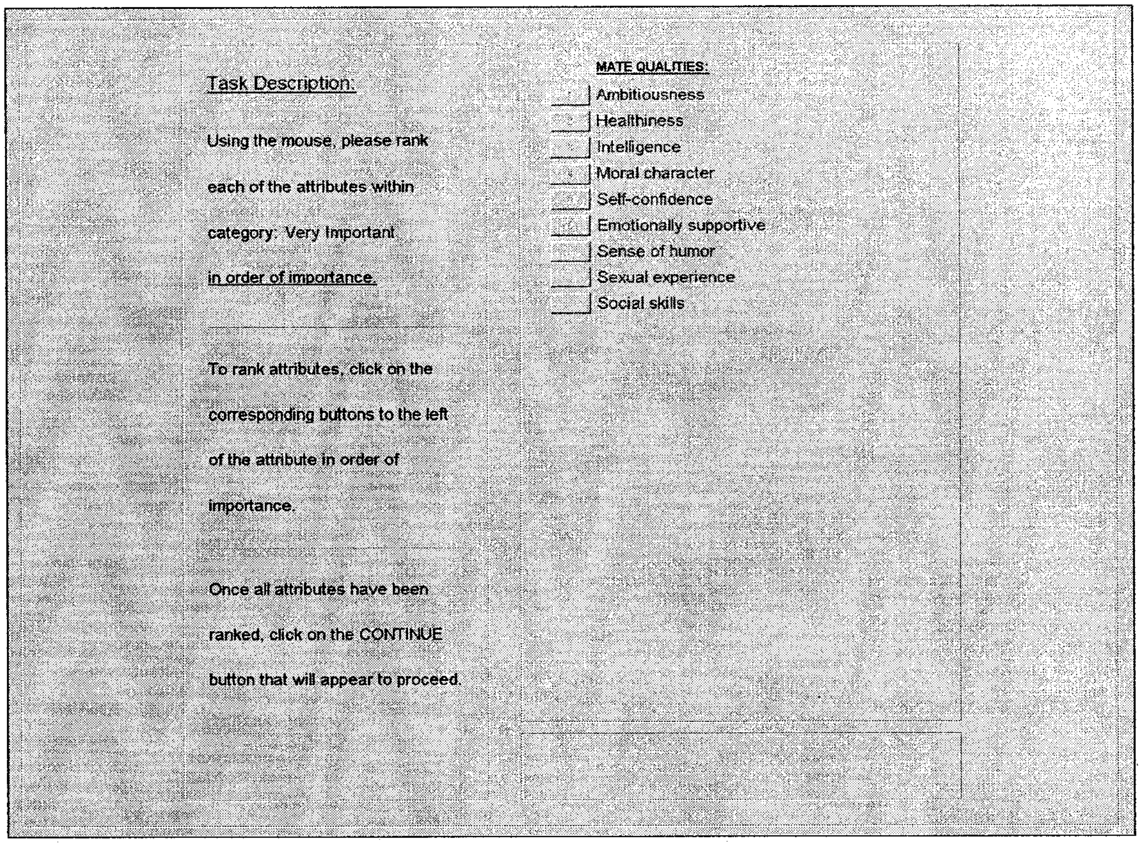


Figure 9: Ranking of attributes (within each category of importance). On a series of screens similar to the one displayed above, subjects were asked to rank-order the attributes within each category of importance.

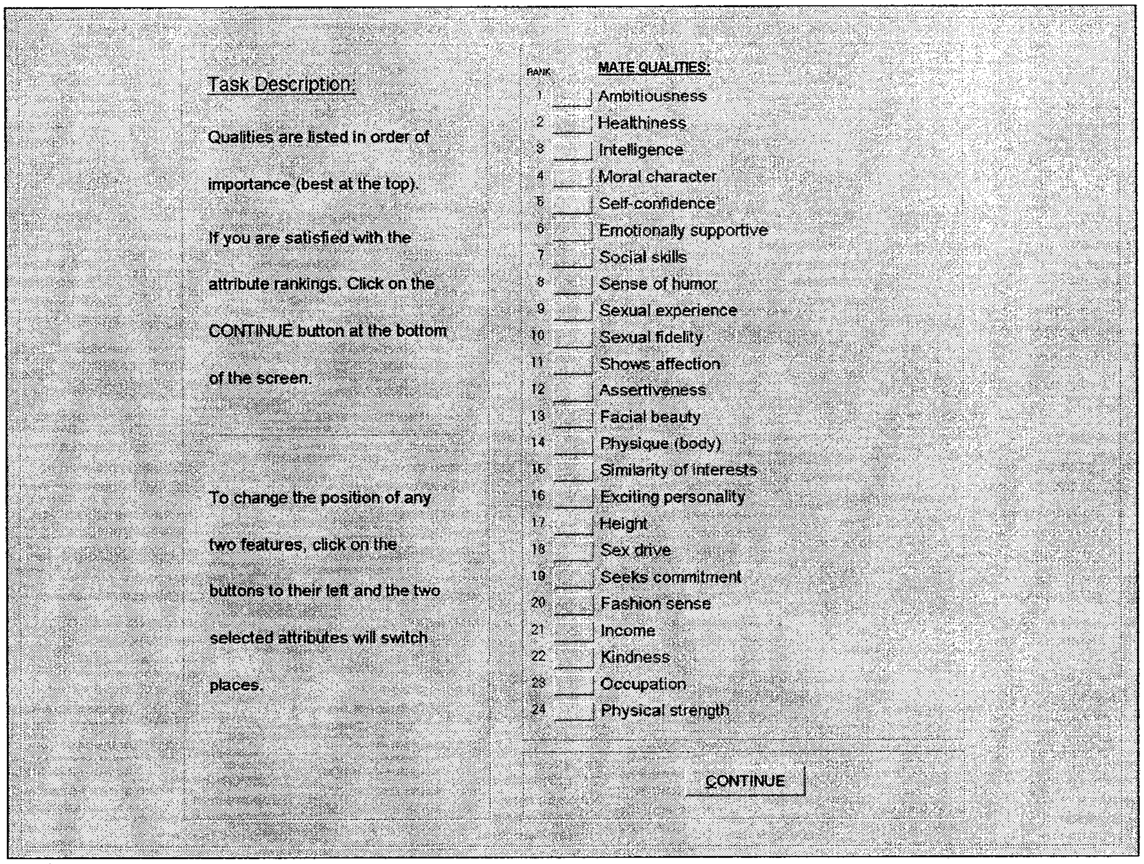


Figure 10: Confirmation of attribute rankings. On this screen, subjects were shown a complete rank ordering of all the attributes and asked to either make any changes by swapping the position of any two features or proceed to the next phase of the Q-Sort.

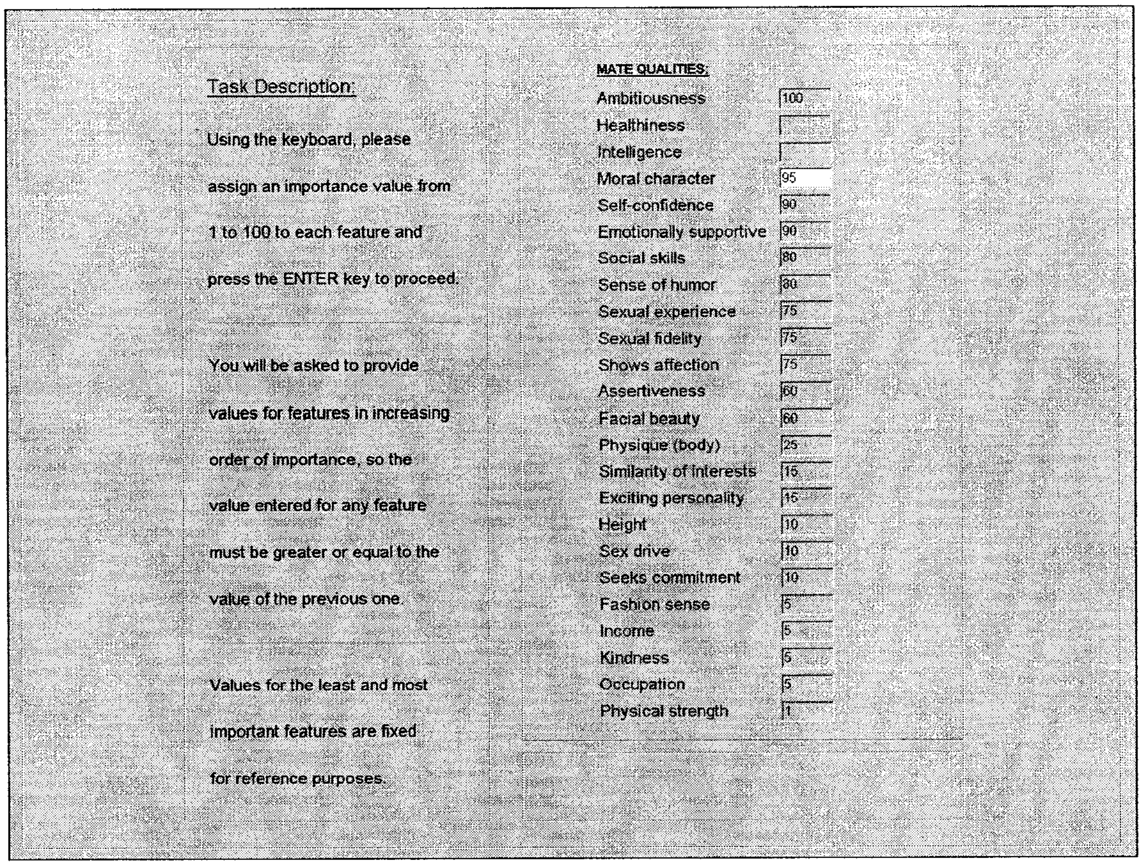


Figure 11: Weighing of attributes. On this screen, subjects were asked to assign an importance weight to each attribute (weights pertaining to the least and most important attributes were anchored at 1 and 100 respectively).

Appendix F: Sample Questionnaire Booklet for Study 3

Please answer all of the following questions honestly. For the questions dealing with behavior, *write* your answers in the blank spaces provided. For the questions dealing with thoughts and attitudes, *circle* the appropriate number on the scales provided.

With how many different partners have you had sex (sexual intercourse) within the past year? ________

How many different partners do you foresee yourself having sex with during the next five years? (Please give a *specific, realistic* estimate). ________

With how many different partners have you had sex on *one and only one* occasion?

____

How often do you fantasize about having sex with someone other than your current dating partner? (Circle one).

1. never
2. once every two or three months
3. once a month
4. once every two weeks
5. once a week
6. a few times each week
7. nearly every day
8. at least once a day

Sex without love is OK.

1 2 3 4 5 6 7 8 9

I strongly disagree I strongly agree

I can imagine myself being comfortable and enjoying "casual" sex with different partners.

1 2 3 4 5 6 7 8 9

I strongly disagree I strongly agree

I would have to be closely attached to someone (both emotionally and psychologically) before I could feel comfortable and fully enjoy having sex with him or her.

1 2 3 4 5 6 7 8 9

I strongly disagree I strongly agree

Please indicate the extent to which you agree with each of the following statements:

1 = strongly disagree
2 = somewhat disagree
3 = uncertain
4 = somewhat agree
5 = strongly agree

	strongly disagree → strongly agree				
I would prefer complex to simple problems.	[1]	[2]	[3]	[4]	[5]
I like to have the responsibility of handling a situation that requires a lot of thinking.	[1]	[2]	[3]	[4]	[5]
Thinking is not my idea of fun.	[1]	[2]	[3]	[4]	[5]
I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.	[1]	[2]	[3]	[4]	[5]
I try to anticipate and avoid situations where there is likely a chance I will have to think in depth about something.	[1]	[2]	[3]	[4]	[5]
I find satisfaction in deliberating hard and for long hours.	[1]	[2]	[3]	[4]	[5]
I only think as hard as I have to.	[1]	[2]	[3]	[4]	[5]
I prefer to think about small, daily projects to long-term ones.	[1]	[2]	[3]	[4]	[5]
I like tasks that require little thought once I've learned them.	[1]	[2]	[3]	[4]	[5]
The idea of relying on thought to make my way to the top appeals to me.	[1]	[2]	[3]	[4]	[5]
I really enjoy a task that involves coming up with new solutions to problems.	[1]	[2]	[3]	[4]	[5]
Learning new ways to think doesn't excite me very much.	[1]	[2]	[3]	[4]	[5]
I prefer my life to be filled with puzzles that I must solve.	[1]	[2]	[3]	[4]	[5]
The notion of thinking abstractly is appealing to me.	[1]	[2]	[3]	[4]	[5]
I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.	[1]	[2]	[3]	[4]	[5]
I feel relief rather than satisfaction after completing a task that required a lot of mental effort.	[1]	[2]	[3]	[4]	[5]
It's enough for me that something gets the job done; I don't care how or why it works.	[1]	[2]	[3]	[4]	[5]
I usually end up deliberating about issues even when they do not affect me personally.	[1]	[2]	[3]	[4]	[5]

Please indicate the extent to which you agree or disagree with each of the following statements.

Completely Disagree	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Completely agree
[1]	[2]	[3]	[4]	[5]	[6]	[7]

Whenever I'm faced with a choice, I try to imagine what all the other possibilities are, even the ones that aren't present at the moment.

[1] [2] [3] [4] [5] [6] [7]

No matter how satisfied I am with my job, it's only right for me to be on the lookout for better opportunities.

[1] [2] [3] [4] [5] [6] [7]

When I am in the car listening to the radio, I often check other stations to see if something better is playing, even if I am relatively satisfied with what I'm listening to.

[1] [2] [3] [4] [5] [6] [7]

When I watch TV, I channel surf, often scanning through the available options even while attempting to watch one program.

[1] [2] [3] [4] [5] [6] [7]

I treat relationships like clothing: I expect to try a lot on before finding the perfect fit.

[1] [2] [3] [4] [5] [6] [7]

I often find it difficult to shop for a gift for a friend.

[1] [2] [3] [4] [5] [6] [7]

Renting videos is really difficult. I'm always struggling to find the best one.

[1] [2] [3] [4] [5] [6] [7]

When shopping, I have a hard time finding clothing that I really love.

[1] [2] [3] [4] [5] [6] [7]

I'm a big fan of lists that attempt to rank things (the best movies, the best singers, the best athletes, the best novels etc.).

[1] [2] [3] [4] [5] [6] [7]

I find that writing is very difficult, even if it's just writing a letter to a friend, because it's so hard to word things just right. I often do several drafts of even simple things.

[1] [2] [3] [4] [5] [6] [7]

No matter what I do, I have the highest standards for myself.

[1] [2] [3] [4] [5] [6] [7]

I never settle for second best.

[1] [2] [3] [4] [5] [6] [7]

I often fantasize about living in ways that are quite different from my actual life.

[1] [2] [3] [4] [5] [6] [7]

Please indicate the following about yourself:

1. Sex: ________________

2. Age: ________________

3. Ethnicity: ________________

4. Sexual orientation: ________________

5. Relationship status (please check of the following):

___ Single and looking for a serious relationship

___ Single and looking for a casual relationship

___ Single and not looking for any type of relationship

___ In non-committed relationship

___ In committed relationship

6. If you are in a committed relationship, please state the extent to which you agree with the following statement (skip this question if you are not in a committed relationship):

I see myself spending the rest of my life with my current mate.

1 2 3 4 5 6 7 8 9

I strongly disagree ... I strongly agree

7. **Overall,** how do you think prospective romantic partners would rate you as a mate out of 10?

___/10

Any other facts about yourself or comments you'd like to share? (Optional)

Appendix G: Attribute Definitions[12]

Ambitiousness – whether the prospective mate has goals and ambitions and whether he/she will work hard to achieve these goals

Assertiveness – whether the prospective mate is self-assured and determined in his/her dealings with people

Emotionally supportive – whether the person is supportive I hard times

Exciting personality – whether the individual displays spontaneity, extroversion, and charm (opposite of boring and uninteresting)

Facial beauty – the overall beauty and attraction of the person's facial features

Fashion sense – whether the person is well dressed and displays a sense of style that is appropriate for the occasion

Healthiness – whether the person has a healthy lifestyle (i.e., adequate amount of exercise, proper nutrition, practices safe-sex etc)

Height – the desirability of the prospective mate's height

Income – the desirability of the prospective mate's annual salary

Intelligence – the intelligence (sharpness & brightness) of the mate

Kindness – whether the person is kind, considerate, and understanding

Moral character – whether the person displays strong values and principles and is guided by these principles

[12] Attribute definitions modified from Eba's (1998) mate selection attribute-guide.

Appendix G (Cont.)

Occupation – the prestige of the prospective mate's occupation

Physical strength – how physically strong and powerful the person is

Physique (body) – the attractiveness of the physique (figure) of the mate

Seeks commitment – whether the partner desires a committed, serious relationship

Self-confidence – whether the prospective mate has confidence in him/herself

Sense of humor – how witty and funny the individual is

Sex drive – the individual's desire for sexual activity

Sexual experience – the extent to which the prospective mate has had sexual experiences with different partners

Sexual fidelity – the prospective mate's history of being faithful to his/her mates

Shows affection – whether the person is affectionate and loving

Similarity of interests – whether the person shares similar hobbies and interests

Social skills – whether the person is friendly, sociable, interesting to talk to