

## Evolutionary Psychology of Investment Decisions: Expected Allocation of Personal Money and Differential Parental Investment in Sons and Daughters

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This paper reports experimental and field studies of risky investment. Evolution by natural selection should have equipped humans with a kith-and-kin rationality for investment decisions while sexual selection entailed a higher expectation for investments from a man than from a woman. In Study 1, participants estimated how a typical man or woman in the same age cohort would allocate lottery money to self and other possible recipients. The results showed that (1) the degree of kith-and-kin relatedness largely determined the amount of investment. (2) An imagined typical man was more generous than an imagined woman. However, male participants were more selfish than female participants. (3) Women were more accurate in estimating the other sex's investment distribution than men. (4) Women invested in more recipients, thus had a larger scope of social sharing. Study 2 tested the evolutionary psychological hypothesis that differential parental investment in sons and daughters would be affected by the family's relative rather than absolute wealth. Using breastfeeding and interbirth interval as the measurements of parental investment, the results showed that (1) real household income affected overall amount of parental investment irrespective of the sex of a child; and (2) relative wealth perceived by parents against their neighborhood households affected differential investment in sons versus daughters. Parental investment in sons is viewed as a riskier prospect than investment in daughters since men have a universally higher variance in wealth and reproduction than women. The two studies suggest that human decision rationality is bounded by social relations and adapted to relative wealth conditions.

**Keywords:** evolutionary psychology, rationality, risky decisions, monetary allocation, parental investment, sex differences

### 投资决策进化心理学的研究：预期的私人资金分配和父母对子女的差异性精力投入

投资决策的进化心理学研究着眼于辨认人类获得进化适应的特定环境中经常出现的典型性风险，探寻为了应对这些风险而进化出的信息处理机制，并验证现时的社会因素和个体因素对这些心理机制的激活或抑制作用。在研究一中，被试预测了与自己同龄的男人或女人如何分配一笔中彩的奖金给自己和其他可能的受益人。研究发现：（1）钱数的分配大体由亲缘关系的疏密程度决定；（2）两性被试都假想男性比女性更慷慨，但实际上男性表现得更自利；（3）女性被试预测男性中奖人的金钱分配比男性被试预测女性中奖人的金钱分配更为准确；（4）女性被试的受益人更多，分享的社会范围更广。研究二探讨了父母对子女投入精力的不同取决于家庭的相对财富而非绝对财富的进化心理学假说。用哺乳与否和生育间隔期为测量指标，研究结果显示：（1）家庭实际收入影响父母对子女的总投入；（2）与邻里家庭相比，父母对于自己家庭相对收入的认知影响了对子女有别的差异性精力投入。基于男性普遍在财富和生育数量上比女性有更大的变异度，投资儿子比投资女儿更具博弈性。两项研究表明，人类的理性决策既受限于社会关系又适应于相对的财富状况

**关键词：**进化心理学，理性，风险决策，金钱分配，父母投资，性别差异。

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#### **Introduction: An Overview of Evolutionary Cognitive Psychology**

Does the mind operate by design? Evolutionary psychologists view the human mind as a collection of specialized mechanisms or computational algorithms that serve as specific tools for solving specific problems recurrent in hominid evolution (e.g.,

Cosmides, & Tooby, 1996, Gigerenzer & Selten, 2001; Wang, 1996). In contrast, a popular view, referred to as the "standard social science model" (Tooby & Cosmides, 1992), considers the mind as a blank slate, virtually free of content until written on by the hand of experience (see Pinker, 1997). From this commonly accepted perspective in social science, as Browne (2006) puts it, "humans were viewed as the animal equivalent of tofu – characterless by themselves but capable of absorbing almost any flavor from the cultural stew in which they find themselves" (p. 143).

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The mind of *Homo sapiens* “the wise man” is characterized by intelligence and rationality. The metaphors of the human mind have been consistently updated over the years from blank slate to switchboard to general purpose computer. However, a central assumption remains unchanged in these different metaphors. That is, human intelligence, learning, reasoning, and rationality are governed predominantly by a small number of general purpose mechanisms. The design of such mechanisms is defined by logical rules, probability principles, and rational axioms. A typical portrait of a human under such content-independent and context-free rationality is the image of *Homo economicus* or the “economic man” who behaves like a secular version of God, omniscient in regard to information search and omnipotent in terms of computational power.

Over the years, the aforementioned standard social science model has been challenged on multiple fronts. Works in cognitive psychology have shown that humans have a limited information processing capacity (e.g., Miller, 1956), are often failed and betrayed by their own memories (e.g., Schacter, 2001), and are prone to persistent judgmental errors and systematic decision biases (e.g., Kahneman, Slovic & Tversky, 1982; Kahneman & Tversky, 2000). These lines of psychological research, however, have focused largely on cognitive constraints of information processing.

In contrast, behavioral ecologists who study foraging insects and birds had found evidence of mechanisms that make rather accurate Bayesian probability judgments as well as normatively appropriate risk-sensitive foraging decisions (e.g., Real, 1991; Stephens & Krebs, 1986). This picture of “rational birds and irrational humans” raises the following questions. Are humans rational after all? By what standard should we decide? Are humans guilty of making irrational choices due to “cognitive illusions” or are they innocent victim of invalid information contexts? How can the fact that bird brains and insect minds make well-calibrated judgments and decisions reconcile with a human mind that is prone to “judgmental fallacies” and “cognitive illusions”?

Herb Simon (1956, 1990) proposes the notion of bounded rationality to connect the ecological and psychological perspectives. In his words: “Human rational behavior is shaped by a scissors whose two blades are the structure of task environments and the computational capabilities of the actor” (p. 7, 1990). The two key components of bounded rationality have not been given equivalent attentions in different disciplines. Economists assume that environmental resources are scarce but, ironically, consider mental resources to be largely unlimited. Psychologists, on the other hand, study mental capabilities and

information overload but largely in contexts deprived of environmental constraints (see also Zwick, Erev & Budescu, 1999).

Simon (1956, 1990) emphasizes the importance of human evolution and learning in providing broad strategic contexts and principles that may seem to be ‘irrational’ in the narrow context of standard economic models. Considering the second key component of bounded rationality, the structure of the environments in which the mind operates, studying human rationality in an invalid environment is equivalent to studying color vision in a dark room. Color blindness as a conclusion from such a study would be reliable but invalid. Then, what are valid defining features of human rationality?

A new synthesis, Evolutionary Psychology has provided promising insights to the above question. Humans have evolved in natural environments both social and physical. To survive and reproduce successfully, humans have to adapt to and make use of the structures of these environments (Gigerenzer, Todd, & the ABC Research Group, 1999). Only recently have psychologists seriously considered how the various abilities of the human mind were created during the long course of hominid evolution. This approach has inspired many investigators to identify evolutionary typical problems and domains of adaptation. Evolutionary psychology directs research attentions to a variety of special-purpose evolutionary solutions to typical and recurrent problems and risks in human evolution.

Evolutionary psychology, as a science of the mind informed by knowledge and principles from evolutionary biology, social and biological anthropology, population genetics, and behavioral ecology, provides insights into the design features of mental processes. From this perspective, human rationality has been shaped by natural selection and sexual selection in the Environment of Evolutionary Adaptedness (EEA). The recurrent and enduring tasks in EEA (i.e., hunter-gatherer’s environments) are viewed as universal contexts for the making of human psychology. These specific adaptations are evaluated in terms of neither logical consistency nor happiness of the human being but in terms of survival and reproductive fitness. A short list of evolutionary tasks investigated by evolutionary psychologists includes social exchange, mating, parental investment, within-group competition, between-group competition, kinship, morality and foraging (e.g., Barrett, Dunbar & Lycett, 2002; Buss 2004, 2005; Pinker, 1997). A next step taken by evolutionary psychologists is to further examine specific mechanisms designed for each of these tasks in terms of the design features of these specific mechanisms. Meanwhile, evolutionary psychologists investigate factors in modern times that either activate or inhibit these mechanisms.

Over the last two decades, the works by evolutionary psychologists have made significant contributions to the current understanding of domain-specific cognitive mechanisms of judgment, reasoning and decision making. Some examples of evolutionary cognitive psychology include studies on conditional reasoning governed by rules of social exchange and cheater detection (Cosmides, 1989; Gigerenzer & Hug, 1992); studies on how evolutionarily valid format of natural frequency sampling in contrast to probability format eliminates base rate neglect in probability judgment (Brase, Cosmides & Tooby, 1998; Cosmides & Tooby, 1996; Gigerenzer & Hoffrage, 1995); studies on some Darwinian decision rules for altruism (Burnstein, Crandall, & Kitayama, 1994); studies on risky decisions guided by a kith-and-kin rationality that is sensitive to group size, kinship, and group composition (Wang, 1996, 2002; Wang, Simons & Brédart, 2001); and studies on some famous decision phenomena (such as ambiguity avoidance and framing effects) reexamined in a framework of optimal foraging theory (Rode, Cosmides, Hell, & Tooby, 1999; Rode & Wang, 2000). In the following sections, I focus on an evolutionary analysis of investment decisions. I derive specific and novel hypotheses within an evolutionary framework and test these hypotheses in two studies.

### **Study 1: What Investment Distributions Do Men and Women Expect From Each Other?**

#### ***Research Questions and Hypotheses***

The research questions of Study 1 are as follows: How would relational factors affect investment distribution? What expectations do men and women have for each other regarding resource allocation?

Investment decisions have been traditionally viewed in a framework of utility maximization, where the expected utility of a choice option is calculated as the sum of expected values of the option's outcomes weighted by corresponding probabilities of the outcomes (e.g., von Neumann and Morgenstern, 1947). Although the maximization assumption is widely accepted as being reasonable and parsimonious, this formulation reduces subjective value associated with each decision option to a single number at the cost of the information about payoff distributions and social/relational context.

Psychologists and economists have recently begun to apply evolutionary thinking to traditional areas of utility formulation (e.g., Wang, 2001, 2002; Burnham, 2005), temporal discounting of future goods (e.g., Wilson & Daly, 2003), human resource management (Colarelli, 2003), and organizational behaviors in the workplace (Browne, 2002). A common feature of these works is a cost-benefit analysis of investment

decisions in terms of evolutionary fitness and adaptations.

What would an evolutionary rule of investment decisions look like? A good example is W. D. Hamilton's (1964) rule of kin selection theory (or inclusive fitness theory), which captures design features of social rationality. Hamilton's rule ( $C \leq rB$ ) shows that an "altruistic design" can spread through the population if it causes an individual to help a kin member whenever the cost ( $C$ ) to the helper's own reproduction is offset by the benefit ( $B$ ) to the recipient's reproduction, weighted by the genetic relatedness between the two ( $r$ ).

Hamilton's (1964) kin selection theory has been a powerful source for generating hypotheses about altruistic behaviors in social interactions for which standard economic models fail to account. In an economic sense,  $r$  can be considered the subjective probability that the two agents in a risky transaction have "inherited" the same helping design. Hamilton's rule implies a relationship bounded rationality for economic cooperation and investment. From an evolutionary perspective, natural selection should have equipped both men and women with a kinship rule (Hamilton, 1964) for investment decisions while sexual selection should have entailed a higher expectation for the amount of investment from a man than from a woman (see e.g., Buss, 1994; Trivers, 1972).

First, from the viewpoint of inclusive fitness theory (Hamilton, 1964), I predict that the amount of investment would be proportional to the direct and indirect genetic relatedness between an investor and the recipients (see also Burnstein, Crandall & Kitayama, 1994; Webster, 2004 for some empirical tests of inclusive fitness theory).

Second, as a female-preference driven process (i.e., males court and females choose), sexual selection should have forged a pact between men and women, which requires men to invest more in their mates than women. Similarly, from a parental investment perspective, women should be concerned about paternal investment more than men are concerned about maternal investment (Trivers, 1972; Buss, 1989). This female preference for male generosity is likely to create a higher expectation than the average generosity of men. It is predicted that a prototypical man would be expected by both men and women to give more of his money to others and to his mate than does a prototypical woman of the same age cohort.

Third, a discrepancy is expected to exist between a female's preferred and a male's actual investment. It is more important for females to accurately detect such a discrepancy because the external resources provided by a potential mate have been evolutionarily pivotal for female's reproductive success. Thus, women should be more accurate in estimating men's

distribution of investments than men estimating women's distribution of investments.

### Method

In a hypothetical task, we asked participants to estimate what a typical man or woman of a reference group would invest a certain amount of money among a list of possible beneficiaries. The study had a 2 (sex of the participants: M or F) by 2 (sex of an imagined investor: m or f) between-subjects design. Using the same-sex estimates as a benchmark, I compared the investment distribution of a hypothetical woman estimated by men (Mf) against the investment distribution of a hypothetical woman estimated by women themselves (Ff). I also compared the investment distribution of a hypothetical man estimated by women (Fm) against the investment distribution of a hypothetical man estimated by men themselves (Mm). Note the capital letter **F** or **M** denotes the sex of the participant and the lower case letter **f** or **m** denotes the sex of the protagonist in the scenario imagined by the participant.

Two hundred thirty one student-volunteers (119 females and 112 males) participated in the study and were awarded extra course credit. The average age of the participants was 21.2 years.

The participants were randomly given one of the following two scenarios:

“Imagine that you were a **man** (or **woman** for a different participant) of your age, who has just won \$10,000. Nobody really knows how much you won, so the way you distribute the money is confidential. The following is a list of persons with whom you may have certain relationship (in an alphabetic order). Please fill in the brackets next to each specified person(s) with any amount of money that you would spend on the person(s) from the \$10,000 prize. This investment amount could be zero.”

Besides the hypothetical person himself or herself, the list of potential investment recipients included Aunt(s) and Uncle(s), Brother(s) and Sister(s), Charity, Friend(s), Grandparents, Nephew(s) and Niece(s), Offspring, Others, Parents, and Mate/Spouse.

The four between-participant groups were the Ff group ( $n = 57$ ), the Fm group ( $n = 55$ ), the Mf group ( $n = 57$ ), and the Mm group ( $n = 62$ ).

### Results and Discussion

1. Kinship and Relational Effect. Table 1 reports the distribution of investment for different recipients. The distribution of investment closely matched the genetic relatedness and reciprocal relatedness between the decision-maker and the hypothetical recipients. The amount of investment reduced as a function of genetic relatedness from \$4134 for self to \$3406 ( $M = \$1135$ ) for the 0.5 genetically related kin, to \$711 ( $M = \$237$ ) for the 0.25 genetically related kin, to \$114

for the 0.125 genetically related kin and to \$57 for charity (strangers). The “other” category was separated from the “charity” category because it included all other relationships that were likely to be different for different participants. The differences between the amount for self, the amount for genetic relatives and the amount for non-relatives (“charity” + “friends” + “other”) were significant ( $F = 6.67$ ,  $p < .0001$ ). These results support the prediction that the amount of investment is proportional to the direct and indirect genetic relatedness between an investor and the recipients.

The mate/spouse category received an amount of investment (\$1186) that was comparable to the amount for close kin (\$1135). The result suggests that psychological value of significant other is about the same as that of a close kin. From an evolutionary point of view, a defining feature of a romantic or marital relationship is shared reproduction. In other words, “your offspring is my offspring. We have an indirect genetic relatedness of 0.5.”

In addition, the results also showed a substantial amount of investment for a reciprocal relationship with friends (see Trivers, 1971 for an evolutionary analysis of reciprocal altruism).

Table 1 *Amount of Investment (\$) in Hypothetical Recipients*

Amount (\$)	Recipient	Genetic Relatedness
4134	Self	1.0
1598	Parents	0.5
1287	Offspring	0.5
521	Sibling	0.5
435	Grandparents	0.25
82	Uncles/Aunts	0.25
194	Nephews/nieces	up to 0.25
114	Cousins	up to 0.125
1186	Mate/Spouse	Indirect genetic relatedness
123	Friends	Reciprocal relatedness
57	Charity	Moral relatedness
269	Others	

Table 2 *Investment (\$) in Hypothetical Recipients by Sex of the Participants*

Recipients	Sex of Participants	
	F	M
Self***	3513	4793
Spouse	1303	1061
Parents	1701	1489
Offspring	1473	1089
Sibling*	612	425
Grandparents	472	396
Uncles/Aunts	63	96
Nephews/Nieces	183	206
Cousins	131	96
Friends	140	104
Charity	76	36
Others	332	203

2. Effect of Sex of Participants and Sex of the Imagined Scenario Protagonist. Table 2 shows the investment amount in hypothetical recipients classified by the sex of the participants while Table 3

shows the investment amount in the same hypothetical recipients by the imagined sex. In order to examine the overall pattern of the investment decisions, I first conducted a multivariate analysis with Sex and Imagined Sex as between-subject variables and the investments (\$) in different recipients as within-subject repeated measures. This analysis found significant differences between the repeated investment measures ( $F = 654.4, p < .0001$ ) and significant interactions between the sex of the participants and the repeated investment measures ( $F = 2.47, p < .006$ ).

Table 3 Investment (\$) in Hypothetical Recipients by Imagined Sex

Recipients	Sex of Imagined Recipients	
	F	M
Self**	4499	3759
Spouse	1162	1216
Parents	1438	1762
Offspring	1278	1295
Sibling*	440	605
Grandparents	464	406
Uncles/Aunts	67	98
Nephews/Nieces	184	205
Cousins	105	124
Friends	86	160
Charity	32	82
Others	243	296

Further univariate analyses were then conducted to identify some specific effect. Female participants regardless of their imagined sex kept less for themselves than did the male participants ( $F = 17.0, p < .0001$ ). That is  $(Ff + Fm) < (Mf + Mm)$ . Female participants were overall more generous in the hypothetical investment. Conversely, both male and

female participants expected that a young woman about their own age would be less generous than a young man and would keep more for herself ( $F = 5.40, p < .02$ ), thus a pattern of  $[(Ff + Mf) > (Mm + Fm)]$ . Consistent with the second prediction, this discrepancy may be viewed as a female-preference-driven investment pattern where men are expected to be more generous than they really are. From a perceptive of reproduction, men could maximize the value of their financial resource by investing in multiple mates. In contrast, women could maximize the value of their financial resource by investing more in parental caring.

3. Accuracy of Estimated Investment. Who's more accurate in reading the mind of the other sex? Consistent with the third prediction, women were more accurate in estimating men's investment distribution ( $Fm = Mm$ ) than did men estimate women's investment distribution ( $Mf \neq Ff$ ). Table 4 shows the group means and the results of F tests. Using Ff (female estimated female investment distribution) as a yardstick for testing the accuracy of Mm (male estimated female investment), F tests showed that men's estimates were consistently biased. Men overestimated the amount of money women would keep for themselves and underestimated the amount of investment in their spouse, relatives and non-relatives. In contrast, using Mm (male estimated male investment) as a yardstick, Fm (female estimated male investment) scores were not significantly different from the Mm scores, suggesting a higher accuracy of women in reading the mind of the other sex.

Table 4 Comparisons between Ff (Female Estimated Female Investment) and Mf (Male Estimated Female Investment) & between Mm (Male Estimated Male Investment) and Fm (Female Estimated Male Investment)

Recipient	Ff	Mf	Ff vs. Mf	Mm	Fm	Mm vs. Fm
Self	\$3660	\$5444	$F = 17.9, p < .0001$	\$4166	\$3352	$F = 3.33, p = .071$
Mate/Spouse	\$1410	\$882	$F = 4.11, p < .045$	\$1410	\$882	$F = 0.04, p = .836$
Relative	\$632	\$496	$F = 5.27, p < .024$	\$589	\$695	$F = 3.36, p = .070$
Non-Relative	\$168	\$67	$F = 8.74, p < .004$	\$199	\$160	$F = 0.59, p = .444$

4. Scope of Investment. Another finding that was not explicitly predicted was that female participants indicated that they would distribute their money among a greater number of individual beneficiaries ( $M = 6.4$  recipients) than did the male participants ( $M = 5.2$  recipients);  $F = 12.93, p < .0004$ . This result is consistent with real property allocation reflected in the testaments probated between 1890 and 1984 in Sacramento County, California (see Judge 1995). These findings suggest another sex difference in investment strategies where women focus more on sharing and social networking.

## Study 2: Differential Parental Investment as a Function of Being Rich or Poor in Social Comparison

### Research Questions and Hypotheses

Study 2, further examined parental investment decisions in real life. Hamilton (1964) predicted that: "The social behavior of a species evolves in such a way that in each distinct behavior-evoking situation the individual will seem to value his neighbor's fitness against his own according to the coefficients of relationship appropriate to that situation." (p. 19)

From this evolutionary point of view, fitness is calculated in a relative sense against other competitors in a local population. Natural selection for or against

certain investment behavior designs would have operated on relative fitness of an individual in a focal population rather than absolute fitness in a global population (see also Hill & Buss, 2006). For instance, a behavioral trait found in a Chinese population could have been selected based on its contributions to the relative wealth of its host compared to his or her competitors in that local population rather than someone in Africa and America, whose wealth had no effect on the fitness of the host. Thus, it is hypothesized that individuals who possess cognitive and emotional mechanisms that guide investment decisions as a function of relative wealth or poverty would on average outperform and outreproduce those who possess general decision mechanisms based on absolute wealth measures.

This proposition is supported by studies of wellbeing. Subjective wellbeing is regulated by an equilibrium mechanism which functions like a "hedonic treadmill" and is affected by relative, rather than absolute wealth levels (see Kahneman, Diener & Schwarz, 1999). A social comparison effect is also evident in choice behavior. Solnick and Hemenway (1998) found that when asked to choose between having an absolutely larger income or an income that was absolutely less but greater than the income of rivals; both men and women preferred the greater positional income. The evolutionary significance of this bias offers fresh insights. In a recent study, Hill and Buss (2006) derived new predictions from a social comparison viewpoint. They first replicated the positional bias initially reported by Solnick and Hemenway (1998). They then tested novel evolutionary predictions that the positional bias would be absent in the domain of loss since the bias will lead to a long-term net cost to oneself.

Hill and Buss (2006) study shows that decisions based on social comparison are gain-loss domain specific. In the current study, I examine another feature of social comparison. That is, decisions based on social comparison are recipient's sex specific. In particular, I predict a differential parental investment in sons and daughters as a function of relative wealth in social comparison (subjectively perceived wealth in comparison to one's neighbors).

The reason for such a differential investment in sons and daughters based on social comparison lies in the difference in reproductive variance or potential between sons and daughters. Universally and throughout hominid evolution, men have a higher reproductive variance than women. That is, women tend to consistently produce a few children whereas men tend to have either a lot of offspring or zero offspring. Thus, parental investment in daughters vs. in sons is like a risky choice between a safer bet and a gamble (a more probabilistic bet), respectively. Parental investment in sons is viewed as a riskier

prospect than investment in daughters since men have a universally higher variance in wealth and reproduction than women.

According to Trivers-Willard (1973) hypothesis, rich parents are more likely to have successful offspring and should favor sons since there is a greater opportunity for their sons to be rich and to have more offspring. Conversely, poor parents should prefer daughters to sons because daughters are not as likely to be reproductively unsuccessful as sons. Gaulin and Robbins (1991) found support for the Trivers-Willard hypothesis in their study of North American women. However, additional tests of this hypothesis have produced mixed results, particularly with human samples. In a study with larger data sets, Keller, Nesse and Hofferth (2001) reported that their results did not replicate the findings of Gaulin and Robbins (1991). Based on the analysis of the results from their own and other previous studies, these authors conclude that Trivers-Willard effects are at best tiny in the contemporary United States, where resources are too abundant compared to the typical conditions of hominid evolution.

Following this line of thinking, parents from a contemporary US population whose wealth conditions are not clearly diversified tend to have comparable parental expectations (aspirations) for their children's financial and reproductive prospects. Thus, what affects their differential investment in sons or daughters, if any, would be their psychologically perceived relative wealth compared to their neighbors. When the perceived relative wealth is lower, the distance to parental expectations would be higher. Thus, sons would be favored since a higher variance in sons' financial and reproductive success would increase the chance of reaching the parental expectations or goals. Conversely, parents who have a higher perceived wealth would favor daughters. Therefore, reversed Trivers-Willard effect is likely to be found in a less stratified population as a result of the difference in perceived relative wealth. In contrast, a Trivers-Willard's effect would be more likely to be found in a population with a stratified wealth structure. For instance, if a wealthy parent has a much higher than average expectation for his or her children's financial and reproductive success, sons would be favored, thus a Trivers-Willard's effect.

In a field study conducted in villages in northwest China, Wang (2002, Study 3) found a reversed Trivers-Willard's effect when perceived wealth condition (rated on a 1 to 9 scale against families in the same local area) was taken into account. The interbirth interval as a measure of parental investment was significantly longer after having a son than that after having a daughter for the lower-perceived wealth families, but not the higher-perceived wealth families. Following this lead, the current study tested the social

comparison hypothesis of parental investment in a U.S. community where the wealth structure was also unstratified.

### Method

Participants were recruited in public places in Yankton County, South Dakota, a rural community of about 21,000 people, located by the Missouri River. Average household size in Yankton County was 2.43; and median household income was \$35,374 in year 2000.

The participants were 50 men and 50 women having two or more biological children. They averaged 49.4 years of age. They each received a \$5 honorarium for participation. Parental investment data were collected via short one-on-one interviews.

The two measures of parental investment were breastfeeding, BF (i.e., breastfed or not) and the interbirth interval, IBI (i.e., the time interval between each pair of age-wise closest siblings measured in months). Both BF and IBI are viewed as good measures of parental investment (Gaulin & Robbins, 1991).

One independent variable was the sex of the offspring of the interviewed parents. A second independent variable was the wealth condition of the interviewed household subjectively perceived and objectively measured by household income. Both perceived wealth in comparison to other families in Yankton and household income were estimated and reported by the participant for the year each child was born, rather than the wealth condition at the time of the interview. The interviewed parents rated the relative wealth condition of their households on a 1 to 9 scale, with 1 representing a very poor condition, 5 representing the average condition and 9 a very wealthy condition.

### Results and Discussion

Table 5 shows the interbirth interval, breastfeeding data and the sample size for each of the target conditions. The two wealth conditions were determined by splitting the self-ranked wealth scores at the middle point of the 1-9 scale.

Table 5 *Breastfeeding Frequency (BF) and Interbirth Interval, IBI (Mean  $\pm$  SD, in Months) as a Function of Sex of the Offspring, Perceived Wealth Condition*

Independent Variables		BF	IBI	Statistics
Children's Sex	Daughters	56.6% ( <i>n</i> = 175)	37.7 $\pm$ 2.51 ( <i>n</i> = 115)	$\chi^2 = 3.43$ <i>p</i> < .064 (BF)
	Sons	46.1% ( <i>n</i> = 141)	39.2 $\pm$ 2.72 ( <i>n</i> = 98)	
Perceived Family Wealth	High	55.0% ( <i>n</i> = 80)	28.0 $\pm$ 3.71 ( <i>n</i> = 50)	<i>F</i> = 10.20 <i>p</i> < .0016 (IBI)
	Low	50.9% ( <i>n</i> = 236)	41.5 $\pm$ 2.06 ( <i>n</i> = 163)	
Children's Sex by Perceived Family Wealth	Daughters/High	67.3% ( <i>n</i> = 49)	25.6 $\pm$ 4.73 ( <i>n</i> = 31)	$\chi^2 = 8.34$ <i>p</i> < .039 (BF)
	Sons/High	35.5% ( <i>n</i> = 31)	31.9 $\pm$ 6.04 ( <i>n</i> = 19)	
	Daughters/Low	52.4% ( <i>n</i> = 126)	42.1 $\pm$ 2.87 ( <i>n</i> = 84)	<i>F</i> = 3.63 <i>p</i> < .014 (IBI)
	Sons/Low	49.1% ( <i>n</i> = 110)	40.9 $\pm$ 2.96 ( <i>n</i> = 79)	

The Yankton study revealed the following main findings. (1) The average interval after having a daughter (37.7 months) was similar to that after having a son (39.2 months). There was a trend of daughter favoritism, however, as indicated in the frequency measure of breastfeeding. There were 56.6 percent of the daughters were breastfed and 46 percent of the sons were breastfed,  $\chi^2 = 3.43$ , *p* > 0.064.

(2) The overall effects of perceived wealth on IBI was significant (28 months for the high perceived wealth families and 42 months for the low perceived wealth families), *F* = 10.2, *p* < .0016. Independent of real income of the family, IBI was longer if the parents' perceived family wealth was lower. This effect of perceived wealth on IBI was evident both for daughters and sons.

(3) As predicted, when the perceived wealth and the sex of the child were taken into account together, a differential breastfeeding pattern in sons and daughters emerged. In the families of higher perceived wealth, the average BF was 67.4 percent for daughters but only 35.5 percent for sons. In contrast, in the lower perceived-wealth families, the BF for daughters decreased to 52.4 and the BF for sons increased to 49.1 percent, although not reversed,  $\chi^2 = 8.34$ , *p* < .039. In support of our social comparison hypothesis of parental investment, the differential parental investment in sons versus daughters was primarily psychological and appeared only when the subjectively perceived measure of wealth was used.

Interestingly, the results showed a different effect of real income measured by income per household member. That is, the higher the income per household

member, the more likely a child would be breastfed,  $\chi^2 = 4.033$ ,  $p < 0.045$ , irrespective of the sex of a child. Each income measure was adjusted by inflation rate for the target year according to the CPI (Consumer Price Index) provided by the U.S. Department of Labor.

Although both measures of wealth were relevant to a local population, perceived relative wealth and real wealth showed distinct effects on parental investment decisions. Real income affected the overall (baseline) investment in a child independent of the sex of the children whereas perceived wealth affected differential investment in daughters and sons.

### General Discussion and Conclusions

Evolutionary psychology helps research in two ways: It not only generates hypotheses on specific designs of information processing but also narrows the search by excluding logically equivalent but evolutionarily invalid alternatives. Examples of such evolutionarily invalid hypotheses include: investment amount is inversely related to kinship; special mechanisms exist for catching logical errors; and risk preference would be more consistent in a large rather than small group context.

Evolutionary psychology brings together the two blades of bounded rationality (Simon, 1990), and integrates separate lines of research on ecological, social and cognitive mechanisms of human judgment and decision-making. The two present empirical studies examined specific and novel predictions derived from evolutionary psychological analysis. The findings of these studies have social, economic, and psychological implications. Study 1 showed that investment distributions among hypothetical recipients were largely determined by a kith-and-kin rationality, which takes into consideration kinship and reciprocal social relationship. Consistent with a female-preference driven sexual selection hypothesis (Trivers, 1972), an imagined typical man was more generous than an imagined woman, reflecting female mate preference. However, men were more selfish in the hypothetical investment than women, regardless of the imagined sex. The discrepancy between the female desired and real male investment can be a source of conflict in family and work places. Two other sex differences were found in Study 1. Women were more accurate in estimating men's investment distribution than men in estimating women's investment distribution, showing a better ability in reading the mind of the other sex. In addition, when considering potential investment beneficiaries, women showed a larger scope of social sharing.

Study 2 examined real parental investment in a rural community in the Midwest of United States. From a Darwinian perspective, parental investment in sons is considered a riskier bet than investment in

daughters since universally men have a higher variance in reproduction as measured by the number of progeny than women who on average have a more certain but moderate reproductive success. Consistent with a social comparison hypothesis of parental investment decisions, relative wealth perceived by parents was correlated with their differential investment in sons and daughters. In the families of higher perceived wealth within an economically less stratified community, breastfeeding frequency was significantly higher for daughters than for sons. Meanwhile, real household income was correlated with overall parental investment in a child irrespective of the sex of the child, measured by breastfeeding and interbirth interval. That is, the more resource parents have, the more they invest in a child.

In sum, the results from the two present studies suggest that human decision rationality is bounded by social relations and adapted to relative wealth condition. Evolutionary psychology of risky decisions identifies domain-specific risks recurrent in EEA, searches for design features of the information processing devices that have evolved for coping with risky problems, and examines social and personal factors that regulate the working of these psychological devices in present time. Evolutionary thinking appears to hold the keys to interdisciplinary synthesis and provides an overarching framework for generating focused and novel hypotheses about domain-specific mechanisms of information processing. However, to avoid "just so story" interpretations, critical rival hypotheses should be further tested against each other in future studies of risky decisions (see Andrews, Gangestad & Matthews, 2002).

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