Family Relationships

An Evolutionary Perspective

Edited by
Catherine A. Salmon and Todd K. Shackelford

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13 Temperament as a Biological Mechanism for Mate Choice: A Hypothesis and Preliminary Data

Helen E. Fisher, Heide D. Island, Daniel Marchalik, and Jonathan Rich

There is a growing interest in behavioral syndromes. Bell writes, "A behavioral syndrome occurs when individuals behave in a consistent way through time or across contexts and is analogous to 'personality' or 'temperament.' Interest is accumulating in behavioural syndromes owing to their important ecological and evolutionary consequences" (Bell 2007). This chapter reports on two pilot studies of questionnaire data, on 3,000 men and women and 2,766 men and women, respectively, collected from a current dating/relationship Web site, Chemistry.com, with the supposition that four broad behavioral syndromes are prevalent in *Homo sapiens*.

These investigations are based on Fisher's hypothesis that men and women tend to be attracted to potential mates who have a somewhat different genetic profile associated with different cognitive and behavioral traits, an unconscious attraction mechanism that enables mating partners to create more genetic variety in their offspring and co-parent their young with a wider array of parenting skills. The paper concludes that the results of these pilot projects provide enough preliminary data to warrant further pursuit of this line of investigation. But the ideas are speculative; they are offered in the hope of stimulating further empirical work on the biological mechanisms associated with mate choice.

A NEURAL MECHANISM FOR "COURTSHIP ATTRACTION"

The phenomenon of "mate choice" is so common in nature that the ethological literature regularly uses several terms to describe it, including "individual preference," "favoritism," "female choice," "sexual choice," "selective proceptivity," and "courtship attraction." Despite variations in the duration of courtship attraction, many species display similar characteristics of attraction as they court. Most important, attracted individuals *focus* their courtship attention on a *preferred* mating partner. They also express heightened energy; obsessive following; sleeplessness; loss of appetite; impulsivity; possessive "mate guarding;" affiliative courtship gestures such as patting, stroking, licking, and nuzzling; goal-oriented courtship behaviors, and intense motivation to win this *particular* individual (Fisher 2004). Moreover, many creatures express this attraction instantly, what may be the forerunner of human "love at first sight."

Scientists have described many physical and behavioral traits in birds and mammals that evolved to "attract" a mate (Andersson 1994, Miller 2000). The peacock's tail is the standard example. But the corresponding brain mechanism by which the "display chooser" responds to these traits, comes to *prefer* a *specific* individual, and displays the above-mentioned suite of traits associated with courtship attraction has not been examined until recently (Fisher, Aron, & Brown 2005). However, current data on prairie voles (Gingrich, Liu, Cascio, Wang, & Insel 2000), sheep (Fabre-Nys 1997), and rats (Robinson, Heien, & Wightman 2002) indicate that the dopaminergic reward system is involved in mammalian courtship attraction.

Human romantic love shares several of the behavioral and physiological traits characteristic of mammalian courtship attraction, including intense focus on a preferred individual, elevated energy, hyperactivity, sleeplessness, loss of appetite, impulsivity, goal-oriented behaviors and strong motivation to pursue and win the beloved (Harris 1995, Hatfield & Sprecher 1986, Liebowitz 1983, Tennov 1979). All these traits can be seen in other mammalian (and avian) species during courtship (Fisher 2004). Men and women also report feelings of euphoria and mood swings into despair during a romantic setback. Adversity heightens romantic passion, known as "frustration attraction" (Fisher 2004). Lovers also become emotionally dependent; they feel empathy for their amour, and they think obsessively about the beloved. Lovers crave emotional union with their sweetheart, and express intense sexual desire and sexual possessiveness. As a result, rejected lovers often go to inappropriate, even dangerous, efforts to win back a departing sweetheart. Many spurned lovers suffer "abandonment rage" and depression as well (Fisher, Aron, & Brown 2006). Romantic love is also involuntary, difficult to control, and often impermanent.

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These behavioral data suggest that human romantic love shares several primary traits with mammalian courtship attraction (Fisher et al. 2005).

The physiological underpinnings of human romantic love and mammalian courtship attraction also have similarities. Using functional magnetic resonance imaging (fMRI), Fisher et al. collected data on the neural mechanisms associated with early-stage intense romantic love (Aron et al. 2005, Fisher et al 2003, Fisher et al 2006), as did Bartels and Zeki (2000, 2004). Both groups found evidence that human romantic love is associated with the subcortical dopaminergic reward system. Moreover, recent fMRI data indicate that romantic love engages a different, but overlapping, constellation of neural correlates than does the sex drive (see Fisher 2005), indicating that this neural network is associated with a specific function: mate preference. But this brain system is triggered by some conspecifics and not by others. So the neural mechanism for romantic love must act in tandem with many other neural systems, including those for sensory perception, discrimination, and memory, to enable courting individuals to feel attraction for some individuals and indifferent to or repelled by others. This article explores what may be one of the unconscious biological mechanisms that stimulates the brain system for romantic love: temperament.

PSYCHOLOGICAL MECHANISMS OF MATE CHOICE

In humans, many social, economic, and psychological forces contribute to mate choice. Timing and proximity affect mate choice (Fiore & Donath 2004, Hatfield 1988, Pines 1999). Mystery plays a role; people tend to be less attracted to those they know well, particularly those with whom they had regular contact as a child (Shepher 1971). Men and women are also attracted to individuals from the same socioeconomic and ethnic background (Buston & Emlen 2003; Byrne, Clore, & Smeaton 1986; Cappella & Palmer 1990; Galton 1884; Pines 1999; Sussman & Reardon 1987), those with a similar level of education and intelligence (Buston & Emlen 2003; Byrne, Clore, & Smeaton 1986; Cappella and Palmer 1990; Galton 1884; Pines 1999), those who share their religious views and have other similar attitudes and values (Krueger & Caspi 1993, Laumann, Gagnon, Michael, & Michaels 1994, Shaikh & Suresh 1994), and those with a similar sense of humor and degree of financial stability (Buston & Emlen 2003). Data indicate that men and women also gravitate to individuals with similar social and communication skills (Buston & Emlen 2003; Byrne, Clore, & Smeaton 1986; Cappella & Palmer 1990; Pines 1999).

Reik (1964) proposed that men and women choose mates who satisfy an important need, including the qualities they lack. Others have proposed that

this "need complementarity" drives mating and marriage (Aron & Aron 1989, Hinde 1997, Winch 1958). Proponents of "social exchange theory," a variant of this hypothesis, hold that men and women are attracted to those who can provide the resources they seek in exchange for the assets they can provide (Blau 1964; Dryer & Horowitz 1997; Foa & Foa 1980; Huston & Burgess 1979; Murstein 1976; Roloff 1981; Sprecher 2001; Sprecher & Regan 2002; Walster, Walster, & Berscheid 1978). Psychologists also propose that men and women tend to fall in love with people who are in love with them (Aronson 1998, Aron & Aron 1989, Hoyt & Hudson 1981, Pines 2005). Murstein (1976) hypothesizes that attraction has several stages, and during the "role stage" one becomes more attracted (or repelled) as they consider whether or not they can fit into the role they are likely to play in the relationship.

People are also attracted to those who show signs of bodily and facial symmetry (Gangestad & Thornhill 1997; Gangestad, Thornhill & Yeo 1994; Jones & Hill 1993), and those with specific bodily proportions (Singh 1993, Lavrakas 1975). Women are drawn to men with rank, money, and other resources (Buss 1994, Ellis 1992) and to those who are self-confident, assertive, and smart (Kenrick, Sadalla, Groth, & Trost 1990), whereas men are drawn to women exhibiting signs of youth, health, and beauty (Buss 1994). Yet, both sexes tend to choose mates of their level of attractiveness (Buston & Emlen 2003).

Freud (and many others) proposed that one's parents affect one's romantic choices. Hazan and Shaver (1987) build on the theories of Bowlby (1969) and Ainsworth, Blehar, Waters, and Wall (1978), proposing that humans seek attachments that mirror the type of infant attachment they made with mother, be it secure, anxious–ambivalent, or avoidant. And Harris (1999) hypothesizes that individuals are attracted to a partner who reflects the values, interests, and goals of childhood friends.

Zentner (2005) proposes that people gradually develop a psychological model of their ideal mate, what he refers to as one's ideal mate personality concept (IMPC). He defines this template as a "unique ordering and configuration of personality characteristics" that an individual regards as ideal for him or her (Zentner 2005, 245). This idiosyncratic psychological chart is subtle and unique and varies considerably from one individual to the next (Zentner 2005). Moreover, one's IMPC is not fixed or rigid; individuals change their image of their ideal mate over time, being most likely to alter this template when they become dissatisfied with a current partnership (Zentner 2005, 253). Zentner reports that women have a more incisive ideal mate personality concept than men do, and that women are better than men at picking a romantic partner who fits within their ideal type (Zentner 2005).

The process of attraction appears to operate like a funnel (Murstein 1976, Pines 2005, Winch 1958, Zentner 2005). Looks, values, background, needs, roles, and one's unique psychological chart all contribute to partner

attraction, and at specific points in this trajectory, the process can fai
what some regard as hidden "breaking points" (Sunnafrank 1986, Walth
Parks 2002). But the role of personality in this process is complex and
troversial.

Several investigations of American couples, married and unmarr
homosexual and heterosexual, have shown that men and women are
tracted to those with a similar personality (Byrne 1997; Caspi & Harbe
1990; Gottman, Murray, Tyson, & Swanson 2002; Holman 2001; Karne
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similar personality traits is often contingent on attraction to other persona
traits. For example, extroverts are regularly attracted to other extroverts,
only extroverts with high self-esteem are attracted to one another; ext
verts with low self-esteem are less drawn to people like themselves (Zent
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It appears that individuals are attracted to potential mates with similarity in some traits and complementarity in others. As Pines writes, "The evidence for an attraction between people with similar personalities is far weaker than the evidence for an attraction between people with similar attitudes" (Pines 2005, p. 137). She concludes, "It seems that we are attracted to partners to whom we are similar in general—in background, values, interests, and intelligence—but who complement us in a particular, significant personality dimension" (Pines 2005, p. 145). Luo and Klohnen come to a similar conclusion, reporting that an interest in a partner's financial stability, good looks, education, or sense of humor are ultimately more important to most people than are the personality traits they share (Luo & Klohnen 2005). And after

reviewing several decades of this literature, Zentner concluded, "How two personalities may be best combined in a relationship remains at present an unresolved issue" (2005, p. 242)." Klohnen concurs, writing, "The temptation to throw in the towel, to conclude that personality does not systematically and importantly influence partner selection is understandable" (Klohnen & Mendelsohn 1998, p. 269).

How can one explain the dearth of clear patterns in psychological studies of human mate choice, an essential aspect of human reproduction? Perhaps biological forces play influential roles. Current data suggest that several of these neural mechanisms exist. For example, humans tend to be attracted to those who are biologically symmetrical (Gangestad & Thornhill 1997). Women tend to be attracted to men with a chiseled jaw and rugged cheekbones, signs of an active testosterone system (Grammer & Thornhill 1994). Men tend to be attracted to women with clear smooth skin, full lips, and neotenous facial features, signs of estrogen activity (Johnston 1999). Most important to this paper, women are attracted to men with a *different* cluster of genes in the major histocompatibility complex (MHC), an aspect of the immune system (Wedekind, Seebeck, Bettens, & Paepke 1995, Ziegler, Kentenich, & Uchanska-Ziegler 2005). Moreover, in a recent study of 48 couples, those women who shared the same cluster of genes in the MHC system as their long-term partner were more likely to be adulterous; the more genes in the MHC system that a woman shared with her mate, the more extra partners she engaged (Garver-Apgar, Gangestad, Thornhill, Miller, & Olp 2006).

This article hypothesizes that both sexes also gravitate to individuals with differences in other biological systems, specifically the systems for dopamine, serotonin, testosterone, and estrogen, variations associated respectively with different suites of cognitive and behavioral traits. This biological attraction to mates with a different genetic profile, Fisher hypothesizes, operates in tandem with the myriad cultural forces that affect mate choice, and most likely evolved to motivate ancestral hominids to produce greater genetic diversity in their young and co-parent these young with a wider array of parenting skills. First we explore data from behavior genetics and related fields that are relevant to this hypothesis, then we report on two pilot studies that offer very preliminary support of this hypothesis.

FOUR PRIMARY TEMPERAMENT SYNDROMES: A HYPOTHESIS

Cloninger defines personality as distinct clusters of thoughts and feelings that color all of a person's actions. He proposes that personality is a mix of biologically based traits, dimensions of "temperament," and traits that an

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individual acquires, dimensions of "character" (Cloninger 1987). It is now believed that 50% (or more) of the observed variance in personality traits is due to genetic influence (Bouchard 1994, Robins 2005). Cross-cultural surveys, brain imaging studies, twin studies, and population and molecular genetics suggest that traits of temperament are heritable, relatively stable across the life course and linked to specific genes, hormones, neurotransmitters, and/or patterns of brain activity (Bouchard 1994, Roberts & DelVecchio 2000, Terracciano et al. 2005). These traits of temperament also appear to be universal among humans. A study of 49 cultures has shown that cross-culturally people share the same array of personality traits, regardless of age, financial status, or social class (Terracciano et al. 2005).

Individuals within a society vary, however. Some are more agreeable, shy, impulsive, or cautious, or express some other traits more regularly and/or more intensely than others. The most commonly discussed traits of temperament are the "big five," openness to new experiences, conscientiousness, extroversion, agreeableness, and neuroticism or anxiety (Gosling, Rentfrow, & Swann 2003, Zentner 2005). Although the expression of these traits can be situation dependent, studies in behavior genetics suggest that their expression is due, in part, to genetic influence (Bouchard 1994); moreover, they are expressed cross-culturally (McCrae et al. 2005), recorded in many species (Gosling & John 1999), and linked with specific lifestyles in humans, including variations in health, life span, success in school and work, ability to sustain a romantic relationship, and likelihood of addiction or criminality (Robins 2005).

Many other traits have been linked with specific alleles, neurotransmitters, and/or hormones. However, the genes associated with specific behavioral and cognitive traits express themselves in complex combinations and interactions (Reif & Lesch 2003). So the activities and levels of these neurotransmitters and neurohormones are most likely not as significant as the functional ratios between them and their interactions with many other neural systems. Nevertheless, data suggest that specific variations in the neural systems for dopamine, serotonin, testosterone, and estrogen are associated with specific suites of behavioral and cognitive traits.

DOPAMINE: THE "EXPLORER"

A cluster of specific behavioral and cognitive traits are associated with activity in dopamine pathways. The DRD4 gene controls much of the dopamine activity in the forebrain, and a polymorphism in the type 4 dopamine receptor gene (DRD4) has been associated with several varieties of novelty seeking, including impulsivity and exploratory excitability (the tendency to approach novel situations). Age and gender do not contribute to the differences in

the expression of these traits (Keltikangas-Jarvinen et al. 2003). Zuckerman (1994) has reported four components of sensation seeking: thrill and adventure seeking; experience seeking (often involving unconventional or innovative mental or social activities); boredom susceptibility; and disinhibition, expressed by alcohol and/or drug use, risky sex, or gambling. Cloninger associates novelty seeking with several other traits, including exploratory excitability, impulsiveness, quick-temperedness, extravagance, and disorderliness (Cloninger, Przybeck, & Svrakic 1991). Many of these novelty-seeking people have one version of the D4 dopamine receptor gene, D4DR (Ebstein et al 1996).

Other traits have been linked with activity in the dopamine system, including sex drive (Meston & Frohlic 2000, Pearson 2006), mania and hypersocial behaviors (La Cerra & Bingham 2002), social dominance, enthusiasm, energy, assertiveness, ambitiousness, and achievement striving (Depue & Collins 1999, Wacker, Chavanon, & Stemmler 2006), and verbal and non-linguistic creativity and idea generation (Flaherty 2005, Reuter, Roth, Holve, & Hennig 2006). When a Parkinson's disease patient was treated with drugs that elevate central dopamine, the patient began to express poetic talent (Schrag & Trimble 2001).

The above data suggest that a suite of biologically based traits can be associated with the central dopamine system, including risk taking, novelty seeking, impulsivity, boredom susceptibility, disinhibition, sex drive, energy, enthusiasm, excitability, curiosity, idea generation, and creativity. The degree to which these traits correlate has not yet been established; and the expression of these genes is highly influenced by myriad other biological and environmental forces. But the above genetic data suggest that, theoretically, a human can inherit a specific matrix of genetic traits associated with a predisposition for a particular suite or syndrome of related cognitions and behaviors. For the purposes of discussion, we label individuals with this possible temperament syndrome as "Explorer."

SEROTONIN: THE "BUILDER"

A different cluster of specific behavioral and cognitive traits is associated with activity in serotonin pathways. Polymorphic alleles of the serotonin 2A receptor gene (5–HTR2A), T102C and A1438G, are associated with variations in emotionality, activity, and sociability (Golimbet, Alfimova, & Mityushina 2004). Individuals with one variation in the T102C gene display lower levels of anxiety and have higher scores on the scale of hypomania (mild mania); whereas those with the A1438G heterozygote A/G (rather than the homozygote G/G) are also more extroverted and have lower scores on the scale

of "no close friends" (Golimbet et al. 2004). Extroversion and positive
have also been associated with increased central serotonin (Flory, Ma
Matthews, & Muldoon, 2004), as has persistence (Davidge et al. 2004)

Allele polymorphisms involved in serotonin metabolism produce
vidual variations in degree of anxiety, neuroticism, and harm avoidan
well (Golimbet et al. 2004, Parks et al. 1998). Harm avoidance is also a
ated with blood platelet 5–HT2 receptor sensitivity (Peirson et al. 1999
degree of fear of uncertainty, shyness, anticipatory worry, and harm avoi
have been associated with a polymorphism in a gene for serotonin rec
type 3 (Melke et al. 2003). Among laboratory rats, elevated central 5
inhibits exploration (Wilson, Gonzalez, & Farabollini 1992), supportin
link between elevated serotonin activity, cautiousness, and harm avoida

There is an inverse relationship between central serotonin activity
human aggression (Davidge et al. 2004). Selective serotonin reuptake in
tors (SSRIs) increase affiliative behavior during a cooperative task, inclu
giving more suggestions and fewer commands, and making fewer atte
at unilateral solutions, correlating with increased plasma levels of thes
rotonin agonists (Knutson et al. 1998). SSRI treatment in male vervet r
keys also enhances a suite of affiliative behaviors, leading to increased s
status (Knutson et al. 1998). People with elevated plasma levels of serot
also exhibit higher socioeconomic status and live in more affluent neigh
hoods (Manuck et al. 2005). Individuals who score lower than averag
Cloninger's Novelty Seeking scale (Cloninger et al. 1991) tend to be r
loyal, stoic, and frugal (Ebstein et al. 1996). Because genes associated
novelty seeking are in the dopamine system, and the dopamine and serot
systems are negatively correlated in many brain regions (Stahl 2000),
likely that the tendencies toward mental inflexibility, loyalty, stoicism,
frugality are also associated with elevated activity in serotonin pathway

A PET study of 15 normal male subjects showed a correlation bet
self-transcendence (religiosity) and elevated serotonin activity (Borg, An
Soderstrom, & Farde 2003, Golimbet et al. 2004). So Borg et al. (2
argue that variability in 5–HT1A receptor density may explain why pe
vary in their degree of religious and/or spiritual fervor. Self-transcend
or religiosity is also associated with other polymorphisms in the serot
system (Bachner-Melman et al. 2005, Ham et al. 2004). When given
of emotional intensity, patients taking SSRIs also report being less ab
cry; feeling less irritable; caring less about others' feelings; and feelin
sadness, less surprise, less anger, and less worry over things or situations
being less able to express their feelings (Opbroek et al. 2002); these
also inhibit sexual desire, sexual function, and sexual pleasure (Rosen, La
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of "no close friends" (Golimbet et al. 2004). Extroversion and positive mood have also been associated with increased central serotonin (Flory, Manuck, Matthews, & Muldoon, 2004), as has persistence (Davidge et al. 2004).

Allele polymorphisms involved in serotonin metabolism produce individual variations in degree of anxiety, neuroticism, and harm avoidance as well (Golimbet et al. 2004, Parks et al. 1998). Harm avoidance is also associated with blood platelet 5–HT2 receptor sensitivity (Peirson et al. 1999); and degree of fear of uncertainty, shyness, anticipatory worry, and harm avoidance have been associated with a polymorphism in a gene for serotonin receptor type 3 (Melke et al. 2003). Among laboratory rats, elevated central 5–HT inhibits exploration (Wilson, Gonzalez, & Farabollini 1992), supporting the link between elevated serotonin activity, cautiousness, and harm avoidance.

There is an inverse relationship between central serotonin activity and human aggression (Davidge et al. 2004). Selective serotonin reuptake inhibitors (SSRIs) increase affiliative behavior during a cooperative task, including giving more suggestions and fewer commands, and making fewer attempts at unilateral solutions, correlating with increased plasma levels of these serotonin agonists (Knutson et al. 1998). SSRI treatment in male vervet monkeys also enhances a suite of affiliative behaviors, leading to increased social status (Knutson et al. 1998). People with elevated plasma levels of serotonin also exhibit higher socioeconomic status and live in more affluent neighborhoods (Manuck et al. 2005). Individuals who score lower than average on Cloninger's Novelty Seeking scale (Cloninger et al. 1991) tend to be rigid, loyal, stoic, and frugal (Ebstein et al. 1996). Because genes associated with novelty seeking are in the dopamine system, and the dopamine and serotonin systems are negatively correlated in many brain regions (Stahl 2000), it is likely that the tendencies toward mental inflexibility, loyalty, stoicism, and frugality are also associated with elevated activity in serotonin pathways.

A PET study of 15 normal male subjects showed a correlation between self-transcendence (religiosity) and elevated serotonin activity (Borg, Andree, Soderstrom, & Farde 2003, Golimbet et al. 2004). So Borg et al. (2003) argue that variability in 5–HT1A receptor density may explain why people vary in their degree of religious and/or spiritual fervor. Self-transcendence or religiosity is also associated with other polymorphisms in the serotonin system (Bachner-Melman et al. 2005, Ham et al. 2004). When given tests of emotional intensity, patients taking SSRIs also report being less able to cry; feeling less irritable; caring less about others' feelings; and feeling less sadness, less surprise, less anger, and less worry over things or situations; and being less able to express their feelings (Opbroek et al. 2002); these drugs also inhibit sexual desire, sexual function, and sexual pleasure (Rosen, Lane, & Menza 1999), exploratory behavior (Wilson et al. 1992), and general creativity (Opbroek et al. 2002).

The above data suggest that specific genetic variables associated with the central and peripheral serotonin system contribute to a suite of cognition and behavioral traits, including lower levels of anxiety, elevated mood, extroversion, sociability, popularity, elevated social status, conventionality, cautiousness and harm avoidance, religiosity, loyalty, stoicism, frugality, figural and numeric creativity, persistence, and managerial qualities, including being more socially cooperative, giving suggestions, giving fewer commands, and making fewer attempts at unilateral solutions. For the purpose of discussion, individuals who express this broad suite of genetically based cognitive and behavioral traits and its associated temperament syndrome are labeled "Builders."

TESTOSTERONE: THE "DIRECTOR"

Data suggest that a different constellation of characteristics is associated with specific activity in the testosterone system. Both men and women can express the traits associated with the activities of testosterone; however, the data on testosterone-related traits have largely been collected via studies of gender differences.

Among those traits associated with testosterone activity is spatial acuity. In a meta-analysis of 150,000 Americans aged 13 to 22 and tested across 32 years, the overwhelming majority of those whose scores fell in the top 5–10% in science, math, mechanical reasoning, and engineering were male (Hedges & Nowell 1995; Hyde, Fennema, & Lamon 1990). In another meta-analysis of 10,000 seventh- and eighth-grade boys and girls, 260 boys and 20 girls scored above 700 (out of 800) on the standard Scholastic Aptitude Test, and studies in several other countries have yielded similar results (Benbow & Stanley 1983, Mann, Sasanuma, Sakuma, & Masaki 1990).

The brain architecture associated with these spatial skills is created by fetal testosterone (Grimshaw, Bryden, & Finegan 1995). But bodily levels of testosterone continue to contribute to men's (and women's) spatial dexterity across the life course (Nyborg 1994). When healthy male senior citizens receive infusions of testosterone, their spatial acuity increases (Janowsky, Oviatt, & Orwoll 1994), and women become more skilled at finding their car in a parking lot just before and during menstruation, when estrogen levels decline and levels of testosterone become unmasked (Hampson 1990). Animal studies support this association between spatial skills and the activity of testosterone (De Vries & Simerley 2002).

Baron-Cohen, Knickmeyer, and Belmonte (2005) distinguish two specific sex differences in cognition, what they refer to as empathizing (E) and systemizing (S). Systemizing is "the drive to analyze a system in terms of the

rules that govern the system, in order to predict the behavior of the sy
whereas "empathizing is the drive to identify another's mental stat
to respond to these with an appropriate emotion, in order to predi
respond to the behavior of another person" (Baron-Cohen et al. 2005
These researchers propose that humans have evolved three specific
types: S (S>E), which is more common in men; E (E>S), which is mor
mon in women; and B (E=S), which is characteristic of men and wome
are equally proficient at both empathizing and systemizing (Baron-
et al. 2005).

They also report that the "extreme" androgenic brain is also assc
with less emotion recognition, less empathy, less eye contact, and less
sensitivity. These individuals also have fewer friends and other socia
tionships, poorer quality of social relations, and fewer language skills (
Cohen et al. 2005, Knickmeyer, Baron-Cohen, Raggatt, & Taylor
However, these individuals express a superior understanding of ma
and an obsession for rule-based systems (Baron-Cohen et al. 2005). I
Cohen et al. propose that this hyper-masculinity is the result of more
range connectivity and less long-distance connectivity in the brain, c
prenatal androgens (Baron-Cohen et al. 2005, Knickmeyer, Baron-C
Raggatt, Taylor, & Hackett 2006).

Another aspect of hyper-masculinity is heightened attention to
and intensified focus on narrow interests (Baron-Cohen et al. 2005), a
of related traits that Baron-Cohen et al. associate with systemizing (K
meyer et al. 2005). Psychological data corroborate this association bet
testosterone and a narrow focus on the details of a system. Faced with a
ness problem, men tend to focus on the immediate dilemma rather than p
the issue into a larger context; then they progress in a straightforward,
causal path toward a specific goal, the solution (Duff 1993, Hampden-T
1994, Helgesen 1990, Rosener 1995).

Baron-Cohen proposes that men compartmentalize their atte
focus narrowly, and have restricted interests because the male brain is
lateralized and less integrated, due to fetal testosterone (Baron-Cohen
2005, Knickmeyer et al. 2005). Testosterone injections in adults ca
produce these traits, however. After three months of testosterone
sions, a female-to-male sex-change patient reported that "he" had beg
have problems expressing himself verbally; his thinking was more con
he now acted more quickly; he imagined less; he saw visual images
intensely; he lost fine motor control; he no longer saw the "overall pic
and he changed "in mental focus from broad to narrow" (Dabbs 2000
Related to this mental compartmentalization and narrow focus may be
traits: men tend to think and plan according to abstract principles more
larly than do women; they also tend to become wedded to these prin

rules that govern the system, in order to predict the behavior of the system"; whereas "empathizing is the drive to identify another's mental states and to respond to these with an appropriate emotion, in order to predict and respond to the behavior of another person" (Baron-Cohen et al. 2005, 820). These researchers propose that humans have evolved three specific brain types: S (S>E), which is more common in men; E (E>S), which is more common in women; and B (E=S), which is characteristic of men and women who are equally proficient at both empathizing and systemizing (Baron-Cohen et al. 2005).

They also report that the "extreme" androgenic brain is also associated with less emotion recognition, less empathy, less eye contact, and less social sensitivity. These individuals also have fewer friends and other social relationships, poorer quality of social relations, and fewer language skills (Baron-Cohen et al. 2005, Knickmeyer, Baron-Cohen, Raggatt, & Taylor 2005). However, these individuals express a superior understanding of machines and an obsession for rule-based systems (Baron-Cohen et al. 2005). Baron-Cohen et al. propose that this hyper-masculinity is the result of more short-range connectivity and less long-distance connectivity in the brain, due to prenatal androgens (Baron-Cohen et al. 2005, Knickmeyer, Baron-Cohen, Raggatt, Taylor, & Hackett 2006).

Another aspect of hyper-masculinity is heightened attention to detail and intensified focus on narrow interests (Baron-Cohen et al. 2005), a suite of related traits that Baron-Cohen et al. associate with systemizing (Knickmeyer et al. 2005). Psychological data corroborate this association between testosterone and a narrow focus on the details of a system. Faced with a business problem, men tend to focus on the immediate dilemma rather than putting the issue into a larger context; then they progress in a straightforward, linear, causal path toward a specific goal, the solution (Duff 1993, Hampden-Turner 1994, Helgesen 1990, Rosener 1995).

Baron-Cohen proposes that men compartmentalize their attention, focus narrowly, and have restricted interests because the male brain is more lateralized and less integrated, due to fetal testosterone (Baron-Cohen et al. 2005, Knickmeyer et al. 2005). Testosterone injections in adults can also produce these traits, however. After three months of testosterone infusions, a female-to-male sex-change patient reported that "he" had begun to have problems expressing himself verbally; his thinking was more concrete; he now acted more quickly; he imagined less; he saw visual images more intensely; he lost fine motor control; he no longer saw the "overall picture"; and he changed "in mental focus from broad to narrow" (Dabbs 2000, 43). Related to this mental compartmentalization and narrow focus may be other traits: men tend to think and plan according to abstract principles more regularly than do women; they also tend to become wedded to these principles

(Gilligan 1982, Kohlberg 1969, Lever 1976, Tannen 1990). Men are, on average, more rule-bound, indicating mental inflexibility (Kohlberg 1981).

Another trait associated with the activity of testosterone is sensitivity to social dominance. Men tend to place themselves within real or perceived hierarchies; then they strive to achieve rank (Gilligan 1982, Hoyenga & Hoyenga 1980, Tannen 1990). Boys' games have clear winners and losers, and boys sort themselves into hierarchical packs and compete to be "top dog" (Lever 1976, Tannen 1990, Thorne 1993). Businessmen assign greater value to titles, office space, and high salary (Browne 1995, Duff 1993, Helgesen 1990), and men are more willing to endure exhausting workloads and sacrifice their health, safety, and spare time to win status, money, and prestige (Duff 1993, Helgesen 1990, Rosener 1995). Men and women exhibit no difference in "internal competitiveness," the desire to meet personal goals and display excellence. But men score higher in "external competitiveness," the willingness to elbow others aside to gain rank (Sassen 1980).

In almost all primate communities where more than one male resides, males also form a male–male dominance hierarchy (Smuts, Cheney, Seyfarth, Wrangham, & Struhsaker 1986), and testosterone has been associated with this drive for rank in many species (Mazur, Susman, & Edelbrock 1997). High levels of testosterone are commonly associated with rank in men and women as well (Booth, Shelley, Mazur, Tharp, & Kittok 1989; Mazur, Booth, & Dabbs 1992; Mazur et al. 1997). There is no simple correlation between androgens and status (Dabbs 1992); nevertheless, cross-culturally men are more likely than women to compete aggressively for rank (Halpern 1992). Testosterone has also been regularly associated with aggressiveness. For centuries, farmers have castrated roosters, bulls, and stallions to curtail physical aggressiveness (Knickmeyer et al. 2005), and approximately half of America's violent crimes are committed by men under age 24, a period of life when the activity of testosterone is greatest (Dabbs 1990).

The above data suggest that a suite of traits is associated with the androgens, specifically testosterone. Included are spatial skills; competency with machines and other rule-based systems; the ability to systemize; the ability to focus one's attention, often narrowly; the tendency to construct and adhere to abstract rules; mental inflexibility; sensitivity to rank and dominance; aggressiveness; outward competitiveness; and poorer linguistic and interpersonal social skills. Although this suite of behavioral and cognitive traits is recorded more regularly in men than in women, both sexes can potentially express these qualities (Baron-Cohen et al. 2005), most likely for a biological reason: the androgens and estrogens are produced in several diverse bodily regions, so an individual can potentially express elevated activity of both the estrogens and the androgens, or low activity of both

these steroids, or any other ratio of these hormones. Those exhibitin constellation of traits and their associated temperament syndrome a ferred to as "Directors."

ESTROGEN: THE "NEGOTIATOR"

Available data suggest that a suite of specific traits is also associated elevated activity in the estrogen system. Once again, both men and w can express the traits associated with the activities of estrogen; howeve data on estrogen-related traits have largely been collected via studies o der differences.

For example, psychologists report that girls and women (more larly than boys and men) think contextually and holistically (Baron-C et al. 2005, Hall 1984); they generalize, synthesize, and integrate mo tails and connect these details faster, details ranging from the nuanc body posture (Hall 1984) to the position of objects in a room (Silverm Eals 1992). This tendency to take a holistic perspective most likely de from brain architecture (Baron-Cohen et al. 2005, Dabbs 2002, F 1999). The splenium, the posterior section of the corpus callosum, is extensive in women than in men (Holloway, Anderson, Defendini, & H 1993); also, the anterior commissure is 12% thicker in women (Allen, Ri Chai, & Gorski 1991), data that indicate greater interhemispheric conne ity (Baron-Cohen et al. 2005). In most women, the two hemispheres ar more symmetrical and similar in function, while in men the brain is asymmetrical, lateralized, and specialized (Geschwind & Galaburda 1 These features of brain architecture are configured during fetal life b hormones (Nyborg 1994) and contribute to women's holistic, conte view (Baron-Cohen et al. 2005, Dabbs 2000, Fisher 1999). However, w also have greater intrahemispheric long-range connectivity (Braeut Rose, Swithenby, & Ambler 2004), which may also contribute to the a to integrate a broad range of information.

Specific genes may contribute to this contextual perspective, anc to a related trait of many women, mental flexibility. Skuse et al. (1 reported that a gene or gene cluster on the X chromosome influence formation of the prefrontal cortex. This segment of DNA is silenced men but active in 50% of women, and it contributes to several cog traits, including the ability to pick up the nuances of social interac (a contextual skill) and mental flexibility (Skuse et al. 1997). Psychol studies support this gender difference in mental flexibility; women ar rule-bound (Kohlberg 1969), perhaps because they envision a wider of alternatives (Fisher 1999).

these steroids, or any other ratio of these hormones. Those exhibiting this constellation of traits and their associated temperament syndrome are referred to as "Directors."

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Specific genes may contribute to this contextual perspective, and also to a related trait of many women, mental flexibility. Skuse et al. (1997) reported that a gene or gene cluster on the X chromosome influences the formation of the prefrontal cortex. This segment of DNA is silenced in all men but active in 50% of women, and it contributes to several cognitive traits, including the ability to pick up the nuances of social interactions (a contextual skill) and mental flexibility (Skuse et al. 1997). Psychological studies support this gender difference in mental flexibility; women are less rule-bound (Kohlberg 1969), perhaps because they envision a wider range of alternatives (Fisher 1999).

Language skills are also linked with estrogen and brain architecture. Infant girls listen more intently to music, pay greater attention to people's voices (McGuinness & Pribram 1979), and speak sooner (Halpern 1992). By age 12, most girls excel at grammar, punctuation, spelling, and understanding and remembering what they read (McGuinness 1985). Girls and women also excel at verbal memory and verbal fluency, finding the right word rapidly (Baron-Cohen 2002). A meta-analysis of studies done between 1960 and 1992 reports that women excelled at several language skills in all three decades; the average differences between the sexes were small, but significantly more women scored in the top 5–10% range in reading comprehension, writing, perceptual speed, and associative memory (Hedges & Nowell 1995). Girls and women also excel at several verbal skills in other countries (Mann et al. 1990).

The activity of estrogen is associated with these linguistic skills. Verbal memory, the ability to find the right word rapidly, and the capacity to pronounce words increase during mid-cycle ovulation when estrogen levels peak (Halpern 1992), and girls with Turner's Syndrome, the genetic disorder wherein females are missing one of the two Xs in the chromosomal pair, have difficulty remembering verbal information and speaking quickly and appropriately (Skuse et al. 1997). Two fMRI studies suggest that the gender difference in the corpus callosum contributes to women's efficiency with words (Hines, Allen, & Gorski 1992, Shaywitz et al. 1995). But genes also enable some women to speak more effectively than men. As mentioned above, Skuse et al. (1997) have located a gene or gene cluster on the X chromosome that influences several language skills, including reading ability and speech disorders; this gene is active in 50% of women and silenced in all men. This explains, Skuse writes, why "males are substantially more vulnerable to a variety of developmental disorders of speech, language impairment and reading disability" (Skuse et al. 1997, 707).

The literature describes another suite of attributes that are likely to be associated with estrogen, specifically the interest in social contacts, the drive to achieve interpersonal harmony, and the tendency to work and play in egalitarian teams (Hoyenga & Hoyenga 1980, Tannen 1990). During informal play, girls form "flat packs," small, non-hierarchical, leaderless groups (Tannen 1990). Girls seek social stability and non-combative interactions (Gilligan 1982, Lever 1976, Thorne 1993). In business, women's style of management is also based on inclusion, consultation, consensus, and collaboration (Duff 1993, Helgesen 1990, Rosener 1995). These traits have been widely linked with the activity of estrogen. At puberty, as estrogen activity increases, the feminine urge to connect, cooperate, and sustain a system of support intensifies (Brown & Gilligan 1992).

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Women in 10 countries also excel at recognizing emotions in a face (Babchuk, Hames, & Thompson 1983; Hall 1984), another ability associated with estrogen (McCauley, Kay, Ito, & Treder 1987). Women, on average, perform better on tests of facial recognition (Herlitz & Yonker 2002), and women in 19 countries excel at reading a person's emotions from their tone of voice, posture, gestures, and other nonverbal cues (Hall 1984, McGuinness & Pribram 1979). Women also display more patience than men (McGuinness 1985), a trait also common to female chimpanzees (McGrew 1981). This feminine patience is also linked to estrogen, via its positive correlation with serotonin: low serotonin activity is associated with impulsivity, and estrogen stimulates the increase of 5–HT2A binding sites (Fink, Sumner, McQueen, Wilson, & Rosie,1998), thereby increasing serotonin activity to produce less impulsivity and more patience.

"Executive social skills" include awareness of others' feelings, the ability to pick up emotional expressions in faces, an aptitude for noticing and integrating body language cues, mental flexibility, and the abilities to make friends, maintain social ties, and override the impulses that distract one from completing one's social goals (Skuse et al. 1997). These social aptitudes have also been associated with this specific gene or gene cluster on the X chromosome, which is active in about 50% of women but silenced in all men, leading Skuse et al. (1997) to conclude that women, on average, excel at these executive social skills.

Girls and women excel at making inferences about what another person is thinking or feeling, "theory of mind"; they develop this ability earlier and excel at adjusting their behavior accordingly (Baron-Cohen, Jolliffe, Mortimore & Robertson, 1997). And on cross-cultural tests of empathy, emotional responsiveness, nurturance, and affection, girls and women achieve higher scores than do boys and men (Baron-Cohen 2002, McGuinness & Pribram 1979). Because empathy activates brain regions that integrate data from multiple neural sources (Ochsner et al. 2004), this feminine compassion may result from the greater long-range connectivity of the female brain (Baron-Cohen et al. 2005). But empathizing, nurturing, and other prosocial skills and behaviors have also been associated directly with estrogen in humans and other mammals (Baron-Cohen 2002, Knickmeyer et al. 2005).

The above data suggest that a suite of traits is associated with activity in the estrogen system, including the ability to synthesize, integrate, and contextualize information to "see the big picture"; verbal fluency, memory, and articulation; executive social skills, including the ability to read faces, postures, gestures, and tone of voice; the ability to pick up on the nuances of social interactions; prosocial behaviors, including mental flexibility, social cooperation, consensus building, egalitarian team playing, and the drive to seek social harmony and non-combative interactions; emotional expressivity;

the ability to discern the emotions and thoughts of others (important components of compassion); patience; and nurturing behaviors. Although this proposed constellation of behavioral and cognitive traits is recorded more regularly in women than in men, both sexes express a range of these traits (Baron-Cohen et al. 2005). Those with this suite of traits and associated temperament syndrome are referred to as "Negotiators."

TEMPERAMENT: A PILOT PROJECT

Using many of the aforementioned traits as domains, Fisher designed a 56-question instrument with 14 questions to explore the degree to which men and women expressed activity in each of these genetic systems: dopamine, serotonin, testosterone, and estrogen. This test was administered to members of Chemistry.com, an Internet dating/relationship service that is part of the parent companies Match.com and InterActiveCorp (IAC). Chemistry.com was launched in the United States in February, 2006; it has served 1.6 million members who are seeking romantic love leading to a long-term attachment to a single partner; 94% of members are between the ages of 20 and 59; 35% are in their 20s, and 30% are in their 30s.

An example of a question designed to measure the expression of activity in the dopamine system was "Do you have more energy than most people?" A question designed to measure a trait associated with the serotonin system was "In general, do you think it's important to follow the rules?" A question designed to measure a trait associated with the estrogen system was "In conversation, can you find the right words rapidly?" A question designed to measure the degree to which an individual expressed elevated activity in the testosterone system was "Does it take a lot of evidence to make you change your mind on an important issue?" Using a 4-point Likert-like scale, participants were requested to respond to all 56 questions with one of four answers: 1 (*almost never*), 2 (*sometimes*), 3 (*most of the time*), or 4 (*all the time*). Responses to these 56 questions were tabulated using a 0–3 scale, with 0 points for the response "almost never," and 3 points for the response "all the time."

After a participant's scores on all 56 questions were tabulated, respondents received their questionnaire results on all four scales; For example: Negotiator 38%, Director 30%, Builder 19%, Explorer 13%. This individual was then registered primarily as a Negotiator and secondarily as a Director (Negotiator–Director). Thus, participants (N=523,622) were placed in 1 of 12 categories: Explorer–Builder. Explorer–Director, Explorer–Negotiator, Builder–Explorer, Builder–Director, Builder–Negotiator, Director–Explorer, Director–Builder, Director–Negotiator, Negotiator–Explorer, Negotiator–

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Table 13.1. Personality Typ
Population

Major Profile	Minor
Explorer	Builde Direct Negot
Explorer Total	
Builder	Explo Direct Negot
Builder Total	
Director	Explo Builde Negot
Director Total	
Negotiator	Explo Builde Direct
Negotiator Total	
Total	

Note: Total 523,622 individuals

Builder, and Negotiator–Director. The distribution of these 12 types is seen in Table 13.1.

Preliminary analysis of the questionnaire responses in an initial sample of 1,500 men and 1,500 women suggests patterns of trait association. Cronbach's alpha coefficients were calculated for each 14-item scale, and these calculations yielded the following results: Explorer .692, Builder .723, Director .702, and Negotiator .604. A factor analysis was performed on all 56 items (4 scales with 14 items each), using a varimax rotation. A scree test suggested that 6 factors adequately explained the item variance. However, the establishment and refinement of this measure will take multiple iterations (Fisher, Island, Rich, & Zava, in preparation). This preliminary investigation suggests only that we have enough data to proceed with this line of investigation. When we have established higher reliability scores, we plan to administer the questionnaire to 200 participants (not members of the site) and collect from each participant samples of blood, urine, and saliva to investigate the biological validity of these four proposed styles of temperament (Fisher et al., in preparation).

However, preliminary data indicate the validity of this instrument. One question unrelated to the 56-item questionnaire asks members to describe the individuals typical of their circle of friends: adventurers, social intellectuals, activists. Explorers chose Adventurers; Builders chose Social;

Table 13.1. Personality Type Distributions for Men, Women, and the Full Population

Major Profile	Minor Profile	Male%	Female%	Population%
Explorer	Builder	2.3	2.74	2.52
	Director	2.57	2.63	2.60
	Negotiator	2.98	3.42	3.21
Explorer Total		7.86	8.79	8.33
Builder	Explorer	3.43	4.18	3.81
	Director	19.6	19.82	19.71
	Negotiator	17.45	19.62	18.55
Builder Total		40.48	43.62	42.07
Director	Explorer	3.67	3.71	3.69
	Builder	15.51	13.00	14.24
	Negotiator	11.01	8.82	9.90
Director Total		30.19	25.52	27.82
Negotiator	Explorer	4.08	4.61	4.35
	Builder	10.12	11.51	10.82
	Director	7.28	5.98	6.61
Negotiator Total		21.47	22.07	21.78
Total		100.00	100.00	100.00

Note: Total 523,622 individuals: 45.01% male, 54.99% female.

Directors chose Intellectuals; Negotiators chose Activists (F [3, 2996] = 16.39, 3.57, 11.79, 4.72 respectively Explorers, Builders, Directors, and Negotiators; $p < .05$ for Builders, $p < .01$ for the other three scales). These results would be expected if these four behavioral profiles reflect biological mechanisms; and they suggest that the four scales show both convergent and divergent validity.

TEMPERAMENT AS A MECHANISM FOR MATE CHOICE: ANOTHER PRELIMINARY INVESTIGATION

The Chemistry.com Web site endeavors to introduce appropriate individuals to one another for the purpose of triggering the brain system associated with romantic love and initiating a long-term pair-bond. During a process known as "1-2-3 Meet," a member on this site first reads the specific written responses of five potential "matches" presented to them by the company; next the member interacts via the Internet with one (or more) of these individuals whom he or she finds interesting; then, if two members express an interest in one another, they meet in person, generally in a coffee house for twenty minutes of conversation. After this first meeting, each member is then requested to return to the Internet site and report on the degree of romantic attraction they feel for the individual just met. Specifically, they respond to the question: "Was there any chemistry between you and _____?" They register the degree of their romantic interest by choosing one of four options: "Not at all," "A little," "Quite a lot," or "A lot." Fisher collected preliminary data on 2,766 of these initial responses, specifically the responses of 1,331 men and 1,435 women.

The first meeting (often the first 3 minutes of the first meeting) makes a significant difference in relationship development and outcome (Pines 2005, Sunnafrank & Ramirez 2004). With no contradictory or temporizing information about a novel individual, men and women tend to weight heavily those few traits they first encounter (Walther & Parks 2002). In one study, love at first sight was reported by 11% of 93 individuals queried (Pines 2005); however, many relationships fail at the first meeting. Hence, the first meeting is an important escalation point in the process of mate choice, perhaps a pivotal node in the trajectory of courtship.

Table 13.2 reflects the degree to which reported attraction to other members after a first meeting varied across different pairs of the proposed personality types (N = 2,766). These numbers are shown relative to the overall population of those having a first meeting. A score of zero means that the proportion of people with the indicated personality types who reported attraction was no different from the percent of attractions in the population of those having first meetings; positive scores reflect a higher percent of

Table 13.2. Relative Attraction by Personality Type After "First Meeting"; Population Normalized

Match: Women Who Found Men Attractive: (N = 1,435 female responses)

	Male			
Female	Explorer	Builder	Director	Neg
Explorer	–0.636	–0.005	–0.041	0.
Builder	0.031	–0.012	–0.065	0.
Director	–0.223	–0.214	0.059	0.
Negotiator	–0.173	–0.291	0.139	0.

Match: Men Who Found Women Attractive: (N = 1,331 male responses)

	Female			
Male	Explorer	Builder	Director	Negc
Explorer	–0.505	0.116	–0.067	0.
Builder	0.319	0.043	–0.079	–0.
Director	0.088	–0.156	0.062	0.
Negotiator	0.185	–0.206	0.123	0.

reported attraction than in the overall sample; lower scores indicate a l percent of attraction than in the overall sample (Charts 1–8).

These tables suggest several patterns. For example, all proposed perament types appear to gravitate to the Negotiator, with the exce of male Builders. Most important, these preliminary data suggest that seeking a long-term (in many cases, potentially reproductive) partne both men and women of several proposed personality types are mor tracted to individuals with a *different* behavioral and cognitive profile less attracted to individuals with a *similar* biological constitution.

Once again, the data in this pilot study are preliminary. They su only that continued investigation using a similar research design may e tually yield some significant data on a biological mechanism associated mate choice.

POSSIBLE EVOLUTION OF FOUR TEMPERAMENT CONSTELLATIONS

The four suites of temperament traits suggested in the literature on beh genetics (cited above) correspond roughly to four basic temperaments n

Table 13.2. Relative Attraction by Personality Type After "First Meeting"; Population Normalized

Match: Women Who Found Men Attractive: (N = 1,435 female responses)

	Male			
Female	Explorer	Builder	Director	Negotiator
Explorer	–0.636	–0.005	–0.041	0.307
Builder	0.031	–0.012	–0.065	0.100
Director	–0.223	–0.214	0.059	0.401
Negotiator	–0.173	–0.291	0.139	0.414

Match: Men Who Found Women Attractive: (N = 1,331 male responses)

	Female			
Male	Explorer	Builder	Director	Negotiator
Explorer	–0.505	0.116	–0.067	0.049
Builder	0.319	0.043	–0.079	–0.122
Director	0.088	–0.156	0.062	0.205
Negotiator	0.185	–0.206	0.123	0.196

reported attraction than in the overall sample; lower scores indicate a lower percent of attraction than in the overall sample (Charts 1–8).

These tables suggest several patterns. For example, all proposed temperament types appear to gravitate to the Negotiator, with the exception of male Builders. Most important, these preliminary data suggest that when seeking a long-term (in many cases, potentially reproductive) partnership, both men and women of several proposed personality types are more attracted to individuals with a *different* behavioral and cognitive profile and less attracted to individuals with a *similar* biological constitution.

Once again, the data in this pilot study are preliminary. They suggest only that continued investigation using a similar research design may eventually yield some significant data on a biological mechanism associated with mate choice.

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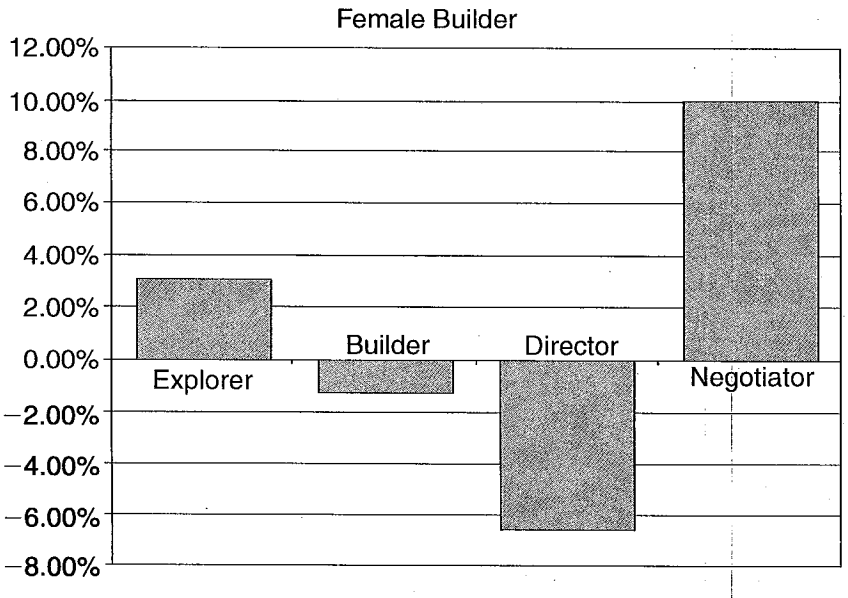

Chart 1. Relative attraction by personality type after "first meeting"; population normalized. Chart of Table 13.2: Female Builder attraction to male Explorers, Builders, Directors, and Negotiators. 0.00% = degree of attraction by chance.

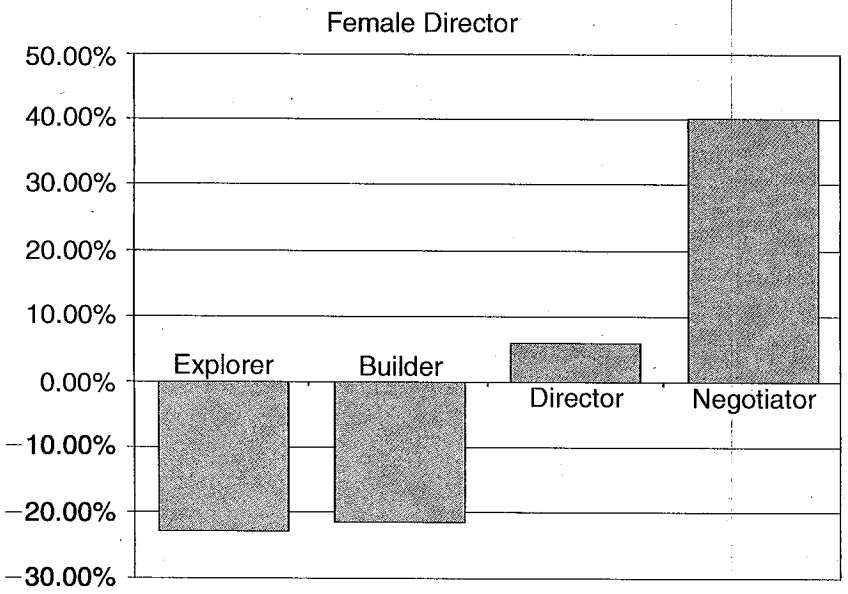

Chart 2. Relative attraction by personality type after "first meeting"; population normalized. Chart of Table 13.2: Female Director attraction to male Explorers, Builders, Directors, and Negotiators. 0.00% = degree of attraction by chance.

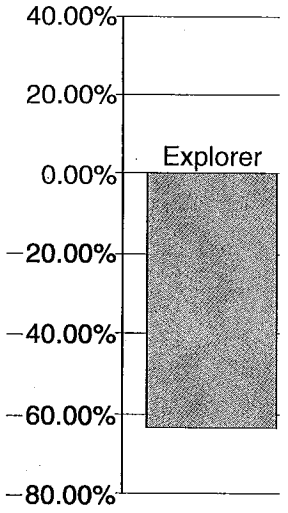

Chart 3. Relative attractio
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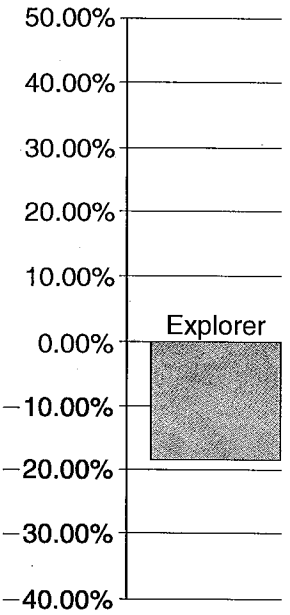

Chart 4. Relative attractior
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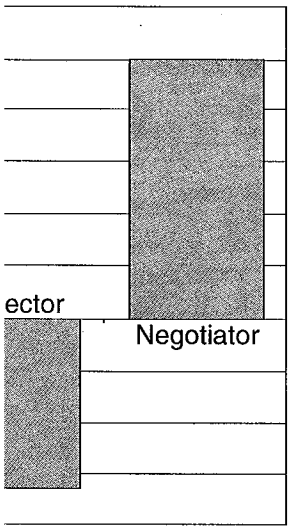

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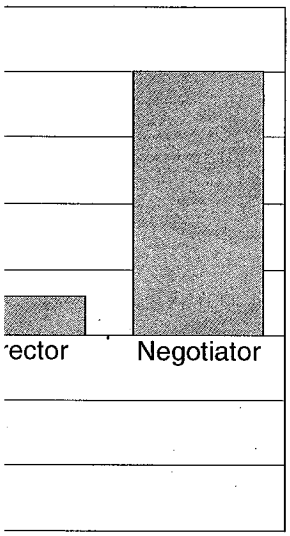

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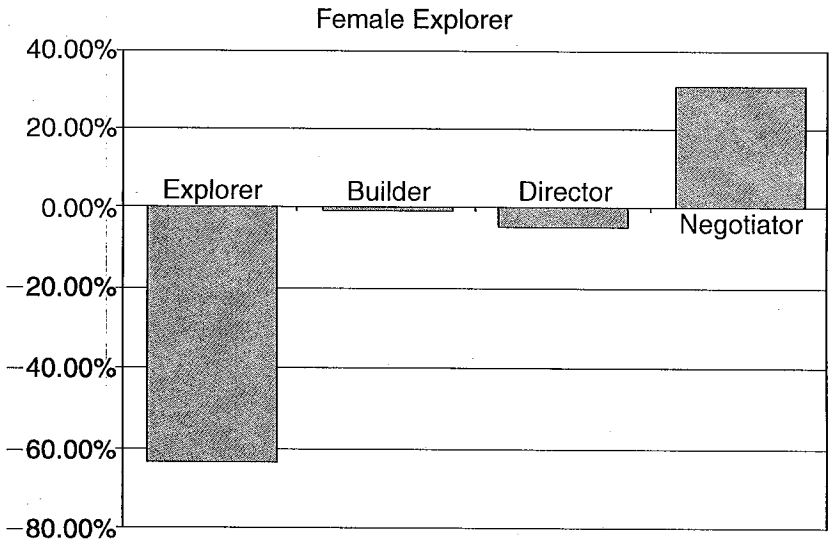


Chart 3. Relative attraction by personality type after "first meeting"; population normalized. Chart of Table 13.2: Female Explorer attraction to male Explorers, Builders, Directors, and Negotiators. 0.00%=degree of attraction by chance.

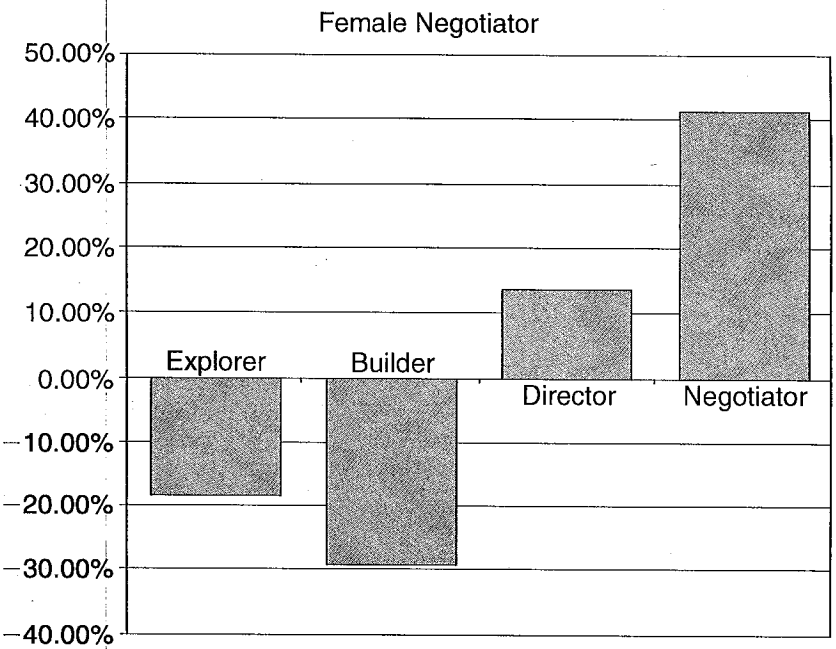


Chart 4. Relative attraction by personality type after "first meeting"; population normalized. Chart of Table 13.2: Female Negotiator attraction to male Explorers, Builders, Directors, and Negotiators. 0.00%=degree of attraction by chance.

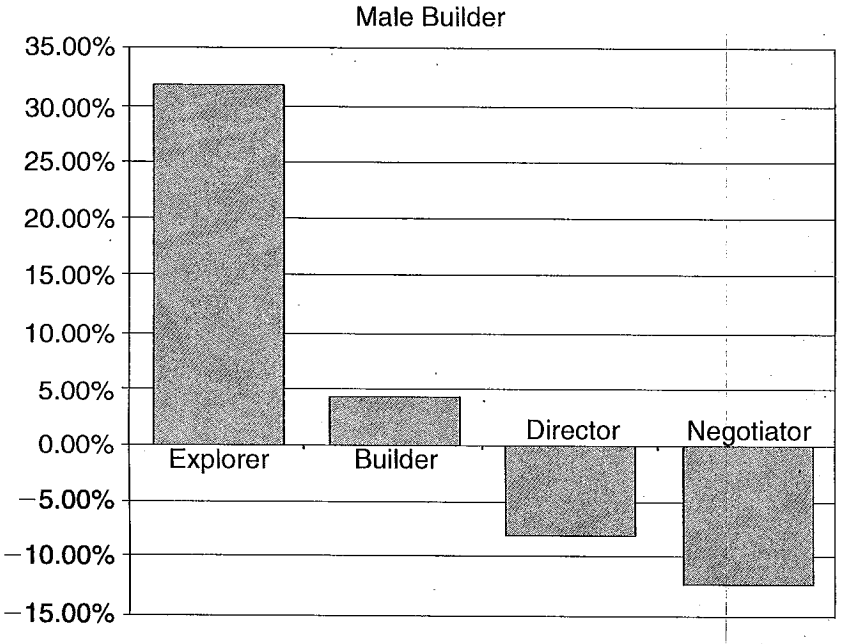


Chart 5. Relative attraction by personality type after "first meeting"; population normalized. Chart of Table 13.2: Male Builder attraction to female Explorers, Builders, Directors, and Negotiators. 0.00%=degree of attraction by chance.

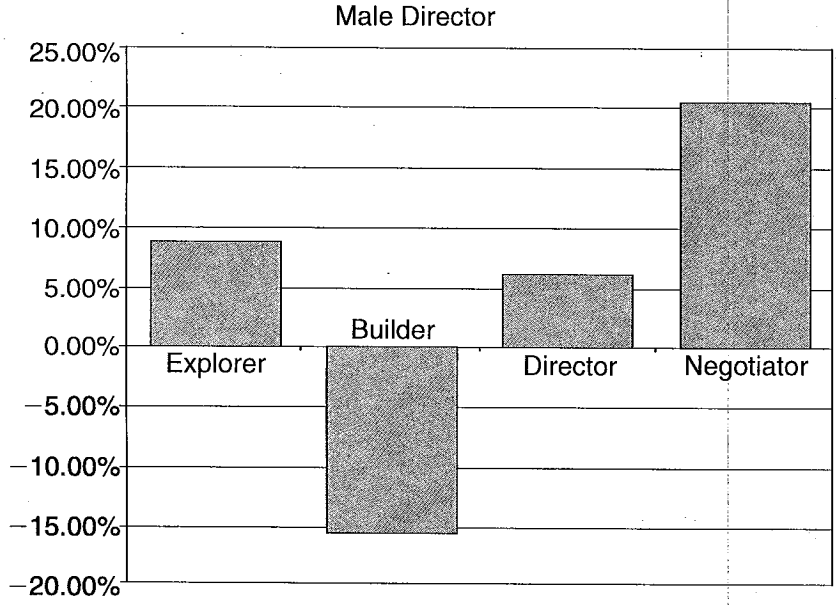


Chart 6. Relative attraction by personality type after "first meeting"; population normalized. Chart of Table 13.2: Male Director attraction to female Explorers, Builders, Directors, and Negotiators. 0.00%=degree of attraction by chance.

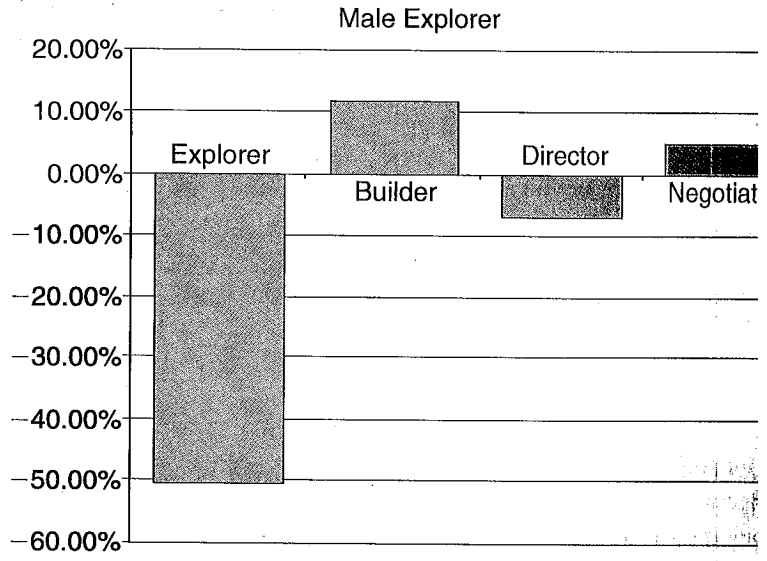


Chart 7. Relative attraction by personality type after "first meeting"; popula normalized. Chart of Table 13.2: Male Explorer attraction to female Explore Builders, Directors, and Negotiators. 0.00%=degree of attraction by chanc

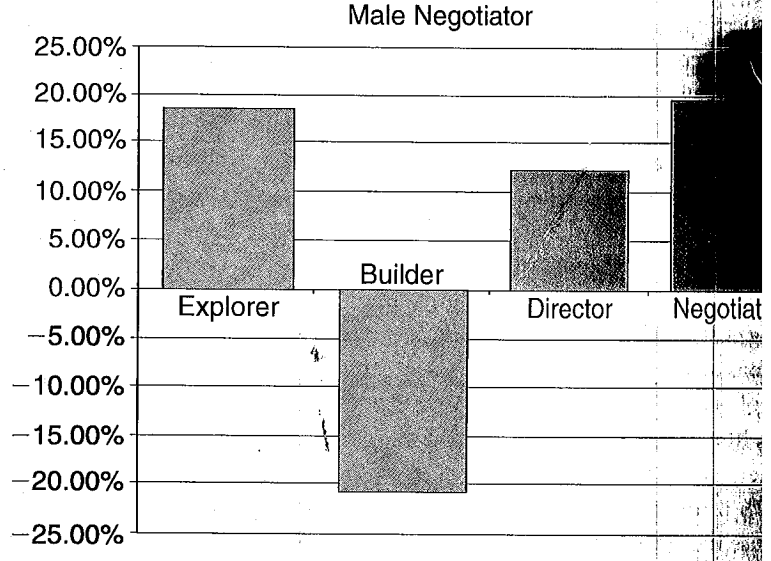
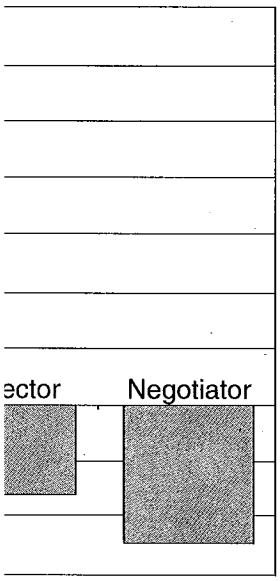


Chart 8. Relative attraction by personality type after "first meeting"; populat normalized. Chart of Table 13.2: Male Negotiator attraction to female Explo Builders, Directors, and Negotiators. 0.00%=degree of attraction by chance



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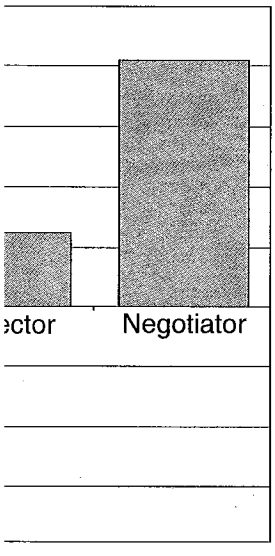

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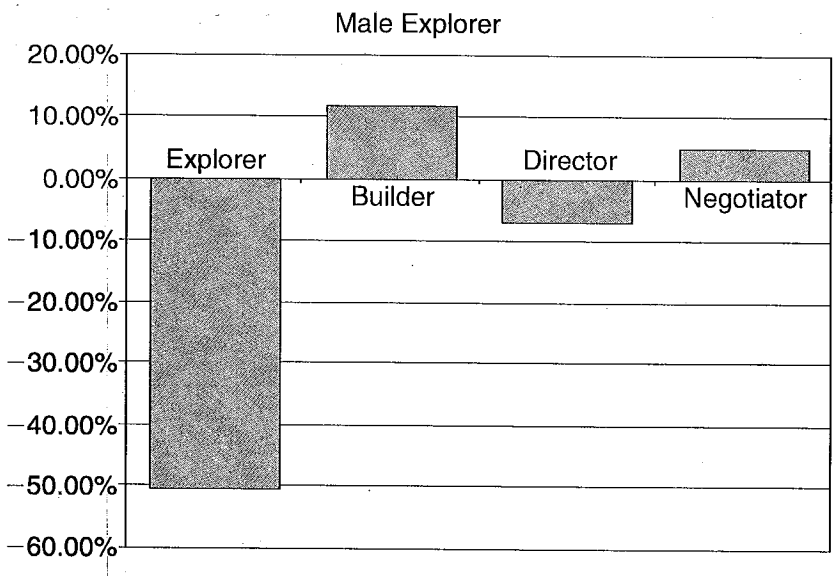

Chart 7. Relative attraction by personality type after "first meeting"; population normalized. Chart of Table 13.2: Male Explorer attraction to female Explorers, Builders, Directors, and Negotiators. 0.00%=degree of attraction by chance.

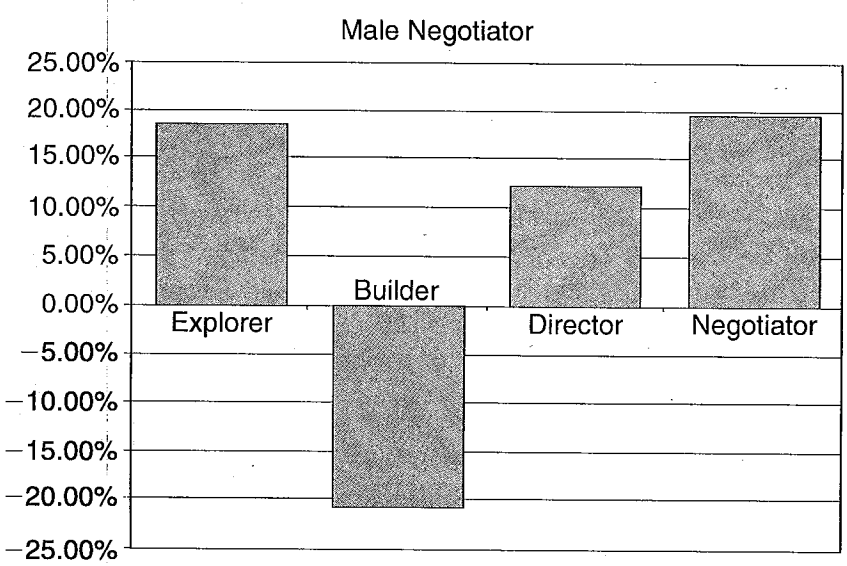

Chart 8. Relative attraction by personality type after "first meeting"; population normalized. Chart of Table 13.2: Male Negotiator attraction to female Explorers, Builders, Directors, and Negotiators. 0.00%=degree of attraction by chance.

since antiquity (Keirsey 1998). In *The Republic,* Plato used the terms "Artisan," "Guardian," "Idealist," and "Rational" to distinguish what Fisher refers to as the Explorer, Builder, Negotiator, and Director. Aristotle, Galen (the 2nd-century Roman doctor), and Paracelsus (the 16th-century Swiss doctor) also categorized people roughly into these four biological types (Keirsey 1998). By the early 20th century, many other scientists and laymen began to divide humankind into broad types, most notably Carl Jung in his text *Psychological Types*. In the 1940s, Myers and Briggs developed a measure of personality based largely on Jung's theories of type, the Myers–Briggs Type Indicator (MBTI) (Myers & Myers 1980). Keirsey (1998) has reinterpreted the MBTI, reducing it to a measure of the four essential types first proposed by Plato. All these investigators roughly described at least three (and often all four) of the possible trait clusters that appear to be associated with the neural systems for dopamine, serotonin, estrogen, and testosterone.

Because these four basic suites of temperament traits are described in the biological literature, because they have been described by physicians, philosophers and laymen for centuries, because preliminary analysis of an initial sample of 523,622 men and women on the Chemistry.com Internet dating/relationship site appear to fall within these four proposed broad dispositional categories, and because preliminary data suggest that several of these dispositional types show disproportional attraction to individuals of a different temperament syndrome than their own, we believe it is acceptable to regard these pilot projects as a first initiative in a continued, more precise investigation.

It is premature to explore how, when, or why the genetic underpinnings of these four proposed syndromes of temperament might have evolved in hominid prehistory. Perhaps these four proposed syndromes will show hallmarks of adaptation; perhaps they are more parsimoniously explained as by-products of the natural variation that occurs in these neurochemical systems. Nevertheless, Ding et al. have proposed that the specific allele for novelty seeking (DRD4*7R) "originated as a rare mutational event that nevertheless increased to high frequency in human populations by positive selection" (Ding et al. 2002, 309). Moreover, Higley et al. (1996) have reported on two versions of a gene in the serotonin system that may shed light on the evolution of genetic temperament syndromes within ancestral hominid populations. Rhesus monkeys who inherit the short version of this gene express less serotonin activity and are more likely to be aggressive and impulsive. Some 5–10% of rhesus monkeys inherit this short version, and many die young because they take too many risks in aggressive encounters with conspecifics (Higley et al. 1996). But Higley et al. propose that this gene has been maintained in the population because aggressive, impulsive male Rhesus monkeys

are also more exploratory, an important quality for a species tha humans) lives in harsh environments. Nettle (2006) describes genetic tions among members of other species that also enhance individual f and the costs and benefits of variations in the big five personality trait

Buss (1991) has proposed that humans may have evolved several e adaptive alternative behavioral strategies, underlain by genetic pol phisms, which are maintained in the population because no one stra optimal at all times; thus, genetic variation is maintained. MacDonald (hypothesizes that individuals expressing different degrees of specific p ality traits may differ in the ways they achieve survival and reproductio not difficult to envision the social and reproductive advantages of e the above proposed temperament syndromes in the shifting ecologic social environment of hominid prehistory. In fact, Bouchard writes of h variation in personality traits: "The purpose of this variation is undoul rooted in the fact that humans have adapted to life in face-to-face g (sociality)" (Bouchard 1994). The four proposed temperament syndr discussed above could have evolved by means of sexual selection, as many other complex constellations of human traits (Miller 2000).

How ancestral individuals would have recognized those with c ent genetic profiles and associated temperament syndromes is unknow noted above, Wedekind has reported that women are attracted to men a different immune system (Wedekind et al. 1995); they select these unconsciously, using smell. Women also tend to be attracted to men specific facial features associated with testosterone (Grammer & Thor 1994), whereas men tend to be attracted to women with facial features ciated with estrogen (Johnston 1999). Perhaps the dopamine and serot systems also have facial and/or odor signals that enable individuals to ide these attributes. A recent study on the iris suggests a marker for the d mine system. The furrows (lines curving around the outer edge) and c (pits) in the iris have been correlated with aspects of personality. Indiv with more furrows are more regularly impulsive and willing to indulge cravings (traits associated with dopamine activity), while those with crypts are more likely to be trusting, warm, and tender (traits associated estrogen activity) (Larsson, Pedersen, Stattin, in press).

Future research on the facial features of the individuals on the Ch istry.com site may illuminate some of the facial signals specific to t proposed four personality syndromes. But it is parsimonious to hypoth that in prehistory all four temperament types also displayed aspects of biological predispositions as they verbalized their values and beliefs, m their faces and bodies in specific ways, and/or pursued specific persona cial, and economic goals.

are also more exploratory, an important quality for a species that (like humans) lives in harsh environments. Nettle (2006) describes genetic variations among members of other species that also enhance individual fitness, and the costs and benefits of variations in the big five personality traits.

Buss (1991) has proposed that humans may have evolved several equally adaptive alternative behavioral strategies, underlain by genetic polymorphisms, which are maintained in the population because no one strategy is optimal at all times; thus, genetic variation is maintained. MacDonald (1995) hypothesizes that individuals expressing different degrees of specific personality traits may differ in the ways they achieve survival and reproduction. It is not difficult to envision the social and reproductive advantages of each of the above proposed temperament syndromes in the shifting ecological and social environment of hominid prehistory. In fact, Bouchard writes of human variation in personality traits: "The purpose of this variation is undoubtedly rooted in the fact that humans have adapted to life in face-to-face groups (sociality)" (Bouchard 1994). The four proposed temperament syndromes discussed above could have evolved by means of sexual selection, as have many other complex constellations of human traits (Miller 2000).

How ancestral individuals would have recognized those with different genetic profiles and associated temperament syndromes is unknown. As noted above, Wedekind has reported that women are attracted to men with a different immune system (Wedekind et al. 1995); they select these men unconsciously, using smell. Women also tend to be attracted to men with specific facial features associated with testosterone (Grammer & Thornhill 1994), whereas men tend to be attracted to women with facial features associated with estrogen (Johnston 1999). Perhaps the dopamine and serotonin systems also have facial and/or odor signals that enable individuals to identify these attributes. A recent study on the iris suggests a marker for the dopamine system. The furrows (lines curving around the outer edge) and crypts (pits) in the iris have been correlated with aspects of personality. Individuals with more furrows are more regularly impulsive and willing to indulge their cravings (traits associated with dopamine activity), while those with more crypts are more likely to be trusting, warm, and tender (traits associated with estrogen activity) (Larsson, Pedersen, Stattin, in press).

Future research on the facial features of the individuals on the Chemistry.com site may illuminate some of the facial signals specific to these proposed four personality syndromes. But it is parsimonious to hypothesize that in prehistory all four temperament types also displayed aspects of their biological predispositions as they verbalized their values and beliefs, moved their faces and bodies in specific ways, and/or pursued specific personal, social, and economic goals.

CONCLUSION

Fisher (1998) has proposed that romantic love is one of three discrete, interrelated emotion/motivation systems that mammalian (and avian) species have evolved to direct courtship, mating, reproduction, and parenting. The other two are the sex drive and attachment. The sex drive evolved to motivate our ancestors to seek coitus with a *range* of appropriate partners. Courtship attraction (and its developed human form, romantic love) evolved to motivate individuals to focus their courtship attention on a preferred mating partner, thereby conserving courtship time and metabolic energy. Partner attachment evolved primarily to motivate individuals to sustain this affiliative connection at least long enough to complete species-specific parental duties.

It is hypothesized here that human romantic love (and mammalian courtship attraction) evolved in tandem with many other biological mechanisms (and cultural mechanisms) that serve to guide an individual to prefer one conspecific rather than another and stimulate the brain system for attraction. This chapter discusses two exploratory pilot projects designed to investigate one of these unconscious mechanisms: a biological appetite to become attracted to individuals with different genetic profiles. It is hypothesized that humans, a socially monogamous species, evolved four very broad genetically based temperament syndromes for a variety of social and ecological reasons and that humans tend to select romantic partners with a different suite of cognitive and behavioral traits in order to create more genetic variety in their offspring and engage in the job of co-parenting with a wider array of parenting skills. This hypothesized unconscious appetite is most likely one of many biological mechanisms that contribute to this central aspect of human reproduction, mate choice.

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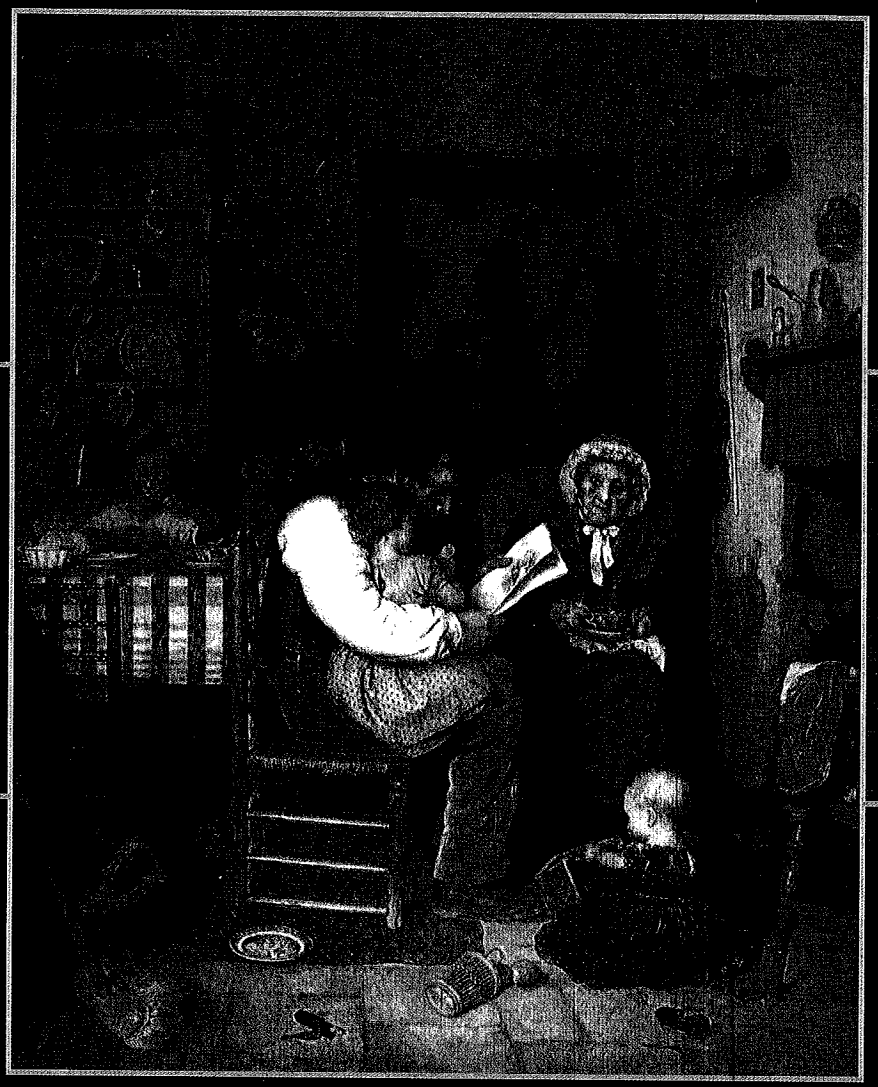

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