Evolutionary cyber-psychology: Applying an evolutionary framework to Internet behavior

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Article info

Article history:
Available online 4 August 2009

Keywords:
Evolutionary psychology
Internet
Parental investment theory
Reputation
Self-disclosure
Sexual competition

Abstract

An evolutionary psychological perspective has much to offer the study of Internet behavior. However, cyber-psychologists have hitherto neglected this rich theoretical tradition and evolutionary psychologists have been slow to apply their perspective to computer-mediated behavior. This paper applies an evolutionary perspective to the study of Internet behavior in four relevant domains: (1) mating and sexual competition, (2) parenting and kinship, (3) trust and social exchange, and (4) personal information management. Both general and specific evolutionary theories are explored in relation to online behavior in each domain, with an emphasis on generating testable hypotheses for future research.

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1. Introduction

Evolutionary psychology (EP) emerged in the early 1990s as an important theoretical perspective with the aim of reconciling, at the time, two remote disciplines: cognitive science and evolutionary biology. Since then, an evolutionary perspective has been extended to virtually all branches of psychology and has generated numerous mini-theories and testable hypotheses regarding a diverse array of human phenomena (see Buss, 2005).

The same decade that witnessed the birth of evolutionary psychology also witnessed the advent of the World Wide Web (WWW) and the growth of personal computer technology. In the United States, over the course of five years, the percentage of Internet users rose from 15% of the adult population in 1995 to nearly half in 2000. And today roughly 75% of adults (and 92% of young adults) living in the U.S. use the Internet regularly (Pew Internet & American Life Project, 2008a), and Internet penetration rates continue to rise around the world (see China Internet Network Information Center, 2008; Internet World Stats, 2008).

The attraction of the Internet is obvious. The Internet offers a host of activities, including sending and reading email, shopping and banking online, participating in online chat rooms, sending instant messages to friends, and searching the Web for information about everything from health and religion to sports scores and local news (Pew Internet, 2008b). Moreover, Internet media offer various features (e.g., visual anonymity) that many people find appealing, especially when communicating or searching for sensitive or stigmatized information (Buchanan, Joinson, Paine, & Reips, 2007; McKenna & Bargh, 1998).

Despite the largely congruent histories of EP and the Internet, and the importance of the Internet for daily life, there remains a startling absence of evolutionary-based theoretical approaches to understanding Internet behavior. Rather, most ‘cyber-psychologists’ (investigators whose psychological research focuses on online-mediated processes and behaviors) have drawn heavily from standard social science models—such as cue reduction theory (e.g., Kiesler, Siegel, & McGuire, 1984), impression management theory (e.g., Chiou, 2006; Gibbs, Ellison, & Heino, 2006), self-awareness theory (e.g., Joinson, 2001; Yao & Flanagin, 2006), social identity theory (e.g., Postmes, Spears, Sakhel, & de Groot, 2001), social information processing theory (e.g., Walther, 2007), and social penetration theory (e.g., Altman & Taylor, 1973; Valkenburg & Peter, 2007; Whitty, 2007)—to explain Internet behavior. Such models are indeed indispensable for mapping the proximal causes of online behavior (e.g., how user self-esteem interacts with media characteristics to influence media choices; see Joinson, 2004). However, they do not address the distal causes of Internet behavior—namely, the role natural selection had in shaping the ancestrally evolved motives, preferences, and psychological dispositions people bring to Internet usage—and this is precisely what an evolutionary psychological perspective has to offer the burgeoning field of cyber-psychology.

The present paper is intended to alert psychologists to the advantages of applying an evolutionary perspective to the study
of Internet behavior. While cyber-psychologists are the intended audience, researchers from other disciplines should find this paper useful as well. Our methods were simple. We surveyed mainstream cyber-psychological literature (e.g., CyberPsychology & Behavior) in search of topics and themes generally covered by standard EP textbooks (e.g., Buss's [2004] Evolutionary Psychology, 2nd ed.). Four such categories, each addressed to some degree by psychologists studying online behavior, are reviewed within an EP interpretive framework. These include: (1) mating and sexual competition; (2) parenting and kinship; (3) trust and social exchange; and; (4) personal information management. For each category, we explore ways of applying both general and specific evolutionary theories to Internet behavior, and present several testable hypotheses motivated directly by these theories (see Table 1 for list of hypotheses). In what follows, we present something of an evolutionary cyber-psychological research program, first clarifying the conceptual relationship between "online" (or computer-mediated) and "offline" (or unmediated) behavior.

1.1. How does cyberspace differ from "real life"?

Although early investigations into the behavioral and psychological effects of new media often emphasized the differences between computer-mediated communication (CMC) and face-to-face (FtF) communication (e.g., Kiesler et al., 1984), as well as the potential hazards of Internet use (e.g., Kraut et al., 1998), a growing body of research has focused on the similarities and potential benefits of online activities (e.g., Boase, Horrigan, Wellman, & Rainie, 2006; Parks & Floyd, 1996; Whitty & Gavin, 2001; see especially McKenna & Bargh, 2000). This research suggests that relationships that form online develop much like traditional FtF relationships (Yum & Hara, 2005). For example, online relationships (much like offline relationships) progress through sequences representing increasing levels of trust, such as first sharing email addresses, then phone numbers, and finally home addresses (Whitty & Gavin, 2001).

Although CMC is often text-based (e.g., email, Instant messaging), it is not devoid of emotional or non-verbal content, as some have assumed. Rather, individuals communicating online have learned to communicate emotional information using emoticons (emotion icons created with typographical symbols that resemble facial expressions) and by explicitly describing their emotional states in text (see Derks, Fischer, & Bos, 2008). Likewise, despite differences between sexual activities conducted online and offline (e.g., cybersex does not entail skin-to-skin contact), evidence suggests many online sexual activities are perceived to be as "real" as sexual activities conducted offline (Whitty, 2003a; Whitty, 2005). Finally, despite claims to the contrary, gender information is not absent from CMC (Lea & Spears, 1995), although in some online settings gender may be difficult to verify (Rollman, Krug, & Parente, 2000).

Regarding the effects of Internet use, increasing evidence suggests that (i) relationships which form online are often just as "deep" and "stable" as relationships formed offline (McKenna, Green, & Gleason, 2002; Parks & Floyd, 1996), (ii) CMC technologies (such as email and Instant messaging) help people maintain their current relationships (Valkenburg & Peter, 2007; but see Cummings, Butler, & Kraut, 2002; Shklovski, Kraut, & Cummings, 2008), as well as help people maintain larger overall social networks (Boase et al., 2006), and (iii) there is no simple relationship between Internet use and health outcomes (e.g., loneliness; see Morahan-Martin & Schumacher, 2003), although controversies still remain (see Kraut & Kiesler, 2003).

However, despite the similarities between CMC and FtF interactions, there are also genuine differences. First, Internet users often interact with a greater degree of visual anonymity1 than when offline (Joinson, 2003). That is not to say that identities are always concealed online. Rather, people have greater control over when and how they disclose personally identifying information (see Qian & Scott, 2007; Viégas, 2005). For example, the same person might disclose their name in an email to a friend, include an edited photograph of themselves in an online dating profile or Weblog, or use a pseudonym when posting to an online community.

Second, geographic distance is largely immaterial online (Lea & Spears, 1995; McKenna & Bargh, 2000). The Internet allows geographically distant individuals to meet and exchange messages (e.g., in chat rooms), share media files (e.g., on YouTube), and even coordinate business transactions (e.g., on eBay). It also allows pre-existing friends and family members, who are geographically separated, to keep in touch (e.g., by email), provide support, and maintain a sense of intimacy (e.g., by web cam) from afar—a point we will return to later (see Section 2.2.2).

Third, there are fewer time constraints when communicating online (Walther, 2007). Unlike face-to-face (FtF) communication, which occurs in "real time," CMC often occurs over time delays (referred to as "asynchrony"). Someone might spend an hour crafting an email, only to receive a response days later. This aspect of CMC gives people greater editorial control over their self-presentations and, as a consequence, often leads to "hyper-personal" social outcomes, such as developing an idealized impression of someone (see Walther, 2007). Finally, the Internet is archival (i.e., content uploaded to the Internet often persists indefinitely) and retrieveable (i.e., information is often easily recalled by an online search engine) (Viégas, 2005). This aspect of Internet communication has psychological and social implications (see Solove, 2007), a point that we will also return later (see Section 2.4.2).

The foregoing list of similarities and differences between FtF and CMC exchanges is not meant to be exhaustive but merely illustrative. The point is that certain aspects of the Internet have real behavioral and psychological consequences—many of which psychologists have only recently begun to explore (Joinson, 2003). An evolutionary psychological perspective aids this work by framing the interaction between human cognition and new media in terms of domain-specific psychological mechanisms responding to computer-mediated information (CMI). Such a perspective would predict no significant differences in human behavior (online or off) to the extent that CMI satisfies the input criteria for a given evolved psychological mechanism (i.e., the type and range of information a psychological mechanism evolved to process; e.g., perceiving a potential partner's facial symmetry in an online dating profile). Domain-specific psychological mechanisms are those psychological mechanisms, which evolved to process input from a specific domain (e.g., mate selection, kin identification) that was invariant across human evolution, and that generate functional responses to this input (see Barrett, 2008; Buss, 2004; Geary, 1998, chap. 6). To the extent that CMI reflects the input criteria for a given psychological mechanism, we would expect computer-mediated behavior to resemble offline behavior.

1 In CMC research, visual anonymity typically refers to the lack of any visual representation of a person, such as pictures or video clips; however, it is sometimes possible to identify an anonymous or pseudonymous writer by written cues. This is referred to as "discursive anonymity" and it applies especially to "bloggers" (or people who maintain online weblogs) (see Qian & Scott, 2007). In addition to this, there is the issue of "traceability," or the extent to which anonymous or pseudonymous postings can be traced to the author's personal computer (see Solove, 2007, pp. 146–147).
Table 1
Testable hypotheses generated by an evolutionary framework. Each hypothesis relates to one of four domains (I–IV) of Internet behavior discussed in the present paper.

| I. Cyber challenges of mating and sexual competition |
| 1. Sexual competition and sex differences in mating |
| (1a) Men more than women will enter chat rooms in pursuit of one-time sexual encounters, with the ultimate goal of sexual gratification |
| (1b) Women more than men will enter chat rooms to seek flirtatious interactions with the same interactive partner, with the ultimate goal of building trust and intimacy |
| (1c) Men will lower their standards of attractiveness to a greater extent than women when pursuing online sexual encounters or when arranging to meet offline to have sex |
| (1d) Men more than women will report using chat rooms as an outlet for sexual variation |
| (1e) Women more than men will report sharing personally identifying information to their online partner as a strategy for procuring relational commitment |

| II. Cyber challenges of parenting and kinship |
| 4. Parenting |
| (4a) Men will take a more active role in monitoring their children’s online behavior when paternity certainty is high than when paternity certainty is low |
| (4b) Women will take a more active role than men, on average, in monitoring their children’s online behavior |
| (4c) Upper-class parents in industrial societies will monitor their sons’ online behavior more closely than lower-class parents (Trivers–Willard hypothesis) |
| (4d) Lower-class parents in industrial societies will monitor their daughters’ online behavior more closely than upper-class parents (Trivers–Willard hypothesis) |

| III. Cyber challenges of trust and social exchange |
| 6. Trust and social exchange |
| (6a) Negative feedback will be distrusted more by eBay users when it is submitted by a single buyer, the same buyer, or affiliated (i.e., interdependent) buyers |

| IV. Cyber challenges of personal information management |
| 7. Personal information management |
| (7a) The mere anticipation of having one’s actions posted to the Internet (e.g., shared in an email) will promote altruistic behavior |
| (7b) Most people will not disclose personal secrets over the Internet even when guaranteed anonymity in a CMC session |
| (7c and d) Perceptions about audience and privacy will moderate online self-disclosure behavior, with more sensitive information shared when the communication channel is perceived to be limited to close friends or family, whose genetic fitness is not compromised by the information |
2. Evolutionary cyber-psychology

2.1. Cyber challenges of mating and sexual competition

According to a 2005 U.S. survey, of the estimated 10 million Internet users that are currently single and looking for romantic partners, 74% say they have used the Internet in one way or another to further their romantic interests; one in ten Internet users (16 million people) say they know someone who has used a dating Web site, and 15% (30 million) say they know someone who has been in a long-term relationship or married someone they met online (Madden & Lenhart, 2006). Moreover, millions of people (both single and married) use the Internet to meet strangers, flirt, engage in highly sexualized conversations in chat rooms, schedule offline sexual liaisons and view pornographic images (Cronin & Davenport, 2001; Joinson, 2003; Whitty, 2003b). Clearly, many people in contemporary industrial societies are using the Internet as an enhancement tool to satisfy their evolved sexual interests and desires.

Online dating is appealing to many people for several reasons. First, those who use online dating sites have access to a larger pool of potential mates. Second, online dating sites require participants to construct a profile. On this profile they can upload photographs and videos of themselves and are given the opportunity to write a description of who they are. Thus, users have a fair amount of control over the kind of impression they make on prospective partners, for example, by choosing a flattering photograph or emphasizing one’s “good” qualities (Whitty, 2007). Finally, online dating sites provide users a safe environment in which to meet potential partners. Many sites allow users to inspect the profiles of contacts before accepting or declining an invitation to communicate through the site. These features facilitate the likelihood of meeting someone with similar interests, and thus may account for the popularity of Internet dating.

Despite these unique features of the medium, online dating resembles offline dating in many respects. This is because the goals, values, and concerns of men and women are often the same whether online or offline (McKenna & Bargh, 2000). For example, people who use online dating sites value physical attractiveness in a partner just as much as offline daters (Whitty, 2007). On the other hand, online dating poses some novel challenges and opportunities for men and women.

One challenge posed by Internet dating is that physical body cues (such as eye contact, smiling, touching) are reduced in CMC. Body cues are important for initiating sexual encounters offline. Nevertheless, Internet users have largely overcome this limitation by reconstructing the physical body through written text (e.g., describing one’s physical features; Whitty, 2003b). Another challenge involves visual anonymity. Online there may be greater temptation to present oneself dishonestly (e.g., by presenting a false photograph, false credentials, or lying about one’s marital status), which makes deception a particular concern of online daters (Whitty, 2007). On the other hand, online dating poses some novel challenges and opportunities for men and women.

An evolutionary perspective sheds important light on online sexual behavior. According to evolutionary psychologists, sexual and relational motives evolved through natural selection to solve various adaptive problems of survival and reproduction faced recurrently by our ancestors (Buss, 1994; Cosmides & Tooby, 2000). Insofar as people pursue these basic evolved motives online, we might expect people’s sexual behavior on the Internet to conform to general evolutionary theories, such as parent selection theory (Trivers, 1972), as well as specific sub-theories, such as sexual strategies theory (Buss & Schmitt, 1993) or strategic interference theory (Buss, 1989a). We might also expect to find on the Internet the same gender differences widely replicated in traditional (i.e., offline) EP research, such as differences in sexual jealousy (Buss, Larsen, Westen, & Semmelroth, 1992; Shackelford, Buss, & Bennett, 2002).

2.1.1. Sexual competition and sex differences in mating behavior

The Internet provides virtual spaces for individuals to conduct many of the same sexual pursuits engaged in offline, including (a) initiating communication with potential short-term or long-term sexual partners (Whitty, 2007); (b) arranging to have sex offline (Daneback, Månsson, & Ross, 2007); (c) seeking extramarital interactions (Mileham, 2007); (d) flirting (Whitty, 2003b); (e) sharing intimate secrets and emotions (Whitty, 2003a); (f) obtaining sexual gratification (e.g., cybersex, hot chat); (g) finding sexual information (e.g., pornography) (Spink, Korichi, Jansen, & Cole, 2004), and: (h) advertising one’s mate value (e.g., embellishing one’s education or income in an online dating portfolio). The full range of online sexual activities must be considered when testing evolutionary hypotheses in cyberspace. As with offline sexual behavior, the type of sexual goal being pursued online affects which psychological mechanisms will be engaged; for example, whether short- or long-term mate preferences will be activated (Greiling & Buss, 2000; Kenrick, Groth, Trost, & Sadalla, 1993).

According to evolutionary psychologists, the qualities men and women find desirable in prospective sexual partners were shaped by natural selection to solve invariant (or recurrent) problems of genetic fitness and reproductive success (e.g., siring or giving birth to viable offspring) faced by ancestral men and women (Buss, 1994). To the extent that men and women faced unique reproductive challenges, modern men and women are expected to differ in their mating preferences and sexual strategies (Buss, 1989b; Buss & Schmitt, 1993; Geary, 1998). Furthermore, sexual conflict is expected to occur both between and within the sexes as a result of competing sexual interests (Buss, 1989a; Buss & Dedden, 1990; Haselton, Buss, Oubaid, & Angleitner, 2005; Shackelford & Buss, 1996).

From an evolutionary perspective, intersexual competition (or competition between the sexes) stems from fundamental biological differences between the sexes. According to parental investment theory (Trivers, 1972), males and females have historically differed in the amount of parenting time and effort needed to produce viable offspring. Although both men and women tend to invest in offspring (Geary, 1998; Geary, 2005), women have a much greater obligatory parental investment, and therefore have less to gain (in terms of number of potential viable offspring) from a short-term mating strategy. Men, on the other hand, have a minimal obligatory investment in offspring (i.e., copulation is all that is required) and can therefore increase their reproductive fitness largely by competing with other men for access to mates. This leads to the evolutionary hypothesis that men are more psychologically “oriented” towards short-term mating than women, on average (Buss & Schmitt, 1993; Schmitt, Shackelford, & Buss, 2001). According to Buss and Schmitt’s sexual strategies theory, men possess three adaptations which orient them more towards short-term mating than women: men more than women (i) desire short-term

2 Online dating sites make their money by requiring the person who initiates contact to pay for ‘stamps’ that enable them to send emails to contacts through the site (Whitty, 2007).
sexual relationships, (ii) prefer greater numbers of sexual partners over time, and (iii) require less time before consenting to sex. Additionally, men are more likely to drop their standards of attractiveness when considering a one-night stand, compared to women, since the reproductive costs are higher for women than men (Kenrick et al., 1993). This is not to say that women are not at all oriented towards short-term mating. Only that men are more oriented towards women, on average, because of biological differences between the sexes in obligatory parental investment (see Buss et al., 2001, for a review of the evidence).

Based on sexual strategies theory, we might make the following predictions concerning online sexual pursuits: (1a) Men more than women will enter chat rooms in pursuit of one-time sexual encounters (i.e., a different anonymous partner each time), with the ultimate goal of sexual gratification (e.g., cybersex); (1b) women more than men will enter chat rooms to seek flirtatious interactions with the same interactive partner, with the ultimate goal of building trust and intimacy; (1c) men will lower their standards of attractiveness to a greater extent than women when pursuing online sexual encounters or when arranging to meet offline to have sex, (1d) men more than women will report using chat rooms simply as an outlet for sexual variation; (1e) women more than men will report sharing personally identifying information (e.g., name, email address) to their online partner, as a sign of their commitment to the relationship.

2.1.2. Intrasexual competition

Intrasexual competition refers to conflict over access to resources or potential mates that occurs between members of the same sex (Geary, 1998). It has been argued that men compete with other men primarily for access to young, attractive sexual partners, while women compete with other women primarily for access to high-status sexual partners, who are willing to invest in their offspring (Buss, 1994). Men and women compete with members of the same sex often using different strategies for reasons having to do with reproductive success (Campbell, 1999; Hess & Hagen, 2006a). Since women prefer men of high status, men compete with other men for status and cultural tokens of status (e.g., expensive clothes, money, or titles), often through physical aggression (Buss & Shackelford, 1997; Wilson & Daly, 1985). On the other hand, since men prefer young, attractive, sexually faithful women as mating partners, women compete with other women by enhancing their physical appearance (Buss, 1994) or by verbally derogating the physical appearance or sexual reputation of competitors (Buss & Dedden, 1990).

On the Internet, it might be possible to test evolutionary predictions about intrasexual competition, and hypothesized sex differences, by comparing the content of men and women's personal home pages and blogs. Personal home pages (or PHPs) are public Web sites sustained by an individual for non-commercial or non-professional purposes that may be accessed through search engines or Web directories, and are often linked to other, similar-themed PHPs in a “Web ring” (Doering, 2002; Papacharissi, 2002). Blogs (or more formally “Weblogs”) are public online journals that generally have current and archived text-based posts from the author. Most blogs are interactive, in that visitors may post comments to them (Stefanone & Jang, 2007). Bloggers write anonymously, pseudonymously, or openly (e.g., including a personal photograph or real name) (Qian & Scott, 2007), and although it is impossible to know everyone who reads one's blog, bloggers generally write for friends and family (Stefanone & Jang, 2007; Vignes, 2005). Furthermore, although most bloggers say they cover many different topics in their blogs, a recent Pew Internet survey suggests that bloggers mostly write about their “life and experiences” (Lenhart & Fox, 2006).

Since people utilize these Internet tools as outlets for self-expression and self-advertisement, we might expect significant sex differences in terms of the content men and women post to their PHPs and blogs, related to sexual competition. This may be especially true for young adults, that is, during the mate-finding period of the life span (Wilson & Daly, 1985). More specifically, we might make the following predictions: (2a) Young men more than young women will stress their skills and resources in their PHPs and blogs (e.g., talk about their achievements or expertise), while young women more than young men will stress their physical appearance and reputation (e.g., include a flattering photo or talk about their community involvement); (2b) young men more than young women will derogate same-sex competitors’ abilities and intelligence in their blogs, while young women more than young men will derogate same-sex competitors’ appearance or sexual reputation.

Furthermore, some evidence suggests that men and women differ in terms of the type of aggressive strategies used in intrasexual competition (Björkqvist, Österman, & Lagerspetz, 1994; Campbell, 1999; Hess & Hagen, 2006a). Campbell (1999) has made the convincing argument that women are less inclined than men to engage in physical acts of aggression in same-sex competition because staying alive to provide maternal care to offspring was more vital to women’s (than men’s) inclusive fitness, while men have more to gain from direct competition with other men over resources and reproductive partners (see also Wilson & Daly, 1985). Nevertheless, to some extent, women are in direct competition with other women for choice resources (e.g., coalition members, mates) and may benefit from certain types of aggressive strategies, strategies that minimize the likelihood of being identified and injured through retaliation (i.e., “covert” or indirect aggressive strategies, such as spreading malicious rumors or gossiping about an adversary in their absence) or that compromise a competitor’s standing within the group (known as “relational aggression”; see Crick & Grotpeter, 1995).

According to a study by Hess and Hagen (2006a), which investigated sex differences in the psychology of indirect aggression, young adult females prefer to employ indirect aggression (e.g., gossip) rather than direct, physical aggression (e.g., taking a punch) when responding to personal insults, at least more so than young adult males, although men and women equally employ covert strategies in practice (see Archer, 2004; Richardson & Green, 1999). According to Hess and Hagen (2006b), the aim of indirect aggression is to attack—using information—a competitor’s standing within the group, thus disadvantaged them as an intra-group rival. Supportive evidence for this perspective comes from McAndrew and Milenkovic (2002), who found that men and women preferentially attend to negative information about rivals (i.e., same-sex nonallies), and ethnographic studies of gossip among adolescent boys and girls suggests that indirect aggression is particularly effective, as a competitive strategy, in that few participants challenge the accusations made by the high in status, who are usually the ones initiating gossip (Eder & Enke, 1991)

The developmental trend that girls (and young women) are more likely to be the targets of relational aggression has also been observed in cyberspace. According to a 2007 Pew Internet & American Life Project report, older girls (ages 15–17) are most likely to report experiencing some form of “cyberbullying” (41%), followed by girls ages 12–14 (34%), then boys ages 15–17 (29%), and boys ages 12–14 (22%) (Lenhart, 2007). Cyberbullying refers to
computer-mediated forms of relational aggression, such as receiving threatening text messages, having one’s private emails forwarded without consent, having an embarrassing picture posted without permission, or having rumors spread about online. Cyberbullying may not be as common as offline “bullying” (i.e., relational aggression), but almost a quarter (23%) of U.S. online teens report having been the target of some form of cyberbullying (Lenhart, 2007).

Given the evolutionary hypothesis that indirect/relational aggression is a predominantly female form of intrasexual aggression (Campbell, 1999; Hess & Hagen, 2006a), we might find patterns featured in offline relational aggression among young female Internet users. For example, girls often use relational aggression to prevent other girls from being included in the local clique or peer group (Crick & Grotzinger, 1995). This behavior has the effect of reducing the clique size to a manageable and effective unit for gathering, disseminating, and analyzing strategic social information (Hess & Hagen, 2006b). Thus, we might expect (2c) victims of cyberbullying to be predominantly girls or boys on the “fringe” of various peer groups (e.g., newcomers or acquaintances of core members). Offline relational aggression (e.g., gossip) is often initiated and perpetuated by high-status (i.e., “perceived popular”) children and teens (Cillessen & Mayeux, 2004; Eder & Enke, 1991). We might predict (2d) the same to be the case online. According to Eder and Enke (1991), few teens challenge negative gossip proffered by high-status peers. Fear of retaliation may prevent individuals from speaking up. If this is the case, we might expect (2e) a greater percentage of teens challenging the assertions of high-status peers in CMC (e.g., during IM conversations), due to greater perceived anonymity and social distance.

2.1.3. Sex differences in jealousy

A robust finding in evolutionary psychology is that men and women react differently to different cues to sexual infidelity (see Buss, 2004, for review). Evidence from Buss et al. (1999), for example, suggests that men more than women find their partner’s sexual infidelity (i.e., having sexual intercourse with someone else) distressing, while women more than men find their partner’s emotional infidelity (i.e., striking up a friendship with someone of the opposite sex) distressing. Moreover, men, relative to women, find it more difficult to forgive a partner’s sexual infidelity than a partner’s emotional infidelity, and are more likely to break up in response to a partner’s sexual infidelity than in response to a partner’s emotional infidelity; the converse being true for women, relative to men (Shackelford et al., 2002). Allegedly, this is because ancestral men and women faced different adaptive problems: men faced the problem of parenthood uncertainty and inadvertently investing in a competitor’s offspring, while women faced the problem of securing a mate to invest in their offspring (Buss, 2004).

Despite the virtual nature of online interactions, many extra-pair sexual acts conducted online are perceived as “real” infidelity (Whitty, 2003a; Whitty, 2005). These include both “sexual” and “emotional” activities, for example, having “cybersex” (online sexual acts while typically masturbating), “hot chat” (highly sexualized conversation), or sharing deeply personal information with a person who is not one’s current partner. As one might expect, men and women differ in what they consider to be partnership betrayal online. For example, Whitty (2003a) had men and women rate on a Likert scale the extent to which they considered their own online and offline activities to be “unfaithfulness to their partner.” Overall, women more than men considered sexual acts (whether performed online or offline) to be infidelity to their partner. This gender difference was replicated in another study, using a story completion task methodology (Whitty, 2005). Unfortunately, no studies to date have directly tested the evolutionary hypothesis that men and women weight sexual vs. emotional infidelity cues in their partner’s behavior differently in relation to online infidelity, although studies are currently underway (M.T. Whitty, personal communication, September 16, 2008).

In order to test the evolutionary hypothesis in relation to cyberspace, one might investigate men and women’s emotional reactions to hypothetical discovery scenarios (e.g., inadvertently discovering one’s partner having cybersex or having formed a close, intimate relationship with an opposite-sex person online). One could vary the extent to which the online interaction is “sexual” or “emotional,” based on Whitty’s (2003a) definitions. The basic prediction (3a) would be that men more than women would experience jealousy over a partner conducting sexual acts (e.g., hot chat or cybersex) with an online partner, while women more than men would experience jealousy over a partner exchanging emotional secrets with an online partner (because it could signify a budding opposite-sex relationship).

Alternatively, because cybersex does not involve skin-to-skin sexual intercourse, perceptions of online sexual activity may not trigger sexual jealousy in men and women. However, we would be surprised if this were the case. More likely is that perceptions about the consequences of online infidelity and the likelihood of offline interaction moderate the emotional reactions of men and women. With this in mind, we would predict that whether the online extra-pair partner is (3b) anonymous or known, (3c) geographically near or distant, and (3d) whether the relationship is recurrent or one-time, will moderate men and women’s reactions to online infidelity.

We might speculate further, regarding reactions to online infidelity: (3e) Men, relative to women, will find it more difficult to forgive a partner’s sexual infidelity online, and (3f) will be more inclined to break up a relationship due to a partner’s online sexual infidelity; (3g and h) we would predict the converse pattern for women (relative to men), regarding emotional infidelity.

In short, if the same evolved psychological mechanisms designed to detect and respond to cues to infidelity in men and women are triggered by cues to online “infidelity,” then the predictions of evolutionary psychologists (e.g., Buss et al., 1999; Shackelford et al., 2002) should hold regarding cyber-betrayal.

2.2. Cyber challenges of parenting and kinship

2.2.1. Parenting

According to a recent Pew Internet & American Life Project report, more than half (55%) of all online American youths ages 12–17 use an online social networking site, such as Facebook, Bebo, or MySpace, and the vast majority (95%) of network-using teens have an online profile that they update regularly (Lenhart & Madden, 2007). Only 59%, however, report restricting their profile to their friends (40% say that their profile is visible to anyone who happens upon it online; 1% are unsure). Although most teens (91%) say they use social networking sites to keep in touch with preexisting friends, about half of all social networking teens report using the sites to make new friends; 82% report having included their first name in their profile; 79% report having included photos of themselves; 61% have included the name of their city or town; and 29% have included video content (Lenhart & Madden, 2007). Additionally, about 28% of online U.S. teens have a blog (Lenhart, Madden, Magcill, & Smith, 2007).

As more and more young people turn to the Internet to socialize with current friends, “browse” for new friends, share photos and videos, and disclose personal thoughts and “ramblings,” more and more parents are confronted with the reality of their teens’ online behavior—and their reaction is often that of concern (Sullivan, 2005). According to Macgill (2007), parents today are more ambivalent about the benefit of the Internet for their children than they were in 2004.
About 32% of online teens have been contacted by a stranger online, and this occurs more often for girls than boys (Smith, 2007). Given the potential dangers of posting personally identifying information and interacting with strangers on the Internet, it is not surprising that 85% of parents of online teens report they have rules about the kinds of Internet sites their teenaged children can visit or cannot visit, as well as rules about what kind of personal information their children can share with people they talk to on the Internet (Lenhart & Madden, 2007).

According to parent-offspring investment theory (Trivers, 1972), human parental investment is not obligate in many contexts (i.e., men are not biologically required to invest in offspring beyond mating effort). According to the paternity uncertainty hypothesis, males can never be 100% certain about their paternity (unlike female maternity) and therefore risk investing in a competitor's offspring. Due to these biological forces, men are expected to contribute less to parenting than women, on average (Buss, 2004). Nevertheless, when paternity certainty is high, and investment improves offspring survival or quality, paternal investment is expected to be great (Geary, 2005). An evolutionary psychological perspective on parental investment could be tested with regards to parents' monitoring of their children's online behavior. We would expect (4a) that men would take a more active role in monitoring their children's online behavior when paternity certainty is high than when paternity certainty is low (e.g., fathers in low-trust relationships), after controlling for other variables (e.g., time spent working). On the other hand, we would predict (4b) that women would take a more active role than men, overall, in monitoring their children's online behavior.

According to the Trivers–Willard hypothesis (Trivers & Willard, 1973; as cited by Buss, 2004), parents are expected to invest more in sons when living in resource-rich conditions and more in daughters when living in resource-poor conditions. This is because, all else being equal, males can do better than females in terms of number of viable offspring produced. Thus, when there are resources to spare, males are the “better” investment (strictly in terms of the parents' inclusive fitness). However, when there are few resources to invest in offspring, investing in females is the safer bet because females are more likely, on average, to produce at least one offspring, while male reproductive fitness is much more varied, due to intense sexual competition. One way to test the Trivers–Willard hypothesis in a modern context is to use parental monitoring behavior as index of investment in offspring. If the hypothesis is correct, we would expect (4c) that upper-class parents in industrial societies would monitor their sons' online behavior more closely than lower-class parents, and (4d) that lower-class parents in industrial societies would monitor their daughters' online behavior more closely than upper-class parents.

2.2.2. Kinship

In sexually reproducing organisms, 50% of an individual's genes are passed to his/her offspring. On average, biological siblings share 50% of their genes with one another. Grandparents share 25% of their genes with their biological grandchildren. According to Hamilton's (1964) rule of “inclusive fitness” (or kin selection) these percentages are not trivial, but reliably predict the likelihood that an individual will commit a costly act (e.g., give assistance, nourishment, protection, etc.) for another. More formally, Hamilton's theory suggests that people should be more willing to incur costs to benefit someone as the probability of genetic relatedness between the benefactor and beneficiary increases.

Empirical support for Hamilton's rule is overwhelming (see Burnstein, 2005). In Burnstein, Crandall, and Kitayama's (1994) well-known study, American and Japanese participants nominated close genetic relatives (e.g., siblings) to be recipients of life-or-death altruism to a greater extent than distant relatives (e.g., cousins) and unrelated acquaintances. More recently, Stewart-Williams (2007) demonstrated that when the costs of helping are extremely high (e.g., when asked to donate a kidney) people report greater willingness to help close relatives (e.g., siblings) compared to close friends. Even nominal kinship cues, such as a shared surname, can elicit altruistic motives (e.g., a response to a minor request) between strangers (Oates & Wilson, 2001). These findings, and others like them, suggest that humans have evolved psychological mechanisms for inferring genetic relatedness based on various kinship cues and for funneling resources towards kin.

In modern industrial societies, such as the United States, vast geographic distances separate many families. However, various communication technologies, including Internet-based tools (e.g., email, Instant messaging, web cam video communication), enable family members to stay in touch and find social support (Boase et al., 2006; Shklovski et al., 2008). All communication technologies vary in terms of their financial costs, usually in relation to their “bandwidth” (or the quality and quantity of cues transmitted: Joinson, 2003). For example, video communication (e.g., calling a landline on Skype) often entails financial costs over and above connection and installation fees, while emailing entails no additional costs.

Given the differences in costs of various communication media, we might predict (5a) that adults will utilize high-cost, high-bandwidth communication channels (e.g., telephone, video communication) more often to communicate with distant kin (e.g., siblings, parents, offspring) than with friends and acquaintances.

2.3. Cyber challenges of trust and social exchange

According to a 2008 Pew Internet & American Life Project report, two-thirds of online Americans report having purchased a product online (e.g., book, clothing), and the number of people shopping online continues to grow (Horrigan, 2008). eBay, one of the largest online marketplaces/auction sites, has over 200 million registered users worldwide, according to a recent ACNielsen International Research Report. (2006). Nevertheless, concerns about electronic shopping remain. For example, 75% of Internet users in the U.S. report concern about giving out their credit card number or personal information online (Horrigan, 2008); anxiety about not being able to “try out the object” and the difficulties associated with returning defective products is also common (Yang & Lester, 2004). On the other hand, the convenience and timesaving aspects of Internet shopping are so appealing that many people are willing to tolerate the negative aspects of online trade.

According to evolutionary psychologists, trust—in the sense of “trust in another's intention and ability to bring about a particular event” (e.g., to repay a debt)—is essential for social exchange to occur between genetically unrelated individuals (Cosmides & Tooby, 1992; Kiyonari, Tanida, & Yamagishi, 2000; Kurzban, 2003), and this is no less true for trade over the Internet. Whether people are buying and selling products on eBay or disclosing sensitive information on a Web site, trust (e.g., trust in a seller to ship the product upon payment or to accurately describe the product's condition; trust in a Web site to protect personal information from third-party acquisition) mediates people's willingness to take risks (Resnick, Zeckhauser, Friedman, & Kuwabara, 2000). In fact, a recent study by Joinson, Paine, Buchanan, and Reips (as cited in Buchanan et al., 2007) demonstrated that, even in low-privacy situations, people willingly disclose personal sensitive information (e.g., salary, sexual history) to Web sites they trust.

The risks associated with the exchange of goods or personal information over the Internet include, among others, loss of money (e.g., paying for something that never gets sent), loss of quality (e.g., seller misrepresents the value or condition of an item), loss of time (e.g., time spent bidding), and loss of reputation.
(e.g., receiving negative feedback from a buyer or having personal information disseminated to third parties). According to economists, the risks associated with e-commerce stem from the fact that most trade interactions online are one-shot (i.e., one-time) deals between anonymous strangers (i.e., unidentifiable individuals with no prior history of interaction) (Dellarocas, 2003; Resnick & Zeckhauser, 2002). In other words, the conditions of online social exchange do not appear conducive to social exchange, as defined by mutual trust in the context of ongoing interactions (see Axelrod, 1984; Trivers, 1971).

Nevertheless, e-commerce continues to thrive as more and more people turn to the Internet to buy and sell goods and services. How do we explain the success of Internet shopping that often occurs between anonymous strangers and businesses? One answer is that many online markets rely on electronic reputation or “feedback” systems to promote trust (Bolton, Katok, & Ockenfels, 2004; Resnick et al., 2000). Online feedback mechanisms, such as eBay’s Feedback Forum, collect, distribute, and aggregate feedback about users’ past behavior (Resnick et al., 2000). Users then use this reputational information (derived from anonymous third parties) to decide whether or not to interact with a given buyer or seller. According to Resnick and Zeckhauser (2002), successful reputation systems meet three challenges: they “provide information that allows buyers to distinguish between trustworthy and non-trustworthy sellers, encourage sellers to be trustworthy, and discourage participation from those who aren’t” (p. 3).

From an evolutionary perspective, online reputation systems exploit evolved psychological mechanisms for indirect reciprocity (Alexander, 1987). Indirect reciprocity refers to the process whereby third parties reward individuals in their group with social benefits (e.g., status, trust, social exchange, mating opportunities, etc.) when they behave altruistically. For example, people who punish free riders are trusted to greater extent than people who do not punish free riders, which makes them more desirable as exchange partners (Barclay, 2006). For indirect reciprocity to evolve, a reputation mechanism is needed. For humans, there are two possible reputation mechanisms: direct observation and gossip (i.e., social information communicated to third parties through language) (Nowak & Sigmund, 2005). Online reputation systems rely almost exclusively on the latter, since most transactions occur between strangers. Nevertheless, online reputation systems, such as eBay’s, facilitate social exchange on the basis of indirect reciprocity: “I trust you because you were trustworthy with others before” (Bolton et al., 2004, p. 1588); that is, buyers utilize the reputational feedback of third parties, which is aggregated and displayed online, to decide which sellers are worthy of their trust.

One heuristic eBay users might use to select trustworthy sellers is simply to avoid sellers with negative feedback. However, findings from Resnick, Zeckhauser, Swanson, and Lockwood (2006) suggest that buyers discount negative feedback when they see it, perhaps because it is so rare (see also Resnick & Zeckhauser, 2002). Why would buyers discount negative online feedback?

Findings from Hess and Hagen (2006b) suggest that humans have evolved psychological adaptations for assessing the veracity of gossip (i.e., emotive, reputational information) in order to counteract deceptive communication. In particular, people are often skeptical of negative social information that is disseminated by single and interdependent sources. Stated differently, people are more likely to accept as true gossip disclosed by multiple, independent sources. Applying this reasoning to negative online feedback, we might expect negative feedback to be distrusted because it is most often posted by a single buyer. This leads to the prediction: (6a) negative feedback will be distrusted by eBay users when it is submitted by a single buyer, the same buyer, or interdependent (affiliated) buyers (e.g., buyers who have similar online identities, who are from the same location/region or who have similar pseudonyms).

2.4. Cyber challenges of personal information management

2.4.1. An evolutionary approach to personal information management

Disclosing personal secrets always has risks. For example, as a result of disclosing personal secrets one might receive unhelpful feedback, be rejected, damage a relationship, cause strife to others, or become the target of negative gossip (Kelly & McKillop, 1996; Vrij, Paterson, Nunkoosing, Soukara, & Oosterweel, 2003). On the other hand, keeping secrets have been shown to cause psychological and immunological stress (Cole, Kemeny, Taylor, & Visscher, 1996; Major & Gramzow, 1999), hyperaccessible or intrusive thoughts (Lane & Wegner, 1995; Smart & Wegner, 1999), and prevent some individuals from gaining beneficial insights (Kelly, Klussas, von Weiss, & Kenny, 2001; Pennebaker, 1990).

From an evolutionary psychological perspective, we might expect people to exhibit psychological mechanisms for revealing and withholding certain classes of personal information, particularly those classes of information related to an individual’s inclusive fitness (beneficial or deleterious). These psychological mechanisms would be domain-specific, in that the fitness consequences of a given confession or disclosure would depend on the relationship between the confessor and the intended (or unintended) audience members (see Bering & Shackelford, 2005). This is because self-disclosures often have fitness consequences for audience members as well. For example, information about betraying a sexual partner would have consistently been costly to one’s sexual partner’s inclusive fitness, but less so for one’s friends or relatives. From an evolutionary psychological perspective, then, psychological mechanisms for revealing and withholding certain classes of personal information should be sensitive to the specific social domain in which personal information is revealed (see also Bering & Shackelford, 2004).

Human decision-making regarding the disclosure of personal information should be sensitive to expected audience members, but it should also weigh the probability that unintended individuals will come to learn about the information (e.g., via gossip). Findings from Christophe and Rimé (1997) suggest that most emotional secrets are disclosed to unintended third parties, and that the likelihood of secondary disclosures increases positively with the emotional nature of the secret. If these findings are representative of ancestral social conditions, then natural selection would have favored decision-making heuristics that minimized these social costs, for example, by accepting a narrow range of cues as indication that an individual is trustworthy (as a confidant) or by biasing decision-making towards committing false negatives (i.e., deciding someone is untrustworthy when they really are trustworthy).

On the other hand, disclosing personal information is essential for building and maintaining relationship intimacy and satisfaction (Altman & Taylor, 1973; Derlega, Metts, Petronio, & Margulis, 1993; Hendrick, 1981; Laurenceau, Barrett, & Rovine, 2005). Confession can serve as a signal of commitment to others (Shackelford & Buss, 1996) and withholding personal information in the context of a close personal relationship is often construed as a form of “deception” (Lane & Wegner, 1995). Thus, decisions about disclosing personal information should weigh both the potential costs and benefits of disclosing.

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4 eBay’s reputation system, the Feedback Forum, entails the buyer and seller rating each other (1, 0, or −1) and leaving comments about the transaction upon completion; leaving feedback is voluntary. A feedback profile is automatically generated for registered sellers, which displays the net scores of positives, neutrals, and negatives received for the past 6 months (see Resnick & Zeckhauser, 2002). There are other electronic feedback systems, such as Amazon’s 5-point scaling system, which displays an average feedback score.
2.4.2. Self-disclosure on the Internet

Increased levels of self-disclosure have been observed in anonymous CMC, relative to F2F communication (e.g., Chiou, 2007; Joinson, 2001; McKenna & Bargh, 1998), although this is not always the case (e.g., Mallen, Day, & Green, 2003). It seems there are several important variables mediating this increase in disclosure behavior. First, Joinson (2001) demonstrated that people disclose significantly more about themselves in dyads when their private self-awareness is raised (by relaying a video-conferencing image of the participant to his/her computer) and their public self-awareness is lowered (by making participants unidentifiable to the communication partner). Second, Barak and Gluck-Ofri (2007) found that social context (e.g., type of online forum) affected both the level and type of self-disclosures (with support forums evoking greater and more personal self-disclosures than discussion forums). Third, Joinson, Paine, Buchanan, and Reips (as cited by Paine & Joinson, 2008) found that trust interacts with privacy to influence disclosure behavior, “such that high privacy compensates for low trustworthiness and high trustworthiness compensates for low privacy” (p. 25). Finally, duration of interaction also affects level of disclosure, both on- and offline. Dietz-Uhler, Bishop-Clark, and Howard (2005), for example, found that during an anonymous, computer-mediated discussion about mental illness, the highest frequency (2005), for example, found that during an anonymous, computer-mediated discussion about mental illness, the highest frequency of self-disclosures occurred early on (due to a reciprocity norm between strangers), followed by a sudden drop-off, then a spike, and then a small decline.

Some researchers suggest that certain aspects of CMC (e.g., visual anonymity, privacy) promote self-disclosure behavior (e.g., Ben-Ze’ev, 2003; Suler, 2004) and that this behavior often has beneficial outcomes (e.g., McKenna & Bargh, 2000). For instance, findings from McKenna and Bargh (1998) suggest many people who possess concealable stigmas (i.e., socially devalued traits that are inconspicuous, e.g., homosexuality) benefit from participating in online newsgroups (or communities). Individuals with concealable stigmas (but not individuals with conspicuous stigmas, e.g., obesity), who participate in online newsgroups and who identify with their online community, report greater self-acceptance, decreased estrangement from society, and increased likelihood of coming out to family and friends.

However, self-disclosure over the Internet also has potential negative consequences. From a personal information management perspective, in particular, there appear to be several aspects of Internet media that may interfere with our evolved psychology for managing personal information. First, information posted to the Internet often persists (i.e., remains on the Internet indefinitely in its original form) and is retrievable by online search engines (e.g., Google, Yahoo), so long as it is in public space (e.g., on a “listed” blog) (Viégas, 2005). This aspect of Internet communication could have serious consequences for many individuals, who find details of their private life stored as “permanent digital baggage” (Solove, 2007, p. 10) on the Internet. For example, according to Finder (2006), many companies that recruit young adults on college campuses have been using search engines to conduct background checks on prospective employees.

Second, information posted to the Internet is accessible to a greater number of people than information traveling through traditional communication channels (Solove, 2007). For most of human history, our ancestors lived in Pleistocene Africa in (relatively) small, kin-based groups where gossip traveled by word-of-mouth between individual group members (Barkow, 1992). For our ancestors, gossip served both to bond group members together and to preempt antisocial behavior from occurring within the community (Dunbar, 2004; Piazza & Bering, 2008a). In contemporary urban societies, individuals often interact in anonymous, transient one-shot encounters. In these settings, gossip is less effective as a social deterrent because people do not fear third-party punishment. However, with the emergence of the Internet and affordable, mobile camera technology, this is not always the case. Cell phone cameras make it easy to snap photos/videos of people, and the Internet provides public space for photos and videos to be uploaded for anyone with a computer and Internet connection to view—thus, increasing the likelihood of third-party punishment from community members.

The Internet can also serve as a powerful shaming mechanism. Perhaps, like traditional gossip, the Internet may also serve as a social deterrent for many people. According to findings from Piazza and Bering (2008a), the mere anticipation that one will be gossiped about serves to promote altruistic behavior. Based on these findings, we would predict (7a) that the mere anticipation of having one’s negative actions posted to the Internet, or disclosed in an email, would promote altruistic behavior. Furthermore, if it were true that human cognition is biased to be overly cautious when it comes to managing personal information, we would expect (7b) most people not to disclose personal secrets even when guaranteed anonymity in a CMC session.

Since humans appear to have evolved psychological mechanisms to disclose personal information under circumstances where the likelihood of social support is high (e.g., when disclosing to close kin), we would predict (7c) that perceptions about audience and (7d) perceptions about privacy would moderate online self-disclosure behavior, with more sensitive content being shared when the communication channel is perceived to be limited to close family members or trusted friends, whose own genetic fitness is not compromised by the disclosed information.

2.5. Conclusion

This paper was intended as a research catalyst for psychologists interested in applying an evolutionary framework to Internet behavior. We were moved by the absence of evolutionary-based investigations into this increasingly important arena of human life. Four core research domains central to mainstream EP analysis (i.e., mating and sexual competition; parenting and kinship; trust and social exchange; and personal information management) were used to demonstrate how an evolutionary psychological perspective could generate testable hypotheses about Internet behavior. We do not anticipate that all of our hypotheses will be confirmed, and we certainly do not claim to have exhausted all possible domains of inquiry. Rather, we hope this paper serves as a mechanism for research. Our desire is that researchers from various sub-disciplines of psychology and evolutionary psychology will begin thinking critically about ways of adapting current evolutionary theories and insights to cyberspace, with the ultimate aim of illuminating all manifestations of human behavior—mediated or unmediated.

The prospect of applying evolutionary perspectives to Internet behavior is appealing. As we have argued, understanding our ancestrally evolved motives can help illuminate user preferences and decisions. Take self-disclosure behavior in CMC, for example. Past research has invoked visual anonymity and changes in self-awareness to explain the disinhibition effect (see Chiou, 2007; Joinson, 2001; Suler, 2004; Yao & Flanagan, 2006). Undoubtedly, visual anonymity and self-awareness are linked to disclosure behavior; however, they do not provide a satisfying biological explanation of the phenomenon because they fail to explain why visual anonymity (or self-awareness) is connected to disinhibition at all. On the other hand, this is exactly what an evolutionary perspective can offer. Elsewhere we have argued that perceptions of anonymity are linked to disinhibition because of the socio-ecological conditions in which mechanisms for information management evolved, namely, tight-knit bands of approximately 100–150 people, in which anonymous interactions were virtually non-existent
and gossip about group members was common (see Piazza & Ber-
ing, 2008b). We argue that evolved mechanisms for inhibiting neg-
ative personal information may become disengaged in the absence
of historically reliable social cues (e.g., human eyes, voice or faces),
as is often the case in CMC, resulting in the temporary suspension
of reputation motives (e.g., efforts to conceal personal secrets or
behave altruistically) in these ostensibly private contexts.
As a final word, we would like to make it clear that evolutionary
perspectives are not sufficient explanatory frameworks for under-
standing Internet behavior. Our argument has been, rather, that
when used in conjunction with proximal theoretical models (e.g.,
Joinson, 2003), evolutionary perspectives can deepen our under-
standing of the cognitive biases and motives people bring to their
online experiences, based on well-articulated assumptions about
psychological mechanisms and the specific problems of survival
and sexual reproduction they evolved to solve.

Acknowledgements
We thank two anonymous reviewers for their helpful com-
ments regarding an earlier draft, and Jerome Barkow for challeng-
ing us to write this paper.

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