Evolutionary Psychology

www.epjournal.net – 2013. 11(3): 718-742

Original Article

Psychobehavioral Effects of Hormonal Contraceptive Use

Lisa L. M. Welling, Psychology Department, Oakland University, Rochester, Michigan, USA. Email: welling@oakland.edu.

Abstract: Although female use of hormonal contraceptives (HCs) has been associated with a variety of physical side effects, the psychological and behavioral side effects have received comparatively little attention until recently. Indeed, the long-term impact of HC use on human psychology has been vastly under-researched and has only recently become a focus for mainstream scholars. Women who use HCs report higher rates of depression, reduced sexual functioning, and higher interest in short-term sexual relationships compared to their naturally-cycling counterparts. Also, HC use may alter women's ability to attract a mate, as well as the mate retention behaviors in both users and their romantic partners. Some evidence even suggests that HC use alters mate choice and may negatively affect sexual satisfaction in parous women, with potential effects on future offspring. Interestingly, HCs have become a standard method of population control for captive nonhuman primates, opening up exciting avenues for potential comparative research. Here, the existing literature on the psychobehavioral effects of HCs in humans and nonhuman primates is reviewed and discussed. The potential resulting downstream consequences for the path of human evolution and recommendations for how future research could tease apart the underlying causes of these psychobehavioral effects of HC use are discussed, including suggestions for research involving nonhuman primates.

Keywords: hormonal contraceptives, birth control, nonhuman primates, exogenous hormones, behavior, preferences

Introduction

The hormonal contraceptive (HC) pill was first introduced in the United States in the early 1960's (Dugdale and Masi, 1971) and has since become a popular and effective method of avoiding unintended pregnancy. The introduction of safe, effective, and reliable contraception coincided with (and arguably led to) second-wave feminism, enabling women to assume formerly inaccessible roles in education, the arts, and the workforce (see discussion in Traulsen, Haugbølle, and Bissell, 2003). In 2007 in the United Kingdom, 40-54% of women aged 16-34 and 27% of women under the age of 50 reported currently using

the most popular form of HC, the oral contraceptive pill (Lader, 2007). From 2006-2008, the number of US women who had ever used the oral contraceptive pill stood at 82%, with 22% of women having used an injectable or shot (Mosher and Jones, 2010). Indeed, the popularity of HCs crosses both political and religious boundaries. High proportions of HC users can be found in developed nations as well as in emerging and developing economies (United Nations, 2009). However, this popular method for avoiding unintended pregnancy is not without physical, mental, and behavioral side effects, including possible effects on mate choice and offspring health. Given the worldwide popularity of hormonal contraception, any potentially disruptive effects of HC use, such as effects on affect, mate choice, and/or influences on offspring health (discussed below), need to be considered, as the widespread use of HCs over several generations may then prove to be an important issue.

Physical Side Effects of Hormonal Contraceptive Use

In normally-cycling women, follicle-stimulating hormone (FSH) promotes the growth of immature egg follicles in the ovary during the first phase of the cycle, termed the follicular phase. Luteinizing hormone (LH) surges instigate the release of a mature ovarian follicle at ovulation, causing progesterone levels to increase steeply in the luteal (second) phase of the menstrual cycle. If implantation of a fertilized egg does not occur, then progesterone and estrogen levels decrease and menstruation occurs. HCs work by preventing the release of gonadotropin-releasing hormone (GnRH) from the hypothalamus, thereby blocking a signal to the pituitary gland to produce FSH and LH. This inhibits follicles from maturing/releasing and causes the ovaries to be relatively dormant. Therefore, daily use of HCs mimics the hormonal state of pregnancy by increasing and flattening a woman's levels of both progesterone and estrogen, resulting in the prevention of ovulation and a loss of normal fertility (reviewed in Alvergne and Lummaa, 2009).

As well as providing human females with control over their fertility, various types of HCs that are identical or similar to brands used in humans have also been administered to captive nonhuman primates with success, with subdermal melengestrol acetate implants the most common form of HC used in zoo primates (Porton and DeMatteo, 2005). In such cases, HCs are administered for either experimental reasons or as a method of population control in captive groups and can be accompanied by certain physical side-effects. Cynomolgus monkeys given low-dose HCs actually showed a reduced risk of arterial thrombosis (Bellinger, Williams, Adams, Honoré, and Bender, 1998) and coronary artery atherosclerosis (Clarkson et al., 1990; Kaplan et al., 1995) compared to controls, but demonstrated reduced bone mineral content and density when given combined oral contraceptives (Register, Jayo, and Jerome, 1997). High-dose HCs are associated with uterine tumors, mammary gland tumors, and mammary gland intraductal hyperplasia, although use of high-dose HCs is no longer standard (Valerio, 1989). Weight gain is a common side effect in baboons (Portugal and Asa, 1995), chimpanzees (Bettinger, Cougar, Lee, Lasley, and Wallis, 1997; Bourrry, Peignot, and Rouquet, 2005), and in common marmosets (Möehle, Heistermann, Einspanier, and Hodges, 1999) administered progestin-based HCs, which have also been shown to decrease the vaginal epithelium of rhesus

monkeys over time (Hild-Petito, Veazey, Larner, Reel, and Blye, 1998). In addition, administering HCs to baboons (Kushwaha and Born, 1991) and cynomolgus monkeys (Colvin, Wagner, Adams, and Sorci-Thomas, 1998; Kavanagh et al., 2009) alters cholesterol levels in a way consistent with an increased risk of gallstones. Other physical side effects have been more striking; although black lemurs are typically sexually dimorphic in color, with males having black fur and females having brown fur, female black lemurs given Depo-Provera experienced pelage darkening (Asa, Porton, and Junge, 2007). In general, however, contraceptives are considered a safe and effective method to control captive nonhuman primate populations (Porton and DeMatteo, 2005).

In humans, HC use is thought to be associated with several non-contraceptive health benefits. For example, women using HCs are at a reduced risk of both ovarian (Lurie et al., 2007; Ness et al., 2000; Royar, Becher, and Chang-Claude, 2001; Walker, Schlesselman, and Ness, 2002) and endometrial cancer (Burkman, 2001; Hannaford and Kay, 1998) compared to women who do not use HCs. Recently, Davis, Godwin, Lippman, Olson, and Kafrissen (2000) found that a triphasic combination oral contraceptive containing norgestimate and ethinyl estradiol (E2) effectively treated dysfunctional uterine bleeding. Oral contraceptive use decreases menstrual blood flow and is associated with a reduced prevalence of anemia and increased hemoglobin concentrations in anemic women (Milman, Clausen, and Byg, 1998; Rivera et al., 1983). Because HCs inhibit ovulation, frequency of functional ovarian cysts are nearly eliminated, and the incidence of dysmenorrhea and premenstrual tension is significantly reduced (Mishell, 1982). Oral contraceptives also protect women from developing rheumatoid arthritis, pelvic inflammatory disease (Mishell, 1982), and reduce acne (Koulianos, 2000; Olson, Lippman, and Robisch, 1998; Thorneycroft et al., 1999).

However, HC use is also associated with a variety of negative physical side-effects, such as an increased risk of venous thromboembolism (Bloemenkamp et al., 1999; Farmer, Lawrenson, Thompson, Kennedy, and Hambleton, 1997; Farmer and Preston, 1995; Lidegaard, Edström, and Kreiner, 2002; Parkin, Skegg, Wilson, Herbison, and Paul, 2000; Spitzer, Lewis, Heinemann, Thorogood, and MacRae, 1996), myocardial infarction (Lewis, Heinemann, Spitzer, MacRae, and Bruppacher, 1997; Lewis, Spitzer, Heinemann, MacRae, and Bruppacher, 1996), ischemic stroke (Heinemann et al., 1998; Kemmeren et al., 2002) (see also Cole, Norman, Doherty, and Walker, 2007), and weight gain (e.g., Molland et al., 1996). HC users also experience more sleep disruption than non-users (Shine Burdick, Hoffmann, and Armitage, 2002) and are at a higher risk of acquiring gallstones (Etminan, Delaney, Bressler, and Brophy, 2011). Additionally, there is some, albeit limited, evidence that HC use may be associated with an increased risk of migraines (Allais, Gabellari, De Lorenzo, Mana, and Benedetto, 2009), high blood pressure (Fisch and Frank, 1977; Weir et al., 1974), cervical cancer (Delgado-Rodriguez, Sillero-Arenas, Martin-Moreno, and Galvez-Vargas, 1992; Moreno et al., 2002), breast cancer (reviewed in Marchbanks et al., 2002), and fetal abnormalities (reviewed in Waller et al., 2010). Despite these slightly elevated health risks, it is generally agreed that HCs are a safe means of effectively preventing pregnancy. However, physicians have tended to focus exclusively on these types of physical issues, leaving the potential psychological and behavioral side-effects largely ignored. For this reason, the investigation into nonphysical side-effects of HC use is

relatively recent and much remains unknown.

Psychological and Behavioral Effects of Hormonal Contraceptive Use

Recently, researchers have documented negative effects on mood and psychological well-being as a consequence of HC use in women (Bancroft, Sanders, Warner, and Loudon, 1987; Herzberg and Coppen, 1970; Kahn and Halbreich, 2001; Kurshan and Epperson, 2006; Oinonen and Mazmanian, 2002). DeSoto, Geary, Hoard, Sheldon, and Cooper (2003) found that women using HCs exhibited more symptoms of borderline personality disorder (BPD), a disorder characterized by a pervasive pattern of instability in affect regulation, impulse control, interpersonal relationships, and self-image (Lieb, Zanarini, Schmahl, Linehan, and Bohus, 2004), and that women with high pre-existing levels of BPD symptoms became significantly worse after starting HC use (DeSoto et al., 2003). Sanders, Graham, Bass, and Bancroft (2001) found that negative changes in emotional and sexual well-being were important predictors of discontinuation of oral contraceptives (see also Graham, Ramos, Bancroft, Maglaya, and Farley, 1995; Rosenberg and Waugh, 1998; Rosenberg, Waugh, and Meehan, 1995), although HC users report experiencing less variability in affect across the menstrual cycle and less negative affect during menstruation (Oinonen and Mazmanian, 2002). While women low in social anxiety are more likely to use oral contraceptives (Leary and Dobbins, 1983), HC users describe higher rates of depression (e.g., Kulkarni, 2007) than normally cycling women. On the other hand, pair-bonded (but not single) women report lower levels of intrasexual competition when using HCs as compared to when they are regularly cycling (Cobey, Klipping, and Buunk, 2013). Oral contraceptive-using women also showed significantly attenuated cortisol responses to stressors compared to controls (Roche, King, Cohoon, and Lovallo, 2013), with peak cortisol levels only slightly elevated above baseline levels (Kirschbaum, Pirke, and Hellhammer, 1995). Therefore, HC use appears to interfere with the adrenocortical response to psychological stress by influencing the amount of bioavailable unbound cortisol (see also Kirschbaum, Kudielka, Gaab, Schommer, and Hellhammer, 1999), although reports of affective responses to identical stressor tasks do not differ as a function of HC use (Marinari, Leshner, and Doyle, 1976). Furthermore, Egarter, Topcuoglu, Imhof, and Huber (1999) found that a low-dose oral contraceptive actually improved patients' perceptions of their own quality of life (see also Caruso et al., 2011; Ernst, Baumgartner, Bauer, and Janssen, 2002), highlighting the need for further research.

Consistent with research in humans, HCs also appear to alter the social behavior of nonhuman primates. Administering HCs to female macaques increases the frequency of contact aggression received or given, time spent in locomotion, activity levels, and the time spent sitting close to another animal, and decreases the time spent fearfully scanning (Henderson and Shively, 2004; Pazol, Wilson, and Whallen, 2004; Shively, 1998; Shively and Bethea, 2004; Shively, Manuck, Kaplan, and Koritnik, 1990; Shively et al., 2007). For example, female long-tailed macaques on HCs behaved more aggressively toward subordinates in the presence of a male (Shively et al., 1990), but also received more contact aggression (Henderson and Shively, 2004, see also Shively, 1998, and Shively and Bethea, 2004, for similar findings in female cynomolgus monkeys). In female lowland gorillas,

combined oral contraceptive pills appear to eliminate cyclic changes in aggressive and affiliative behavior, as well as any temporal trends in proximity to males (Sarfaty, Margulis, and Atsalis, 2012). Similarly, hamadryas baboon females treated with melengestrol acetate engaged in fewer affiliative interactions, although there was no change in aggression (Portugal and Asa, 1995). In cynomolgus monkeys, past HC use increases cardiovascular and hypothalamic-pituitary-adrenal (HPA) responses to stress in socially dominant females only, suggesting complex interactions with social hierarchies (Shively, 1998). Experimental studies of this nature with nonhuman primates reinforce the concept that HC use changes social behavior and psychology, although some studies found little or no influence of HCs on some primate social behaviors, such as social grooming (de Vleeschouwer, van Elsacker, Leus, and Heistermann, 2000; Guy et al., 2008; Portugal and Asa, 1995; Steklis, Linn, Howard, Kling, and Tiger, 1982). This research further provides experimenters with a method infrequently used in humans for ethical reasons, thereby providing valuable demonstrations of the experimental (versus correlational) effect of HCs on social behavior.

HCs appear to influence sexual behavior, with reported or apparent reduced sexual functioning and interest in humans (Bancroft et al., 1987; Caruso et al., 2004; Graham et al., 1995; Sanders et al., 2001; Wallwiener et al., 2010; but see Caruso et al., 2005) and in other primates (Guy et al., 2008; Michael, Saayman, and Zumpe, 1968; Nadler, Dahl, Gould, and Collins, 1993; Shimizu, Takenoshita, Mitsunaga, and Nozaki, 1996; Steklis et al., 1982). However, human female HC use is also associated with a greater number of reported sexual partners (Little, Jones, Penton-Voak, Burt, and Perrett, 2002) and significantly greater interest in engaging in short-term sexual relationships across all phases of the menstrual cycle (Guillermo, Manlove, Gray, Zava, and Marrs, 2010), indicating that women who choose to use HCs may differ from others in their degree of sociosexuality. Still, whether a higher number of sexual partners is the cause or the consequence of the use of contraception is unknown. While it is possible that some other, unmeasured difference between women who choose to use or not use HCs may be driving these findings, these studies suggest the possibility that synthetic hormones administered via HCs may influence female psychology and behavior. In line with this suggestion, Nadler et al. (1993) found that copulations were reduced in chimpanzees when the females were administered HCs, but that the effect of HCs on copulation was directly related to the social and sexual relationship of the pairs during natural cycles. Chimpanzee pairs that were more compatible and who copulated more frequently prior to HC use continued to copulate while using HCs, albeit at reduced rates, whereas the less compatible and less frequently copulating pairs ceased copulating altogether. Similar to the aforementioned finding that HCs differentially influence stress responses based on dominance status (Shively, 1998), Nadler et al.'s (1993) findings suggest that social factors may determine the degree of response to HCs on sexual behavior and may have comparative implications for human relationships.

Other behavioral effects of HCs have also been documented. Typically, gross electrical activity in the brain recorded via Electro Encephalography (EEG) changes with hormonal fluctuations over the menstrual cycle (Becker, Creutzfeldt, Schwibbe, and Wuttke, 1982; Gawali, Rokade, Janvale, and Mehrota, 2009; Soliz-Ortiz, Ramos, Arce, Guevara, and Corsi-Cabrera, 1994). This physiological change is accompanied by an

increase in several performance task scores during the periovulatory period compared with the late luteal and early menstrual phases, but only in naturally-cycling women (Becker et al., 1982). Interestingly, although some studies have found that HC users tend to outperform non-users in reaction time and short-term memory tasks across the cycle (Griksiene and Ruksenas, 2010), higher doses of synthetic progesterone are associated with decreased information processing and verbal memory function, and increased fatigue (Freeman, Weinstock, Rickels, Sondheimer, and Coutifaris, 1992). The full implications of these findings and whether analogous effects exist in nonhuman primates remain to be investigated.

Effects on Mate-Choice

HCs seem to, in some ways, limit women's ability to attract mates. In nonhuman primates, males of several species, including rhesus monkeys (Baum, Keverne, Everitt, Herbert, and De Greef, 1977b; Michael, Herbert, and Welegalla, 1967; Michael et al., 1968), stumptail macaques (Linn and Steklis, 1990; Steklis et al., 1982), hamadryas baboons (Guy et al., 2008), and chimpanzees (Nadler et al., 1993), are less likely to copulate with females that have been treated with synthetic progesterone or a combined HC. Crawford, Boulet, and Dreal (2011) found that male ring-tailed lemurs preferentially investigated the odorants of naturally-cycling over contracepted females, and that administration of the commonly used contraceptive medroxyprogesterone acetate to females altered the olfactory cues that signal their identity, fertility status, genetic quality, and relatedness. In humans, because men prefer ovulating women in situations where they can compare the attractiveness of different women's scents (Thornhill et al., 2003) and facial attractiveness (Roberts et al., 2004), the use of HCs may also influence a woman's attractiveness to men. Indeed, pill users and non-pill users do not differ in their overall odor attractiveness but, unlike in normally cycling women, the attractiveness of the odors of pill users do not depend on their menstrual cycle phase (Kuukasjärvi et al., 2004). Additionally, although the voices of normally cycling women become more attractive near ovulation, potentially allowing women to be better able to attract high quality mates when fertility is high, this effect of changing vocal attractiveness is not observed in those using contraceptive pills (Pipitone and Gallup, 2008). One study by Miller, Tybur, and Jordan (2007) looked at average earnings of lap-dancers and compared income in naturally-cycling women versus those using HCs at difference points in their cycles. Normally cycling lap dancers earned significantly more per shift during the fertile phase of their menstrual cycle than at other phases, while participants using contraceptive pills, by contrast, showed no earnings peak associated with cycle phase (Miller et al., 2007). This is among the most direct current evidence for HC use disrupting women's attractiveness over the cycle, particularly given that real-life consumer spending on exotic dancers may more accurately reflect actual male mate choice decisions (and preferences) than hypothetical attractiveness laboratory-based judgments (Miller et al., 2007), although effects of HC use in other attractiveness domains (e.g., changes in ornamentation, which changes as a function of fertility status in naturally-cycling women; Haselton, Mortezaie, Pillsworth, Bleske-Rechek, and Frederick, 2006) remain to be investigated. Critically, this research shows that

oral contraceptives may remove the cyclicity of female attractiveness, which may substantially limit the ability of some women to draw the interest of attractive men of high genetic quality.

Preferences for men's traits vary over the ovulatory cycle in a potentially adaptive way in naturally-cycling women. Traits such as masculinity, symmetry, and dominance are thought to signal genetic quality in human males (reviewed in Gangestad and Thornhill, 2008), making an increase in preferences for these traits at fertile periods in the cycle a potentially adaptive mechanism. Indeed, women's preferences for male facial masculinity (Johnston, Hagel, Franklin, Fink, and Grammer, 2001; Little, Jones, and DeBruine, 2008; Penton-Voak and Perrett, 2000; Penton-Voak et al., 1999), masculine body shape (Little, Jones, and Burriss, 2007), the odor of masculine men (Grammer, 1993; Havlíček, Roberts, and Flegr, 2005), masculine voices (Feinberg et al., 2006; Puts, 2005), and various non-physical traits, such as dominant and intrasexually competitive behavior (Gangestad, Garver-Apgar, Simpson, and Cousins, 2007; Gangestad, Simpson, Cousins, Garver-Apgar, and Christensen, 2004; Lukaszewski and Roney, 2009) and creativity (Haselton and Miller, 2006) are highest near peak fertility. These cyclic changes in preferences could increase the likelihood of women mating with high genetic quality individuals, thereby maximizing the chances of offspring survival. Comparably, female rhesus monkeys display a higher visual preference for male rhesus monkey faces than for female rhesus monkey faces during the peri-ovulatory phase of their menstrual cycles compared to other phases (Lacreuse, Martin-Malivel, Lange, and Herndon, 2007), indicating an increase in attention to reproductively relevant stimuli during peak fertility.

Adaptive mechanisms at other points in women's menstrual cycles may have likewise evolved. During the luteal phase when conception risk is low and progesterone levels are high, preferences increase for facial self-resemblance (DeBruine, Jones, and Perrett, 2005), apparent health in faces (Jones et al., 2005a, 2005b), and attention to social stimuli (Miller, 2011). These preference changes may function to promote affiliation with kin, healthy individuals, and those demonstrating positive social affiliation, respectively, prior to and during pregnancy when progesterone levels are also raised. Affiliation with kin, healthy individuals, and those demonstrating positive social regard during pregnancy would be extremely adaptive because it would reduce risks to both the mother and the fetus by limiting exposure to pathogens and by increasing association with individuals offering support. Certainly, progesterone level is positively associated with other behaviors that are potentially beneficial to offspring, such as maternal competence (i.e., the ability to effectively rear young), in nonhuman primates (reviewed in Maestripieri, 1999).

It is likely that variation in preferences over the ovulatory cycle are governed by natural changes in hormone levels (e.g., Jones et al., 2008; Lacreuse et al., 2007; Little et al., 2008; Welling et al., 2007). Therefore, it is perhaps unsurprising that these possibly adaptive variations in preferences are largely absent in those reporting HC use (Gangestad et al., 2007; Guéguen, 2009; Johnston et al., 2001; Jones et al., 2005b; Laeng and Falkenberg, 2007; Little et al., 2007; Pawłowski and Jasienska, 2005; Penton-Voak et al., 1999; Puts, 2005, 2006; Rosen and López, 2009). As compared to normally cycling women, pill users show either weaker or no preferences for facial (Little et al., 2002; Penton-Voak et al., 1999) and vocal masculinity (Feinberg, DeBruine, Jones, and Little,

2008), and initiation of HC use actually decreases women's preferences for male facial masculinity (Little, Burriss, Petrie, Jones, and Roberts, in press). For example, Penton-Voak et al. (1999) found that, unlike naturally-cycling women, women using HCs showed no change in preference for masculinity in male faces over their cycles. Likewise, in contrast to non-pill users, pill users express neither a preference for the scents of symmetrical men (thought to be an honest signal of phenotypic and genetic quality in human males), nor a change in male scent preferences over the menstrual cycle (Thornhill and Gangestad, 2003), nor an attentional bias toward courtship language during the fertile (versus non-fertile) phase of their menstrual cycles (Rosen and López 2009).

Because of the potentially adaptive nature of ovulatory cycle shifts in preferences (Gangestad and Thornhill, 2008), HCs that alter them may detrimentally influence mate preferences and mate choice (Alvergne and Lummaa, 2009; Havlíček and Roberts, 2009; Roberts, Gosling, Carter, and Petrie, 2008; Wedekind and Füri, 1997). Perhaps the clearest evidence for this hypothesis comes from research on mate preferences for genetic complementarity at the major histocompatibility complex (MHC, also called human leukocyte antigen, or HLA; see Havlíček and Roberts, 2009), which appears to be important for primate fitness (Havlíček and Roberts, 2009; Sauermann et al., 2001; Schwensow, Eberle, and Sommer, 2008; Setchell and Huchard, 2010; Widdig et al., 2004). Although evidence for preferences for the faces of MHC-dissimilar people is somewhat mixed (reviewed in Havlíček and Roberts, 2009), women not using HCs demonstrate adaptive preferences for the scent of MHC-dissimilar men, but women using the contraceptive pill preferred the smell of MHC-*similar* men (Wedekind and Füri, 1997; Wedekind, Seebeck, Bettens, and Paepke, 1995). Following this work, Roberts et al. (2008) tested whether contraceptive pill use alters odor preferences using a longitudinal design in which women were tested before and after initiating pill use. Contrary to previous findings (Wedekind and Füri, 1997; Wedekind et al., 1995), Roberts et al. (2008) found no significant difference in ratings between odors of MHC-dissimilar and MHC-similar men among naturally-cycling women. However, there was an effect of relationship status, with single women preferring the odors of MHC-similar men and women in relationships preferring the odors of MHC-dissimilar men. This suggests that paired females may seek to improve offspring quality through extra-pair partnerships (Roberts et al., 2008). Nonetheless, there was a significant preference shift towards MHC-similarity associated with pill use across tests, which was not evident in a control group of nonusers. Together, these results suggest that, if odor plays a role in human mate choice, contraceptive pill use could disrupt adaptive disassortative mate preferences.

Effects on Current Romantic Relationships

Disruption of natural shifts in preferences (Gangestad et al., 2007; Guéguen, 2009; Johnston et al., 2001; Jones et al., 2005b; Laeng and Falkenberg, 2007; Little et al., 2007; Pawłowski and Jasienska, 2005; Penton-Voak et al., 1999; Puts, 2005, 2006; Rosen and López, 2009) and shifts in attractiveness (Miller et al., 2007; Pipitone and Gallup, 2008) caused by HC use could lead to more or less conflict within a relationship. Although currently untested, it is possible, for example, that women using HCs will be less likely to

establish long-term partnerships with masculine men, since HC users (compared to non-users) show weaker preferences for male masculinity (Feinberg et al., 2008; Little et al., 2002; Penton-Voak et al., 1999). If true, this could theoretically lead to less relationship conflict because masculine traits in men are associated with negative personality characteristics (e.g., dishonesty; Perrett et al., 1998) that could have a negative influence on relationship quality. However, if HC use does have possible negative consequences for the romantic relationships of the user, perhaps because it leads women to select different partners than they would otherwise, one might expect to see links between HC use and negative relationship properties. Certainly, this appears to be the case: Use of HCs shifts preferences towards more MHC-similar mates (Roberts et al., 2008), and women with relatively MHC-similar partners report increased interest in extra-pair relationships and reduced in-pair sexual satisfaction (Garver-Apgar, Gangestad, Thornhill, Miller, and Olp, 2006). If subsequent cessation of HCs leads to a realignment of a woman's preferences and a reduction in attraction to her partner after a partnership has already formed, then the cessation of HCs could lead to relationship dissolution. Moreover, women who use HCs report more intense affective responses to partner infidelity and greater overall sexual jealousy than women who do not use HCs (Geary, DeSoto, Hoard, Skaggs Sheldon, and Cooper, 2001), potentially because of the disruption of natural masculinity preferences (e.g., Penton-Voak et al., 1999). Despite recent arguments that most of the side effects of hormonal contraception are a result of a psychological response to the practice of contraception and not actually due to hormonal influences (Robinson, Dowell, Pedulla, and McCauley, 2004), Cobey, Pollet, Roberts, and Buunk (2011) recently extended Geary et al.'s (2001) research by examining whether feelings of jealousy vary with the dose of synthetic hormones in combined oral contraceptives. They found that higher doses of synthetic estradiol, but not progestin, were associated with significantly higher levels of self-reported jealousy.

One hypothesized function of jealousy is that it generates behaviors that might function to maintain relationships by reducing the likelihood of a partner straying or being poached by a rival (e.g., Buss, 1988; Daly, Wilson, and Weghorst, 1982; Shackelford, Besser, and Goetz, 2008; Shackelford, Goetz, Buss, Euler, and Hoier, 2005). Jealousy and other types of so-called "mate retention behaviors" can be assessed using the Mate Retention Inventory (MRI; Buss, 1988; Buss, Shackelford, and McKibbin, 2008), which assesses the incidence of mate retention behaviors ranging from expressions of love to outright physical violence that can be directed at either romantic partners or potential romantic rivals. Scores on the MRI are positively related to relationship aggression and negatively related to marital satisfaction (as discussed in Buss et al., 2008), demonstrating that incidence of mate retention behaviors has real-life consequences for romantic relationships. Because HC use may alter mate preferences (Alvergne and Lummaa, 2009; Havlíček and Roberts, 2009; Roberts et al., 2008; Wedekind and Füri, 1997), potentially leading to relationship conflict and increased jealousy (Cobey et al., 2011; Geary et al., 2001), Welling, Puts, Roberts, Little, and Burriss (2012) investigated the effects of HC use on reported mate retention behaviors in heterosexual women and their male partners, finding that HC users report more frequent use of mate retention tactics, specifically those directed at their partners. Also, men partnered with women using HCs report more frequent

use of mate retention behaviors in general than men with naturally-cycling partners. Finally, in line with previous findings (Cobey et al., 2011), the dose of synthetic estradiol, but not of synthetic progesterone, predicted the frequency of mate retention behaviors among women using HCs (Welling et al., 2012). Thus, HCs, particularly those high in synthetic estradiol, may influence intra-couple behavior that may affect the quality of romantic relationships.

Further evidence that HC use may affect interpersonal romantic relationships comes from Roberts et al.'s (2012) recent study, which tested for differences in relationship quality and dissolution between women who were using or not using oral contraceptives when they chose the partner who fathered their first child. They found that female oral contraceptive users (relative to non-users) scored lower on measures of sexual satisfaction and partner attraction, experienced decreasing sexual satisfaction during the relationship, and were more likely than their partner to be the one to initiate an eventual separation if it occurred. However, these same contraceptive-using women were less likely to separate from their partners overall and were more satisfied with their partner's financial provision than women who were not using contraceptives when they met the father of their first child (Roberts et al., 2012). When taken with the findings that HCs suppress shifts in women's preferences for phenotypic indicators of men's genetic quality (e.g., Little et al., 2007), these results suggest that oral contraceptive use could potentially lead women to choose different partners than they would otherwise, which may have wide-reaching impacts on relationship outcome, human reproductive behavior, sexual satisfaction, and the quality of family life. Certainly, although no such findings currently exist, experimental research on HC administration to monogamous nonhuman primates may shed particular light on these potential relationship issues.

Potential Consequences for Offspring

There may also be genetic issues to consider, aside from the slight increase in the possibility of fetal abnormalities for pill users (for a review, see Waller et al., 2010). As suggested by Havlíček and Roberts (2009), if HC use while forming relationships leads to a choice of partner that would otherwise not be preferred, low genetic compatibility between partners could result through the choice of MHC-similar mates. MHC similarity between partners can be associated with pre-eclampsia (Ooki et al., 2008) and low genetic compatibility between partners could influence the time taken to conceive a child (Havlíček and Roberts, 2009). Still, effects on the hypothetically-resulting homozygosity (a property of the offspring of parents who are MHC-similar) of fetuses and children is arguably even more important, since it extends further beyond the initial mate preference disruption. Although there are currently no studies investigating the direct effect of HC use on the homozygosity of pill users' offspring, homozygosity may influence the ability to reproduce. In rhesus macaques, MHC heterozygosity (the opposite of homozygosity) is positively related to the number of offspring produced (Sauermann et al., 2001; Widdig et al., 2004). In humans, there is limited evidence that homozygous fetuses are more often aborted via spontaneous fetal abortion (reviewed in Beydoun and Saftlas, 2005; Ober, Hyslop, and Hauck, 1999; Reznikoff-Etievant et al., 1991) and offspring homozygosity is

associated with reduced birthweight (Reznikoff-Etievant et al., 1991), which may influence the offspring's eventual health and reproductive success (Lummaa and Clutton-Brock, 2002). Roberts et al. (2005) also predicted that surviving human offspring of pill users will be more homozygous, which may be related to impaired immune function and decreased perceived health and attractiveness. However, it is important to note that none of these studies directly tests for the impact of HC use on offspring health and success in either human or nonhuman primates.

If commencement or cessation of HCs influences relationship quality and stability (Havlíček and Roberts, 2009; Roberts et al., 2012; Vollrath and Milinski, 1995; Welling et al., 2012), what might the possible consequences be for potential offspring? Conflict in the family environment, including between parents, can have an impact on offspring emotional, social, and physical well-being. Belsky, Steinberg, and Draper (1991) predicted that early childhood family-related stress would be associated with behavioral problems, early puberty, precocious sexual behavior, and unstable pair bonds and limited investment in children in adulthood. Consistent with these predictions, Kim (1998) found that earlier menarche in women and earlier spermarche in men was associated with parental conflict and earlier age at dating for both sexes (see also Kim and Smith, 1999; Moffitt, Caspi, Belsky, and Silva, 1992). Other research has found relationships between unfavorable childhood environments and number of deceased siblings (Bereczkei and Csanaky, 2001) as well as marital problems later in life (Bereczkei and Csanaky, 1996). Therefore, if commencement or cessation of HCs negatively influences relationship quality/stability, then it could also influence the experiences of potential children that are born into those relationships. Importantly, however, there is currently no research that directly tests or finds this association. Accordingly, any predicted associations between pill use and negative family environment, offspring homozygosity, offspring health or attractiveness, and offspring reproductive success are largely speculative and should be treated with due caution.

Conclusions and Future Directions

The above research suggests that HC use has consequences for women's physical (e.g., Burkman, 2001; Hannaford and Kay, 1998; Heinemann et al., 1998; Kemmeren et al., 2002) and mental well-being (DeSoto et al., 2003; Leary and Dobbins, 1983; Sanders et al., 2001), disrupts potentially adaptive changes in women's preferences (Gangestad et al., 2007; Johnston et al., 2001; Jones et al., 2005b; Little et al., 2007; Pawłowski and Jasienska, 2005; Penton-Voak et al., 1999; Puts, 2006; Rosen and López, 2009), limits women's ability to attract mates (Miller et al., 2007; Pipitone and Gallup, 2008), and may have negative consequences for relationship satisfaction (Cobey et al., 2011; Geary et al., 2001; Roberts et al., 2012; Welling et al., 2012) and partner choice (e.g., Roberts et al., 2008, 2012). However, given that investigations into the psychobehavioral effects of HC use are fairly recent, much of the research exploring these issues is correlational and tentative. Further studies, particularly ones using within-subject designs and cross-cultural (non-Western) comparisons, are needed. Moreover, additional retrospective research on HC instigation or cessation before or during a long-term relationship could provide needed

insight into the impact of HCs on women's psychosocial behavior and mating decisions.

Despite some investigators' attempts at controlling for potential differences between pill users and non-users, more research on whether general differences between those using and not using HCs account for the above effects is warranted. As mentioned by Roberts et al. (2012), perhaps the most effective way to experimentally demonstrate effects of HC use (as opposed to HC-related confounds) would be to employ a placebo-controlled double-blind study with random assignment to either a contraceptive pill or placebo, using non-hormonal birth control for both groups to minimize ethical considerations. However, an alternative and potentially simpler way to look for evidence of psychobehavioral changes, such as changes in mating strategy, mate guarding, preferences, and ability to attract partners, would be to test for effects of HC use on nonhuman primates. Some evidence suggests that synthetic ovarian steroids can modulate the expression of nonhuman female primates' proceptive behavior (e.g., Baum, 1983; Baum, Everitt, Herbert, and Keverne, 1977a; Trimble and Herbert, 1968), can reduce their ability to attract mates (e.g., Guy et al., 2008; Linn and Steklis, 1990), and can abolish or significantly reduce the cyclic increase in female anogenital swelling (Bettinger et al., 1997; Bourry et al., 2005; Nadler, Dahl, Collins, and Gould, 1992; Nadler et al., 1993; Portugal and Asa, 1995). Other research on female lowland gorillas (Sarfaty et al., 2012) and chimpanzees (Nadler et al., 1993) suggest marked changes in reproductive and social behavior as a consequence of HC use. Future work should continue to take advantage of this fruitful line of comparative research by examining the psychobehavioral and genetic influences of HC use on female (and male; McLachlan et al., 2002) promiscuous and monogamous nonhuman primates and how findings may generalize to humans.

Currently, it is unclear whether HCs influence actual mate choice and whether this has real-life consequences for potential offspring. Although HC use may negatively affect intra-couple behavior (Cobey et al., 2011, 2012; Havlíček and Roberts, 2009; Roberts et al., 2012; Vollrath and Milinski, 1995; Welling et al., 2012) and may alter preferences for MHC heterozygosity (Havlíček and Roberts, 2009; Roberts et al., 2008; Wedekind et al., 1995; Wedekind and Füri, 1997), which could hypothetically have negative consequences for future offspring (e.g., Reznikoff-Etievant et al., 1991), direct empirical evidence for these theoretical longitudinal consequences of HC use is lacking. Additionally, although there is some evidence that laboratory-tested mate preferences may reflect real-life mate choices (DeBruine et al., 2006), supporting evidence that preferences in naturally-cycling women reflect real partner choice, and that HC use disrupts natural preferences, is desirable. Finally, no studies have looked at long-term effects of HC use as it relates to offspring health, offspring physical and behavioral traits, and/or offspring mating strategies in any primate species.

In closing, it should be noted that although a full and complete understanding of the potential effects of hormonal contraceptive use on physiology, psychology, and behavior is incredibly important, any effects should be weighed against the multiple benefits that the revolutionary invention of HCs has brought. Effective contraceptive methods have given women control over their fertility that is unprecedented and has aided in many personal and economic achievements for women (Goldin and Katz, 2002). Regardless, future independent and comparative research on the psychological and behavioral effects of HC

use in humans and nonhuman primates is crucial. The additional knowledge gained from this research could help in the development of new contraceptive methods and will allow women to make more informed decisions regarding the type and timing of their HC use.

Received 01 July 2012; Revision submitted 01 October 2012; Accepted 02 October 2012

References

Allais, G., Gabellari, I. C., De Lorenzo, C., Mana, O., and Benedetto, C. (2009). Oral contraceptives in migraine. *Expert Review of Neurotherapeutics, 9*, 381-393.

Alvergne, A., and Lummaa, V. (2009). Does the contraceptive pill alter mate choice in humans? *Trends in Ecology & Evolution, 25*, 171-179.

Asa, C. S., Porton, I. J., and Junge, R. (2007). Reproductive cycles and contraception of black lemurs (*Eulemur macaco macaco*) with depot medroxyprogesterone acetate during the breeding season. *Zoo Biology, 26*, 289-298.

Bancroft, J., Sanders, D., Warner, P., and Loudon, N. (1987). The effects of oral contraceptives on mood and sexuality: A comparison of triphasic and combined preparations. *Journal of Psychosomatic Obstetrics & Gynecology, 7*, 1-8.

Baum, M. J. (1983). Hormonal modulation of sexuality in female primates. *BioScience, 33*, 578-582.

Baum, M. J., Everitt, B. J., Herbert, J., and Keverne, E. B. (1977a). Hormonal basis of proceptivity and receptivity in female primates. *Archives of Sexual Behavior, 6*, 173-192.

Baum, M. J., Keverne, E. B., Everitt, B. J., Herbert, J., and De Greef, W. J. (1977b). Effects of progesterone and estradiol on sexual attractivity of female rhesus monkeys. *Physiology & Behavior, 18*, 659-670.

Becker, D., Creutzfeldt, O. D., Schwibbe, M., and Wuttke, W. (1982). *Psychoneuroendocrinology, 2*, 75-90.

Bellinger, D. A., Williams, J. K., Adams, M. R., Honoré, E. K., and Bender, D. E. (1998). Oral contraceptives and hormone replacement therapy do not increase the incidence of arterial thrombosis in a nonhuman primate model. *Arteriosclerosis, Thrombosis, and Vascular Biology,18*, 92-99.

Belsky, J., Steinberg, L., and Draper, P. (1991). Childhood experience, interpersonal development, and reproductive strategy: An evolutionary theory of socialization. *Child Development, 62*, 647-670.

Bereczkei, T., and Csanaky, A. (1996). Evolutionary pathway of child development. *Human Nature, 7*, 257-280.

Bereczkei, T., and Csanaky, A. (2001). Stressful family environment, mortality, and child socialisation: Life-history strategies among adolescents and adults from unfavourable social circumstances. *International Journal of Behavioral Development, 25*, 501-508.

Bettinger, T., Cougar, D., Lee, D. R., Lasley, B. L., and Wallis, J. (1997). Ovarian hormone concentrations and genital swelling patterns in female chimpanzees with Norplant

implants. *Zoo Biology, 16*, 209-223.

Beydoun, H., and Saftlas, A. F. (2005). Association of human leucocyte antigen sharing with recurrent spontaneous abortions. *Tissue Antigens, 65*, 123-135.

Bloemenkamp, K. W. M., Rosendaal, F. R., Buller, H. R., Helmerhorst, F. M., Colly, L. P., and Vandenbroucke, J. P. (1999). Risk of venous thrombosis with use of current low-dose oral contraceptives is not explained by diagnostic suspicion and referral bias. *Archives of Internal Medicine, 159*, 65-70.

Bourry, O., Peignot, P., and Rouquet, P. (2005). Contraception in the chimpanzee: 12-year experience at the CIRMF Primate Centre, Gabon. *Journal of Medical Primatology, 34*, 25-34.

Burkman, R. T. (2001). Oral contraceptives: Current status. *Clinical Obstetrics and Gynecology, 44*, 62-72.

Buss, D. M. (1988). From vigilance to violence: Tactics of mate retention in American undergraduates. *Ethology and Sociobiology, 9*, 291-317.

Buss, D. M., Shackelford, T. K., and McKibbin, W. F. (2008). The Mate Retention Inventory-Short Form (MRI-SF). *Personality and Individual Differences, 44*, 322-334.

Caruso, S., Agnello, C., Intelisano, G., Farina, M., Di Mari, L., and Ciancia, A. (2004). Sexual behavior of women taking low-dose oral contraceptive containing 15 μg ethinylestradiol/60 μg gestodene. *Contraception, 69*, 237-240.

Caruso, S., Agnello, C., Intelisano, G., Farina, M., Di Mari, L., Sparacino, L., and Ciancia, A. (2005). Prospective study on sexual behavior of women using 30 μg ethinylestradiol and 3 mg drospirenone oral contraceptive. *Contraception, 72*, 19-23.

Caruso, S., Sareri, M. I., Agnello, C., Romano, M., Lo Presti, L., Malandrino, C., and Ciancia, A. (2011). Conventional vs. extended-cycle oral contraceptives on the quality of sexual life: Comparison between two regimens containing 3 mg drospirenone and 20 μg ethinyl estradiol. *The Journal of Sexual Medicine, 8*, 1478-1485.

Clarkson, T. B., Shively, C. A., Morgan, T. M., Koritnik, D., Adams, M., and Kaplan, J. R. (1990). Oral contraceptives and coronary artery atherosclerosis of cynomolgus monkeys. *Obstetrics & Gynecology, 75*, 217-222.

Cobey, K. D., Buunk, A. P., Robert, S. C., Klipping, C., Appels, N., Zimmerman, Y., . . . Pollet, T. V. (2012). Reported jealousy differs as a function of menstrual cycle stage and contraceptive pill use: A within-subjects investigation. *Evolution and Human Behavior, 33*, 395-401.

Cobey, K. D., Klipping, C., and Buunk, A. P. (2013). Hormonal contraceptive use lowers female intrasexual competition in pair-bonded women. *Evolution and Human Behavior, 34*, 294-298.

Cobey, K. D., Pollet, T. V., Roberts, S. C., and Buunk, A. P. (2011). Hormonal birth control use and relationship jealousy: Evidence for estrogen dosage effects. *Personality and Individual Differences, 50*, 315-317.

Cole, J. A., Norman, H., Doherty, M., and Walker, A. M. (2007). Venous thromboembolism, myocardial infarction, and stroke among transdermal

contraceptive system users. *Obstetrics & Gynecology, 109*, 339-346.

Colvin, P. L., Jr, Wagner, J. D., Adams, M. R., and Sorci-Thomas, M. G. (1998). Sex steroids increase cholesterol 7α-hydroxylase mRNA in nonhuman primates. *Metabolism, 47*, 391-395.

Crawford, J. C., Boulet, M., and Drea1, C. M. (2011). Smelling wrong: Hormonal contraception in lemurs alters critical female odour cues. *Proceedings of the Royal Society B: Biological Sciences, 278*, 122-130.

Daly, M., Wilson, M., and Weghorst, S. J. (1982). Male sexual jealousy. *Ethology and Sociobiology, 3*, 11-27.

Davis, A., Godwin, A., Lippman, J., Olson, W., and Kafrissen, M. (2000). Triphasic norgestimate-ethinyl estradiol for treating dysfunctional uterine bleeding. *Obstetrics & Gynecology, 96*, 913-920.

DeBruine, L. M., Jones, B. C., Little, A. C., Boothroyd, L. G., Perrett, D. I., Penton-Voak, I. S., . . . Tiddeman, B. P. (2006). Correlated preferences for facial masculinity and ideal or actual partner's masculinity. *Proceedings of the Royal Society B: Biological Sciences, 273*, 1355-1360.

DeBruine, L. M., Jones, B. C., and Perrett, D. I. (2005). Women's attractiveness judgments of self-resembling faces change across the menstrual cycle. *Hormones and Behavior, 47*, 379-383.

Delgado-Rodriguez, M., Sillero-Arenas, M., Martin-Moreno, J. M., and Galvez-Vargas, R. (1992). Oral contraceptives and cancer of the cervix uteri: A meta-analysis. *Acta Obstetricia et Gynecologica Scandinavica, 71*, 368-376.

DeSoto, M. C., Geary, D. C., Hoard, M. K., Sheldon, M. S., and Cooper, L. (2003). Estrogen fluctuations, oral contraceptives and borderline personality. *Psychoneuroendocrinology, 28*, 751-766.

de Vleeschouwer, K., van Elsacker, L., Leus, K., and Heistermann, M. (2000). An evaluation of the suitability of contraceptive methods in golden-headed lion tamarins (*leontopithecus Chrysomelas*), with emphasis on melengestrol acetate (MGA) implants: (i) Effectiveness, reversibility and medical side-effects. *Animal welfare, 9*, 251-271.

Dugdale, M., and Masi, A. T. (1971). Hormonal contraception and thromboembolic disease: Effects of the oral contraceptives on hemostatic mechanisms: A review of the literature. *Journal of Chronic Diseases, 23*, 775-790.

Egarter, C., Topcuoglu, M. A., Imhof, M., and Huber, J. (1999). Low dose oral contraceptives and quality of life. *Contraception, 59*, 287-291.

Ernst, U., Baumgartner, L., Bauer, U., and Janssen, G. (2002). Improvement of quality of life in women using a low-dose desogestrel-containing contraceptive: Results of an observational clinical evaluation. *The European Journal of Contraception and Reproductive Health Care, 7*, 238-243.

Etminan, M., Delaney, J. A. C., Bressler, B., and Brophy, J. M. (2011). Oral contraceptives and the risk of gallbladder disease: A comparative safety study. *Canadian Medical Association Journal, 183*, 899-904.

Farmer, R. D. T., Lawrenson, R. A., Thompson, C. R., Kennedy, J. G., and Hambleton, I. R. (1997). Population-based study of risk of venous thromboembolism associated

with various oral contraceptives. *The Lancet, 349*, 83-88.

Farmer, R. D. T., and Preston, T. D. (1995). The risk of venous thromboembolism associated with low oestrogen oral contraceptives. *Journal of Obstetrics & Gynaecology, 15*, 195-200.

Feinberg, D. R., DeBruine, L. M., Jones, B. C., and Little, A. C. (2008). Correlated preferences for men's facial and vocal masculinity. *Evolution and Human Behavior, 29*, 233-241.

Feinberg, D. R., Jones, B. C., Law Smith, M. J., Moore, F. R., DeBruine, L. M., Cornwell, R. E., . . . Perrett, D. I. (2006). Menstrual cycle, trait estrogen level, and masculinity preferences in the human voice. *Hormones and Behavior, 49*, 215-222.

Fisch, I. R., and Frank, J. (1977). Oral contraceptives and blood pressure. *The Journal of the American Medical Association, 237*, 2499-2503.

Freeman, E. W., Weinstock, L., Rickels, K., Sondheimer, S. J., and Coutifaris, C. (1992). A placebo-controlled study of effects of oral progesterone on performance and mood. *British Journal of Clinical Pharmacology, 33*, 293-298.

Gangestad, S. W., Garver-Apgar, C. E., Simpson, J. A., and Cousins, A. J. (2007). Changes in women's mate preferences across the cycle. *Journal of Personality and Social Psychology, 92*, 151-163.

Gangestad, S. W., Simpson, J. A., Cousins, A. J., Garver-Apgar, C. E., and Christensen, P. N. (2004). Women's preferences for male behavioral displays change across the menstrual cycle. *Psychological Science, 15*, 203-207.

Gangestad, S. W., and Thornhill, R. (2008). Human oestrus. *Proceedings of the Royal Society B: Biological Sciences, 275*, 991-1000.

Garver-Apgar, C. E., Gangestad, S. W., Thornhill, R., Miller, R. D., and Olp, J. (2006). Major histocompatibility complex alleles, sexual responsivity, and unfaithfulness in romantic couples. *Psychoogical Science, 17*, 830-835.

Gawali, B. W., Rokade, P. B., Janvale, G. B., and Mehrotra, S. C. (2009). Ovarian hormones and the brain signals. *Annals of Neuroscience, 16*, 72-74.

Geary, D. C., DeSoto, M. C., Hoard, M. K., Skaggs Sheldon, M., and Cooper, M. L. (2001). Estrogens and relationship jealousy. *Human Nature, 12*, 299-320.

Goldin, C., and Katz, L. F. (2002). The power of the pill: Oral contraceptives and women's career and marriage decisions. *Journal of Political Economy, 110*, 730-770.

Graham, C. A., Ramos, R., Bancroft, J., Maglaya, C., and Farley, T. M. M. (1995). The effects of steroidal contraceptives on the well-being and sexuality of women: A double-blind, placebo-controlled, two-centre study of combined and progestogen-only methods. *Contraception, 52*, 363-369.

Grammer, K. (1993). 5-α-androst-16en-3α-on: A male pheromone? A brief report. *Ethology and Sociobiology, 14*, 201-208.

Griksiene, R. and Ruksenas, O. (2010). Cognitive effects of hormone-based contraception in young healthy women. *Biologija, 55*, 115-124.

Guéguen, N. (2009). The receptivity of women to courtship solicitation across the menstrual cycle: A field experiment. *Biological Psychology, 80*, 321-324.

Guillermo, C., Manlove, H., Gray, P. B., Zava, D., and Marrs, C. (2010). Female social and sexual interest across the menstrual cycle: The roles of pain, sleep and hormones.

BMC Women's Health, 10, 19-29.

Guy, A. J., Schuerch, F. S., Heffernan, S., Thomson, P. C., O'Brien, J. K., and McGreevy, P. D. (2008). The effect of medroxyprogesterone acetate on behavioural responses of captive female hamadryas baboons (*Papio hamadryas*). *Animal Reproduction Science, 108*, 412-424.

Hannaford, P. C., and Kay, C. R. (1998). The risk of serious illness among oral contraceptive users: Evidence from the RCGP's oral contraceptive study. *The British Journal of General Practice, 48*, 1657-1662.

Haselton, M. G., and Miller, G. F. (2006). Women's fertility across the cycle increases the short-term attractiveness of creative intelligence compared to wealth. *Human Nature, 17*, 50-73.

Haselton, M. G., Mortezaie, M., Pillsworth, E. G., Bleske-Rechek, A., and Frederick, D. A. (2006). Ovulatory shifts in human female ornamentation: Near ovulation, women dress to impress. *Hormones and Behavior, 51,* 40-45.

Havlíček, J., and Roberts, S. C. (2009). MHC-correlated mate choice in humans: A review. *Psychoneuroendocrinology, 34*, 497-512.

Havlíček, J., Roberts, S. C., and Flegr, J. (2005). Women's preference for dominant male odour: Effects of menstrual cycle and relationship status. *Biology Letters, 1*, 256-259.

Heinemann, L. A. J., Lewis, M. A., Spitzer, W. O., Thorogood, M., Guggenmoos-Holzmann, I., and Bruppacher, R. (1998). Thromboembolic stroke in young women: A European case-control study on oral contraceptives. *Contraception, 57*, 29-37.

Henderson, J. A., and Shively, C. A. (2004). Triphasic oral contraceptive treatment alters the behavior and neurobiology of female cynomolgus monkeys. *Psychoneuroendocrinology, 29*, 21-34.

Herzberg, B. and Coppen, A. (1970). Changes in psychological symptoms in women taking oral contraceptives. *The British Journal of Psychiatry, 116*, 161-164.

Hild-Petito, S., Veazey, R. S., Larner, J. M., Reel, J. R., and Blye, R. P. (1998). Effects of two progestin-only contraceptives, Depo-Provera and Norplant-II, on the vaginal epithelium of rhesus monkeys. *AIDS Research and Human Retroviruses, 14*, S125-S1.30

Johnston, V. S., Hagel, R., Franklin, M., Fink, B., and Grammer, K. (2001). Male facial attractiveness: Evidence for hormone-mediated adaptive design. *Evolution and Human Behavior, 21,* 251-267.

Jones, B. C., DeBruine, L. M., Perrett, D. I., Little, A. C., Feinberg, D. R., and Law Smith, M. J. (2008). Effects of menstrual cycle phase on face preferences. *Archives of Sexual Behavior, 37*, 78-84.

Jones, B. C., Little, A. C., Boothroyd, L., DeBruine, L. M., Feinberg, D. R., Law Smith, M. J., . . . Perrett, D. I. (2005). Commitment to relationships and preferences for femininity and apparent health in faces are strongest on days of the menstrual cycle when progesterone level is high. *Hormones and Behavior, 48*, 283-290.

Jones, B. C., Perrett, D. I., Little, A. C., Boothroyd, L., Cornwell, R. E., Feinberg, D. R., . . . Moore, F. R. (2005). Menstrual cycle, pregnancy and oral contraceptive use

alter attraction to apparent health in faces. *Proceedings of the Royal Society B: Biological Sciences, 272*, 347-354.

Kahn, L. S., and Halbreich, U. (2001). Oral contraceptives and mood. *Expert Opinion on Pharmacotherapy, 2*, 1367-1382.

Kaplan, J. R., Adams, M. R., Anthony, M. S., Morgan, T. M., Manuck, S. B., and Clarkson, T. B. (1995). Dominant social status and contraceptive hormone treatment inhibit atherogenesis in premenopausal monkeys. *Arteriosclerosis, Thrombosis, and Vascular Biology, 15*, 2094-2100.

Kavanagh, K., Davis, M. A., Zhang, L., Wilson, M. D., Register, T. C., Adams, M. R., . . . Wagner, J. D. (2009). Estrogen Decreases Atherosclerosis in Part by Reducing Hepatic Acyl-CoA:Cholesterol Acyltransferase 2 (ACAT2) in Monkeys**.** *Arteriosclerosis, Thrombosis, and Vascular Biology*, *29*, 1471-1477.

Kemmeren, J. M., Tanis, B. C., van den Bosch, M. A. A. J., Bollen, E. L. E. M., Helmerhorst, F. M., van der Graaf, Y., . . . Algra, A. (2002). Risk of arterial thrombosis in relation to oral contraceptives (RATIO) study: Oral contraceptives and the risk of ischemic stroke. *Stroke, 33*, 1202-1208.

Kim, K. (1998). Retrospective survey of parental marital relations and child reproductive development. *International Journal of Behavioral Development, 22*, 729-751.

Kim, K., and Smith, P. K. (1999). Family relations in early childhood and reproductive development. *Journal of Reproductive and Infant Psychology, 17*, 133-148.

Kirschbaum, C., Kudielka, B. M., Gaab, J., Schommer, N. C., and Hellhammer, D. H. (1999). Impact of gender, menstrual cycle phase, and oral contraceptives on the activity of the hypothalamus-pituitary-adrenal axis. *Psychosomatic Medicine, 61*, 154-162.

Kirschbaum, C., Pirke, K., and Hellhammer, D. H. (1995). Preliminary evidence for reduced cortisol responsivity to psychological stress in women using oral contraceptive medication. *Psychoneuroendocrinology, 20*, 509-514.

Koulianos, G. T. (2000). Treatment of acne with oral contraceptives: Criteria for pill selection. *Cutis, 66*, 281-286.

Kulkarni, J. (2007). Depression as a side effect of the contraceptive pill. *Expert Opinion on Drug Safety, 6*, 371-374.

Kurshan, N., and Epperson, C. N. (2006). Oral contraceptives and mood in women with and without premenstrual dysphoria: A theoretical model. *Archives of Women's Mental Health, 9*, 1-14.

Kushwaha, R. S., and Born, K. M. (1991). Effect of estrogen and progesterone on the hepatic cholesterol 7-alpha-hydroxylase activity in ovariectomized baboons. *Biochimica et Biophysica Acta, 1084*, 300-302.

Kuukasjärvi, S., Eriksson, C. J. P., Koskela, E., Mappes, T., Nissinen, K., and Rantala, M. J. (2004). Attractiveness of women's body odors over the menstrual cycle: The role of oral contraceptives and receiver sex. *Behavioral Ecology, 15*, 579-584.

Lacreuse, A., Martin-Malivel, J., Lange, H. S., and Herndon, J. G. (2007). Effects of the menstrual cycle on looking preferences for faces in female rhesus monkeys. *Animal Cognition, 10*, 105-115.

Lader, D. (2007). *Contraception and sexual health, 2008/9*. Newport, UK: UK Office for

National Statistics.

Laeng, B., and Falkenberg, L. (2007). Women's pupillary responses to sexually significant others during the hormonal cycle. *Hormones and Behavior, 52*, 520-530.

Leary, M. R., and Dobbins, S. E. (1983). Social anxiety, sexual behavior, and contraceptive use. *Journal of Personality and Social Psychology, 6*, 1347-1354.

Lewis, M. A., Heinemann, L. A. J., Spitzer, W. O., MacRae, K. D., and Bruppacher, R. (1997). The use of oral contraceptives and the occurrence of acute myocardial infarction in young women: Results from the transnational study on oral contraceptives and the health of young women. *Contraception, 56*, 129-140.

Lewis, M. A., Spitzer, W. O., Heinemann, L. A. J., MacRae, K. D., and Bruppacher, R. (1996). Third generation oral contraceptives and risk of myocardial infarction: An international case-control study. *BMJ, 312*, 88-90.

Lidegaard, Ø., Edström, B., and Kreiner, S. (2002). Oral contraceptives and venous thromboembolism: A five-year national case-control study. *Contraception, 65*, 187-196.

Lieb, K., Zanarini, M. C., Schmahl, C., Linehan, M. M., and Bohus, M. (2004). Borderline personality disorder. *The Lancet, 364*, 453-461.

Linn, G. S., and Steklis, H. D. (1990). The effects of depo-medroxyprogesterone acetate (DMPA) on copulation-related and agonistic behaviors in an island colony of stumptail macaques (Macaca arctoides). *Physiology & Behavior, 47*, 403-408.

Little, A. C., Burriss, R. P., Petrie, M., Jones, B. C., and Roberts, S. C. (in press). Oral contraceptive use in women changes preferences for male facial masculinity and is associated with partner facial masculinity. *Psychoneuroendocrinology*.

Little, A. C., Jones, B. C., and Burriss, R. P. (2007). Preferences for masculinity in male bodies change across the menstrual cycle. *Hormones and Behavior, 51*, 633-639.

Little, A. C., Jones, B. C., and DeBruine, L. M. (2008). Preferences for variation in masculinity in real male faces change across the menstrual cycle: Women prefer more masculine faces when they are more fertile. *Personality and Individual Differences, 45*, 478-482.

Little, A. C., Jones, B. C., Penton-Voak, I. S., Burt, D. M., and Perrett, D. I. (2002). Partnership status and the temporal context of relationships influence human female preferences for sexual dimorphism in male face shape. *Proceedings of the Royal Society B: Biological Sciences, 269*, 1095-1100.

Lukaszewski, A. W., and Roney, J. R. (2009). Estimated hormones predict women's mate preferences for dominant personality traits. *Personality and Individual Differences, 47*, 191-196.

Lummaa, V., and Clutton-Brock, T. (2002). Early development, survival and reproduction in humans. *Trends in Ecology and Evolution, 17*, 141-147.

Lurie, G., Thompson, P., McDuffie, K. E., Carney, M. E., Terada, K. Y., and Goodman, M. T. (2007). Association of estrogen and progestin potency of oral contraceptives with ovarian carcinoma risk. *Obstetrics & Gynecology, 109*, 597-607.

Maestripieri, D. (1999). The biology of human parenting: Insights from nonhuman primates. *Neuroscience & Biobehavioral Reviews, 23*, 411-422.

Marchbanks, P. A., McDonald, J. A., Wilson, H. G., Folger, S. G., Mandel, M. G., Daling,

J. R., . . . Weiss, L. K. (2002). Oral contraceptives and the risk of breast cancer. *New England Journal of Medicine, 346,* 2025-2032.

Marinari, K. T., Leshner, A. I., and Doyle, M. P. (1976). Menstrual cycle status and adrenocortical reactivity to pyschological stress. *Psychoneuroendocrinology, 1*, 213-218.

McLachlan, R. I., O'Donnell, L., Meachem, S. J., Stanton, P. G., De Kretser, D. M., Pratis, K., and Robertson, D. M. (2002). Hormonal regulation of spermatogenesis in primates and man: Insights for development of the male hormonal contraceptive *Journal of Andorology, 23*, 149-162.

Michael, R. P., Herbert, J., and Welegalla, J. (1967). Ovarian hormones and the sexual behaviour of the male rhesus monkey (*Macaca mulatta*) under laboratory conditions. *Journal of Endocrinology, 39*, 81-98.

Michael, R. P., Saayman, G. S., and Zumpe, D. (1968). The suppression of mounting behaviour and ejaculation in male rhesus monkeys (*Macaca mulatta*) by administration of progesterone to their female partners. *Journal of Endocrinology, 41*, 421-431.

Miller, G., Tybur, J. M., and Jordan, B. D. (2007). Ovulatory cycle effects on tip earnings by lap dancers: Economic evidence for human estrus? *Evolution and Human Behavior, 28*, 375-381.

Miller, S. L. (2011). *Hormones and social affiliation: Menstrual cycle shifts in progesterone underlie women's attention to signs of social support.* Unpublished Ph.D., Florida State University, Tallahassee, FL.

Milman, N., Clausen, J., and Byg, K. E. (1998). Iron status in 268 Danish women aged 18–30 years: Influence of menstruation, contraceptive method, and iron supplementation. *Annals of Hematology, 77*, 13-19.

Mishell, D. R., Jr. (1982). Noncontraceptive health benefits of oral steroidal contraceptives. *American Journal of Obstetrics and Gynecology, 15*, 809-816.

Möehle, U., Heistermann, M., Einspanier, A., and Hodges, J. K. (1999). Efficacy and effects of short- and medium-term contraception in the common marmoset (*Callithrix jacchus*) using melegestrol acetate implants. *Journal of Medical Primatology, 28*, 36-47.

Moffitt, T. E., Caspi, A., Belsky, J., and Silva, P. A. (1992). Childhood experience and the onset of menarche: A test of a sociobiological model. *Child Development, 63*, 47-58.

Molland, J. R., Morehead, D. B., Baldwin, D. M., Castracane, V. D., Lasley, B. L., and Bergquist, C. A. (1996). Immediate postpartum insertion of the Norplant contraceptive device. *Fertility and Sterility, 66*, 43-48.

Moreno, V., Bosch, F. X., Muñoz, N., Meijer, C. J. L. M., Shah, K. V., Walboomers, J. M. M., et al. (2002). Effect of oral contraceptives on risk of cervical cancer in women with human papillomavirus infection: The IARC multicentric case-control study. *The Lancet, 359*, 1085-1092.

Mosher, W. D., and Jones, J. (2010). Vital Health Statistics - Use of contraception in the United States: 1982-2008. U.S. Department of Health and Human Services Centers for Disease Control and Prevention. Hyattsville, Maryland: *National Center for*

Health Statistics, 23.

Nadler, R. D., Dahl, J. F., Collins, D. C., and Gould, K. G. (1992). Hormone levels and anogenital swelling of female chimpanzees as a function of estrogen dosage in a combined oral contraceptive. *Proceedings of the Society for Experimental Biology and Medicine, 201*, 73-79.

Nadler, R. D., Dahl, J. F., Gould, K. G., and Collins, D. C. (1993). Effects of an oral contraceptive on sexual behavior of chimpanzees (*Pan troglodytes*). *Archives of Sexual Behavior, 22*, 477-500.

Ness, R. B., Grisso, J. A., Klapper, J., Schlesselman, J. J., Silberzweig, S., Vergona, R., . . . Wheeler, J. E. (2000). Risk of Ovarian Cancer in Relation to Estrogen and Progestin Dose and Use Characteristics of Oral Contraceptives. *American Journal of Epidemiology, 152*, 233-241.

Ober, C., Hyslop, T., and Hauck, W. W. (1999). Inbreeding effects on fertility in humans: Evidence for reproductive compensation. *The American Journal of Human Genetics, 64*, 225-231.

Oinonen, K. A., and Mazmanian, D. (2002). To what extent do oral contraceptives influence mood and affect? *Journal of affective disorders, 70*, 229-240.

Olson, W. H., Lippman, J. S., and Robisch, D. M. (1998). The duration of response to norgestimate and ethinyl estradiol in the treatment of acne vulgaris. *International Journal of Fertility and Women's Medicine, 43*, 286-290.

Ooki, I., Takakuwa, K., Akashi, M., Nonaka, T., Yokoo, T., and Tanaka, K. (2008). Studies on the compatibility of HLA-Class II alleles in patient couples with severe pre-eclampsia using PCR–RFLP methods. *American Journal of Reproductive Immunology, 60*, 75-84.

Parkin, L., Skegg, D. C. G., Wilson, M., Herbison, G. P., and Paul, C. (2000). Oral contraceptives and fatal pulmonary embolism. *The Lancet, 355*, 2133-2134.

Pawłowski, B., and Jasienska, G. (2005). Women's preferences for sexual dimorphism in height depend on menstrual cycle phase and expected duration of relationship. *Biological Psychology, 70*, 38-43.

Pazol, K., Wilson, M. E., and Whallen, K. (2004). Medroxyprogesterone acetate antagonizes the effects of estrogen treatment on social and sexual behavior in female macaques. *Journal of Clinical Endocrinology & Metabolism, 89*, 2998-3006.

Penton-Voak, I. S., and Perrett, D. I. (2000). Female preference for male faces changes cyclically: Further evidence. *Evolution and Human Behavior, 21*, 39-48.

Penton-Voak, I. S., Perrett, D. I., Castles, D. L., Kobayashi, T., Burt, D. M., Murray, L. K., and Minamisawa, R. (1999). Menstrual cycle alters face preference. *Nature, 399*, 741-742.

Perrett, D. I., Lee, K. J., Penton-Voak, I., Rowland, D., Yoshikawa, S., Burt, D. M., . . . Akamatsu, S. (1998). Effects of sexual dimorphism on facial attractiveness. *Nature, 394*, 884-887.

Pipitone, R. N., and Gallup, G. G. (2008). Women's voice attractiveness varies across the menstrual cycle. *Evolution and Human Behavior, 29*, 268-274.

Porton, I. J., and Dematteo, K. E. (2005). Contraception in nonhuman primates. In C. S.

Asa and I. J. Porton (Eds.), *Wildlife contraception: Issues, methods, and applications*. Baltimore, MD: The John Hopkins University Press.

Portugal, M. M., and Asa, C. S. (1995). Effects of chronic melengestrol acetate contraceptive treatment on perineal tumescence, body weight, and sociosexual behavior of hamadryas baboons (*Papio hamadryas*). *Zoo Biology, 14*, 251-259.

Puts, D. A. (2005). Mating context and menstrual phase affect women's preferences for male voice pitch. *Evolution and Human Behavior, 26*, 388-397.

Puts, D. A. (2006). Cyclic variation in women's preferences for masculine traits: Potential hormonal causes. *Human Nature, 17*, 114-127.

Register, T. C., Jayo, M. J., and Jerome, C. P. (1997). Oral contraceptive treatment inhibits the normal acquisition of bone mineral in skeletally immature young adult female monkeys. *Osteoporosis International, 7*, 348-353.

Reznikoff-Etievant, M. F., Bonneau, J. C., Alcalay, D., Cavelier, B., Touré, C., Lobet, R., and Netter, A. (1991). HLA antigen-sharing in couples with repeated spontaneous abortions and the birthweight of babies in successful pregnancies. *American Journal of Reproductive Immunology, 25*, 25-27.

Rivera, R., Almonte, H., Arreola, M., Lopez, F., Monarrez, G., Navarro, C., . . . Ruiz, R. (1983). The effects of three different regimens of oral contraceptives and three different intrauterine devices on the levels of hemoglobin, serum iron and iron binding capacity in anemic women. *Contraception, 27*, 311-327.

Roberts, S. C., Gosling, L. M., Carter, V., and Petrie, M. (2008). MHC-correlated odour preferences in humans and the use of oral contraceptives. *Proceedings of the Royal Society B: Biological Sciences, 275*, 2715-2722.

Roberts, S. C., Havlicek, J., Flegr, J., Hruskova, M., Little, A. C., Jones, B. C., . . . Petrie, M. (2004). Female facial attractiveness increases during the fertile phase of the menstrual cycle. *Proceedings of the Royal Society B: Biological Sciences, 271*, S270-S272.

Roberts, S. C., Klapilová, K., Little, A. C., Burriss, R. P., Jones, B. C., DeBruine, L. M., . . . Havlíček, J. (2012). Relationship satisfaction and outcome in women who meet their partner while using oral contraception. *Proceedings of the Royal Society B: Biological Sciences, 279*, 1430-1436.

Roberts, S. C., Little, A. C., Gosling, L. M., Jones, B. C., Perrett, D. I., Carter, V., Petrie, M. (2005). MHC-assortative facial preferences in humans. *Biology Letters, 1*, 400-403.

Robinson, S. A., Dowell, M., Pedulla, D., and McCauley, L. (2004). Do the emotional side-effects of hormonalcontraceptives come from pharmacologic or psychological mechanisms? *Medical Hypotheses, 63*, 268-273.

Roche, D. J. O., King, A. C., Cohoon, A. J., and Lovallo, W. R. (2013). Hormonal contraceptive use diminishes salivary cortisol response to psychosocial stress and naltrexone in healthy women. *Pharmacology Biochemistry and Behavior, 109*, 84-90.

Rosen, M. L., and López, H. H. (2009). Menstrual cycle shifts in attentional bias for courtship language. *Evolution and Human Behavior, 30*, 131-140.

Rosenberg, M. J., and Waugh, M. S. (1998). Oral contraceptive discontinuation: A

prospective evaluation of frequency and reasons. *American Journal of Obstetrics and Gynecology, 179*, 577-582.

Rosenberg, M. J., Waugh, M. S., and Meehan, T. E. (1995). Use and misuse of oral contraceptives: Risk indicators for poor pill taking and discontinuation. *Contraception, 51*, 283-288.

Royar, J., Becher, H., and Chang-Claude, J. (2001). Low-dose oral contraceptives: Protective effect on ovarian cancer risk. *International Journal of Cancer, 95*, 370-374.

Sanders, S. A., Graham, C. A., Bass, J. L., and Bancroft, J. (2001). A prospective study of the effects of oral contraceptives on sexuality and well-being and their relationship to discontinuation. *Contraception, 64*, 51-58.

Sarfaty, A., Margulis, S. W., and Atsalis, S. (2012). Effects of combination birth control on estrous behavior in captive western lowland gorillas, *Gorilla gorilla gorilla*. *Zoo Biology, 31*, 350-361.

Sauermann, U., Nürnberg, P., Bercovitch, F. B., Berard, J., Trefilov, A., Widdig, A., Krawczak, M. (2001). Increased reproductive success of MHC class II heterozygous males among free-ranging rhesus macaques. *Human Genetics, 108*, 249-254.

Schwensow, N., Eberle, M., and Sommer, S. (2008). Compatibility counts: MHC-associated mate choice in a wild promiscuous primate. *Proceedings of the Royal Society B: Biological Sciences, 275*, 555-564.

Setchell, J. M., and Huchard, E. (2010). The hidden benefits of sex: Evidence for MHC-associated mate choice in primate societies. *BioEssays, 32*, 940-948.

Shackelford, T. K., Besser, A., and Goetz, A. T. (2008). Personality, marital satisfaction, and probability of marital infidelity. *Individual Differences Research, 6*, 13-25.

Shackelford, T. K., Goetz, A. T., Buss, D. M., Euler, H. A., and Hoier, S. (2005). When we hurt the ones we love: Predicting violence against women from men's mate retention. *Personal Relationships, 12*, 447-463.

Shimizu, K., Takenoshita, Y., Mitsunaga, F., and Nozaki, M. (1996). Suppression of ovarian function and successful contraception in macaque monkeys following a single injection of medroxyprogesterone acetate. *Journal of Reproduction and Development, 42*, 147-155.

Shine Burdick, R., Hoffmann, R., and Armitage, R. (2002). Oral contraceptives and sleep in depressed and healthy women. *Sleep and Dreaming, 25*, 347-349.

Shively, C. A. (1998). Behavioral and neurobiological effects of estrogen replacement therapy and a history of triphasic oral contraceptive exposure. *Psychoneuroendocrinology, 23*, 713-732.

Shively, C. A., and Bethea, C. L. (2004). Cognition, mood disorders, and sex hormones. *Institute for Laboratory Animal Research Journal, 45*, 189-199.

Shively, C. A., Manuck, S. B., Kaplan, J. R., and Koritnik, D. R. (1990). Oral contraceptive administration, interfemale relationships, and sexual behavior in *Macaca fascicularis*. *Archives of Sexual Behavior, 19*, 101-117.

Shively, C. A., Wood, C. E., Register, T. C., Willard, S. L., Lees, C. J., Chen, H., . . . Cline, J. M. (2007). Hormone therapy effects on social behavior and activity levels of

surgically postmenopausal cynomolgus monkeys. *Psychoneuroendocrinology, 32*, 981-990.

Soliz-Ortiz, S., Ramos, J., Arce, C., Guevara, M. A., and Corsi-Cabrera, M. (1994). EEG oscillations during menstrual cycle. *International Journal of Neuroscience, 76*, 279-292.

Spitzer, W. O., Lewis, M. A., Heinemann, L. A. J., Thorogood, M., and MacRae, K. D. (1996). Third generation oral contraceptives and risk of venous thromboembolic disorders: An international case-control study. *BMJ, 312*, 83-88.

Steklis, H. D., Linn, G. S., Howard, S. M., Kling, A. S., and Tiger, L. (1982). Effects of medroxyprogesterone acetate on socio-sexual behavior of stumptail macaques. *Physiology & Behavior, 28*, 535-544.

Thorneycroft, I. H., Stanczyk, F. Z., Bradshaw, K. D., Ballagh, S. A., Nichols, M., and Weber, M. E. (1999). Effect of low-dose oral contraceptives on androgenic markers and acne. *Contraception, 60*, 255-262.

Thornhill, R., and Gangestad, S. W. (2003). Do women have evolved adaptation for extra-pair copulation? In E. Voland and K. Grammer (Eds.), *Evolutionary aesthetics* (pp. 341-368). Heidelberg, Germany: Springer-Verlag.

Thornhill, R., Gangestad, S. W., Miller, R., Scheyd, G., McCollough, J. K., and Franklin, M. (2003). Major histocompatibility complex genes, symmetry, and body scent attractiveness in men and women (*Homo sapiens*). *Behavioral Ecology, 14*, 668-678.

Traulsen, J. M., Haugbølle, L. S., and Bissell, P. (2003). Feminist theory and pharmacy practice. *International Journal of Pharmacy Practice, 11*, 55-68.

Trimble, M. R., and Herbert, J. (1968). The effect of testosterone or oestradiol upon the sexual and associated behaviour of the adult female rhesus monkey. *Journal of Endocrinology, 42*, 171-185.

United Nations (2009). *World Contraceptive Use 2009*. from http://www.un.org/esa/population/publications/contraceptive2009/contraceptive2009.htm.

Valerio, M. G. (1989). Comparative aspects of contraceptive steroids: Effects observed in the monkey. *Toxicologic Pathology, 17*, 401-410.

Vollrath, F., and Milinski, M. (1995). Fragrant genes help Damenwahl. *Trends in Ecology and Evolution, 10*, 307-308.

Walker, R., Schlesselman, J. J., and Ness, R. B. (2002). Family history of cancer, oral contraceptive use, and ovarian cancer risk. *Obstetrical & Gynecological Survey, 57*, 288-290.

Waller, D. K., Gallaway, M. S., Taylor, L. G., Ramadhani, T. A., Canfield, M. A., Scheuerle, A., . . . Correa, A. (2010). Use of oral contraceptives in pregnancy and major structural birth defects in offspring. *Epidemiology, 21*, 232-239.

Wallwiener, C. W., Wallwiener, L. M., Seeger, H., Mück, A. O., Bitzer, J., and Wallwiener, M. (2010). Prevalence of sexual dysfunction and impact of contraception in female German medical students. *The Journal of Sexual Medicine, 7*, 2139-2148.

Wedekind, C., and Füri, S. (1997). Body odour preferences in men and women: Do they

aim for specific MHC combinations or simply heterozygosity? *Proceedings of the Royal Society B: Biological Sciences, 264*, 1471-1479.

Wedekind, C., Seebeck, T., Bettens, F., and Paepke, A. J. (1995). MHC-dependent mate preferences in humans. *Proceedings of the Royal Society B: Biological Sciences, 260*, 245-249.

Weir, R. J., Briggs, E., Mack, A., Naismith, L., Taylor, L., and Wilson, E. (1974). Blood pressure in women taking oral contraceptives. *BMJ, 1*, 533-535.

Welling, L. L. M., Jones, B. C., DeBruine, L. M., Conway, C. A., Law Smith, M. J., Little, A. C., . . . Al-Dujaili, E. A. S. (2007). Raised salivary testosterone in women is associated with increased attraction to masculine faces. *Hormones and Behavior, 52*, 156-161.

Welling, L. L. M., Puts, D. A., Roberts, S. C., Little, A. C., and Burriss, R. P. (2012). Hormonal contraceptive use and mate retention behavior in women and their male partners. *Hormones and Behavior, 61*, 114-120.

Widdig, A., Bercovitch, F. B., Streich, W. J., Sauermann, U., Nürnberg, P., and Krawczak, M. (2004). A longitudinal analysis of reproductive skew in male rhesus macaques. *Proceedings of the Royal Society B: Biological Sciences, 271*, 819-826.