

Ovulation, Female Competition, and Product Choice: Hormonal Influences on Consumer Behavior

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Recent research shows that women experience nonconscious shifts across different phases of the monthly ovulatory cycle. For example, women at peak fertility (near ovulation) are attracted to different kinds of men and show increased desire to attend social gatherings. Building on the evolutionary logic behind such effects, we examined how, why, and when hormonal fluctuations associated with ovulation influenced women's product choices. In three experiments, we show that at peak fertility women nonconsciously choose products that enhance appearance (e.g., choosing sexy rather than more conservative clothing). This hormonally regulated effect appears to be driven by a desire to outdo attractive rival women. Consequently, minimizing the salience of attractive women who are potential rivals suppresses the ovulatory effect on product choice. This research provides some of the first evidence of how, why, and when consumer behavior is influenced by hormonal factors.

Across cultures throughout history, women have consistently allocated a large portion of their resources to a very particular class of consumer goods—those that enhance physical appearance (Bloch and Richins 1992; Burton, Netemeyer, and Lichtenstien 1995; Rich and Jain 1968; Wheeler and Berger 2007). Although this product

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category includes many items (e.g., makeup, hair products), by far the largest portion of this category, especially in modern societies, consists of clothing and other fashion apparel (e.g., shoes, clothing accessories). For example, not only do women in modern cultures use credit cards primarily to obtain new clothing (Turner 2000), but in the United States alone, women spend well over \$100 billion annually on fashion apparel (Seckler 2005). The yearly amount spent on fashion apparel by women is 50% more than the entire U.S. government spent on education in 2008 (U.S. Department of the Treasury 2008).

What are the factors that lead women to desire and seek out appearance-enhancing products? We draw on emerging

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theory and research in biology and evolutionary psychology to examine whether women's product choices are influenced by their current phase of the monthly ovulatory cycle. We hypothesize that women choose sexier and more revealing clothing specifically when they are ovulating—even if the women themselves are not consciously aware of this biological fact. Additional studies not only shed light on reasons why ovulation leads women to choose products that enhance appearance but also provide evidence for conditions under which such ovulatory effects are enhanced and suppressed.

WOMEN, CONSUMPTION, AND FASHION

Early research in consumer behavior found that women have a high level of interest in shopping for fashion-related items (Rich and Jain 1968). Compared to men, for example, women spend considerably more time searching for fashion-related items and cosmetics (Seock and Bailey 2008) and spend a significantly greater amount of income on clothes, jewelry, and other fashion accessories (Chiger 2001; Kim and Kim 2004; Zollo 1995). Women also spend more on makeup and clothes, regardless of income or social status (Schaninger 1981). Unlike men, who tend to spend on clothing when items are on sale or needed, women often desire to stay up to date on fashion trends and purchase new items even when they are not dissatisfied with the products they already own (Mitchell and Walsh 2004).

To help explain why women place such importance on appearance-enhancing products, previous research has examined how women's shopping is influenced by a variety of factors. For example, early research found that younger women and women from higher socioeconomic classes spend more time shopping for fashion than do older women or women from lower socioeconomic classes (Rich and Jain 1968). Others have found that women tend to use clothing to enhance their mood and social self-esteem (Kwon and Shim 1999) and are significantly more likely to go shopping to pass time, to browse around, or just as an escape (Mitchell and Walsh 2004; Wheeler and Berger 2007). Accordingly, women's fashion purchases can often include impulse buys, which means women are more likely to make such purchases when they lack the cognitive resources to exercise self-control (Faber and Vohs 2004; Vohs and Faber 2007).

Despite the growing literature on women's consumer behavior, no research thus far has examined whether women's consumption might be influenced by hormonal factors. We redress this gap in the literature by investigating how women's product choices might be influenced by hormonal fluctuations associated with the monthly ovulatory cycle. As we describe below, emerging research in biology and evolutionary psychology shows that the ovulatory cycle might have a direct bearing on consumer choices.

THE HUMAN OVULATORY CYCLE AND HORMONAL CHANGES

The human ovulatory cycle spans, on average, 28 days, whereby women can become pregnant on only about 10%–

15% of the days during each ovulatory cycle. This means that although many adult women are sexually active throughout their entire monthly cycle, they are only fertile in the few days when ovulation occurs (around day 14 of a 28-day cycle). Without specific education and training, most women do not know when they are ovulating because there are few obvious signals indicating a woman's fertility (Thornhill and Gangestad 2008). For example, whereas ovulation in female chimpanzees is accompanied by bright redness and swelling in the rump, humans do not exhibit such overt bodily markers of ovulation (Burt 1992).

The human ovulatory cycle is associated with a specific pattern of hormonal changes. Just before ovulation, women experience an increase in estrogen (an ovarian hormone) and luteinizing hormone (LH; a pituitary hormone). Estrogen and LH fluctuate together, peaking around the same time within each menstrual cycle (Lipson and Ellison 1996). The rise of these two hormones indicates that ovulation will occur within 24–36 hours, whereby the greatest chance for conception occurs within a 48-hour period surrounding ovulation (Eichner and Timpe 2004; Wilcox et al. 2001). If a woman does not become pregnant in this period, estrogen and LH levels drop significantly (Venners et al. 2006; see also Garver-Apgar, Gangestad, and Thornhill 2008). Thus, the window of fertility is accompanied by a distinct hormonal marker—a spike in estrogen and LH—that is specific to the fertile phase in a woman's cycle.

THE OVULATORY SHIFT HYPOTHESIS

It has been believed historically that the biological occurrence of ovulation was not related to psychology or behavior in any meaningful way (e.g., Beach 1948). After noting that nonhuman mammalian females show specific behavioral changes during estrus (ovulation), however, an evolutionary psychologist and a biologist proposed an intriguing—but, at that point, yet untested—idea called the Ovulatory Shift Hypothesis (Gangestad and Thornhill 1998, 2008). The Ovulatory Shift Hypothesis proposed that natural selection may have shaped aspects of women's psychology to shift during the brief window within each cycle when conception is possible. In particular, this hypothesis predicts that women at peak fertility should have more pronounced preferences for potential sex partners who show classic biological indicators of male genetic fitness (e.g., symmetry, masculinity, intelligence). Because poor mating choices have significantly higher consequences when women are ovulating, ovulating women should be choosier regarding mates. Moreover, this hypothesis predicts that women at peak fertility should show increased mating interest, meaning that near ovulation they should be more motivated to behave in ways that would help secure a desirable mate.

Several empirical studies have borne out predictions derived from the Ovulatory Shift Hypothesis. Regarding mate preferences, for example, near ovulation women do indeed prefer men with symmetrical and masculine faces (Penton-Voak and Perrett 2000; Thornhill and Gangestad 2003; Thornhill et al. 2003), men who display greater social dom-

inance (Gangestad et al. 2004), men who possess deeper masculine voices (Puts 2005), and men who possess creative intelligence rather than inherited wealth (Haselton and Miller 2006). Women near ovulation are also more motivated to cheat on their current romantic partner, especially if their current partner lacks indicators of genetic fitness (Gangestad, Thornhill, and Garver 2002; Garver-Apgar et al. 2006). Evidence also indicates that ovulating women are motivated to be more social and appear more attractive at social events (Durante, Li, and Haselton 2008; Haselton and Gangestad 2006; Haselton et al. 2007). For example, in a laboratory task, ovulating women sketched an outfit to wear to a party that was sexier and more revealing (Durante et al. 2008). Parallel to making a greater effort to appear more alluring at high fertility, lap dancers at a gentlemen's club earn significantly more in tips near ovulation (Miller, Tybur, and Jordan 2007). Consistent with the hormonal underpinnings of ovulatory effects, all ovulatory shift effects are "turned off" when women are using hormonal contraception (e.g., the pill, the patch, vaginal ring). Because contraception disrupts the normal fluctuation of hormones across the menstrual cycle, it predictably erases the shifts associated with normal ovulation (see Fleischman, Navarette, and Fessler 2010).

Taken together, this literature shows that women around ovulation show a shift in mating preferences and motivation (see Gangestad, Thornhill, and Garver-Apgar 2005, for a review). Notably, research demonstrates that the high-fertility shift experienced by women in these and other studies cannot be accounted for by possible changes in mood, affect, or sense of well-being (Gangestad and Thornhill 2008; Laessle et al. 1990; Reilly and Kremer 2001; Van Goozen et al. 1997), and the ovulatory shift effects are not conscious or deliberate (e.g., Durante et al. 2008; Haselton et al. 2007).

OVULATION AND PRODUCT CHOICE

While ovulation appears to influence women's mate preferences, it remains to be seen whether hormonal fluctuations associated with ovulation would influence women's deliberate product choices. For example, when women are carefully evaluating a set of products, would ovulating women actually make different choices compared to women who are not ovulating?

Building on previous research (Durante et al. 2008; Haselton et al. 2007), we hypothesized that ovulation should lead women to value a particular set of products: fashion goods that enhance physical attractiveness and sexiness. That is, across cultures and history, women have perpetually competed with female rivals for the attention of men by trying to enhance their physical attractiveness and sexiness (Buss 1988; Etcoff 1999; Grammer, Renninger, and Fischer 2004), especially through clothing and other fashion apparel (Saad 2007; Tooke and Camire 1991). Given that the potential payoffs associated with attractiveness enhancement are greatest when conception probability is highest, we hypothesized that women at high fertility should be more likely

to choose products that enhance their sexiness and appearance.

- H1:** Near ovulation, women should be more likely to choose sexier and revealing clothing and other fashion items rather than items that are less revealing and sexy.

OVULATION AND FEMALE COMPETITION

We hypothesize that ovulation should lead women to choose sexy fashion items intended for public wear primarily because the hormonal changes associated with fertility heighten female sensitivity to same-sex competition (Durante et al. 2008; Fisher 2004; Haselton et al. 2007). The hypothesis that fertility should exacerbate female competition is consistent with the effects of ovulation in nonhuman females. In other primates, ovulating females become more aggressive specifically toward same-sex rivals—females in the same group who are competing for male attention (Walker, Wilson, and Gordon 1983; Wallen 1995). Thus, given the link between ovulation and female-female competition, we predict that ovulation should lead women to desire to appear sexier and more attractive, particularly when attractive female rivals are salient.

However, an alternative possibility to our female-competition account is that women might choose sexier clothing at ovulation, not in hopes of outcompeting other women but to attract men directly. That is, it remains to be seen whether women "dress to impress" at ovulation to attract desirable men, to outdo attractive rival women, or perhaps both. The question of the intended audience is particularly important from an evolutionary perspective. An understanding of the intended audience would provide insight into the evolutionary function of the ovulatory-regulated shift. For example, consider three different evolved animal traits: the peacock's tail, the red deer's antlers, and the lion's mane. While all three traits evolved because they ultimately serve to enhance reproduction, each one has evolved for a different function and via different selection pressures (see Alcock 2005; Andersson 1994; Griskevicius, Tybur, et al. 2009). Specifically, whereas the peacock uses its tail exclusively to display to the opposite sex in courtship, the red deer uses its antlers exclusively to compete with same-sex rivals for status, whereby the highest status male earns access to females. The lion's mane, however, serves a function both in courtship and in same-sex competition, meaning that both types of selection pressures contributed to the evolution of this trait.

Although there is reason to believe that the ovulation effect on sexy clothing choice is most akin to the example of a deer's antlers, it is currently unclear whether the function of this ovulatory effect is most analogous to the function of a peacock's tail (courtship function), a deer's antlers (same-sex competition function), or a lion's mane (both courtship and same-sex competition function). To answer

this question, we examine in study 2 whether experimentally priming women with attractive women versus attractive men would produce a different effect for ovulating versus non-ovulating women. Considering that hormonal changes associated with fertility heighten female sensitivity to same-sex competition (Durante et al. 2008), we predicted that the ovulation effect should be enhanced specifically when attractive potential rivals are salient. That is, we argue that the function of the ovulatory effect is most akin to that of a deer's antlers:

H2: Ovulation should lead women to be especially likely to choose sexier products when women are primed to compare themselves to attractive female rivals.

If the ovulation effect is driven by female competition with attractive rivals as we predict, this means that the effect of ovulation on product choice should be suppressed when the salience of attractive potential rivals is minimized. That is, the influence of ovulation should be "turned off" when women are primed either with men or with unattractive women who do not constitute potential rivals:

H3: There should be no differences in product choice between ovulating and nonovulating women when women are primed with unattractive women or men.

Finally, if the effect of ovulation on clothing choice is related to same-sex competition with attractive potential rivals, we hypothesized that the salience of attractive women who are not direct potential rivals should also suppress the influence of ovulation on product choice. Thus, in study 3 we tested the following prediction:

H4: Ovulation should lead women to choose sexier products when primed to think about local attractive women who constitute potential direct rivals. However, ovulation should not influence product choice when women are primed to think about women from distant locations because such women do not constitute direct rivals.

STUDY 1: OVULATION AND PRODUCT CHOICE

Method

Participants and Procedure. Participants were 60 female students at a large public university in the United States ($M_{\text{age}} = 18.73$, $SD = 1.24$). Participants were compensated either with course credit or with \$30.

Assessing Fertility. Women were recruited to participate in the study via e-mail and campus flyers. The women were told that they would be participating in a study on relationships, fashion, and health. Women were initially prescreened over the telephone, and only women who reported regular monthly menstrual cycles (e.g., cycles run-

ning 25–35 days) and were not on any form of hormonal contraception were recruited for participation in the study. About 30% of the women in the participant pool reported regular use of hormonal contraception, and 25% of the women reported highly irregular menstrual cycles and, thus, were not eligible.

On the basis of the information women provided about their cycles during the telephone prescreening interview, each participant was scheduled to come into the lab for two experimental sessions—one on an expected high-fertility day and one on an expected low-fertility day. Whether a woman completed a high-fertility or a low-fertility session first was determined by where she was in her menstrual cycle on the day of the telephone screening. Using this randomization method led to 37% of women completing low-fertility testing first and 63% completing high-fertility testing first. On the basis of previous studies that have used this type of within-subjects methodology (e.g., Durante et al. 2008; Gangestad et al. 2002; Pillsworth and Haselton 2006), no order effects were expected. Indeed, as detailed later in the results section, there were no indications of order effects in any of the current studies.

For high-fertility testing, women also reported to the lab to complete LH tests (over-the-counter urine applicator tests—Clearblue(r) Easy Ovulation Test Kit). Women were told that they needed to complete the urine test so that we would have a better medical assessment of their health, consistent with the cover story. A surge in LH indicates that ovulation will occur within 24–36 hours and also indicates that the ovarian hormone estrogen should be at peak levels (Lipson and Ellison 1996). The first urine test was scheduled 2 days before the expected day of ovulation. If an LH surge was not detected, women came back each day until an LH surge was detected or six tests had been completed, whichever came first. Although the participants provided the urine sample, the actual reading and recording of test results were completed by laboratory research assistants.

Low-fertility sessions were scheduled 7 days or more after the LH surge (if high-fertility testing took place first) or at least 3 days before the expected onset of their menstrual periods (if low-fertility testing took place first). All participants completed their high-fertility session either on the day of their LH surge or no later than 3 days after their LH surge; these women were considered to be fertile at the time of high-fertility testing. On average, high-fertility testing sessions took place .23 days before the day of ovulation ($SD = 1.15$). On average, low-fertility testing sessions took place about 8.37 days after ovulation ($SD = 1.95$). We used this time of the cycle as our comparison because LH and estrogen levels are known to drop to baseline at this point (Hoff, Quigley, and Yen 1983; Lipson and Ellison 1996).

Product Choices. Once participants' fertility status was determined, they came into a different room to complete the shopping task. Participants were told that we were interested in fashion design and product preferences. To examine these questions, participants would go virtual shopping on the retail Web site created for this research. The Web site was

designed to look similar to popular retail Web sites such as those of the Gap and Old Navy, meaning that the main Web page contained multiple rows and columns of pictures of various fashion products. Because each participant would see the Web site twice (once at high fertility and once at low fertility), each participant saw the products on the Web site in a different order, so that a participant never saw the same order twice. Participants were instructed as follows: "When shopping, select the ten items you would like to own for yourself and take home with you today." Once the shopping Web page was opened, participants were instructed to scroll through the Web page to view all of the available products.

Approximately half of the participants ($n = 29$) made product choices from a Web site that contained 64 casual clothing items, and the other half of the participants ($n = 31$) saw a Web site that contained these 64 clothing items plus 64 additional accessory items, for a total of 128 items. Of these, half consisted of casual women's clothing (tops, skirts, and pants/shorts), and half consisted of shoes and fashion accessories (e.g., shoes, handbags, purses). Participants chose 10 items from a total of either 64 or 128 products, whereby half of the products were pretested to be sexy, and the other matched products were pretested to be less sexy. Photographs of the specific items were collected from several retail Web sites and were selected for use in the study for several reasons: items were selected to be generally appealing to the sample population, the sexier items were selected to be sexy but not blatantly sexual, items were selected to be relatively similar in price to one another, and items were selected to not contain any identifiable brand information. The number of products from each item type (i.e., clothing vs. accessories) was matched across levels of sexiness.

To ensure that participants perceived half of the items as relatively more sexy and half of the items as relatively less sexy, a separate sample of 15 participants rated each product. Specifically, each product was rated on a 9-point scale on the extent to which it was sexy ("not at all" to "extremely"). Each product fell into its expected category, whereby half of the products were judged as relatively more sexy without being overly sexual ($M_{\text{sexy}} = 4.90$, $SD = 1.50$), and the other half were judged relatively less sexy ($M_{\text{not sexy}} = 2.66$, $SD = .97$, $p < .001$; see fig. A1). Because we were interested in the extent to which participants would choose the sexier versus the less sexy clothing, neither brand association nor price could be seen on the Web page.

Shopping Web Site Pretest. We argue that ovulation should lead women to choose sexier clothing because ovulation amplifies the desire to outdo other attractive women. Thus, we wanted to examine whether the act of shopping for clothing might naturally lead women to compare themselves to other attractive or other average-looking women. To examine this question, 25 undergraduate women ($M_{\text{age}} = 20.00$ years, $SD = 1.87$) underwent the shopping task with the same instructions as in the current study. Immediately afterward, the women indicated, on a 9-point scale anchored

at "not at all" and "definitely," to what extent this experience led them to (1) think about attractive women, (2) think about average-looking women, (3) compare themselves to attractive women, and (4) compare themselves to average-looking women. Findings showed that the shopping task led women to think significantly more about attractive than about average-looking women ($M_{\text{att}} = 6.24$, $SD = 2.42$; $M_{\text{av}} = 3.80$, $SD = 2.43$; $t(24) = 4.46$, $p < .001$). The task also led women to compare themselves more to attractive rather than average-looking women ($M_{\text{att}} = 6.44$, $SD = 2.31$; $M_{\text{av}} = 4.0$, $SD = 2.55$; $t(24) = 4.61$, $p < .001$). Thus, it appears that the act of shopping for clothing and other fashion accessories naturally primes comparisons with attractive potential rivals.

Dependent Measure. The dependent measure in the study consisted of the percentage of sexy products that was chosen by participants (i.e., of the 10 products that were chosen, what percentage of those products was from the more sexy category?).

Results

The total number of sexy items chosen by each participant was summed and converted into a percentage score. We then tested whether the percentage of sexy items chosen differed between high- versus low-fertility sessions using a repeated-measures ANOVA with fertility (high vs. low) as the repeated factor and number of items (64 clothing vs. 128 clothing plus accessories) as the between-subjects factor. There was no interaction between fertility and number of items ($p > .64$), meaning that fertility had a similar effect, regardless of the number of items women had to choose from. As expected, order of session did not interact with fertility session ($p > .43$), meaning that fertility had the same effect on product choice, regardless of the order in which participants completed the study sessions.

Results were consistent with hypothesis 1: there was a significant main effect of fertility ($F(1, 58) = 8.40$, $p = .005$; $\eta^2 = .13$). Women chose a greater percentage of sexy clothing and accessory items near ovulation ($M_{\text{ov}} = 59.8\%$, $SD = 21.6\%$) compared to when they were not ovulating ($M_{\text{nonov}} = 51.3\%$, $SD = 22.4\%$). Manipulation checks at debriefing indicated that none of the participants were aware of the research hypothesis, and none of the participants reported knowledge that the urine applicator tests were being used to detect ovulation.

Discussion

Findings showed that near peak fertility (the time around ovulation characterized by a hormonal spike in estrogen and LH), women chose sexier clothing and other fashion accessories. The current study shows directly that the effects of the ovulatory cycle extend to women's deliberate product choices, extending previous findings in which ovulating women sketched sexier outfits to wear to a party (Durante et al. 2008).

STUDY 2: OVULATION AND FEMALE COMPETITION

The findings from the first study showed that ovulating women choose outfits and fashion accessories that make them appear sexier and more alluring. As noted earlier, we hypothesize that ovulation leads to this consumer-choice effect because hormonal changes associated with fertility heighten female sensitivity to same-sex competition (Durante et al. 2008; Fisher 2004; Haselton et al. 2007). Thus, study 2 was designed to investigate this hypothesis more directly. Specifically, we sought to examine the specific conditions under which the ovulation effect found in the first study should be exacerbated and suppressed.

In study 2, ovulating and nonovulating women completed the same shopping task as in study 1. However, participants in different conditions were primed to think about specific types of individuals immediately before the shopping task. Specifically, women were primed to think about (1) attractive local women, (2) unattractive local women, (3) attractive local men, or (4) unattractive local men. On the basis of reasoning that the ovulation product-choice effect is related to female competition with attractive rivals, we predicted that ovulating women should be especially likely to choose sexier products when they are primed with attractive local women. This attractive-female prime condition is a conceptual replication of study 1, in which the shopping task itself implicitly primed women to think about and compare themselves to attractive women. In study 2, we therefore expected that the ovulatory effect on product choice should be even more pronounced when women are explicitly primed to think about attractive same-sex rivals (see hypothesis 2).

In contrast, we predicted that the effect of ovulation should be minimized in the other three conditions, all of which make attractive women less salient. That is, if the salience of female competition is pertinent for ovulatory consumer effects, there should be small differences between ovulating and nonovulating women when comparisons with attractive rivals are minimized because women are primed to think about unattractive women or about men (see hypothesis 3).

Method

Participants. Participants were 48 female students at a large public university in the United States ($M_{\text{age}} = 19.15$, $SD = 3.23$). All participants were normally ovulating and not on hormonal contraceptives. The recruitment procedure was the same as described in study 1. High-fertility testing sessions took place, on average, 0.18 days before the day of ovulation ($SD = 0.90$). Low-fertility testing sessions took place, on average, 8.24 days after ovulation ($SD = 1.03$).

Design and Procedure. The study had a 2 (fertility: high vs. low, within-subjects) \times 2 (sex of photo prime: male vs. female, between-subjects) \times 2 (attractiveness of photo prime: attractive vs. unattractive, between-subjects)

design. As in study 1, all participants completed the dependent measures twice—once near ovulation and once when not ovulating. Using the same randomization procedures as in the first study led to about half of the participants (54%) completing high-fertility testing first and about half (46%) completing low-fertility testing first. No order effects were expected, and, as presented in the results, no order effects were detected.

The product-choice procedure was identical to that in study 1. All participants went virtual shopping on the same Web site, choosing 10 total items from the same assortment of 128 more sexy/less sexy products (see fig. A1). The only difference between this study and the first study was the addition of the photo prime conditions.

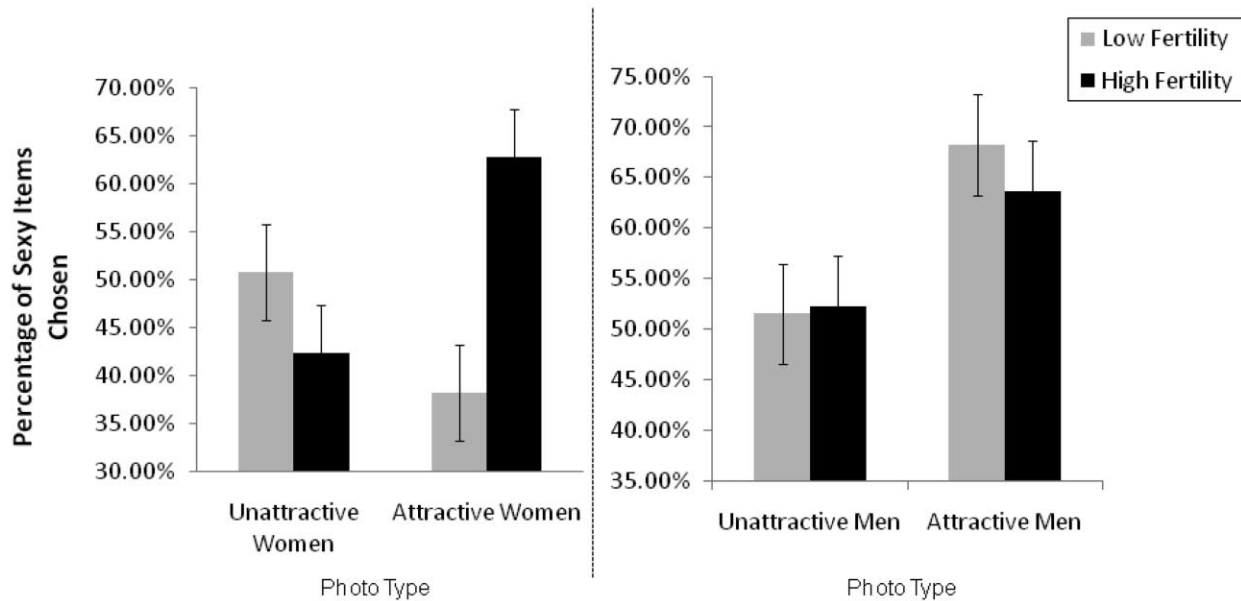
Photo Priming Task. Before the shopping task, participants viewed and rated a series of photographs (see Griskevicius et al. 2007; Wilson and Daly 2004). As a cover story, participants were informed that we were interested in learning about several different things, including people's ability to judge attractiveness. Thus, everyone would see facial shots of 10 purportedly current students at the university and rate each one on attractiveness. The attractiveness ratings in all four prime conditions did not vary significantly as a function of fertility. All participants saw the same set of photographs before the shopping task at each of the two testing sessions. Photographs were presented in reverse order during the participants' second testing session.

The female participants viewed either 10 attractive or 10 less attractive facial photographs of men or women who were purported to be students at the university. (All photographs were actually obtained from public online domains.) The photographs were selected from a larger set of photos that were pre-rated on physical attractiveness by a separate sample of 16 students who were blind to the purpose of this research. On a 9-point scale, the mean attractiveness rating for the 10 attractive female photographs was 7.47 ($SD = 0.54$), and the mean attractiveness rating for the 10 less attractive female photographs was 4.25 ($SD = 0.69$, $p < .001$). The mean attractiveness rating for the 10 attractive male photographs was 7.22 ($SD = 0.96$), and the mean attractiveness rating for the 10 less attractive male photographs was 4.05 ($SD = 0.62$, $p < .001$). Consistent with the premise of the primes, the attractive photographs were over 2 SD above the scale midpoint, whereas the less attractive photographs were over 1 SD below the scale midpoint.

Photo Priming Task Pretest. Our predictions are based on the assumption that women in the attractive female prime condition will be more likely to compare themselves to attractive women during the shopping task. We therefore pretested our experimental procedure—the four photo priming tasks in conjunction with the shopping task—with a separate sample of 90 undergraduate women ($M_{\text{age}} = 19.60$, $SD = 2.98$). These women viewed and rated the same photographs of attractive women ($n = 24$), less attractive women ($n = 25$), attractive men ($n = 22$), and less attractive

FIGURE 1

PERCENTAGE OF SEXIER PRODUCTS CHOSEN AS A FUNCTION OF FERTILITY AND ATTRACTIVENESS OF SALIENT RIVAL WOMEN AND SALIENT MEN (STUDY 2)



men ($n = 19$). Then, all of the women performed the same shopping task as in the current study. Immediately afterward, the women indicated, on a 9-point scale anchored at “not at all” and “definitely,” to what extent the task led them to compare themselves to attractive women.

Results were consistent with expectations. Participants primed with attractive females were more likely to compare themselves to attractive women, relative to participants primed with the less attractive females ($M_{\text{att wo}} = 6.75$, $M_{\text{less att wo}} = 4.72$, $p = .002$). Participants primed with attractive females were also more likely to compare themselves to attractive women, relative to participants in either of the two male photo prime conditions ($M_{\text{att wo}} = 6.75$, $M_{\text{att men}} = 4.95$, $M_{\text{less att men}} = 5.22$, $p < .03$). Overall, the shopping task led women to compare themselves to other attractive women more so when primed with attractive females before the task. In the other three photo prime conditions, women were significantly less likely to compare themselves to attractive women during the shopping task.

Results

The total number of sexy products chosen by each participant was summed and converted into a percentage score. Product choices across fertility session were examined using a repeated-measures ANOVA with fertility (high vs. low) as a repeated factor and photo sex (male vs. female) and photo attractiveness (attractive vs. unattractive) as between-subjects variables. Order of session did not interact with fertility, nor was there an interaction with prime condition

or a three-way interaction with prime condition by fertility (all $p > .62$).

Analyses revealed a significant three-way interaction with fertility, photo attractiveness, and photo sex ($F(1, 44) = 5.66$, $p = .022$; $\eta^2 = .11$). The specific patterns of this interaction were consistent with hypothesis 2: women primed with attractive women chose significantly more sexy products near ovulation ($M_{\text{ov}} = 62.7\%$, $M_{\text{nonov}} = 38.2\%$; $F(1, 10) = 6.10$, $p = .033$; $\eta^2 = .38$). However, supporting hypothesis 3, ovulation did not influence product choice when women were primed with unattractive women ($M_{\text{ov}} = 42.3\%$, $M_{\text{nonov}} = 50.8\%$, $p = .43$), unattractive men ($M_{\text{ov}} = 52.5\%$, $M_{\text{nonov}} = 51.5\%$, $p = .84$), or attractive men ($M_{\text{ov}} = 63.6\%$, $M_{\text{nonov}} = 68.2\%$, $p = .49$; see fig. 1). Thus, the effect of ovulation was especially strong when women were primed with attractive female rivals, but the effect of ovulation was suppressed when women were primed with unattractive women or with men.

For women who viewed photos of males, the interaction between fertility and photo attractiveness was not significant ($F(1, 22) = .56$, $p = .46$), meaning that the male photos had a similar effect on women, regardless of whether they were ovulating. The only significant finding that emerged was a main effect of the attractive male prime. Seeing photographs of attractive men led women to choose significantly more sexy products, compared to seeing photographs of less attractive men ($F(1, 22) = 4.61$, $p = .043$; $\eta^2 = .17$), but this was regardless of women’s fertility status. To our knowledge, this main effect finding is the first empirical demonstration of the widely held presumption that activating

mating motives (i.e., priming women with desirable romantic partners) should lead women to want to enhance their appearance. Nevertheless, while women chose sexier products when primed with desirable men, these choices were not affected by ovulatory status. Manipulation checks at debriefing indicated that none of the participants were aware of the research hypotheses, none made any connections between the photo primes and the shopping task, and none reported knowledge that the urine tests were being used to detect ovulation.

Discussion

Study 2 tested the prediction of whether making attractive same-sex rivals salient would exacerbate the ovulatory effect found in study 1, whereas the salience of unattractive women or men would suppress this effect. Findings were consistent with predictions. When primed with attractive rivals, ovulation led women to choose significantly more sexy outfits. In fact, the 25% fertility difference observed in study 2 was quite a bit more than the 10% boost found in study 1; in that study, the shopping task led women to think about attractive other women, but salience of attractive rivals was not explicitly primed.

When primed with unattractive women, there was no difference in choices between ovulating and nonovulating women. This means that the ovulatory effect was suppressed when comparisons with attractive women were less salient. Consistent with this logic, ovulation also had no effect on women's product choices when women were primed to think about men. We do not mean to imply that women do not try to enhance their appearance because they desire to attract the attention of a desirable man. Indeed, findings from study 2 showed that women chose significantly more appearance-enhancing products when primed with attractive rather than unattractive men. However, women chose products to enhance their appearance regardless of whether they were ovulating, meaning that the effect of ovulation on these types of product choices does not appear to be related directly to women's desire to impress men.

STUDY 3: OVULATION AND FEMALE COMPETITION WITH DIRECT RIVALS

The findings thus far support the notion that the ovulatory product-choice effect documented in the first two studies is related to same-sex competition with attractive rivals. In fact, this is the precise reason why participants in study 2 were told that they were rating photos of attractive women from the same school they currently attend, meaning that those attractive women constitute potential direct rivals. However, an alternate possibility is that priming any attractive women, regardless of whether the women are viewed as potential direct rivals, would produce an ovulatory effect on product choice. Thus, in the current study, ovulating and nonovulating women completed the same shopping task as in study 2. However, participants in different conditions were primed to think about (1) attractive

local women, (2) unattractive local women, (3) attractive distant women, or (4) unattractive distant women.

Participants again viewed photos of the same attractive women used in study 2. However, whereas in study 2 participants were told that the attractive women in the photos were from the same university (i.e., they were potential direct rivals), participants in the distant-women conditions were told that the women in the photographs were from a university located over 1,000 miles from the participants' school. Thus, these women did not constitute direct rivals. If the ovulatory effect is related to comparisons to a general attractive ideal, ovulation should lead women to choose more sexy items when primed with attractive women who are from a distant location. However, if the ovulatory effect is related to direct female competition, as we contend, we would expect that the ovulatory effect should be strongest when women are primed to think about attractive local women who constitute direct potential rivals (see hypothesis 4).

Method

Participants and Study Design. Participants were 161 female students at a university in the United States ($M_{\text{age}} = 19.91$, $SD = 1.95$). Participants were compensated with course credit or \$5. All participants were normally ovulating and not on hormonal contraceptives. Whereas in studies 1 and 2 fertility was assessed via urine tests, in study 3 fertility was assessed via a counting method (see below), such that fertility was a between-subjects factor. Thus, the study had a 2 (fertility: high vs. low, between-subjects) \times 2 (attractiveness of female photo prime: attractive vs. unattractive, between-subjects) \times 2 (location of photo target: local vs. distant, between-subjects) factorial design.

Assessing Fertility. To ascertain fertility, we obtained from participants (1) the start date of their last menstrual period and previous menstrual period, (2) the expected start date of their next menstrual period, and (3) the typical length of their menstrual cycle. We then used the reverse-cycle-day method to predict the day of ovulation for each participant. This method has been shown to be a reliable measure of fertility in previous ovulatory cycle research (e.g., DeBruine et al. 2005; Gangestad and Thornhill 1998; Haselton and Gangestad 2006). On the basis of these established methods, women were divided into two groups, depending on cycle phase: (1) women who participated on fertile days (near ovulation; cycle days 6–14; $n = 73$) and (2) women who participated on infertile days after ovulation (cycle days 17–27; $n = 87$).

Photo Primes. The procedure was identical to that described in study 2, except participants were randomly assigned to rate photographs of (1) attractive local women (high fertility: $n = 19$; low fertility: $n = 22$), (2) unattractive local women (high fertility: $n = 17$; low fertility: $n = 24$), (3) attractive distant women (high fertility: $n = 17$; low fertility: $n = 21$), and (4) unattractive distant women

(high fertility: $n = 20$; low fertility: $n = 20$) before completing the shopping task.

Results and Discussion

As in studies 1 and 2, the total number of sexy products chosen by each participant was summed and converted into a percentage score. Product choices were examined via an ANOVA with fertility (high vs. low), photo attractiveness (attractive vs. unattractive), and location of photo target (local vs. distant) as between-subjects variables.

Analyses revealed a marginally significant three-way interaction with fertility, photo attractiveness, and location of target ($F(1, 152) = 2.87, p = .09$). To examine hypothesis 4, a series of planned contrasts was performed. Conceptually replicating study 2, ovulating women primed with attractive local women chose significantly more sexy products than did nonovulating women ($M_{ov} = 65.8\%, M_{nonov} = 39.1\%$; $F(1, 38) = 12.15, p = .001; \eta^2 = .24$). However, supporting hypothesis 4, ovulation did not produce differences in the other three prime conditions. That is, ovulation had no effect when women were primed with unattractive local women ($M_{ov} = 52.4\%, M_{nonov} = 51.3\%$; $F(1, 39) = .03, p = .85$), attractive distant women ($M_{ov} = 52.4\%, M_{nonov} = 51.4\%$; $F(1, 36) = .02, p = .90$), or unattractive distant women ($M_{ov} = 52.5\%, M_{nonov} = 53.5\%$; $F(1, 38) = .02, p = .89$; see fig. 2). Thus, varying the methodology of ascertaining fertility status, we replicated the key effect from study 2, and we extended the findings to provide further support that the ovulatory effect on clothing and fashion

choice is related to female competition with attractive potential rivals.

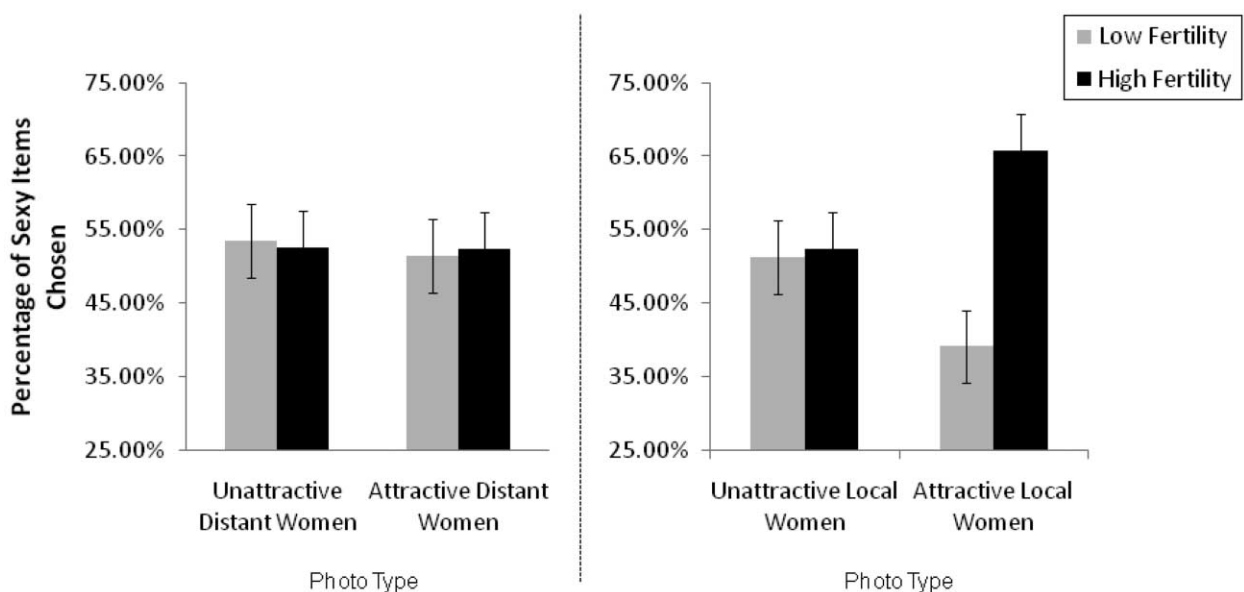
GENERAL DISCUSSION

We examined how, when, and why women’s product choices are influenced by the ovulatory cycle. The ovulatory cycle is a monthly occurrence for most women from the onset of puberty (i.e., first menstrual period) to approximately 50 years of age (Bunting and Boivin 2008). The cycle is marked by specific hormonal changes during the several days around ovulation when women are fertile. Drawing on theory and research based on the Ovulatory Shift Hypothesis (Gangestad and Thornhill 1998, 2008), we predicted that women near ovulation—a time when attempts to appear more attractive than same-sex rivals has the largest evolutionary payoff—should choose sexier and more revealing products. We tested this hypothesis by having women shop on a retail Web site when they were and were not ovulating. Consistent with predictions, women at peak fertility chose sexier and more revealing clothing, shoes, and fashion accessories. Women were not aware that they were ovulating at the time of the study or that their current stage in the ovulatory cycle was influencing them to choose outfits to make themselves appear sexier and more alluring. This study provides some of the first evidence that product choice is influenced by hormonal factors.

Two additional studies examined conditions under which the ovulatory effect should be enhanced and suppressed. These studies addressed the question of whether women

FIGURE 2

PERCENTAGE OF SEXIER PRODUCTS CHOSEN AS A FUNCTION OF FERTILITY, ATTRACTIVENESS OF POTENTIAL RIVAL WOMEN, AND THEIR LOCATION (STUDY 3)



“dress to impress” at ovulation to attract desirable men, to outdo attractive rival women, or both. From an evolutionary perspective, this question is akin to asking whether the function of the ovulatory effect is most analogous to that of a peacock’s tail (courtship function), a deer’s antlers (same-sex competition function), or a lion’s mane (both courtship and same-sex competition function).

We contend that ovulation leads women to want to dress to impress because the hormonal changes associated with fertility heighten female sensitivity to same-sex competition—that is, the ovulatory effect is most akin to the function of a deer’s antlers. Indeed, explicitly priming participants with local attractive women before the shopping task produced the largest ovulation effect, whereby ovulating women purchased 25% more sexy clothing, compared to nonovulating women (see figs. 1 and 2). In contrast, when women first saw photos of unattractive women, ovulation had no effect on product choice. These findings suggest that the effects of ovulation on consumer choices appear to be suppressed when the salience of attractive rivals is minimized. Consistent with our theoretical argument, study 3 showed that when participants saw attractive women living over 1,000 miles away (i.e., women who do not constitute direct rivals), ovulation did not lead women to want to dress to impress.

It is also noteworthy that priming attractive or unattractive men did not produce an effect of ovulation on choices of clothing or fashion accessories. These null findings do not suggest that women do not try to enhance their appearance at least in part because they want to impress a desirable mate. Indeed, study 2 found that women chose significantly more appearance-enhancing products when primed with attractive men. However, women chose sexier products after seeing attractive men regardless of whether the women were ovulating, meaning that ovulation was not related to women’s desire to impress men directly through these kinds of products. In contrast, studies 2 and 3 showed that ovulation was directly related to women’s desire to outcompete rival attractive females. When women were primed with attractive female rivals, it was only ovulating women who wanted to dress to impress.

Overall, we provide some of the first evidence of how product choice is influenced by hormonal factors. The examination of moderators in studies 2 and 3 is especially important because most ovulatory research papers present only a single study, often demonstrating a single main effect. In contrast, we presented a series of conceptually related studies that enabled us to demonstrate a novel effect and to test theoretically relevant moderators of this effect, including demonstrating conditions under which the effect is suppressed. This theoretically driven and rigorous study of how hormones influence product choice marks the potential beginning of a new frontier in consumer research. The study of how biological factors such as hormones influence consumption not only has vast implications for linking theory and research in consumer behavior with theory and research in other disciplines (e.g., biology, animal behavior, anthro-

pology, evolutionary psychology), but it also presents a fruitful avenue for future research and potential implications for marketers.

Limitations and Future Directions

The hypotheses in the current set of studies were derived from theory and research based on the Ovulatory Shift Hypothesis (Gangestad and Thornhill 1998, 2008) and on research in evolutionary consumer behavior (Griskevicius, Goldstein, et al. 2009; Griskevicius, Shiota, and Nowlis 2010; Van den Bergh, Dewitte, and Warlop 2008). It is certainly possible that predictions regarding ovulatory hormones and product choice might be generated by other perspectives. It is not clear, however, whether these other perspectives would offer as parsimonious and complete an account of the pattern of results obtained across our studies. For example, social learning, social role, or social identity models might suggest that priming women with photos of attractive women would make the female social role or identity more salient, which could lead women to want to choose sexier clothing. However, these perspectives are silent on why women’s social roles or identities would be more salient specifically when women are ovulating. Indeed, in no society of which we are aware are women explicitly or implicitly taught or encouraged to dress sexier when they are ovulating.

There is no doubt that cultural, social, psychological, and economic factors have powerful influences on women’s preferences and consumer choices. However, it is difficult to account for the pattern of results across our studies—patterns that correspond directly to monthly hormonal changes—by these factors alone. Of course, it is important to note that social learning and social identity theories are not mutually exclusive with evolutionary accounts, since evolutionary theorists presume that learning across cultures is a function of evolutionary constraints, and that many behaviors involve an adaptive interplay of learning and evolved predispositions. For example, knowing what is considered sexy and appropriate in a given culture must be learned socially. Nevertheless, we are not aware of a priori predictions made by social learning, social role, or social identity models alone for the specific pattern of results obtained here—a pattern that follows directly from considerations of theory and research based on the Ovulatory Shift Hypothesis and evolutionary social cognition.

Research on the influences of the ovulatory cycle—and of hormones more generally—on consumer behavior is in its infancy. Many intriguing questions await asking and testing. For example, we show that female competition plays a key role in ovulatory effects on women’s fashion product choice. However, the focus of this research was on fashion products intended to be worn in public (e.g., clothing and other accessories). Because previous research shows that, at ovulation, women shift their preferences toward specific types of men (masculine, symmetric, dominant), it is possible that mating motives (e.g., priming photographs of attractive men) may influence women’s desire for other attractiveness-enhancing goods near ovulation. Specifically,

mating motives may elicit an ovulatory effect on the desire for lingerie—products that play a larger role in a mating context than in competition with female rivals.

Future work might also examine possible psychological mediators underlying women's behavioral changes around ovulation. There are multiple possibilities that would be highly consistent with our theoretical perspective. For example, ovulating women might feel more comfortable with their bodies, or another possibility is that ovulating women might feel more competitive and desire to seek status (Hill and Durante 2009). These and other possibilities represent possible proximate-level mechanisms for how ovulation might influence behavior, whereby each proximate-level mechanism is consistent with our ultimate-level explanation for the existence of ovulatory shift effects. Of course, these two levels of analysis are not competing (they are complementary), meaning that both types of explanations are required for a complete understanding of most phenomena (see Kenrick et al. 2010).

An interesting unanticipated finding in the current studies concerns female competition and nonovulating women. Specifically, when nonovulating women viewed photographs of attractive local women, they subsequently chose fewer sexy items compared to nonovulating women in the other prime conditions in both study 2 (see fig. 1) and study 3 (see fig. 2). One possible explanation for this apparent suppression effect is that the salience of female rivals might lead nonovulating women to become less competitive and, thus, less likely to want to dress to impress. That is, because the potential evolutionary benefits of winning costly status competitions are lower when women are not ovulating, it is possible that the salience of female rivals leads nonovulating women to distance themselves from direct competition. Instead, the risks and costs associated with competition might

be saved for when women are ovulating—the time when the potential evolutionary benefits of winning status competitions are highest. Of course, further research is needed to understand the specific nature of how female competition changes across the ovulatory cycle.

In addition to ovulatory hormones, an emerging body of research is beginning to show how psychology and behavior is influenced by many different hormones (Durante and Li 2009). High levels of testosterone in men, for example, are associated with mating effort, social dominance, and entrepreneurship (Mazur and Booth 1998; Mehta, Jones, and Josephs 2008; Saad and Vongas 2009; White, Thornhill, and Hampson 2007), and men's testosterone is known to decrease when men get married and become fathers (Burnham et al. 2006). As such, higher levels of testosterone are likely to be related to male purchases of products and services related to status displays and male competition. A different hormone, cortisol, is known to be activated in response to physical exertion and in times of psychological stress (e.g., fear, defeat; Dickerson and Kemeny 2004). Cortisol boosts may shift consumer purchases away from status-display goods to products associated with safety and comfort. Yet a different set of hormones are present when people fall in love and become parents (oxytocin in women; vasopressin in men; Young and Insel 2002). High levels of oxytocin and vasopressin may be associated with purchasing products that enhance the level of care one is able to provide for a spouse or children.

In sum, the current research is among the first to establish a theoretically derived link between hormones and consumer choice, and it is the first to demonstrate a direct link between product choice and hormonal variation across the ovulatory cycle. The examination of hormonal influences on consumer behavior provides fertile ground for future research.

APPENDIX

FIGURE A1

SAMPLE OF AVAILABLE CASUAL WOMEN'S CLOTHING AND ACCESSORY PRODUCTS

Relatively More
Sexy/RevealingRelatively Less
Sexy/Revealing

NOTE.—Color version available as an online enhancement.

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