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RESEARCH ARTICLE

Envy Mediates the Link Between Social Comparison and Appearance Enhancement in Women

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Abstract Envy has recently been considered from an evolutionary perspective as an emotion which might motivate compensatory action following unfavorable social comparisons. In two studies, the role of envy in women's motivation to enhance their physical appearance was examined. Study 1 explored the mediating role of dispositional envy on the relationship between social comparison and women's resource spending on appearance-enhancing products, desired weight loss, and tanning intention in a cross-sectional sample of undergraduate women (N=188). Controlling for age and self-perceived mate-value, results revealed that social comparison significantly predicted all three dependent variables, with mediation effects of envy on desired weight loss, consumer spending, and tanning intentions. Study 2 replicated and extended these findings via an experimental social comparison priming procedure. Women (N=90) who made social comparisons toward attractive women in magazine advertisements (N=45) reported greater state envy relative to women viewing advertisements featuring a product only (N=45). Moreover, induced state envy subsequently predicted greater willingness to use facial cosmetics and to take a risky diet pill, and increased positive attitudes toward cosmetic surgery. These results support the role of envy, activated by unfavorable social comparisons, in motivating compensatory competitive appearance enhancement behaviors.

Keywords Envy · Social comparison · Appearance enhancement · Evolution of emotion · Skin tanning · Dieting · Cosmetics use · Cosmetic surgery · Appearance enhancement products

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Envy is characterized by the unpleasant experience of hostility, inferiority, and resentment toward those who possess something desirable (Smith and Kim 2007). Historically, envy has been considered a "deadly sin" (Epstein 2003), believed to be evil and to father other wrongdoings (for a review, see Silver and Sabini 1978). In stark contrast, some researchers argue that envy is an adaptive emotional experience that coordinates psychological and behavioral responses to unfavorable social comparisons in domains of reproductive relevance (Hill and Buss 2008). In two studies, we examined (1) whether dispositional envy mediates links between women's upward appearance comparisons and the desire to enhance their physical appearance, and (2) whether experimentally induced appearance comparisons increase state expressions of envy, which may in turn predict positive attitudes and intentions toward enhancing physical appearance.

Appearance Enhancement as Sexual Competition

Across cultures, men prioritize physical attractiveness in their mates more than women do (Buss 1989; Buss and Dedden 1990; Buss et al. 2001). Some evolutionary psychologists argue that this is because men have faced the recurrent adaptive problem of identifying fertile mates, given that women's fertility varies more than that of men (Symons 1979). Specifically, men

who were (unconsciously) attracted to traits correlated with a woman's health, youth, and fertility preferentially directed their mating effort toward women with the highest reproductive value, thereby increasing their likelihood of reproducing and of passing along such preferences to offspring. Many specific traits in women's faces and bodies (e.g., facial femininity, skin clarity, symmetry, waist-hip ratio, body mass index, breast size) have been identified as indices of women's underlying health, youth, and fertility (for a review, see Arnocky et al. 2014; Cloud and Perilloux 2014; Sugiyama 2005). Because men have recurrently selected mates based on these cues (i.e., physical attractiveness), women—more so than men—attempt to advertise and enhance their physical attractiveness to compete against intrasexual rivals (Buss 1988; Meston and Buss 2009). Researchers have identified various methods of appearance enhancement which seem to underlie intrasexual competition among women, including the purchase and use of appearance enhancement products (e.g., cosmetics; Meston and Buss 2009), dieting and weight loss efforts (Abed et al. 2012), skin tanning (Hill and Durante 2011), and cosmetic surgery (Arnocky and Piché 2014).

Appearance Enhancement Products Women in Western cultures spend almost ten times the amount of money that men spend on appearance enhancement products each year (Meston and Buss 2009). Other research shows that, even in an economic recession, women increase their spending on beauty products, while decreasing their spending on other products (Hill et al. 2012). This tendency to prioritize the purchase of appearance enhancement products over other needs in resource-scarce conditions has been suggested to be a tactic for outcompeting intrasexual rivals in order to attract mates who have more resources—colloquially termed the "lipstick effect" (see Hill et al. 2012).

Desire to Lose Weight Intrasexual competition has also been linked with body dissatisfaction, drive for thinness, and disordered eating behavior among women (Faer et al. 2005; Li et al. 2010). For example, Li et al. (2010) exposed participants to one of two photo conditions depicting either high status or low status intrasexual rivals. Results showed that heterosexual women (but not men or homosexual women) were more likely to report body dissatisfaction and more restrictive eating attitudes following exposure to the high status intrasexual rivals. Furthermore, women who are experimentally primed with intrasexual competition and mating motives report a greater willingness to take diet pills relative to controls (Hill and Durante 2011).

Tanning Many young women report a belief that skin tanning improves their general appearance (Hillhouse et al. 1996; Prior et al. 2014; Yoo and Kim 2014). In a North American sample, Hill and Durante (2011) found that women who were primed with intrasexual competition or intersexual courtship motives showed an increase in their interest in skin tanning (i.e., using a free 1-week tanning membership). One possible explanation for this finding is that women believe that tanning hides imperfections or masks cellulite, traits which men find unattractive in women (Buss 1989). Evolutionary psychologists have argued that a preference for women with lighter skin may be an adaptation that directs men's mating effort toward nubile women, as women's skin tone darkens with age and parity (Symons 1995).

Cosmetic Surgery Women's intrasexually competitive attitudes predict a more favorable view of having cosmetic surgery, as well as a greater desire to spend money on cosmetic surgical procedures (Arnocky and Piché 2014). Interestingly, in the aforementioned study, the perceived risks associated with cosmetic surgery were not diminished among those who scored high in intrasexual competition, suggesting that women who scored high on intrasexual competitiveness exhibited more favorable views of cosmetic surgery, even in the face of perceived health risks, compared to those who were less competitive (Arnocky and Piché 2014).

Social Comparison

Strategies of physical appearance enhancement, such as those described above, are often viewed by women as viable methods for competing with rivals (Cashdan 1998), enhancing desirability to men (Tooke and Camire 1991), and retaining mates (Buss 2002). In ancestral environments, competing for scarce resources (e.g., high-quality mates) would not only depend on individuals' own traits, but would also depend on how their traits compare to those of their competitors (Hill and Buss 2008). Accordingly, human ancestors who were able to assess how they fared relative to others in key domains would have been at a distinct reproductive advantage (Frank 1999; Hill and Buss 2008). Today, modern humans often compare themselves to others in order to assess their relative rank on important abilities or characteristics (including physical appearance) and determine which traits are worth investing effort into improving (e.g., Collins 1996; Festinger 1954; Gilbert et al. 1995; Mendes et al. 2001).

Given organisms' finite energy budgets (Kaplan and Gangestad 2005), mechanisms that were successful—but not wasteful—in allocating effort to solving a variety of adaptive problems would have increased reproductive success. Therefore, social comparison likely functions to gauge the optimal amount of effort necessary to succeed relative to one's competitors. For instance, Hill and Buss (2008) argue that employing a simple social comparison decision rule of "do better than your nearest competitor" motivates individuals to outcompete others, but not to invest more effort than is necessary (p. 61). Other types of decision rules such as "always do the best you can" or "be attractive enough to acquire a

mate" do not specify an appropriate limit for when to stop investing in that particular dimension, and instead divert attention to other adaptive problems. That said, it is important to note that our evolved psychological mechanisms for identifying our "nearest competitor" are likely exploited in the modern environment. In ancestral environments, there was no selection pressure to distinguish between "real" competitors and "fake" competitors; the only input human competitor-assessment mechanisms received was the presence of actual women. In the modern environment, however, women are exposed to beautiful young "rivals" everywhere: on billboards, in magazines, on television. These women, although not actually direct competitors, are likely perceived as such due to the simple visual nature of our competitor-assessment mechanisms. Therefore, exposing women to images of highly attractive intrasexual competitors is likely to automatically prompt unfavorable social comparisons.

Envy

Unfavorable social comparisons in domains relevant to reproductive success have been hypothesized to elicit an emotional response of envy (Hill and Buss 2008). For instance, DelPriore et al. (2012) observed that participants identified envy-eliciting situations to occur most frequently in correspondence with key adaptive problems relevant to one's sex. In their study, women, more than men, reported envy as a result of comparing themselves to a more attractive same-sex competitor, whereas men, more than women, reported envy toward those with greater financial resources and apparent status. Furthermore, female students in a daily diary study expressed more envy in response to physical appearance comparisons than in response to other types of comparisons, such as those relating to lifestyle or intelligence (McKee et al. 2013). Interestingly, recent evidence also suggests that individuals' attention is disproportionately drawn toward an envied target, which might motivate individuals to procure resources necessary for success in intrasexual competition (Hill et al. 2011; Zhong et al. 2013). Because a fruitful tactic for dealing with reproductive challenges involves increasing one's value to the opposite sex (Buss 1988; Buss and Dedden 1990), envy likely motivates physical appearance enhancement behaviors among women.

This concept of envy is consistent with evolutionary explanations of emotions as superordinate programs designed to coordinate a variety of relevant psychological and physiological mechanisms that motivate adaptive behavioral responses (Buss 1989; Cosmides and Tooby 2000; Nesse 1990; Tooby and Cosmides 2008). In support of this model, Pila et al. (2014) found that among undergraduates, the most frequently reported trigger of body-related envy was a discrepancy in physical comparisons, and that envy predicted reported exercise motivation and behaviors. Moreover, Nabi and Keblusek (2014) found that women's self-reported comparisons with media figures were associated with greater reported intention to undergo risky cosmetic surgical procedures (e.g., botulinum toxin injections, liposuction, breast implants), and that envy (rather than hope or sadness) mediated this relationship; however, this study was limited in its focus solely on extreme appearance enhancement (i.e., cosmetic) procedures, as well as in the cross-sectional nature of its design, leaving unanswered the question of whether envy mediates a more generalized tendency among women to enhance their physical attractiveness in light of making appearance-based social comparisons.

In the current research, we conducted two studies, one cross-sectional and one experimental, which directly tested the mediating role of envy on the relationship between attractiveness comparison and physical appearance enhancement. Based on the literature reviewed above, it is clear that women employ a variety of tactics for appearance enhancement. Accordingly, we included diverse sets of appearance enhancement attitudes and intentions in these studies (Study 1: appearance enhancement spending, skin tanning intention, and desired weight loss; Study 2: attitude toward cosmetic surgery, intended facial cosmetics use, skin tanning, and diet pill use), all of which have previously been conceptually and empirically linked to intrasexual competition as tactics to enhance one's physical appearance.

Study 1

We investigated the motivational role of dispositional (i.e., trait) envy in outward appearance modification as a function of women's social comparisons. We predicted that dispositional envy would mediate the link between women's tendency to make physical appearance comparisons and several appearance enhancement behaviors: money spent on appearance enhancement products (Prediction 1), tanning intentions (Prediction 2), and desire to lose weight (Prediction 3). We anticipated these findings would remain in light of controlling for women's self-perceived mate-value, which might simultaneously influence women's intrasexually competitive behaviors (see Arnocky et al. 2012), and age, which has been linked to dispositional envy (Lange and Crusias 2015).

Method

Participants

The sample consisted of 188 heterosexual women between the ages of 17 and 33 (M_{age}=21.24, SD_{age}=2.94), who primarily self-identified as Caucasian (90 %), and 48 % of whom were currently in committed romantic relationships. Participants

were recruited in common areas of a mid-sized university and college and were compensated with a chance to win $100.

Materials and Procedure

Participants completed a self-report paper and pencil questionnaire package in a private testing room (mean testing time including informed consent and debriefing was 25 min). The questionnaire consisted of a demographics section (e.g., age, ethnicity) and the following measures (order was randomized across participants).

Physical Appearance Comparison To assess the degree to which individuals typically compare their physical appearance to the appearance of their peers, participants completed the 5-item Physical Appearance Comparison Scale (PACS; Thompson et al. 1991). Using a 5-point Likert-type scale ranging from 1=*never* to 5=*always*, participants rated the frequency with which they make physical appearance comparisons such as "At parties or other social events, I compare my physical appearance to the physical appearance of others." Participants' responses to the five items were averaged to create a physical appearance comparison score. In the current study, the PACS demonstrated acceptable internal consistency (α=0.75).

Dispositional Envy We used the Dispositional Envy Scale (DES) to measure individual differences in the tendency to envy others (Smith et al. 1999). The DES consists of eight items rated with a 9-point Likert-type scale ranging from −4="*very strong disagreement*" to +4="*very strong agreement*." Example items are as follows: "I feel envy every day," "It is so frustrating to see some people succeed so easily, " and "I am troubled by feelings of inadequacy." Participants' responses to the items were averaged to create a dispositional envy score. The DES generally exhibits good factorial and criterion validity (Milfont and Gouveia 2009; Smith et al. 1999), and demonstrated good internal consistency (α=0.90) in the current study.

Self-Perceived Mate-Value Self-perceived mate-value was assessed using the Components of Mate-Value Survey (CMVS; Fisher et al. 2008). The measure consists of 22 items with response options ranging along a 7-point Likert-type scale (1="*strongly disagree*", 7="*strongly agree*"). The CMVS incorporates items from a diverse set of mate-value dimensions including sociality (e.g., "I run into friends wherever I go"), how the respondent is viewed by members of the opposite sex (e.g., "Members of the opposite sex are attracted to me"), parenting (e.g., "I would make a good parent"), wealth (e.g., "I want people to think that I am wealthy"), physical attractiveness (e.g., "I would like members of the opposite sex to consider me sexy"), relationship history (e.g., "After I date someone they often want to date me again"), and fear of romantic failure ("I often worry about not having a date"). In the present study, the measure showed good internal consistency, (α=0.84).

Appearance Enhancement Products Participants indicated the approximate proportion of income they spend on consumer goods and services to enhance their physical appearance using an 11-point scale from 0 to 100 % (with 10 % intervals). A list of example products was provided: clothing, make-up, jewelry, hair-styling, hair-cuts, cologne/perfume, and skin treatments/products. Participants on average reported spending 20 % of their income on this category of products/services.

Desire to Lose Weight Participants first reported their current weight and then their desire to lose weight was assessed using the question: "Would you like to lose weight?" with answer choices of "yes" or "no" followed by "If so, how much weight would you like to lose?" with open response options in pounds or kilograms (women who indicated they did not want to lose weight thus entered a "0" for desired amount of weight loss). Studies have shown such strong concordance between measured and self-reported body weight (e.g., Craig and Adams 2009; Dekkers et al. 2008; Spencer et al. 2002), that some researchers suggest that self-reported weight is "remarkably accurate … and may obviate the need for measured weights in epidemiological investigations" (Stunkard and Albaum 1981, pp. 1593).

Tanning Intention To measure intentions toward tanning behavior, we employed the following single-item measure developed by Jones and Leary (1994): "Please rate how much you plan to work on getting a tan this coming summer, compared to last summer" with response options ranging on a Likert-type scale from 1=*much less* to 12=*much more*. This measure shows evidence of good criterion validity, as it correlates positively with appearance motivation and negatively (among those low in appearance motivation) with perceived risks of tanning to one's health (Jones and Leary 1994). See Table 1 for descriptive statistics and intercorrelations for all measures.

Analytic Approach

We examined the simple effects of physical appearance comparison on each of the outcome variables: consumer spending on appearance enhancement products, intended skin tanning, and desired weight loss, controlling for self-perceived mate-value. Bootstrapping procedures, as outlined by MacKinnon et al. (2002), were used to examine the role of dispositional envy in mediating these relationships. For each analysis, 1000 bootstrapping samples were derived. Unstandardized regression coefficients are reported as they are the preferred metric in causal modeling (Hayes n.d.).

Table 1 Descriptive statistics and bivariate correlations for Study 1 variables

	M	SD	Min.	Max.	1.	2.	3.	4.	5.
1. Appearance comparison	3.21	0.70	1.20	4.80	–				
2. Envy	2.35	0.89	1.00	5.00	0.47**	–			
3. Mate-value	4.27	0.83	1.24	5.86	0.18*	−0.07	–		
4. Appearance product spending	3.28	1.90	0.00	9.00	0.30**	0.29**	0.19*	–	
5. Desired weight loss (lbs)	14.10	17.82	0.00	90.00	0.31**	0.22**	−0.06	0.01	–
6. Skin tanning intention	6.08	3.19	1.00	12.00	0.22**	0.26**	0.28**	0.13	0.06

M mean, *SD* standard deviation, *Min.* minimum score observed, *Max.* maximum score observed
* = $p < .05$, ** = $p < .01$

Results

To test whether dispositional envy mediated the relationships between physical appearance comparison and appearance enhancement variables, we first determined whether women who scored higher in physical appearance comparison were in fact more likely to exhibit dispositional envy. Results confirmed that women's physical appearance comparisons significantly predicted dispositional envy, $b=0.60$, $p=0.001$.

Appearance Enhancement Products/Services

The covariate, self-perceived mate-value, $b=0.41$, $t=2.43$, SE=0.17, $p=0.02$, positively predicted women's spending on appearance-related goods and services. Age did not predict women's appearance-related consumer spending, $b=-0.06$, $t=-1.14$, SE=0.05, *ns*. Social comparison had a total effect on consumer spending on appearance enhancement products of $b=0.78$, $t=3.61$, SE=0.22, $p=0.001$. However, when dispositional envy was added to the model, the direct effect of social comparison on spending was statistically significantly reduced, $b=0.52$, $t=2.17$, SE=0.24, $p=0.03$. Dispositional envy statistically significantly predicted spending, $b=0.41$, $t=2.28$, SE=0.18, $p=0.02$, mediating the link between social comparison and spending (bootstrapping: 95 % LL=0.04, 95 % UL=0.53). The mediation model contributed 13 % ($R^2adj=0.13$) toward explained variance in consumer spending.

Desire to Lose Weight

We examined whether social comparison would predict the amount of weight women desired to lose, independent of participants' current weight and self-perceived mate-value, and whether dispositional envy would mediate this. Results showed that weight (entered as a covariate) significantly predicted the desired weight loss, $b=0.52$, $t=23.17$, SE=0.02, $p=0.001$. Self-perceived mate-value also predicted desired weight loss, $b=-1.91$, $t=-2.38$, SE=0.80, $p=0.01$, such that high mate-value women were less likely to desire losing weight. Age did not predict desired weight loss, $b=0.23$, $t=0.90$, SE=0.25, *ns*. Social comparison had a total effect on desired weight loss of $b=3.80$, $t=3.74$, SE=1.02, $p=0.003$. However, when dispositional envy was added to the model, the direct effect of social comparison upon desired weight loss was no longer significant, $b=1.93$, $t=1.75$, SE=1.10, *ns*. Dispositional envy significantly predicted desired weight loss, $b=2.96$, $t=3.63$, SE=0.82, $p=0.001$. Thus, dispositional envy fully mediated the link between social comparison and the desire to lose weight (bootstrapping: 95 % LL=0.89, 95 % UL=3.21). The mediation model contributed 80 % ($R^2adj=0.80$) toward explained variance in desired weight loss.

Table 2 Descriptive statistics and bivariate correlations for Study 2 variables

	M	SD	Min.	Max.	1.	2.	3.	4.	5.
1. Condition	–	–	–	–	–				
2. Envy	3.03	1.29	1.00	6.20	−0.68**	–			
3. Intended cosmetics use	1.73	0.70	0.13	3.38	−0.11	0.34**	–		
4. Intended use of diet pill	1.66	1.15	1.00	5.00	−0.07	0.29**	0.27*	–	
5. Intended use of free tanning	2.98	2.17	1.00	7.00	0.07	0.02	0.28**	0.53**	–
6. Cosmetic surgery attitude	2.42	1.21	1.00	6.53	0.02	0.26*	0.50**	0.54**	0.38**

M mean, *SD* standard deviation, *Min.* minimum score observed, *Max.* maximum score observed
* = $p < .05$, ** = $p < .01$

Tanning Intention

Self-perceived mate-value positively predicted women's skin tanning intentions, b=1.12, t=4.01, SE=0.28, p=0.001. Age did not predict tanning intentions, b=−0.13, t=−1.06, SE=0.08, *ns*. Physical appearance comparison had a total effect on tanning intention of b=0.81, t=2.24, SE=0.36, p=0.02. However, when dispositional envy was added to the model, the direct effect of social comparison on tanning intention was statistically significantly reduced, b=0.28, t=0.71, SE=0.40, *ns*. Dispositional envy significantly predicted tanning intention, b=0.80, t=2.72, SE=0.29, p=0.007, mediating the link between social comparison and tanning intention (bootstrapping: 95 % LL=0.17, 95 % UL=0.96). The mediation model contributed 15 % (R^2adj=0.15) toward explained variance in women's tanning intentions.

Study 2

The cross-sectional findings obtained in Study 1 supported the mediational model of envy. However, directional conclusions cannot be drawn from correlational data. In contrast to Study 1, which explored *trait* measures of appearance comparison and envy, Study 2 examined the effects of induced appearance comparison upon *state* feelings of envy. Study 2 was designed to determine whether being assigned to make appearance-based social comparisons to female models would cause women to experience greater envy and to subsequently report stronger attitudes and intentions toward appearance enhancement behaviors. It was anticipated that women who were randomly assigned to compare themselves to female models in advertisements would express greater feelings of envy than women assigned to view advertisements (from the same companies) that did not feature female models. Envy, in turn, was expected to predict four appearance enhancement variables: intended facial cosmetics use, interest in using a diet pill that posed a risk to future health, interest in using a free 1-week indoor tanning membership, and positive attitudes toward having cosmetic surgery. These variables were unique from those used in Study 1 to determine whether statistical support for the mediational model of envy would be robust across a variety of appearance enhancement measures.

Method

Participants

Our sample consisted of 90 women (M_{age}=19.77, SD_{age}=2.19) between the ages of 19 and 32 who primarily self-identified as Caucasian (91 %), 50 % of whom were currently involved in committed romantic relationships. Participants were recruited using a university online participation pool and participated in exchange for partial course credit. Forty-five women were randomly assigned to the experimental (social comparison) condition, and 45 women were randomly assigned to the control condition.

Procedure

Women completed all experimental procedures in a private testing room. Participants were told that they were engaging in a marketing study about the efficacy of various magazine advertisements, and were asked to view a series of five ads and subsequently answer questions regarding each ad. Participants then completed a paper and pencil questionnaire composed of the following instruments (the first two were presented first and in order; the order of the remaining three instruments was counterbalanced across participants) and were then debriefed about the goals of the study.

Materials

Physical Appearance Comparison Priming Task Women were randomly assigned to one of two experimental conditions previously shown to induce between-group differences in the evocation of physical appearance comparisons in women (based on Tiggemann and McGill 2004): viewing advertisements featuring female models (appearance comparison condition) or advertisements that did not feature female models but rather images of the product being sold (control condition). In both conditions, participants viewed a series of five magazine advertisements promoting various products sold by clothing, vehicle, food, and alcoholic beverage companies. Advertisements were selected based on the criteria of (1) availability of the advertised product in Canada (where the study took place), (2) separate advertisements from the same companies (e.g., Budweiser) existing for appropriate use in the appearance comparison condition and control condition to eliminate the possibility that the status of the brand names could confound the results, (3) advertisements for the appearance comparison condition featuring most prominently a one women who was not fully clothed (i.e., with visible body parts as in wearing a bikini, a shirt but no bottoms, being strategically covered only in bottle-caps, or in a bra and panties), and (4) the control advertisement featuring the product or logo most prominently.

In the control condition, participants viewed each ad for 30 s, after which they responded to the following five survey items using a 5-point Likert-type scale (1=*strongly disagree*, 5=*strongly agree*): "If I saw this ad in a magazine, it would catch my eye," "I like the layout of this ad," "This ad makes me interested in the product," "This ad is creative," and "This ad is effective in promoting its product."

In the appearance comparison condition, participants viewed each ad for 30 s, after which they responded to the following five questions using the same 5-point scale. Two of the items were retained from the control condition ("I like the layout of this ad" and "This ad is effective in promoting its product"), whereas three of the items differed from the control condition in order to facilitate appearance comparison: "I would like my body to look like this woman's body," "This woman is thinner or prettier than me," and "In a busy clothing store, I would not like to try on bikinis in the same room as this woman if she were also trying on bikinis" (Tiggemann and McGill 2004).

Two manipulation check items, from Tiggemann and McGill (2004) were included to assess the efficacy of the priming task. Following the priming task, all participants responded to the following two items using a 7-point Likert-type scale ranging from 1=*not at all* to 7=*a great deal*: "To what extent did you think about your appearance when viewing the magazine advertisements?" and "To what extent did you compare your physical appearance to other women when viewing the magazine advertisements?".

State Envy Following the priming manipulation, participants completed a questionnaire package. State envy was assessed using a scale developed by Hill et al. (2011). Using a 7-point Likert-type scale ranging from 1=*not at all* to 7=*very much*, participants reported the degree to which viewing the advertisements made them feel emotions characteristic of envy ("envious," "hostile," "inferior," "longing for what another has," "mediocre," "motivation to improve," "resentful," "unlucky," and "wishful"). Participants' responses to the items were averaged to create a state envy score. In the current study, the measure of state envy showed good internal consistency (α=0.92).

Cosmetics use The Situational Cosmetics Use Inventory (Cash and Cash 1982) assessed women's intention to use various amounts of facial cosmetics in everyday situations. Using a 5-point Likert-type scale ranging from 0=*no cosmetics use* to 4=*use as much as ever used in any situation*, participants rated their intended use of facial cosmetics in eight social situations such as attending class, dining at a nice restaurant with a date (or spouse), or exercising outdoors with male and female friends. Participants' responses to the items were averaged to create an intended cosmetics use score. In the current study, the Situational Cosmetics Use Inventory showed good internal consistency (α=0.90).

Desire to Lose Weight and Tanning Intention Following Hill and Durante (2011), participants rated their interest in taking a diet pill known to cause heart problems later in life and their interest in using a 1-week free tanning membership. As a control variable for risk-taking unrelated to appearance enhancement, participants were also asked to rate their willingness to paint in an unventilated room to avoid outside noise and cold weather. Each item was rated along a 7-point Likert-type scale ranging from 1=*not at all interested* to 7=*very interested* (Hill and Durante 2011).

Attitudes Toward Cosmetic Surgery Favorable attitudes toward cosmetic surgery procedures were assessed using the 15-item Acceptance of Cosmetic Surgery Scale (ACSS; Henderson-King and Henderson-King 2005). Using a 7-point Likert-type scale anchored at 1=*strongly disagree* and 7=*strongly agree*, participants rated the extent to which they agreed with statements about their willingness to consider cosmetic surgery. Example items are: "If it would benefit my career, I would think about having plastic surgery," "In the future, I could end up having some kind of cosmetic surgery," "If a simple cosmetic surgery procedure would make me more attractive to others, I would think about trying it," and "I would never have any kind of plastic surgery" (reverse-scored). Participants' responses to the items were averaged to create an attitude toward cosmetic surgery score. The ACSS exhibits good convergent and discriminant validity (Henderson-King and Henderson-King 2005). The measure showed very good internal consistency in the current study (α=0.95). See Table 2 for descriptive statistics and intercorrelations for all Study 2 measures.

Analytic Approach

We developed and tested an observed variable path model to explore whether experimentally induced appearance comparison would cause increased state envy, which in turn would predict an increase in intentions toward appearance enhancement efforts (intended cosmetics use, desire to lose weight, tanning intention, and attitudes toward cosmetic surgery). Age did not correlate with any of the study variables and thus was not included as a covariate. We also predicted that increases in envy as a result of the appearance comparison manipulation would not predict risk behavior unrelated to appearance enhancement (i.e., painting in an unventilated room).

The use of path analysis confers a number of distinct advantages over ordinary least-squares regression, as it can be used to test predictions of the relationship between appearance comparison, envy, and appearance enhancement simultaneously, as well as alternative explanatory models. For each model in the present study, overall fit was assessed using the following indices: the chi-square test of significance (χ^2), comparative fit index (CFI), the normed fit index (NFI), and the root mean square error of approximation (RMSEA; Kline 2005). Good model fit is indicated by a non-significant model χ^2. Model fit can also be informed by an RMSEA lower than 1.00 (Kenny 2003), as well as a CFI and an NFI above 0.90. We compared differences in fit between our models using the Akaike information criterion

(AIC) scores whereby lower values suggest better fit (Kenny 2003).

Results

Manipulation Checks

We first examined whether the priming manipulation had the desired effects on appearance comparison relative to the control condition. Consistent with Tiggemann and McGill (2004), our results showed that participants in the appearance comparison condition (M=5.20; SD=0.91) responded more strongly to the item, "To what extent did you think about your appearance when viewing the magazine advertisements?" than participants in the control condition (M=3.39; SD=1.80), $t(1, 88)=5.97$, $p<0.001$, d=1.25. Similarly, participants in the appearance comparison condition (M=5.73; SD=1.15) responded more strongly to the item, "To what extent did you compare your physical appearance to other women when viewing the magazine advertisements?" than participants in control condition (M=3.60; SD=1.88), $t(1, 88)=6.54$, $p<0.001$, d=1.40. We also examined whether our control variable for risky behavior unrelated to appearance enhancement (i.e., painting in an unventilated room to avoid inclement weather conditions) was correlated with any of the study variables, but as anticipated, it was not related to condition, $t(1, 88)=-0.06$, $p>0.05$, envy (r=0.08, $p>0.05$), nor any of the appearance enhancement dependent variables (rs=−0.08 to 0.03, ps>0.05). The risky behavior unrelated to appearance enhancement variable was thus excluded from subsequent model testing.

Direct Effects Comparison Model

We first explored a comparison model in which direct effects of the priming manipulation were considered for envy and appearance enhancement. This model tests the alternative hypothesis that it is appearance comparison, rather than envy, which directly influences efforts to enhance physical appearance (Fig. 1). Model fit indices suggested that the comparison model (Model 1) fit the data poorly, χ^2=22.21 (df=4, p=0.001), RMSEA=0.23 (95 % CI=0.14–0.32), CFI=0.86, NFI=0.85, AIC=68.21. All appearance enhancement outcome variables positively covaried with one another (bs=0.21 to 1.30, ps ranged from 0.001 to 0.02). The priming manipulation predicted state envy (b=−1.73, $p<0.001$), but did not predict any of the appearance enhancement outcome variables, (bs=−0.05 to 0.31, $p>0.05$; see Fig. 1), suggesting that appearance comparisons did not directly influence efforts to enhance one's physical appearance.

Mediation Envy Model

We next tested our theoretical model whereby induced appearance comparison was expected to predict envy, which in turn was expected to predict women's intentions to engage in three forms of physical appearance enhancement (Fig. 2). Model fit indices suggested that the mediation model (Model 2) fit the data well, χ^2=5.54 (df=4, p=0.24, $p>0.05$), RMSEA=0.60 (95 % CI=0.00–0.18), CFI=0.99, NFI=0.97, AIC=51.54. Specifically, results showed that, again, all appearance enhancement outcome variables positively covaried with one another (bs ranged from 0.14 to 1.30, ps ranged from 0.06 to 0.001). The priming manipulation significantly predicted state envy (b=−1.73, $p<0.001$). State envy, in turn, significantly predicted positive attitudes toward cosmetic surgery (b=0.24, p=0.01), intended facial cosmetic product use (b=0.18, $p<0.001$), and willingness to use a diet pill with potential health risks (b=0.26, p=0.004). State envy, however, did not predict women's intention to use a free 1-week tanning membership (b=0.03, $p>0.05$). We then trimmed the model of the non-significant tanning intention pathways. All remaining path coefficients were unaffected, and the model continued to fit the data well, χ^2=5.50 (df=3, p=0.14, $p>0.05$), RMSEA=0.9 (95 % CI=0.00–0.22), CFI=0.98, NFI=0.96, AIC=39.50. Taken together, these findings support the role of envy mediating the links between social comparison and several appearance enhancement measures.

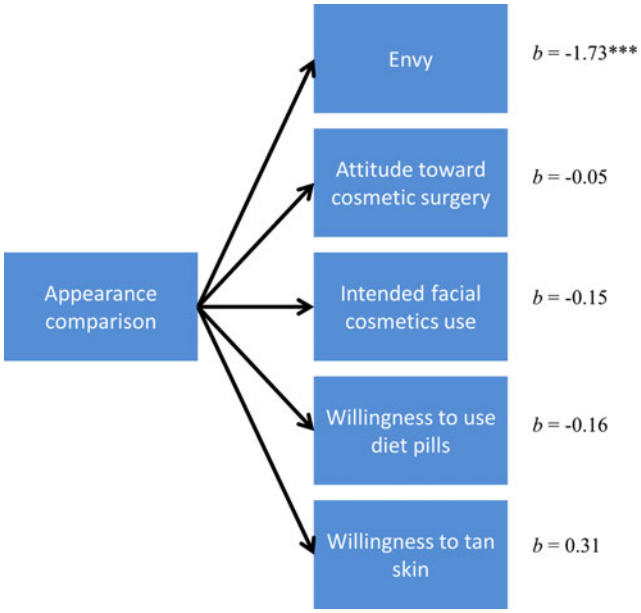

Fig. 1 Direct effects model testing links between appearance comparison manipulation and direct outcomes of envy and appearance enhancement. Note that for ease of interpretation, the covariance between appearance enhancement dependent variables is not depicted

Discussion

Emotions, such as envy, have recently been explored as superordinate mechanisms designed to coordinate the activation of many psychological mechanisms in response to perceived opportunities and threats that affect reproductive

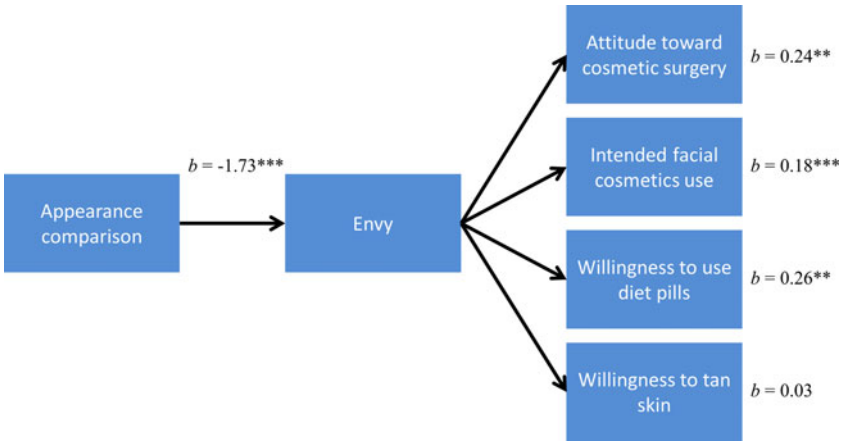

Fig. 2 Mediation model testing the influence of appearance comparison upon envy in turn predicting appearance enhancement outcomes. Note that for ease of interpretation, the covariance between appearance enhancement dependent variables is not depicted

success (Arnocky et al. 2015; DelPriore et al. 2012; Hill and Buss 2008; Tooby and Cosmides 2008). The present study further tested this framework by examining the mediating role of envy between women's social comparisons of physical appearance and their subsequent attitudes and intentions toward appearance enhancement behaviors.

In Study 1, partial mediation effects of envy were found for tanning intention and percentage of income spent on appearance-enhancing products, and a full mediation effect was found for desired weight loss. Interestingly, the mediation effect on desired weight loss was significantly independent of current weight. Consistent with this finding, previous research has shown that many women desire to lose weight, despite being within normal weight range (e.g., Biener and Heaton 1995; Crawford and Campbell 1999).

The results of Study 1 provide support for the role of envy in motivating women's appearance-enhancing behaviors. Although these findings are correlational in nature, they are gleaned from a sample of young women at the peak of their reproductive lifespan, individuals who are perhaps most likely to be affected by intrasexual competition in the mating domain. Our results converge with evidence that envy naturally occurs in women's everyday social comparisons (McKee et al. 2013), physical attractiveness comparisons (DelPriore et al. 2012; Hill et al. 2011), body comparisons with respect to sports and exercise (Pila et al. 2014), and media comparisons affecting cosmetic surgery choices (Nabi and Keblusek 2014). The finding that dispositional envy mediated links between appearance comparison and appearance enhancement motives are consistent with those of Nabi and Keblusek (2014) who found that envy mediated links between attractiveness comparison to media figures (i.e., individuals featured on makeover programs) and cosmetic surgery motives. Our findings add to this literature by examining appearance comparison more broadly and its effects on a larger range of appearance enhancement motives (purchase of appearance enhancement products, desire to lose weight, and skin tanning).

Study 2 extended these initial findings by going beyond trait-based measures of envy to explore state-based changes in envy using an experimental design with two conditions: appearance comparison (i.e., images of models in ads and questions aimed at inducing a comparison to them) and control (i.e., images of product only and no questions about physical appearance). Path analytic results showed that a mediation model in which appearance comparison predicted envy which, in turn, predicted appearance enhancement fit the data well according to conventional fit indices. Specifically, appearance comparison induced significantly more envy relative to the control condition. Envy in turn significantly predicted cosmetic surgery attitudes, intended facial cosmetic use, and willingness to use diet pills (but not use of a free 1-week indoor tanning membership). This is, to our knowledge, the first experimental evidence that social comparison *causes* increases in envy, which in turn predict women's appearance enhancement efforts. Taken together, the findings of Study 1 and 2 suggest that at both the dispositional and state levels, envy mediates the relationship between unfavorable appearance comparisons and a variety of appearance enhancement efforts.

It is noteworthy that for skin tanning, Study 1 found support for skin tanning intention as a correlate of both appearance comparison and envy, whereas in Study 2, interest in using a 1-week free tanning membership was unrelated to induced appearance comparison and envy. Interestingly, tanning membership showed positive covariance with all other outcome variables, suggesting that it was related to a general tendency toward appearance enhancement. One possible explanation of the null effect is that knowledge of indoor tanning health risks may be generally high among young Canadians (e.g., Sun Smart Saskatchewan 2013). Conversely, perhaps a 1-week membership to a tanning facility was insufficient to motivate use of the service (e.g., participants might have questioned the extent to which they would become tanned in just 1 week). In Study 1, we used a previously established measure of tanning intention which assessed a perceived change (compared to last summer) in tanning behavior,

rather than direct intentions to tan. Accordingly, a dispositionally frequent tanner (who intends to tan as frequently as in the past summer, but not more) would score on the mid-point rather than high-point of the scale. Given the conflicting findings between Study 1 and 2 with respect to skin tanning, future research should attempt to replicate and extend these findings to a wider array of tanning intentions and absolute (rather than relative) tanning behaviors in order to determine whether tanning intent is subject to the influence of social comparison and envy in the same manner as other appearance enhancement variables.

From an evolutionary perspective, envy-based motivation to enhance physical appearance is likely to yield some of the reproductive advantages that attractive individuals are afforded (Buss 1989; Sunderani et al. 2013; Symons 1979). However, this mechanism evolved in ancestral environments very different from the modern environment. Western culture abounds with unrealistic social comparison targets (e.g., fashion models and actresses), who as Study 2 evidenced, now serve as targets of social comparison. This can generate a skewed perception of where one stands relative to intrasexual competitors on important mating dimensions (e.g., physical attractiveness), potentially hyper-activating the envy mechanism and escalating appearance enhancement outcomes. From this perspective, it is not surprising that media consumption has been linked to cosmetic surgical procedures (Swami 2009), eating disorders (Harrison and Cantor 1997), and skin tanning (Cafri et al. 2006).

Limitations and Future Directions

A potential limitation of these studies was our sole focus on women. However, given that men place a higher priority on their mates' physical attractiveness than women do (e.g., Buss 1989; Li et al. 2002), our samples of young heterosexual women likely represent the ideal demographic for studying these mechanisms. This, of course, does not preclude the possibility of a mediating role of envy in men's appearance enhancement behaviors as well. Men also face pressures relating to their physical appearances (Gosse and Arnocky 2012). For instance, research has shown that men exercise (Guðnadóttir and Garðarsdóttir 2014; Shomaker and Furman 2010), tailor their clothing choices (Frith and Gleeson 2004), and even engage in risky behaviors, such as steroid use (Blouin and Goldfield 1995; Ricciardelli and McCabe 2003), to appeal to women. Envy might motivate a desire to build bigger muscles or to display status and resources (e.g., expensive clothing) to signal the types of traits women prioritize in their mates (Buss 1989; Li et al. 2002). Men have been shown to express more envy than women about others' status, prestige, superior athletic talent, resource acquisition, and sexual access to women (DelPriore et al. 2012). Future research would thus benefit from exploring whether men's social comparisons on these factors increase envy, and whether their envy leads to increased intentions to enhance their competitiveness within domains. Similarly, our focus on a restricted age range constituting undergraduate women also limits the generalizability of the effect to all women. Perhaps among women at different stages of life (e.g., married, career-women, with children), the effects of advertisements containing young women upon social comparison and envy would be reduced, and appearance behaviors themselves would likely vary from those of younger women.

It is likely that envy mediates a host of reproductively relevant self-enhancement behaviors in addition to those examined in the present study. Future research could benefit from an exploratory study designed to generate a comprehensive list of envy-mediated behaviors. Moreover, tests of model discriminant validity would benefit from including measures of non-reproductively relevant self-enhancement in place of the risk-taking measure (painting in an unventilated room) employed in the present study. Future research might also consider the alternative hypothesis that comparing oneself to others who appear to be engaging in appearance enhancement effort themselves (e.g., peers dressed for a party, models in advertisements) makes appearance enhancement seem normative and thus increases acceptance of these types of behaviors.

Such envy-mediated appearance enhancement behaviors likely also differ cross-culturally. For example, skin tanning is less prominent in non-Western cultures. Interestingly, in other areas of the world such as Tanzania, where individuals have naturally darker complexions, skin bleaching is a common practice (Lewis et al. 2011). Although the input cues that produce a desire to tan might differ cross-culturally, one of the major motivations for such behavior stems from a desire to appeal to the opposite sex (Lewis et al. 2011). Similar cross-cultural differences might exist with respect to body weight and shape ideals. In some cultures, a relatively higher body mass index is sometimes considered attractive, especially in food or resources deprived contexts (e.g., Baker et al. 2004; Clark et al. 1999; Mvo et al. 1999; Swami and Tovée 2006). It would be interesting to examine whether culture-specific appearance enhancement practices are similarly motivated by social comparison and envy in diverse human societies.

Given that individuals can outcompete competitors by either increasing their own value (e.g., self-enhancement behaviors) or by decreasing others' value (e.g., derogating competitors; Buss and Dedden 1990), future research would benefit from examining envy not only as a mediator between unfavorable comparisons and a variety of self-enhancement behaviors, but also as a mediator between unfavorable comparisons and derogation behavior. The tendency to select one of these routes over the other might be predicted by an assortment of variables, including the domain, of comparison one's perceived ability to improve in that domain, one's perception of the degree to which derogation would be believed by others, and perceived interpersonal costs associated with derogation.

Conclusion

Results of the present studies suggest that envy mediates the link between appearance comparisons and appearance enhancement effort. Study 1 showed this effect between trait assessments of appearance comparison tendencies and dispositional envy. Study 2 extended these findings by experimentally manipulating state appearance comparisons and feelings of envy. In both instances, envy mediated the relationship between social comparison and a variety of appearance enhancement efforts including spending on appearance products (e.g., cosmetics), intentions toward skin tanning, and desire to lose weight (Study 1), as well as positive attitudes toward cosmetic surgery, intended facial cosmetics use, and willingness to use a diet pill that entails future health risk (Study 2). Collectively, these findings provide empirical support for the hypothesis that envy has evolved as a mechanism to motivate adaptive psychological responses to unfavorable social comparisons.

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