The Cognitive Consequences of Envy: Attention, Memory, and Self-Regulatory Depletion

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In a series of 4 experiments, we provide evidence that—in addition to having an affective component—envy may also have important consequences for cognitive processing. Our first experiment ($N = 69$) demonstrated that individuals primed with envy better attended to and more accurately recalled information about fictitious peers than did a control group. Studies 2 ($N = 187$) and 3 ($N = 65$) conceptually replicated these results, demonstrating that envy elicited by targets predicts attention and later memory for information about them. We demonstrate that these effects cannot be accounted for by admiration or changes in negative affect or arousal elicited by the targets. Study 4 ($N = 152$) provides evidence that greater memory for envied—but not neutral—targets leads to diminished perseverance on a difficult anagram task. Findings demonstrate that envy may play an important role in attention and memory systems and deplete limited self-regulatory resources available for acts of volition.

Keywords: envy, social cognition, social comparisons, evolutionary psychology

There is something captivating about people who have advantages that we wish we had for ourselves. Whether using Twitter to see where an attractive celebrity dined last night or poring over a famous colleague's Facebook page, many of us find ourselves riveted by even the most trivial information about others we see as being better off than ourselves. This information often finds its way into our memories with greater ease than many of us would like to admit, occupying valuable cognitive space that many of us wish was available for the latest advances in psychological science or a distant relative's birthday. The ease with which our interest is held and our memories are triggered by advantaged others raises an important question: What are the proximal mechanisms by which our limited cognitive resources are captured and potentially depleted by such information? There are a number of social, cultural, and psychological factors that play a role in addressing this complex question. Here, we employ a sociofunctional framework to explore the role that envy plays in directing cognitive resources toward processing information about relevant others. Our function-based perspective predicts that experiencing envy should increase attention to and memory for advantaged targets. Additionally, we explore whether heightened processing of advantaged targets depletes self-regulatory resources such that individuals are less able or willing to dedicate cognitive effort toward persevering on other, unrelated tasks.

A Sociofunctional Perspective on Envy

Envy is a subjectively unpleasant emotion that can arise in response to social comparisons with advantaged others in domains of personal relevance (Feather & Sherman, 2002; Parrott & Smith, 1993; Salovey & Rodin, 1984; Silver & Sabini, 1978; Smith, 1991; Smith & Kim, 2007). Unlike that of many emotions, the experience of envy does not elicit a unique affective state or facial expression (Sabini & Silver, 2005). Instead, it is experienced as a complex mix of unpleasant psychological states—including inferiority, injustice, and resentment—all of which tend to be intentionally concealed from others (Salovey, 1991; Salovey & Rodin, 1984; Silver & Sabini, 1978; Smith, 1991; Smith & Insko, 1987; Smith & Kim, 2007; Smith, Kim, & Parrott, 1988). Although these feelings are sometimes associated with increased motivation to improve oneself, or a "moving up motivation" (van de Ven, Zeelenberg, & Pieters, 2009), envy is often accompanied by feelings of hostility and ill will toward the advantaged other (Smith, 1991; Smith, Parrott, Ozer, & Moniz, 1994). This latter tendency is responsible for the relationship between envy and a number of socially undesirable behaviors, such as willingness to sacrifice one's own outcomes to diminish a competitor's relative advantage (Berke, 1988; Parks, Rumble, & Posey, 2002; Thernstrom, 1998;

Zizzo & Oswald, 2001), criminal behavior (Schoeck, 1969), ingroup biases (Glick, 2002; White, Langer, Yariv, & Welch, 2006), and feelings of joy in response to an envied other's failure or suffering (Leach, Spears, Branscombe, & Doosje, 2003; Smith et al., 1996).

Although great empirical inroads have been made into understanding the various affective states typically associated with envy, much less is known about the impact of this emotion on cognition (for an overview, see Zizzo, 2008). Is it possible that envy may have important consequences for cognitive processes such as attention and memory? Existing function-based theories of social cognition suggest that it may. Researchers have noted that attention and memory appear to be adaptively tuned such that individuals focus on and remember key features of the environment that have been closely linked to differential reproductive success over evolutionary time (Buss, 1989a; Klein, Cosmides, Tooby, & Chance, 2002; Maner, Gailliot, Rouby, & Miller, 2007; McArthur & Baron, 1983; Nairne, Pandeirada, Gregory, & Van Arsdall, 2009; Schützwohl, 2006; Schützwohl & Koch, 2004).

Given that cognitive processing is often geared toward those features of the environment having consequences for one's fitness-related goals, is it possible that the experience of envy is similarly associated with selective attention to and memory for those individuals toward whom one's envy is directed? Heightened memory for information about advantaged peers would enhance the individual's ability to determine the steps necessary to achieve the same outcome (i.e., benign envy, aimed at improving one's own position) or the best tactic for damaging the position of the advantaged other (i.e., malicious envy) to mitigate unflattering contrast effects (van de Ven et al., 2009).

As an illustration of this point, consider a man, John, whose new colleague is a rising star in the company, attracting favor from their common supervisors. If John were to experience his colleague's advantage in a subjectively neutral way, it is likely that he would pay little attention to his colleague and simply tend to his business as usual. Such a response may be more pleasant to experience than envy; however, this response would put John at a disadvantage relative to his green-eyed coworker, Bertrand. Bertrand, as a result of experiencing the injustice and longing typical of envy, pays close attention to the source of his pain, processing details of his colleague's behaviors that likely would have gone unnoticed in the absence of this unpleasant emotional response. For instance, he may note that his colleague is the last to leave the office at night and regularly attends all company networking functions—behaviors that he may choose to adopt in order to increase the likelihood of culling favor himself. Conversely, his heightened attention may cause Bertrand to learn that his new colleague is actually fabricating data to conform to the supervisor's desires, and he may use this information to simultaneously undercut his colleague's advantaged position and render himself more eligible for the boss's favor. In summary, envy experienced in response to an advantaged other may evoke a functionally coordinated cascade of cognitive processes, each of which may render oneself better able to acquire the coveted advantages. In the present research, we examined the possibility that envy—although unpleasant—may play an important role in shifting limited cognitive resources toward processing information about meaningful others.

The Current Studies

In a series of four experiments, we tested novel hypotheses about the cognitive consequences of envy. Our studies focused on processes that operate on lower order stages of perception—attention, encoding, and memory—and also higher order processing that is required for acts of personal volition. In our first study, we explored whether activating envy would correspond to participants paying more attention to and being better able to recall information about fictitious same-sex targets than a control group. In the second and third studies, we sought to conceptually replicate these results, testing whether envy activated specifically in response to advantaged others would lead to greater attention to and better recall for these targets than for less advantaged targets who did not elicit envy. We also tested whether increased attention and recall could be accounted for by alternative states: admiration or negative affect and arousal. Our last study tested whether increased memory for high-envy targets would decrease the cognitive resources available for higher order processing, such as that required for acts of volition in the face of repeated failure (i.e., ego depletion; Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven, Tice, & Baumeister, 1998).

Study 1

Method

Participants. Forty-two men and 27 women (M_{age} = 20.09 years, SD = 1.58) participated in this study in exchange for partial course credit.

Design and procedure. The overall design of the study was a 2 (writing prime: envy vs. neutral) $\times$ 2 (participant sex: men vs. women) between-subjects design. Participants were told that they would be participating in a study on how responses to social information are influenced by media type, individual differences, and mood. To this end, participants were told that they would be asked to write about a randomly selected emotion (e.g., surprise, upset) and then to make judgments about information presented in various sections of a local student newspaper. Participants completed the experiment at partitioned computers running Qualtrics experimental software. The randomization feature of this software randomly assigned them to one of two writing conditions: envy versus neutral prime. After completing the priming procedure, all participants viewed two interviews with fictitious same-sex others that were ostensibly being evaluated for use in an online student newspaper. This was followed by a distraction task (rating a series of cartoons), after which participants were given a spontaneous cued-recall task wherein they were asked to recall information from the target interviews. The experiment closed with participants answering a series of questions about themselves (e.g., age, sex). Participants were then thanked, debriefed, and dismissed. The debriefing procedure indicated that none of the participants guessed the true nature of the research hypothesis under investigation.

Priming procedure. We used a written guided imagery procedure similar to that used by Maner and colleagues (Maner, Gailliot, Rouby, & Miller, 2007; Maner, Miller, Rouby, & Gailliot, 2009) in which an emotional state is activated through a writing exercise. Participants in the experimental condition

were asked to write about four occasions in which they felt envious of a friend or an acquaintance. Participants in the control condition were asked to write about daily activities that they routinely perform. Participants were then prompted to write in detail about one of these respective occasions for 10 min. A manipulation check conducted prior to the experiment ($n_{envy} = 25$, $n_{control} = 29$) verified that the envy prime elicited significantly greater envy (rated on a 1–7 scale) than did the control prime ($M_{envy} = 3.16$, $SD = 1.11$; $M_{control} = 2.38$, $SD = 1.25$), $F(1, 52) = 5.82$, $p = .02$, $d = 0.66$.

Target interviews and dependent measures. We created two fictitious interviews with students who were said to attend a local university. Each interview was formatted to look like a page from a human interest section of a newspaper and included the following five questions: (a) What is your full name? (b) What year are you and what is your major? (c) What are your career goals for the future? (d) What is something about you that most people don't know? and (e) Where would you live if you could live anywhere in the world? The content of the responses was written such that it was devoid of information that itself might prime envy (e.g., information diagnostic of wealth or popularity) and ranged from 430 to 435 words in length. This was done to ensure that any differences in memory for targets would be the result of experienced envy, per se, and not admiration or upward social comparisons more generally. A photograph of a college-age man or woman was then linked with each of the two interviews such that men believed that they were reading interviews with college-age men and women believed they were reading interviews with college-age women.

Participants viewed only same-sex targets for two key reasons. First, research indicates that envy is most frequently experienced in response to same- rather than opposite-sex others (Gastorf & Suls, 1978; Hill & Buss, 2006; Salovey & Rodin, 1984; Tesser, 1988; van Dijk, Ouwerkerk, Goslinga, & Nieweg, 2005). Accordingly same-sex targets are preferable to opposite-sex targets to maintain ecological validity in the current study (i.e., elicited envy being paired with a same-sex target). Furthermore, a large body of research suggests that viewing opposite-sex targets activates mating motivations (see, e.g., Durante, Griskevicius, Hill, Perilloux, & Li, 2010; Griskevicius et al., 2007; Hill & Durante, 2011; Roney, 2003; Wilson & Daly, 2004) and that mating motivations direct one's attentional resources toward attractive members of the opposite sex (Maner, Gailliot, & DeWall, 2007; Maner, Gailliot, Rouby, & Miller, 2007). The use of same-sex targets thus reduces the possibility that other processes—such as attraction, sexual arousal, and courtship motivations—are responsible for any demonstrated effects.

Participants were free to examine each target interview for as long as they wanted, and the number of seconds spent examining each target was recorded with the timing feature in Qualtrics. After participants read the interviews and filled out the corresponding rating scales, they were given a 10-min distraction task (rating a series of cartoons for "funniness"), followed by a spontaneous cued-recall task in which they were presented with each interview stimulus in random order. Participants were shown the photograph and interview questions "answered by" each target. Each interview question was followed by a text box wherein participants were

asked to recall the responses given by the depicted interviewees as specifically as possible before completing the follow-up demographic questions.

Results

Scoring written memory recall. Two trained research assistants blind to the purpose of the study counted the number of interview responses correctly recalled for each target. The arithmetic mean of the assistants' scores was then calculated for each target (αs > .90), and the resulting scores—in addition to time spent examining each target—served as our primary dependent measures.

Does activating envy increase interest in and memory for same-sex targets? To test our predictions, we first created composite variables for examination time and for the amount of information correctly recalled by averaging participants' responses across the two targets (αs > .70). The scores on these variables served as our dependent measures and were entered into a 2 (condition: envy vs. control) $\times$ 2 (participant sex: men vs. women) multivariate analysis of variance (MANOVA). As shown in Figure 1, the results of our analysis revealed that activating envy increased the amount of time participants spent examining the target interviews ($M_{envy} = 72.29$ s, $SD = 23.97$; $M_{control} = 60.21$ s, $SD = 21.97$), $F(1, 63) = 6.09$, $p = .02$, $d = 0.53$.

Further, participants who wrote about a time they experienced envy correctly recalled a greater number of answers to the target interview questions than did the control group ($M_{envy} = 3.46$, $SD = 1.11$; $M_{control} = 2.79$, $SD = 1.09$), $F(1, 63) = 17.17$, $p < .001$, $d = 0.61$ (see Figure 2). The results of a follow-up analysis of covariance revealed that exposure to the experimental prime continued to correspond to increased recall of target information even after controlling for increased attention, $F(1, 64) = 13.37$, $p = .001$. Finally, there were no main effects of participant sex on the dependent measures, nor did sex interact with condition in either of the models.

Discussion

The results of Study 1 demonstrated that experimentally activating envy increased attention to and memory for information about same-sex targets. When envy was elicited, men and women
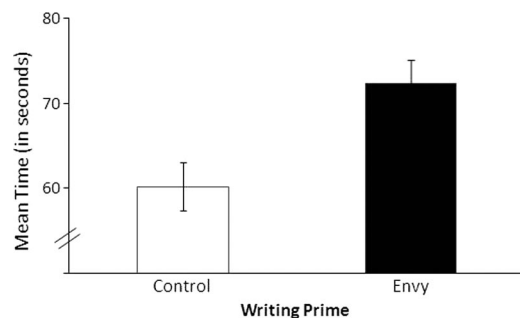

Figure 1. Mean time (in seconds) spent examining same-sex targets following an envy prime or a neutral (control) writing task (Study 1). Error bars reflect standard error.
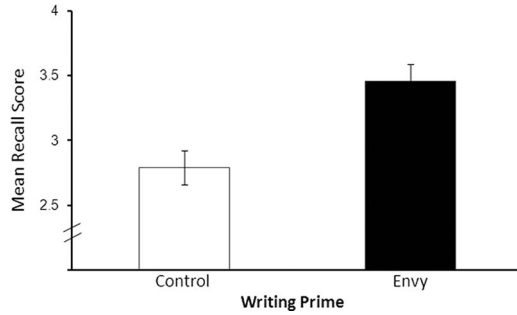
Figure 2. Mean recall score for participants examining same-sex targets following an envy prime or a neutral (control) writing task (Study 1). Higher scores indicate better recall of target information. Error bars reflect standard error.

spent significantly more time examining interviews with fictitious same-sex peers. Moreover, they were later able to correctly recall more information about the targets even after controlling for longer examination time. These results lend support for the hypothesis that the experience of envy—and not upward social comparisons more generally—increases attention to and memory for information about same-sex targets. The results of the current research are the first to demonstrate that in addition to having an affective component, envy may also have an adaptively tuned cognitive dimension.

Although our experiment found initial support for the hypothesis that envy may facilitate functionally specific cognitive shifts, it left a key question unanswered: Do people pay more attention to and remember more about individuals possessing advantages that themselves elicit envy? This question is particularly important because the function-based logic from which our hypothesis was derived implies that the cognitive shifts experienced in response to envy should be target specific. That is, people should pay more attention to and remember more information about advantaged others who themselves evoke envy. Study 2 was developed to test this possibility and also to explore whether the specific advantages that elicit envy differ somewhat between men and women.

Study 2

The current study was designed to test the hypothesis that participants would pay more attention to and remember more information about targets who themselves prime envy than those who do not. We tested this possibility by manipulating target wealth and attractiveness, as these are two adaptively relevant domains in which having an advantage has been found to activate envy (DelPriore, Hill, & Buss, 2011; Foster, 1972; Hill & Buss, 2006; Salovey & Rodin, 1991). Further, manipulating these two characteristics allowed us to explore whether the specific peer advantages that elicit envy might differ somewhat between the sexes. That is, we could address the following question: Do men and women experience envy in response to an advantaged other's attractiveness, wealth, or both?

Because women's physical attractiveness is more strongly tied to reproductive capacity than is men's, superiority in this domain likely has provided a greater fitness advantage to women—both in terms of mate attraction and actual reproductive potential—than it

has to men (Buss, 1989a, 2003; Kenrick & Keefe, 1992; Sugiyama, 2005; Symons, 1979; Williams, 1975). Accordingly, we predicted that women would experience greater envy than would men in response to a peer's possessing an advantage in this domain, replicating and extending others' results (DelPriore et al., 2011; Dijkstra & Buunk, 1998, 2002; Hill & Buss, 2006; Salovey & Rodin, 1991). However, the prediction is less clear about the effects of a target's wealth on envy. Although wealth is more central to men's mating desirability than women's, in our modern environment, money increases both men's and women's ability to acquire resources necessary to meet a wide variety of adaptive goals (e.g., products to increase attractiveness, educate and feed one's children, protect close kin; Buss, 1989b, 2003). Accordingly, if envy occurs in response to fitness-relevant advantages, it is possible that both men and women will respond in an envious manner to targets possessing a wealth advantage. Study 2 thus provides insights into the specific advantages that elicit envy, whether they are sex-differentiated in nature, and their ultimate effects on attention and memory.

Method

Participants.   Eighty-one male and 106 female undergraduates (M_{age} = 19.29 years, SD = 2.54) participated in this study in exchange for partial course credit.

Materials.   Envy has been found to occur most frequently in response to others being similar on comparison-relevant characteristics (Heider, 1958; Salovey & Rodin, 1984, 1991; Schaubroeck & Lam, 2004; Smith, 1991; Smith & Kim, 2007; Smith, Parrott, Diener, Hoyle, & Kim, 1999; Tesser, 1988; van de Ven et al., 2009). Accordingly, our six target stimuli were designed to look like interviews with fictitious students from the same university attended by participants. As in Study 1, each six-question interview was formatted to look like a page from a human interest section of a school newspaper. However, in the current study, the content of the interviews varied to imply different amounts of financial resources possessed by the interviewees. Of the interviews, two provided cues suggesting that the fictitious students were wealthy (e.g., having a new BMW, a parent on the board of trustees at their school), two provided cues implying that the target lacked wealth (e.g., being on financial assistance, having an old car that breaks down frequently), and two were written devoid of any information that would be diagnostic of financial background (e.g., enjoying spending time at the park).

A photograph of either an attractive or a below-average man (for male participants) or woman (for female participants) was then linked with each of the three resource conditions such that there was an attractive and a below-average person associated with each condition (e.g., one interview with a wealthy student was linked to an attractive photograph and the other was linked to a below-average photograph) for each sex. Each of the 12 photographic stimuli (six men and six women) was chosen from a larger set of photographs that had been rated in advance for attractiveness by a group of 84 undergraduates (36 men and 48 women) in exchange for extra credit in a psychology course. The attractive stimuli were chosen based on satisfying the criterion of having received an average attractiveness rating between 7.5 and 9 on a 1–10 scale (1 = *very unattractive,* 10 = *very attractive*). All unattractive

stimuli received an average attractiveness rating between a 2.5 and 4 on the same 1–10 scale.

Next, four experimental web pages—two for each sex—were designed to look like a gender-specific online newspaper targeting either male or female university students. Each page of the newspaper displayed an interview with a fictitious same-sex student depicted at the top of the page. For each sex, two versions of the paper were created such that the order of the interview stimuli differed between participants. Half of participants within each sex would read the interviews in order 1–6, and half of participants would read the interviews in the order 5, 4, 1, 6, 3, 2.

Procedure. Participants were told that they would be participating in an experiment designed to explore how individual differences and media type affect emotional responses to social information. To this end, they were asked to read six student interviews that were supposedly being considered for a new gender-specific newspaper for students at their university. After reading each interview, participants were asked to estimate five personality traits about the author of the article and also the degree to which reading the interviews made them feel 17 different emotions, 10 of which have been found to load heavily on the emotion of envy (Parrott & Smith, 1993; Smith et al., 1988). These 10 items were "dissatisfied with self," "envious," "hostile," "inferior," "longing for what another has," "mediocre," "motivation to improve," "resentful," "unlucky," and "wishful." All items were rated on 7-point Likert-type rating scales. The rest of the procedure and the dependent measures were the same as those used in Study 1.

Results

Measuring envy in response to each target. Each of the 10 emotion ratings related to envy was collapsed within stimulus to create six composite envy ratings for each participant (one for each interview stimulus; $\alpha > .74$).

Scoring written memory recall. Four trained research assistants (3 women, 1 man) blind to the purpose of the study counted the number of words correctly remembered by participants for each target interview. The arithmetic mean of the assistants' scores was then calculated ($\alpha = .99$), and the data were turned into a proportion by dividing the number of words correctly recalled by the total number of words present in the interview.

Analyses. We used hierarchical linear modeling (HLM) to test the research hypotheses under investigation. Level 1 observations consisted of the within-participant observations, six for each participant. Observations at this level included each participant's envy ratings, examination times, and the amount of information correctly recalled about each target, as well as values indicating the attractiveness and wealth ratings given to each target. Participants themselves were the Level 2 observations; therefore, sex was a predictor at this level. The models were of general HLM form, wherein each participant had his or her own regression equation based on the six Level 1 observations, and the coefficients from these equations served as outcome variables at Level 2. Group mean centering (here, within persons) was used for all Level 1 variables, and all effects at this level were specified as randomly varying. All Level 2 effects were fixed, and all models were estimated with HLM 6.02 (Raudenbush, Bryk, Cheong, & Congdon, 2004).

Does envy affect attention to and memory for advantaged peers? To examine the effects of envy on attention to—and memory for—same-sex peers, we constructed a model for memory outcome as follows:

$$\text{Level 1: time/interview recall}_{ij} = \beta_{0j} + \beta_{1j}(\text{envy})_{ij} + r_{ij}$$

$$\text{Level 2: } \beta_{0j} = \gamma_{00} + \gamma_{01}(\text{female})_j + \mu_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{female})_j + \mu_{1j}$$

The i subscript refers to the within-person Level 1 observations. The j subscript refers to participants (i.e., the Level 2 observations). Results of these models are shown in Table 1.

The results indicated that, for men, a 1-unit increase in reported envy for a target resulted in spending an additional 0.29 min examining that target interview ($p < .001$). A similar pattern of results was found for women, for whom a 1-unit increase in reported envy for a target corresponded to spending an additional 0.37 min (i.e., 0.29 + 0.08) examining that target ($p < .001$). This sex difference was not statistically significant ($p = .35$). Findings were similar with respect to the relationship between participants' reported envy and participants' ability to correctly remember the information presented in each target interview. For men as well as women, each 1-unit increase in reported envy for a target resulted

Table 1

Examination Time and Interview Recall Regressed on Participant Envy and Sex (Study 2)

Coefficient	Dependent variable: Time			Dependent variable: Interview recall		
	Value	SE	p	Value	SE	p
Male mean, γ_{00}	3.53	0.09	.00	0.08	0.01	.00
Female mean difference, γ_{01}	−0.19	0.12	.11	0.01	0.01	.41
Male envy slope, γ_{10}	0.29	0.07	.00	0.01	0.00	.00
Female envy slope difference, γ_{11}	0.08	0.09	.35	0.00	0.00	.67

Note. Because group mean centering of the envy variable was used, γ_{00} is the mean value for male participants for the relevant dependent measure, and γ_{01} is the difference between this mean and that of the female participants (female mean minus the male mean). γ_{10} is the estimated slope relating envy to the outcome variables for men, and γ_{11} is the estimated difference from men's slope for women. For example, men spent approximately 3.53 min on average examining each target (γ_{00}). Women spent 0.19 min less on each target (i.e., 3.34 min), but this sex difference (γ_{01}) was not statistically significant ($p = .11$). SE = standard error.

in correctly remembering an additional 1% of information presented in the target's interview ($p < .001$).

What are the net effects of envy and examination time on interview recall? Because envy was associated with increased time spent examining each target, we constructed a model to examine the individual effects of envy and examination time on ability to correctly recall information from each interview. This analysis was performed to determine the extent to which the demonstrated increase in information recall for envied targets was attributable to increased time spent examining the advantaged targets rather than to the direct effect of envy itself. The model was of the following form:

$$\text{Level 1: interview recall}_{ij} = \beta_{0j} + \beta_{1j}(\text{envy})_{ij}$$
$$+ \beta_{2j}(\text{time})_{ij} + r_{ij}$$

$$\text{Level 2: } \beta_{0j} = \gamma_{00} + \gamma_{01}(\text{female})_j + \mu_{0j}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{female})_j + \mu_{1j}$$
$$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{female})_j + \mu_{2j}$$

The results of our analysis revealed that increased envy led to increased memory for information about targets, even after controlling for amount of time participants spent examining each. We found that each 1-unit increase in envy resulted in a .01-unit increase in recall for men and for women ($p < .001$). This analysis also revealed that examination time differently influenced men's and women's ability to correctly recall information about the targets. For men, the amount of time spent looking at each target had essentially no relationship to their ability to remember information about the target ($p = .32$). However, greater examination time was reliably associated with greater recall for women ($p < .001$; see Table 2).

Do target wealth and attractiveness influence men's and women's envy responses and memory differently? To test whether target wealth and attractiveness would affect participants' levels of envy differently based on participant sex ("female";

dummy coded, with male $= 0$ and female $= 1$), we constructed a model with the following form:

$$\text{Level 1: envy}_{ij} = \beta_{0j} + \beta_{1j}(\text{target attractiveness})_{ij}$$
$$+ \beta_{2j}(\text{target wealth})_{ij} + r_{ij}$$

$$\text{Level 2: } \beta_{0j} = \gamma_{00} + \gamma_{01}(\text{female})_j + \mu_{0j}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{female})_j + \mu_{1j}$$
$$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{female})_j + \mu_{2j}$$

Results are shown in Table 3. The results of this analysis revealed that women ($b = .02 + .05 = .07$) but not men ($b = .02$) envied the targets more as the targets became more attractive. Both men and women, however, envied targets more as the targets became more wealthy (men: $b = .19$, $p < .001$; women: $b = .17$, ns).

Similarly, to test whether target wealth and attractiveness directly predict participants' memory and whether they differ based on participant sex ("female"; dummy coded, with male $= 0$ and female $= 1$), we constructed a model with the following form:

$$\text{Level 1: interview recall}_{ij} = \beta_{0j}$$
$$+ \beta_{1j}(\text{target attractiveness})_{ij} + \beta_{2j}(\text{target wealth})_{ij} + r_{ij}$$

$$\text{Level 2: } \beta_{0j} = \gamma_{00} + \gamma_{01}(\text{female})_j + \mu_{0j}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{female})_j + \mu_{1j}$$
$$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{female})_j + \mu_{2j}$$

The results of this analysis revealed that target wealth and attractiveness did not themselves predict memory ($ps \geq .37$) and that there were no differences on this measure depending on target sex ($p = .22$).

Discussion

The results of Study 2 provide additional support for the hypothesis that envy affects cognitive processing. Participants in the study spent more time examining fictitious interviews with targets toward whom they reported feeling most envious (see Table 1). Moreover, participants were able to correctly recall the greatest proportion of information from the interviews with their most envied targets, even after controlling for the amount of time spent looking at interviews (see Table 2). Taken together with the results from Study 1, these findings indicate that the experience of envy increases attunement to and memory for relevant social targets and that these findings are driven by experienced envy rather than by the process of social comparisons, more generally, or by the other's advantage in the absence of envy.

Study 2 also found support for the prediction that envy-eliciting traits are somewhat sex differentiated. Although both men and women became increasingly envious of targets as they became wealthier, only women were increasingly envious of targets as they became more physically attractive (see Table 3). This result is consistent with prior function-based research demonstrating that a peer's physical attractiveness is more frequently the source of women's envy than it is men's (DelPriore et al., 2011; Hill & Buss, 2006; Salovey & Rodin, 1991). Because women's physical attractiveness is more strongly tied to reproductive capacity, superiority

Table 2
Participant Interview Recall Regressed on Envy and Examination Time (Study 2)

	Dependent variable: Interview recall		
Coefficient	Value	SE	p
Male mean, γ_{00}	0.08	0.01	.00
Female mean difference, γ_{01}	0.01	0.01	.41
Male envy slope, γ_{10}	0.01	0.00	.00
Female envy slope difference, γ_{11}	0.00	0.00	.25
Male time slope, γ_{20}	0.00	0.00	.32
Female time slope difference, γ_{21}	0.02	0.00	.00

Note. γ_{10} is the estimated slope relating envy to the memory outcome for men after controlling for time spent examining targets, and γ_{11} is the estimated difference from men's slope for women. γ_{20} is the estimated slope relating examination time to the memory outcome for men after controlling for envy experienced in response to each target, and γ_{21} is the estimated difference from men's slope for women. $SE =$ standard error.

Table 3

Participant Envy Regressed on Target Attractiveness, Target Wealth, and Participant Sex (Study 2)

Coefficient	Dependent variable: Envy		
	Value	SE	p
Male mean, γ_{00}	3.24	0.06	.00
Female mean difference, γ_{01}	−0.08	0.08	.33
Male attractiveness slope, γ_{10}	0.02	0.01	.12
Female attractiveness slope difference, γ_{11}	0.05	0.02	.00
Male wealth slope, γ_{20}	0.19	0.02	.00
Female wealth slope difference, γ_{21}	−0.02	0.03	.49

Note. Because group mean centering was applied to the attractiveness and wealth variables, γ_{00} is the mean value of male participants' envy, and γ_{01} is the difference from this mean for the female participants. γ_{10} is the estimated slope relating target attractiveness to envy for the male participants, and γ_{11} is the estimated difference from this slope for the female participants; γ_{20} and γ_{21} are the analogous coefficients relating target wealth to participant envy. *SE* = standard error.

in this domain provides a greater advantage to women—both in terms of mate attraction and of actual reproductive potential—than it does to men (Buss, 1989b, 2003; Sugiyama, 2005; Symons, 1979; Williams, 1975). On the other hand, both men and women became increasingly envious of targets as they became wealthier, a result that may owe itself to the fungible nature of money. Although wealth is more central to men's mating desirability than women's, money is easily converted into an astonishing variety of resources that can be used to augment both men's and women's reproductive success (e.g., access to health care, educational opportunities for children, quality nutrition; Buss, 1989a, 2003).

Our first two studies provide evidence that envy may have important implications for the cognitive processes involved in attention and memory. Study 1 provided evidence that compared to individuals experiencing a neutral state, individuals who were primed to feel envious exhibited increased attention to and memory for neutral targets. Study 2 built on this logic, demonstrating that envy experienced in response to specific targets predicts attention to and memory for those targets. Although the results of our first two studies provide novel insights into one potential function served by envy, a limitation of these studies is that they do not rule out the possibility that other affective states that may arise in response to envied others—such as admiration, specifically, or changes in affect and arousal, more generally—may be responsible for the reported effects. Study 3 was thus designed to rule out these possibilities, predicting that envy—but not admiration or changes in affect or arousal—would increase attention to and memory for same-sex social targets.

Study 3

Method

Participants. Sixty-five undergraduates (30 male; M_{age}= 19.12 years, $SD = 1.20$) participated in this study in exchange for partial course credit.

Design and procedure. The overall design of the study was similar to that of Studies 1 and 2. Sessions were conducted in a research laboratory containing partitioned computer terminals running Qualtrics experimental software. Participants were randomly assigned to view fictitious interviews with either high-envy or neutral targets via the randomization feature in the Qualtrics program. Participants in the high-envy target condition were shown two fictitious interviews with wealthy, attractive students similar to those in Study 2. Participants in the control condition saw two student interviews with average-looking students of unknown wealth.

The procedure and cover story were the same as Study 2 with two important exceptions. First, after they viewed each target, in addition to being asked about the degree to which they were experiencing envy-related affect (e.g., envy, hostility, longing), participants were asked about experiencing states related to their admiration of the target (e.g., admiration, awe, inspiration; see Algoe & Haidt, 2009). Second, after they read both target interviews, participants were asked to fill out the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988), a 20-item self-report measure of positive and negative affect and arousal. This scale was chosen because of its demonstrated reliability and validity (see, e.g., Crawford & Henry, 2004) and because its items measure changes both in affect (e.g., "ashamed," "inspired") and in arousal (e.g., "jittery," "excited"). Participants' responses to these questions allowed us to test whether changes in these states—admiration, specifically or affect and arousal, more generally—played a role in the heightened target memory demonstrated in Studies 1 and 2. After viewing and responding to target questions, participants engaged in the 10-min cartoon rating distraction task before engaging in the recall task.

Dependent measures. As in Studies 1 and 2, participants were given a spontaneous cued recall task as the primary dependent measure. In the current study, memory was prompted by showing participants the target photographs and asking them to recall each target's full (first, middle, and last) name. We chose name recall as our primary dependent measure to increase coding efficiency and to explore whether the effect of envy on memory is specific to information related to the target's advantage (e.g., that the target has a BMW and a father on the board of trustees) or whether it generalizes to information about targets that does not yield cues to their being advantaged or not (i.e., there is presumably nothing more advantageous about being a Rachel than an Erika). Participants' responses were scored for accuracy by a research assistant blind to the purpose of the study. Participants received 1 point for each name correctly recalled (range: 0 = *none of targets' names correctly recalled*, 6 = *both targets' first, middle, and last names correctly recalled*).

Results

What are the subjective responses to target stimuli? We first created composite scores for each of the following within-participant measures: envy (αs > .86 for each target), admiration (αs > .75 for each target), positive affect and arousal ($\alpha = .90$), and negative affect and arousal ($\alpha = .90$). Next, we entered each of these scores into a between-subjects multivariate ANOVA with condition (high-envy vs. neutral targets) as the between-subjects predictor. As predicted, participants viewing the high-envy targets reported experiencing significantly more envy than did those viewing the neutral targets ($M_{high\ envy} = 3.77$, $SD = 0.83$; $M_{neutral} =$

2.75, $SD = 1.00$), $F(1, 63) = 20.32$, $p < .001$, $d = 1.11$. No differences were found between conditions for ratings of positive affect, negative affect, or target admiration ($ps > .12$).

Do individuals attend to and correctly recall the names of high-envy compared to neutral targets? To test the effects of target (high envy vs. neutral) on attention and recall score, we created a composite memory variable by summing participants' recall scores across targets. Participants' scores ranged from 0 (no correct names recalled) to 6 (first, middle, and last name correctly recalled) for both targets. Next, because participants' name recall scores were positively skewed, the scores were normalized by calculating the square root of participants' name recall score to make them conform to the normality assumptions of our statistical models (see, e.g., Tabachnick & Fidell, 2001). We next entered this score as well as target examination time into a between-subjects multivariate ANOVA with target condition (high-envy vs. neutral targets) as the predictor. As in Studies 1 and 2, participants spent significantly more time examining the high-envy than the neutral targets ($M_{\text{high envy}} = 172.06$ s, $SD = 67.11$; $M_{\text{neutral}} = 139.19$, $SD = 42.03$), $F(1, 63) = 5.05$, $p = .03$, $d = 0.59$, and had more accurate recall of the names of the high-envy than the neutral targets ($M_{\text{high envy}} = 1.14$, $SD = 0.67$; $M_{\text{neutral}} = 0.42$, $SD = 0.68$), $F(1, 63) = 17.83$, $p < .001$, $d = 1.07$ (see Figures 3 and 4). A follow-up analysis of covariance revealed that participants more accurately recalled the names of high-envy targets even after controlling for the increased amount of examination time that participants spent with these targets, $F(1, 62) = 16.19$, $p < .001$.

What are the independent effects of each reported subjective response on attention? To explore the independent effects of self-reported envy, admiration, negative affect/arousal, and positive affect/arousal on target examination time, we regressed target examination time on each continuous independent variable of interest. For each analysis, condition (dummy coded) and the continuous independent variable of interest (centered) were entered simultaneously as predictors in the first step, followed by the two-way interaction in the second step (see Aiken & West, 1991). We also controlled for each of the nontarget subjective states in each analysis (e.g., in the model testing the effects of envy on target examination time, we controlled for admiration, negative affect/arousal, and positive affect/arousal) to ensure that the results of each analysis would bear on the independent effects of each subjective response on participants' examination time.

Consistent with the results from the MANOVA presented above, each of these analyses revealed a significant main effect of
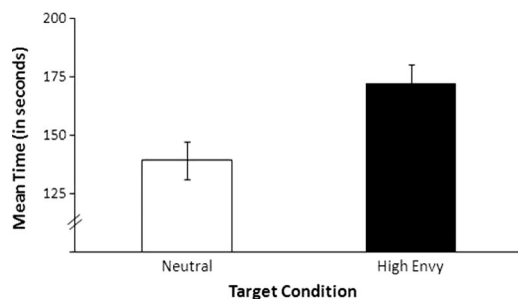

Figure 3. Target examination time (in seconds) for high-envy and neutral targets (Study 3). Error bars reflect standard error.
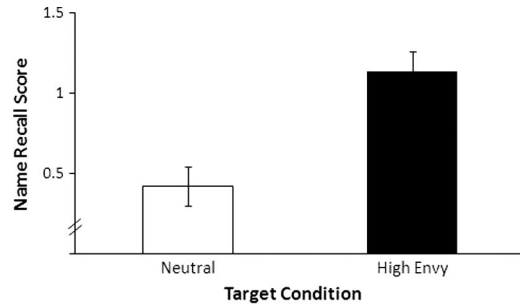

Figure 4. Correct name recall for high-envy and neutral targets (Study 3). Higher scores indicate better recall of target information. Data reflect recall scores following square root transformation; error bars reflect standard error.

condition on target interview examination time. Participants spent significantly more time examining high-envy targets than neutral targets ($ts \geq 2.13$; $ps \leq .04$). However, none of these analyses found a significant relationship between participants' self-reported subjective response on time spent examining targets, nor did any interactions between the subjective response and target condition emerge ($ts \leq 0.90$; $ps \geq .37$).

What are the independent effects of each reported subjective response on correct name recall? To test the independent effects of experienced envy, admiration, negative affect/arousal, and positive affect/arousal on correct name recall, we regressed the transformed name recall score on each continuous independent variable of interest. As in the analysis presented above, condition (dummy coded) and the continuous independent variable of interest (centered) were entered simultaneously as predictors in the first step, followed by the two-way interaction in the second step (see Aiken & West, 1991). Additionally, because target examination time was found to differ on the basis of condition, we controlled for this variable in each of the four models. We also controlled for each of the nontarget subjective states in each analysis to ensure that the results of each analysis would bear on the independent effects of each subjective response to targets (i.e., envy, admiration, negative affect/arousal, and positive affect/arousal) on correct name recall score.

As predicted, our first model revealed a significant interaction between condition and envy on memory for targets' names, $\beta = -0.37$, $SE = 0.19$, $t(57) = 2.12$, $p = .04$. Simple slope tests (Rosenthal & Rosnow, 1985) revealed that for participants viewing the advantaged target, higher envy predicted greater memory for the targets' names, $\beta = 0.63$, $SE = 0.13$, $t(57) = 3.53$, $p = .001$ (see Figure 5). No such relationship was present for those viewing the neutral targets ($p = .66$).

We next looked at the effects of target admiration (centered) on memory. Target admiration did not interact with condition to predict memory for targets' names ($p = .61$), nor did target admiration predict memory scores in either condition ($ps > .50$). Similar results were found for negative and positive affect/arousal. Neither of these measures interacted with condition to predict memory for targets' names ($p = .28$), nor did either of these factors predict memory scores in either condition ($ps > .29$).
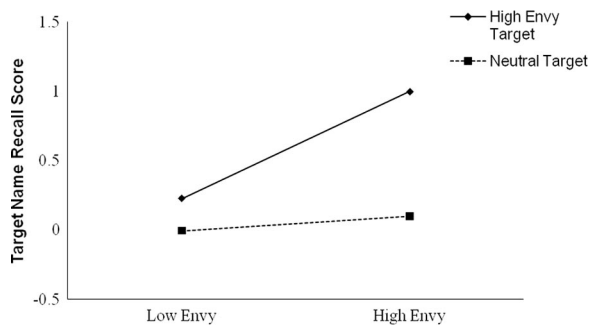
Figure 5. Correct name recall scores by participants as a function of self-reported envy in response to targets (Study 3). Data reflect scores following square root transformation.

Discussion

Study 3 found additional support for envy playing a role in attention and memory. As in Studies 1 and 2, individuals spent significantly more time examining fictitious interviews with high-envy than neutral targets. We also replicated the effect of envy on memory, demonstrating once again that individuals were better able to correctly recall the names of the high-envy targets than the neutral targets, even after controlling for greater examination time. Moreover, our results indicate that envy experienced in response to advantaged targets predicted correct target name recall, even when controlling for greater amount of time that participants spent examining them. These results stand in sharp contrast to those found for admiration and affect/arousal. There were no differences in the amount of admiration or positive and negative affect elicited by the high-envy and the neutral targets. Moreover, the degree to which participants experienced these subjective states failed to predict either attention or memory in follow-up regression analyses. These results extend the findings of Studies 1 and 2 by demonstrating that the observed effects are specific to envy and are not the result of other states that may be elicited by advantaged targets. Additionally, these results build on the previous studies by demonstrating that the effects of envy on memory are not dependent on the information being directly related to the target's advantage. Participants in Study 3 had heightened memory for target names, which presumably has no bearing on the advantaged nature of the target possessing it.

An unexpected result of Study 3 was that none of the self-reported subjective responses to targets—including envy—were found to independently predict time spent examining them. That self-reported envy reported in response to targets did not predict examination time in this experiment raises the possibility that envy may be a somewhat less reliable predictor of attention than it is of encoding efficiency (i.e., the ability to quickly encode information about others). However, that both Studies 1 and 2 found envy to predict target examination time (Study 1 using a priming methodology, Study 2 using self-report) and that the current study found that target examination time was higher for high-envy than neutral targets suggests that envy does play a role in maintaining cognitive focus on advantaged peers.

Our first three studies provide evidence that envy may have important implications for the cognitive processes involved in attention and memory. The function-based logic from which our hypotheses were derived, however, also implies that envy may have implications for higher order cognitive processing, such as that required for deliberate, conscious acts. If, as our model suggests, the experience of envy functions to focus cognitive effort on its source, then enhanced encoding of information about advantaged peers may correspond to the diminution of cognitive resources available for self-regulatory effort in unrelated domains. Study 4 was designed to test this possibility. We predicted that exposure to a high-envy—but not neutral—target would lead to increased ability to recall the high-envy target's name, a conceptual replication of Studies 1–3. Moreover, we predicted that those individuals who correctly recalled the target's name (i.e., for those individuals who experienced heightened cognitive processing of the advantaged target)—but not those who did not—would exhibit diminished persistence in the face of consistent failure on a subsequent anagram-solving task (see, e.g., Baumeister et al., 1998; Glass, Singer, & Friedman, 1969; Muraven et al., 1998). We predicted this pattern of results because the depleting effects of envy are predicted to be specific to those whose cognitions are captured by the advantaged targets.

Study 4

Method

Participants. A sample of 152 undergraduates (61 male) participated in this study in exchange for partial course credit (M_{age} = 19.37 years, SD = 1.17).

Design and procedure. The overall design of the study was similar to that of Study 3. All participants in the current experiment were told that they would be participating in a study exploring the effects of seemingly irrelevant features of one's environment and physiological state on evaluations of ambiguous stimuli. All participants began the experiment by answering a series of questions about their environment (e.g., lighting) and physiological state (e.g., hunger) to keep the procedure consistent with the cover story. Participants were then directed to examine and respond to a series of three ambiguous images: two filler stimuli (a Chinese character and a picture of a neutral city scene, viewed in that order) and the target stimulus (viewed last). The target stimulus, similar to those in Studies 1–3, was a fictitious interview with a same-sex student from a nearby university. The high-envy target was both attractive and wealthy (experimental), whereas the low-envy target was average looking and not wealthy (control). All targets were the same sex as the participants.

Participants were told to carefully examine each image and allow themselves to fully experience any emotions they had in response to the stimuli. They were told to let their emotions guide their impressions of each stimulus and that the computer screen would automatically change after 1 min had passed. Participants were then asked a few questions about each image consistent with the cover story (e.g., how dangerous is this object/place/person). As in Studies 1–3, participants were also given a spontaneous cued recall task. Participants were shown the target's photo and were asked to recall the target's correct first name. This recall procedure was chosen so that we could create a binary memory score that could serve both as a first-order-dependent measure and as a predictor to test for changes in self-regulatory effort. Participants were also asked to view and attempt to unscramble six anagrams,

ostensibly to determine their ability to interpret ambiguous word-based stimuli. In actuality, however, they were being timed to measure their perseverance on each word puzzle, all of which were extremely difficult or impossible to solve. We chose this dependent measure because others have found it to be a valid measure of persistence in the face of consistent failure, which requires significant self-regulatory control (Baumeister et al., 1998; Glass et al., 1969; Muraven et al., 1998). Participants ended the experiment by answering a few questions about themselves and about the stimuli they had viewed. Finally, participants were thanked, debriefed, and released.

Manipulation check. A manipulation check was performed to ensure that the high-envy target elicited a greater amount of envy than the neutral target. To this end, 36 women and 22 men viewed either the advantaged target ($n = 32$) or the neutral target ($n = 26$). Participants were given 3 min to examine the target and were then asked to rate the degree to which they felt a variety of emotions, including envy. All ratings were made on a 1–9 scale (e.g., 1 = *not at all envious,* 9 = *extremely envious*). The results of our 2 (participant sex: male, female) $\times$ 2 (target: high envy, neutral) univariate ANOVA revealed that both men and women reported experiencing greater envy in response to the advantaged target ($M = 6.59$, $SD = 1.46$) than the neutral target ($M = 2.88$, $SD = 1.31$), $F(1, 54) = 93.19$, $p < .001$, $d = 2.67$.

Results

A binary logistic regression analysis was performed for target name recall to test the prediction that participants would have better recall for the name of the high-envy than the neutral target. Condition (dummy coded) served as the independent variable, and name recall score (0 = not correctly recalled, 1 = correctly recalled) was the dependent measure. As predicted, the results of our model indicated that participants who viewed the high-envy target were more accurate in their name recall (71% were correct) than were those who viewed the neutral target (54% were correct), $\beta = 2.94$, $SE = 0.48$, $\chi^2(1) = 5.16$, $p = .02$.

Next, as a test of the hypothesis that memory for envied targets would lead to decreased perseverance on a difficult anagram task, time spent on each puzzle was summed and then entered as a continuous dependent variable in a 2 (condition: high-envy vs. neutral target) $\times$ 2 (name recall: correct vs. incorrect) between-subjects univariate ANOVA. As predicted, the analysis did not reveal a significant main effect of condition on perseverance ($p = .95$). The results did indicate a significant interaction between condition and name recall on time spent on the puzzles, $F(1, 120) = 3.82$, $p = .05$. Probing this interaction revealed that there were no differences between participants who viewed the neutral targets based on correct recall of the target's name ($p = .58$). However, as predicted, participants who correctly recalled the high-envy target's name spent significantly less time on the anagram-solving task ($M_{correct} = 264.19$ s, $SD = 270.88$) than did those who did not correctly recall the target's name ($M_{incorrect} = 449.94$ s, $SD = 381.43$), $F(1, 60) = 4.75$, $p = .03$, $d = 0.56$ (see Figure 6).

Discussion

Study 4 provides the first evidence that experiencing envy may be cognitively depleting. As in Studies 1–3, individuals who
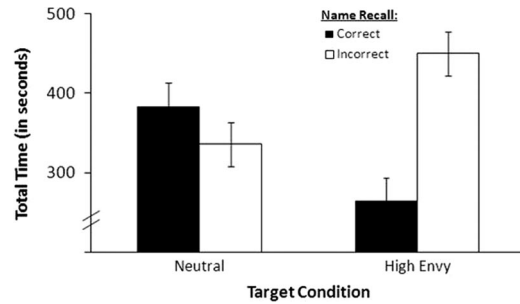

Figure 6. Mean time (in seconds) participants spent working on anagrams based on correct target name recall (correct or incorrect) and target advantage (high envy or neutral; Study 4). Error bars reflect standard error.

viewed a fictitious interview with an advantaged, envy-eliciting target demonstrated significantly more accurate name recall than did those exposed to a less advantaged, neutral target. Moreover, the results of Study 4 found that those individuals who exhibited greater memory for the high-envy target—but not those who did not—spent less time persevering on an anagram-solving task in the face of repeated failure. These findings extend those presented in the earlier studies in an important way. Experiencing envy not only increases the automatic cognitive processing associated with attention and memory for information about social targets; for those individuals whose cognitions are captured by advantaged others, envy may render them less able or willing to engage in more deliberate processing, such as that which is required for acts of determination and personal volition (e.g., Baumeister et al., 1998; Glass et al., 1969; Muraven et al., 1998).

General Discussion

Envy is a subjectively unpleasant, experientially painful emotion characterized by feelings of inferiority, hostility, and resentment and produced by an awareness that another person or group enjoys a desired possession (object, social position, attribute, or quality) that one lacks (e.g., Parrott, 1991; Parrott & Smith, 1993; Smith & Kim, 2007). Although great empirical inroads have been made into understanding the various affective states typically associated with envy, little has been revealed about the impact of this emotion on cognition. The findings presented provide some of the first research on the cognitive consequences of envy. The results of our four experiments indicate that when envy is activated, people attend to information about social targets and are better able to correctly recall this information. Further, we demonstrate that these effects are due to changes in envy and cannot be accounted for by changes in admiration, negative affect and arousal, or the process of making upward social comparisons in general.

The results of the present research also suggest that heightened cognitive processing of advantaged others may have implications for individuals' willingness to invest cognitive effort in unrelated pursuits. Prior research indicates that envy is correlated with behaviors intended to improve one's position in one's organization (Cohen-Charash, 2009) and leads to worse performance in social settings (Duffy & Shaw, 2000; Duffy, Shaw, & Schaubroeck, 2008; Parks et al., 2002). Study 4 adds to this literature by

demonstrating that individuals whose memories were triggered by the high-envy targets were subsequently less able or willing to devote scarce cognitive resources to solving a series of difficult word puzzles. The effects of envy on cognitive processing thus may have consequences that are surprisingly far reaching (i.e., enhancing memory but rendering one less able or willing to exert willpower or persistence in other domains).

The current research also provides insight into the types of advantages that elicit envy. Researchers have noted that envy tends to occur in response to another's advantage in domains that are highly self-relevant (e.g., Parrott, 1991; Salovey & Rodin, 1984, 1991; Salovey & Rothman, 1991; Schaubroeck & Lam, 2004; Smith & Kim, 2007; Tesser, 1988). However, little research has specified precisely which domains are likely to be self-relevant to most individuals (with notable exceptions; see, e.g., Dijkstra & Buunk, 1998, 2002; Salovey & Rodin, 1991). In Study 2, evolutionary logic was used to test predictions about the domains that are likely to be the source of envy for men and women, exploring the relative effects of a target's wealth and physical attractiveness on envy. Our results provide evidence that the domains that elicit envy are somewhat sex differentiated; although women became increasingly envious of targets as they became more physically attractive, this pattern was not exhibited among men. This finding is similar to others' results (DelPriore et al., 2011; Hill & Buss, 2006; Salovey & Rodin, 1991) and is consistent with sex differences in the potential benefits available to men and women from physical attractiveness. Throughout evolutionary history, a woman's physical attractiveness has served as a reliable indicator of her fertility status (i.e., that she is young and healthy; Buss & Schmitt, 1993; Kenrick & Keefe, 1992; Kenrick, Sadalla, Groth, & Trost, 1990). Accordingly, men place a premium on a woman's appearance in their mate choice, making beautiful women better able to attract desired romantic partners (Elder, 1969; Feingold, 1992; Langlois et al., 2000; Walster, Aronson, Abrahams, & Rottmann, 1966). A mating rival's attractiveness thus poses a significant threat to a woman's own likelihood of mating success.

Study 2 found that both men and women experienced envy in response to targets' perceived wealth. Although a man's financial resources influence his desirability as a mate more than do a woman's (Buss, 1989b; Buss & Schmitt, 1993; Symons, 1979), access to financial resources plays a critical role in meeting both men's and women's proximate-level fitness goals (e.g., being able to acquire food, shelter, and items that increase attractiveness). In our modern environment, money is both fungible and transferable. Accordingly, unlike men's preference for attractiveness—the benefits of which cannot be decoupled from its possessor—the benefits available from wealth can be enjoyed independent of the mate providing it. Thus, a peer's possession of financial resources is an indicator to men and women alike that they are being bested in a domain relevant to their respective adaptive goals.

Alternative Explanations, Limitations, and Future Directions

The current studies were derived from two evolution-grounded insights. The first is that humans' limited attentional and memory capacities are expected to be adaptively tuned to fitness-relevant features of the environment (Klein et al., 2002; McArthur & Baron, 1983; Nairne, 2005; Nairne et al., 2009; Nairne, Pandei-

rada, & Thompson, 2008; Öhman & Mineka, 2001). The second is that proximate-level cues activate functionally specific responses historically associated with successfully solving adaptive problems over evolutionary time (see, e.g., Cosmides & Tooby, 2000; Griskevicius, Cialdini, & Kenrick, 2006; Griskevicius et al., 2009; Maner, Gailliot, Rouby, & Miller, 2007; Maner et al., 2005). These insights provided the theoretical framework from which we were able to explore the effects of envy on cognitive processing. Although it is possible that our results may be explained in terms of alternative theoretical perspectives (e.g., social learning), the current research was not designed as a test of the relative merits of different theoretical accounts of envy. Instead, it was designed to test novel predictions about the cognitive consequences of envy that were borne from the function-based logic of evolutionary theory. Regardless of the theoretical standpoint from which one would like to interpret the current results, they provide novel insights into our current understanding of the far-reaching effects of this complex emotion.

The current research has a number of limitations and accordingly provides direction for additional avenues of inquiry. For instance, although Study 3 found that individuals spent significantly more time examining interviews with high-envy than neutral targets, subsequent analyses did not find a direct relationship between self-reported envy in response to the targets and interview examination time. This unexpected result may indicate that the effect of envy on target examination time is somewhat less reliable than its effects on encoding efficiency and precision. However, that the results of both Studies 1 and 2 found envy (both experimentally primed and measured through self-report) to predict examination time suggests that its role in directing attention is noteworthy nonetheless. Another limitation of the current research is that our experiments did not involve interactions with actual social targets (e.g., other students or research confederates). Future research on envy activated in response to real others and the effects of experimentally manipulated envy on interactions with actual peers is necessary and would be an excellent contribution to the field. For example, one might predict that activating envy will increase hostile interactions with others or that it will increase hostile interactions with advantaged (e.g., wealthy, highly attractive)—but not disadvantaged—others. It is also possible that individuals may attempt to conceal their envy and instead bestow benefits upon advantaged others in public domains (see, e.g., Smith, 1991). Future research is needed to explore these possibilities.

An additional limitation of the current research is that it did not explore the effects of envy on relevant social behavior. The logic of the model presented was that envy would heighten attention to and memory for social targets such that individuals may use this information to increase their own position (benign envy) or detract from their competitor's advantage (hostile envy). Indeed, it is possible that the results of Study 4 reflect participants with heightened target memory being anxious to leave the laboratory specifically to engage in such behaviors. Although beyond the scope of the current investigation, research on precisely how envious individuals use the information that they encode about advantaged others is a critical next step to understanding the function of this emotion. Further, it is important to understand approximately how long this heightened memory for advantaged others might persist.

The current research could also be extended to provide insight into the specific contextual cues that influence one's chosen behavioral response to this emotional state. Researchers have noted that envy motivates at least three categories of behavior: submission, ambition, and destruction (see, e.g., Hill & Buss, 2008; van de Ven et al., 2009). Which contexts are likely to facilitate each of these responses? Do the same contextual cues (e.g., perceived likelihood of being able to acquire the same outcome for oneself) influence the type of information about rivals that is selectively encoded? For instance, in some contexts, envy may simply provide the motivation that one needs to get working to achieve the same outcomes for oneself (i.e., "white" or "competitive" envy; Frank & Sunstein, 2001; Matt, 2003; McAdams, 1992). In yet other circumstances, envy motivates attempts to reduce the relative advantage of the envied rival (i.e., "black" or "destructive" envy; Berke, 1988; Elster, 1998; Neu, 1980; Smith, 1991; Zizzo & Oswald, 2001). Accordingly, one may predict that in cases where the likelihood of obtaining a similar outcome is small, it is likely that black envy will be activated, leading to heightened memory specifically for information that can be used to undercut another's advantage. Conversely, in cases where the likelihood of being able to acquire the outcome is high, envy may facilitate encoding of information bearing on how the advantaged other reached his superior position.

Finally, the current research was limited to understanding the effects of envy on attention and memory for same-sex—but not opposite-sex—others. The studies were conducted with only opposite-sex targets for two reasons. First, previous research has demonstrated that individuals tend to focus many of their envious feelings on similar, same-sex others (see, e.g., DelPriore et al., 2011; Hill & Buss, 2006; Salovey & Rodin, 1984; Schaubroeck & Lam, 2004; Smith & Kim, 2007). Second, the use of opposite-sex targets would increase the likelihood that mating-related responses (e.g., attraction, sexual arousal) would influence attention and memory, making it more difficult to determine the effects of envy, per se, on the measured behaviors. Because this is the first study on the effects of envy on memory, we wanted the results on each of the measures to be as clean as possible; however, it is certainly feasible that envy may also impact intersexual relations. For instance, activating envy could potentially increase a woman's memory for and interest in successful men who may provide an alternate pathway to obtain some of the advantages that the woman currently lacks. It is also possible that activating envy may decrease the amount of cognitive resources individuals reserve for opposite-sex others, as these individuals are not typically the focus of one's envy. Future research should explore whether envy evoked by advantaged same-sex peers has any impact on the cognitive processing of opposite-sex others.

Despite these limitations, the current research yields novel insights into the varied cognitive consequences of envy. At a broader conceptual level, our findings contribute to a growing empirical literature integrating social–cognitive and evolutionary approaches to psychological inquiry and highlight the utility of a fundamental goals approach to conducting social psychological research. The continued conceptual integration of these complementary perspectives promises to promote novel findings about the processes influencing human social behavior.

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