Threat and Social Choice: When Eye Size Matters

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ABSTRACT. The Environmental Security Hypothesis (T. F. Pettijohn II & A. Tesser, 1999) indicates that as environmental threat increases, the desirability of persons with neotenous features should decrease. In 2 experiments (*N*s = 96, 80), the authors tested this hypothesis and a mediation account that was based on the attributions made about neotenous and mature-featured others. In each experiment, the authors manipulated threat and gave participants the choice of a neotenous (increased eye-size) or mature (decreased eye-size) female partner. The authors tested mediation in Study 1 by experimentally uncoupling attributions from facial features and in Study 2 by manipulating the participant's dependence on his or her partner. Both studies provided evidence for the Environmental Security Hypothesis: Preference for partners with neotenous facial features decreased under high threat. Support for the role of attributions as mediators was mixed. An alternative interpretation of the results indicates the possibility that responses to facial features may depend on nonconscious processing.

Key words: facial features, inferences, personality, physical appearance, physical attraction, threat

LARGE EYES, a small nose, round cheeks, and soft skin—all infants are born displaying those neotenous features (Cunningham, 1986). As early as 1943, Lorenz suggested that an infant's wide eyes, chubby cheeks, and soft, rounded features make the infant appear cute and lovable, increasing the likelihood of—that is, serving as a releaser for—the potential caregiver's attending to the baby. A variety of ethological (e.g., Lorenz, 1943), psychological (e.g., Zebrowitz, 1997), and evolutionary (e.g., Gould, 1992) literatures points to the importance of neotenous facial features in social behavior. Perhaps even more remarkable is the relationship between neotenous facial features and social perception and behavior in adults. For example, people from different cultures agree about some of the facial features that compose an ideal mate when judg-

ing different ethnic groups (e.g., Cunningham, Roberts, Barbee, Druen, & Wu, 1995): Women with neotenous features, such as large eye size, are consistently rated as most physically attractive.

The Environmental Security Hypothesis

In the present study, we intended to help researchers better understand the relationship between neotenous facial features and attractiveness. In previous work (Pettijohn & Tesser, 1999, 2003; Pettijohn & Jungeberg, 2004), we have suggested that environmental threat moderates the relationship between neotenous facial features and attractiveness. Specifically, we hypothesized that as threat increases, the desirability of persons with neotenous features decreases. This hypothesis is based on a large and growing body of research indicating that mature facial features and neotenous facial features produce different attributions. For example, Keating, Mazur, and Segall (1981) found that people with round faces and small chins (neotenous features) were rated as less dominant, less intelligent, and less shrewd than people with angular faces and large chins. In another study, Keating (1985) found that nonbabyish, thin-lipped persons were rated higher in perceived importance, influence, control, and dominance than the same person with facial composites for babyish, full lips. Berry and McArthur (1985) computed physiognomic scores on several facial-feature dimensions of photographs of faces. Berry and McArthur had participants view the faces and rate them on overall "babyfacedness" and several psychological trait dimensions. Ratings of babyfacedness were positively correlated with the physiognomic features of large eyes, round eyes, narrow chin, and high eyebrows and with the psychological traits of warmth, honesty, naïveté, and kindness.

To summarize a number of studies (e.g., Alley, 1983; Berry & McArthur, 1985; Brownlow, 1992; Brownlow & Zebrowitz, 1990; Cunningham et al., 1995; Cunningham et al., 1990; Enquist & Ghirlanda, 1998; McArthur & Apatow, 1983–1984; Zebrowitz, 1997; Zebrowitz & McDonald, 1991; Zebrowitz, Tenenbaum, & Goldstein, 1991), people associate baby faces with the attributes of warmth, caring, honesty, naïveté, kindness, agreeableness, sociability, trustworthiness, and physical weakness. Mature faces are associated with the attributes of

strength, dominance, competency, expertise, maturity, independence, status, and shrewdness. People with mature faces are also considered more important, more influential, more in control, and physically stronger.

The constellations of attributions humans make about baby-faced people and about mature-faced people seem coherent. The attributions about baby-faced people make them appear to be fun to be with and perhaps to take care of. However, they might not be the kind of people whom we want at our sides when circumstances are threatening. On the other hand, the mature-featured person may not be a lot of fun but might be helpful to have around when the going gets tough. In short, the attributions that we make about baby-faced others make them more attractive when we feel secure, and the attributions that we make about mature-faced people make them more attractive when we feel threatened. If this is the case, then under ordinary or low-threat circumstances, persons with neotenous faces would be relatively more attractive, whereas under high-threat circumstances, mature-faced persons would be relatively more attractive.

We (Pettijohn & Tesser, 1999) completed a field test concerning the role of environmental threat on preferences for facial features. The index of threat consisted of an assortment of social and economic indicators (unemployment rate, disposable personal income, consumer price index, death rate, birth rate, marriage rate, divorce rate, suicide rate, and homicide rate) for each of the years between 1932 and 1995 in the United States. We collected facial photographs of the most popular movie actresses for each of these same years and calculated physiognomic measures related to neoteny—for example, eye area and chin width—for each picture. Supporting the hypothesis, we found negative correlations between the index of social and economic threat and the preference for neotenous features such as large relative eye size and found positive correlations between the index of threat and the preference for mature features such as large relative chin size. In sum, as social and economic threat increased, so did the preference for more mature-faced actresses. In subsequent investigations, Pettijohn and Jungeberg (2004) also connected threatening social and economic conditions with preferences for mature facial features, body features, and age of *Playboy* Playmates, but these factors have not systematically influenced preferences for popular American actors (Pettijohn & Tesser, 2003).

The Present Studies

Several issues in the previous work prompted the present set of studies. First, the archival studies were based on aggregate, not individual, measures of attractiveness and threat. The Environmental Security Hypothesis is based on individual responses. Second, the correlational nature of the archival studies makes the causal role of threat ambiguous. Random assignment of individuals to levels of threat would help disambiguate the causal connection. Third, the

threat moderation effect could involve attributions made about targets with baby faces or mature faces. Previous researchers neither manipulated nor measured such attributions in the archival studies.

We developed two studies to address each of these concerns. In both studies, we randomly assigned individuals to levels of threat. In addition, in each study, we assessed individual differences in chronic, personal feelings of threat. In Study 1, we manipulated attributions independent of neoteny; in Study 2, we measured attributions and subjected them to mediational analysis. We will derive specific hypotheses in the introductions to the studies.

STUDY 1

Study 1 provided a conceptual replication of the archival investigations of facial-feature preferences across time. We randomly assigned participants to either a high-threat condition or a low-threat condition. Each participant was asked to choose between two potential partners that differed in their facial neoteny. Our expectation was that under high threat, there would be a relatively greater preference for mature faces and that under low threat, there would be a relatively greater preference for neotenous faces. We also included several individual difference measures that reflected chronic perceptions of threat (broadly conceived). Our exploratory hypothesis was that individual differences in perceived threat would show the same kind of association with facial preference as do situational differences in threat.

The Role of Attributions

We introduced a summary of two clusters of attributions earlier: The baby-face cluster contains attributes like playful, social, dependent; the mature-face cluster contains attributes like independent, competent, strong. These clusters may play a role in determining preferences. Under threatening conditions, compared to secure conditions, the preference for others who are mature and independent should go up, and the preference for others who are naive and dependent should go down. This may explain, at least in part, the relatively greater preference for mature-faced others under conditions of threat.

We gave some participants direct information about the attributes of their potential partners, in addition to information about the environmental threat, and gave others no such information. If an individual has good, direct information about the characteristics of another, then he or she would not have to infer them from facial features, and the effect of facial features on social choice should be reduced. Therefore, we should observe the threat effect captured by our hypothesis when there is no direct information, but that effect should be attenuated or should disappear when participants have direct information about the attributes of the others.

Kinds of Information

Participants in the information conditions received one of three kinds of direct information. We asked them to choose one of two other people, both of whom we described as having (a) attributes from the mature-faced cluster, (b) attributes from the baby-faced cluster, or (c) attributes irrelevant to either cluster. Mature- and baby-faced attributes are relevant to facial cues, so that the information about them that we provided should have reduced the participants' reliance on facial cues. The irrelevant information can go in either of two ways: On the one hand, because this information is irrelevant to the attributions made from facial cues, it should not reduce the effect of facial cues on social choice. On the other hand, there is evidence in the attribution literature for a *dilution effect* (e.g., Hilton & Fein, 1989; Nisbett, Zukier, & Lemley, 1981). This effect refers to a tendency for individuals to ignore diagnostic information when irrelevant information is presented, that is, the irrelevant information may also reduce the effect of facial cues. Preliminary tests on the information conditions addressed this issue.

Method

Participants

Participants were 96 college students[1] (32 men and 64 women) who volunteered to participate in a study entitled "Learning and Social Situations." Participants received partial course credit for their participation.

Design and Procedure

The independent variables in Study 1 were threat (high or low) and personality description type (four levels: mature faced, baby faced, irrelevant, or no information). The dependent variable was the participant's choice of a baby-faced target or a mature-faced target.

Upon entering the experimental room, we gave participants a consent form to read, sign, and return to the experimenter. Next, each participant was told, "We are interested in how people get to know one another and how they learn in social situations. We will take your digital photograph because we want to control for the effects of physical appearance on these interactions. Sometimes a person's looks and demeanor make a difference in terms of how people interact. Experimental raters would like to use your image to control for these effects after the experiment is completed. The photograph prints out instantly in another room so after the experiment is completed, you can view the photograph and decide whether or not you will grant us permission to use your photograph." This photograph explanation was intended to make the presence of the photographs of other participants plausible.

After the photograph was taken, we gave all participants a packet of questionnaires including the State-Trait Anxiety Inventory (STAI) Form Y (Spielberger, 1983), the Life Orientation Test (LOT; Scheier & Carver, 1985), the Undergraduate Stress Questionnaire (USQ; Crandell, Preisler, & Aussprung, 1992), and a background questionnaire asking the participant's sex, age, and college major. Participants also rated themselves on 24 personality traits as well as physical attractiveness. After the participants started answering these questionnaires, the experimenter left the room.

When the participants had completed the questionnaires, we told them that the next part of the experiment required that they be introduced to a partner and be given a list of word pairs that they must learn before the testing phase of the experiment, when they would be hooked up to an electrical shock mechanism that would deliver shocks to them based on their responses to word pair question stimuli. We told participants that their own incorrect responses, but not their partners' incorrect responses, would result in an electrical shock to themselves (i.e., the frequency of a participant's shock was independent of his or her partner's responses). We told participants that their experimental partner would sit next to them through the entire experiment and that "electrical shock is necessary because we are interested in your reactions and responses under these conditions."

Threat manipulation. We told all participants that "experiments that involve electrical shock must demonstrate that there are no long-lasting or permanent effects associated with the shock" and that "this experiment had been carefully reviewed by a review board." We randomly assigned participants to either the high-threat condition or the low-threat condition. To differentiate between the high- and low-threat conditions, we told participants in the high-threat condition that the electrical shocks ". . . will hurt, they will be painful . . . but, of course, they will do no permanent damage" (Schachter, 1959, p. 13). Participants in the low-threat condition were told, ". . . do not let the word 'shock' trouble you . . . what you will feel will not in any way be painful. It will resemble more a tickle or a tingle than anything unpleasant" (Schachter, p. 13).

Social choice. Next, we told all participants that there would be a brief preparation delay of about 10 min before the next portion of the experiment would continue, so the experimenter could prepare the electrical shock mechanism and the stimuli. Then, participants were told, "We were waiting for a fourth participant, but this person has not shown. Since I have these photos of the other two participants who are here, in different rooms up the hall, why don't you choose a person to be your partner; the person you will interact with and go through the rest of the experiment with. You can get to know your partner while the experiment is prepared and I will assign the other person to another experimental session." Then, we asked participants to choose a partner by examining the two photographs with personality descriptions.[2] Participants were told that the personal-

ity descriptions were the terms on which the participants rated themselves highest while taking the personality trait measure earlier in the experiment.

After participants made their choices, we asked them to write why they preferred the particular target whose photograph they chose. Then we instructed them to complete the state anxiety scale (Spielberger, 1983), to measure their current state of anxiety, for a manipulation check. After these activities were completed, participants were debriefed and thanked for their participation. We actually delivered no electrical shocks in Study 1.

Target photographs. A number of features distinguish neotenous faces from mature faces. We focused on eye size for a theoretical reason (i.e., the eyes may be the most important facial feature for differentiating between mature and neotenous faces) and a practical reason (i.e., the eyes were the least complicated facial feature to manipulate). Two female-target black-and-white photographs were chosen from a college yearbook that was unfamiliar to the participants. The photographs were of white, college-aged (18–25-year-old) women having equivalent facial-feature measurement values for *eye area* (see Cunningham et al., 1995, for computation of eye area) and equivalent physical attractiveness ratings.[3] We converted these photographs into computer graphics files, using a flat-bed scanner. We prepared two versions of each photograph using the computer graphics software packages Picture Publisher (1997) and PhotoMagic (1993): The original eye size was enlarged by 20% or decreased by 10%. We converted these four manipulated images to 5 in. × 7 in. (12.7 cm × 17.8 cm) black-and-white photographs. Each participant had a choice between an increased eye-size version of one target and a decreased eye-size version of the other target. We counterbalanced target photograph presentation so that an equal number of participants saw each of the variations of the photographs an equal number of times.

Written personality descriptions. Written personality descriptions accompanied the photos in some conditions. We derived pairs of descriptions from the constellation of attributions that are typically made to baby faces, from attributions that are associated with mature faces, or from attributions that are irrelevant to this distinction. We matched each pair of descriptions on social desirability.[4] The pairs of descriptions were as follows: Mature face descriptions were "strong, mature, expert, and competent" and "dominant, influential, independent, and in control"; baby-face descriptions were "warm, naïve, kind, and agreeable" and "caring, weak, sociable, and honest"; irrelevant descriptions were "lucky, interesting, non-athletic, and neat" and "healthy, superstitious, artistic, and intriguing."[5] We joined each pair of target photographs with one of four types of written personality descriptions: mature face, baby face, irrelevant, or no information. For example, we presented participants in the condition of mature-face personality description with two photographs (one increased eye-size photograph and one decreased eye-size photograph), each with a different mature-face personality

description. Pairings were counterbalanced: An equal number of increased eye-size variations and decreased eye-size variations appeared in each of the two experimental-threat conditions: we paired each photograph with each of the two variations of each of the four possible written personality description types (mature face, baby face, irrelevant, and no information) an equal number of times.

Results and Discussion

Threat Manipulation

Participants completed the state anxiety scale after the threat manipulation. Those exposed to the high-threat condition reported a significantly greater level of anxiety than did those exposed to the low-threat condition ($M = 45.0$, $SD = 15.76$, and $M = 33.8$, $SD = 8.87$, respectively), $F(1, 94) = 18.8$, $p < .001$, $\eta^2 = .167$. The threat manipulation appears to have been successful.

Threat and Social Choice

We expected a relatively greater preference for mature faces under high threat and a relatively greater preference for baby faces under low threat. The results confirmed this hypothesis. A log-linear analysis of variance (ANOVA) revealed that within the no-personality description condition, participants in the low-threat condition showed a greater preference for the increased eye-size partner compared to participants in the high-threat condition (91.7% vs. 33.3%, respectively), $\chi^2(1, N = 24) = 6.52$, $p < .01$, $\varphi = .521$.

These data complement the previous archival investigations in a variety of ways. First they extend the generality of the threat effect. The archival studies focused on social and economic threat. The present study used a more personal, physical threat, that is, that of the pain from electric shock. Threat and choice were aggregate variables in the archival studies. The present study confirmed the impact of threat on choice using individual-level measures. The archival studies were correlational. Because in the present study we randomly assigned participants to levels of threat, the present study confirmed the causal role of threat in moderating the effect of facial neoteny or maturity on social choice.

Information, Threat, and Social Choice

The difference in attributions associated with baby faces versus mature faces may account for the threat effect. If attributions are important, then the threat effect that occurs when there is no direct information should be attenuated or should disappear when participants have direct information about the attributes of the others and do not have to make inferences from facial cues. Recall that there were three information conditions: Participants received either two mature

descriptions, or two baby-faced descriptions, or two irrelevant descriptions. Because there was some ambiguity about the prediction for the irrelevant-information condition, we decided to compare the information conditions among themselves before comparing them with the no-information condition.

We conducted a 3 (personality description type: baby face, mature face, or irrelevant) × 2 (threat: high or low) log-linear ANOVA for partner eye-size preference. The main effect for personality description type was not statistically significant, $\chi^2(2, N = 72) = 1.46$, indicating that there were no differences among the informational personality description conditions with respect to partner eye-size preference. Also, there was no personality interaction of description type with threat, $\chi^2(2, N = 72) = 1.46$, indicating that threat and personality description type did not interact to determine partner eye-size preference. This outcome is consistent with the literature on the dilution effect. Even irrelevant information tends to reduce reliance on another potential source of information, namely facial cues. Only the main effect for threat approached significance, $\chi^2(1, N = 72) = 3.58, p = .059$. Participants tended to choose the increased eye-size partner more often in the high-threat condition than in the low-threat condition (63.9% vs. 41.7%, respectively). Because this effect is of marginal significance and in the direction opposite to what we found in the no-information condition, attempts to explain it may be premature.

Because there was no interaction between threat and the information personality description types, we collapsed the baby-face personality description, mature-face personality description, and irrelevant personality description conditions to form a single *information condition*. To test the hypothesis that the threat effect would be attenuated when direct, written information about a potential partner's personality was provided, we conducted a 2 (threat: high or low) × 2 (personality description type: none or informational) log-linear ANOVA. The analysis revealed a nonsignificant main effect of threat, $\chi^2(1, N = 96) = 2.80$, *ns*, and a nonsignificant main effect of information, $\chi^2(1, N = 96) = 1.27$, *ns*. However, the crucial Threat × Information interaction was statistically significant, $\chi^2(1, N = 96) = 9.40, p < .01, \varphi = .313$. As previously noted, in the no-information condition, low-threat participants showed a greater preference for the increased eye-size partner than did high-threat participants; in the combined-information conditions, high-threat participants showed a marginally greater preference for the increased eye-size partner than did low-threat participants. Figure 1 presents the relevant data.

Additional Results

We scored the three individual difference questionnaires (STAI-T, LOT, and USQ) and divided them at the medians. Each was separately added to a 2 (threat: high or low) × 2 (personality description type: none or informational) log-linear ANOVA model with choice of partner eye size as the dependent variable. There

FIGURE 1. Study 1—Percentage of participants choosing increased eye-size partner as a function of information condition and threat.
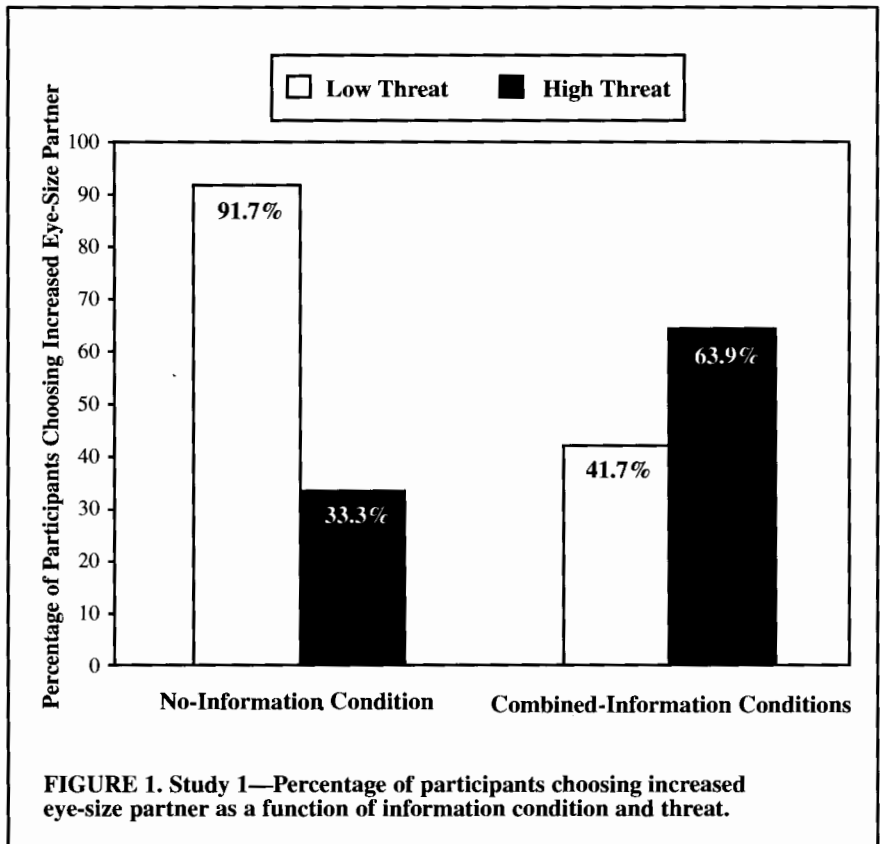
were no statistically significant effects. Chronic perceptions of stress, at least as indexed in these measures in this particular sample, seem to have little relationship with preference for mature-faced partners versus baby-faced partners.

As part of the experimental procedure, we asked participants to "please explain briefly why you chose the partner you chose." The written responses were coded[6] for presence of partner's traits (e.g., "easy to get along with," "fun to be around," or "smart"), random choice (e.g., "no reason," "because she was on the left," "just picked at random"), physical appearance (e.g., "she's attractive," "she has a pretty smile," "she looks natural," "she doesn't look fake"), and similarity (e.g., partner was chosen because of her similarity to either the participant or her similarity to someone the participant knows, such as a friend or a relative). We conducted separate exploratory log-linear ANOVA analyses for each of the four choice reason categories (presence or absence) and personality description types (presence or absence). There were no significant effects for similarity. However, compared to participants in the no-information condition, those in the combined-information condition listed partner's traits significantly more often (97.2% vs.

45.8%), $\chi^2(1, N = 96) = 20.3$, $p < .001$, $\varphi = .460$; but they listed random-choice reasons (2.8% vs. 16.7%), $\chi^2(1, N = 96) = 4.65$, $p = .031$, $\varphi = .220$, and physical-appearance reasons (11.1% vs. 50%), $\chi^2(1, N = 96) = 14.1$, $p < .001$, $\varphi = .383$, significantly less often. In short, people appear to have paid more attention to other's attributes when direct information was provided and more attention to appearance when direct information was not provided.

Conclusions

The results of the information analysis are quite consistent with our expectations. We expected that if people are using facial features as a source of information, then directly providing information should reduce the influence of the facial features. That outcome is precisely what we obtained, and the present results appear to support the attribution explanation. There is, however, another interpretation. Because participants appeared to pay little attention to facial features when they had other information (even irrelevant information), it may be that the eye-size preference effect is relatively automatic with little conscious cognitive content. When participants are given information that seems like a more justifiable basis for choice, they pay attention to that information, and the influence of facial features is reduced or lost. We will say more about this possibility in the General Discussion.

STUDY 2

We have observed a relationship between facial features and social preference that is moderated by threat: When conditions are relaxed, there is a tendency in a person to prefer others with neotenous features; when conditions are threatening, there is a tendency to prefer others with mature facial features. Neotenous and mature facial features also influence attributions. The attributions that the person makes from baby-face features (e.g., fun loving, dependent) may be more attractive when we feel secure, and the attributions that the person makes from mature facial features (e.g., dependable, independent) may be more attractive when we feel threatened. In Study 1, we reasoned that if these attributions mediate the moderation effect of threat, then if we uncoupled the attributions from eye size, we should eliminate the effect. On the other hand, if the effect of eye size were not to diminish even when attributions were controlled, then the attribution hypothesis would fail. The present results were consistent with the attribution hypothesis. When stimulus persons' attributes were provided, differences in eye size did not affect preferences.

The attribution hypothesis has withstood one test, but some ambiguity remains. Differences in preferences for neotenous faces disappeared even when the attributions were provided on dimensions irrelevant to eye size. Although this outcome is consistent with the established *dilution effect* (e.g., Hilton & Fein, 1989; Nisbett, Zukier, & Lemley, 1981) in the judgment literature, it still raises questions.

Researchers presume neotenous attributions to be functional under relaxed conditions and mature attributions to be functional under threatening conditions. Clearly the validity of this argument depends on the content of the attributions. If the content of the attributions makes little difference, then this explanation is difficult to sustain. The dilution effect renders the strategy that we used in Study 1 ambiguous. In Study 2, we took a different route to testing the attribution hypothesis.

The attribution hypothesis is functional. It suggests that the inferred attributes of the neotenous targets are more useful under relaxed conditions and that the inferred attributes of the mature-featured targets are more useful under threatening conditions. Up to now, we have treated functionality in a generalized and abstract manner. For example, the attributes of an image on a movie screen or on the page of a magazine are personally useful in, at best, only a very generalized and abstract way. If the attribution interpretation of the threat moderation effect is correct, then the moderation effect should be stronger when participants are expressing preferences for persons with whom they will share much interdependence than when participants are expressing preferences for persons with whom they will share little interdependence.

In the present study, we manipulated threat as in Study 1 but gave no direct information about potential partners. Individual difference measures related to threat and stress were again administered. In Study 1, participants expressed preferences for others with whom they shared little interdependence. In Study 2, we replicated these conditions and compared them with a set of conditions in which participants expressed preferences for others with whom they would be interdependent. We expected to replicate the threat moderation effect obtained in Study 1 in the former conditions. Because the latter conditions are more engaging from a functional perspective, the attribution mediation hypothesis indicates a stronger threat moderation effect in the latter conditions. The structure of Study 2 also gave us the opportunity to measure participants' attributions about others and to perform mediation analyses on these attributions.

Method

Participants

Participants were 80 psychology students[7] (40 men and 40 women) who volunteered to participate in a study entitled "Learning and Social Situations." We awarded participants with partial course credit for their participation.

Materials

In Study 2, we used the same female-target black-and-white photographs that we used in Study 1, with increased and decreased eye size. See Materials in Study 1 earlier in the present article for details regarding these materials.

Design and Procedure

The independent variables in Study 2 were threat (high vs. low) and partner's interdependence with potential partner (dependent vs. independent). Preference for a partner with a mature face versus a baby face served as the major dependent variable.

The procedures were similar to those of Study 1. We took a digital photograph of each participant, as explained earlier in Study 1, and gave all participants a packet of three individual difference measures and a general background questionnaire. As in Study 1, the STAI Form Y (Spielberger, 1983), the LOT (Scheier & Carver, 1985), the USQ (Crandell, Preisler, & Aussprung, 1992), and a background questionnaire were in the packet.

When participants finished the questionnaires, we randomly assigned them to either the high-threat condition or the low-threat condition and either the independent task outcome condition or the dependent task outcome condition. We told participants that the next part of the experiment required that they be introduced to a partner, that they would be given a list of word pairs to learn before the testing phase of the experiment began, and that then both participant and partner would be hooked up to an electrical-shock mechanism that would deliver shocks for incorrect responses to word pair questions. Participants were told that their experimental partner would sit next to them through the entire experiment and that "electrical shock is necessary because we are interested in your reactions and responses under these conditions."

Threat manipulation. We told participants in the high-threat condition that the electrical shocks that they were to receive would be painful and told participants in the low-threat condition that the electrical shocks that they were to receive would be mild, more like a tingle. See Study 1 earlier in the present article for further details about this manipulation.

Manipulation of (in)dependence. We told participants in the dependent condition that their incorrect responses, as well as their partner's incorrect responses, would result in an electrical shock to each of them (i.e., the frequency of shock would depend on their partner's responses as well as their own). Participants in the independent condition were told that their incorrect responses, but not their partner's incorrect responses, would result in an electrical shock to themselves only (i.e., the frequency of shock would not depend on their partner's responses).

Next, we told all participants that there would be a brief preparation delay of about 10 min before the next portion of the experiment would continue, so that the experimenter could prepare the electrical shock mechanism and the stimuli. Then, we gave participants the same pretext for choosing a partner as in Study 1.

After participants made their choices, we asked them to rate both target photographs on 25 "personality traits" using 7-point Likert-type scales. The items

consisted of neotenous attributes (warm, naive, kind, agreeable, caring, weak, sociable, and honest), mature attributes (strong, mature, expert, competent, dominant, influential, independent, and in control), and irrelevant attributes.

We asked participants to explain why they preferred the particular target photograph that they chose and instructed them to complete the STAI-S (state anxiety only). Finally, we debriefed participants and thanked them for their participation.

Results

The threat manipulation appeared to be successful. Recall that participants completed the STAI-S (Spielberger, 1983) before being debriefed. The high-threat condition was associated with greater state anxiety than the low-threat condition ($M = 40.9$, $SD = 13.3$, and $M = 33.5$, $SD = 8.71$, respectively), $F(1, 78) = 8.99$, $p < .01$, $\eta^2 = .103$.
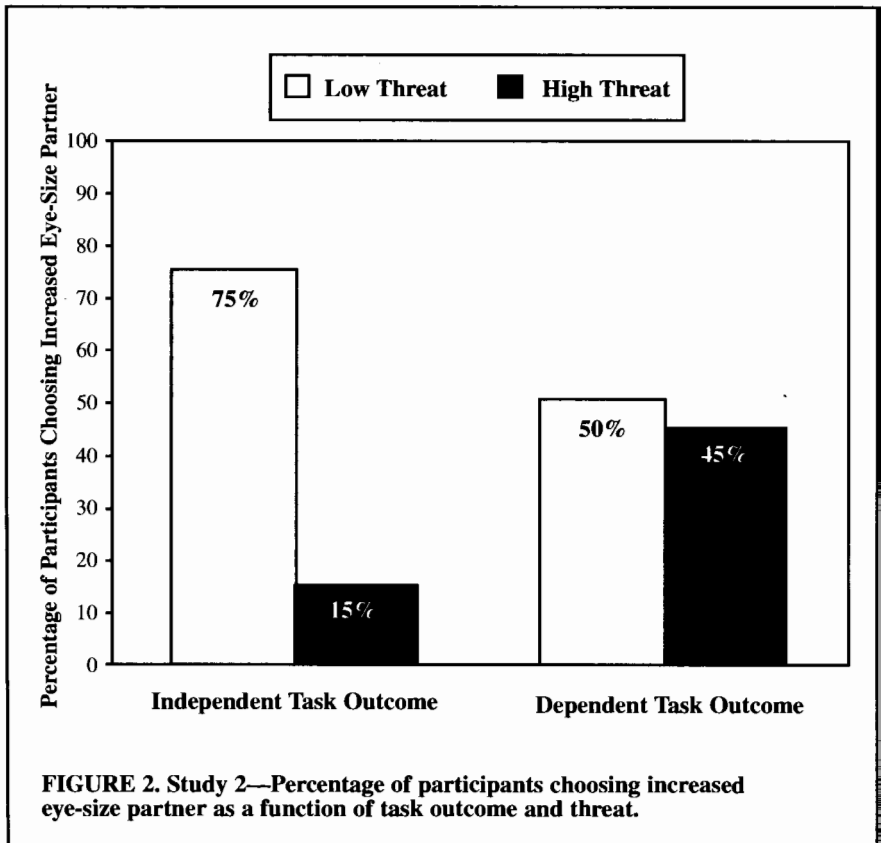
Target Choice

We provided participants with photographs of two potential partners from which they were to choose. Using preference for the increased eye-size partner or the decreased eye-size partner as a categorical dependent variable, we conducted a 2 (threat: high or low) × 2 (partner's role with participant in the outcome of the task: independent of or dependent on a partner) log-linear ANOVA.[8] The predicted main effect of threat on target photograph choice was significant, $\chi^2(1, N = 80) = 8.68$, $p < .01$, $\varphi = .329$. Participants in the low-threat condition showed a greater preference for the increased eye-size partner than did participants in the high-threat condition (62.5% vs. 30.0%, respectively). The main effect for interdependence was not significant ($\chi^2 < 1$). Our theoretical analysis indicated an interaction between threat and interdependence: The effect of threat would be greater in the interdependent condition than in the independent condition. The predicted interaction was significant, $\chi^2(1, N = 80) = 6.53$, $p < .01$, $\varphi = .286$. However, the effect was in the direction opposite of what we predicted!

As Figure 2 shows, when task outcomes were independent, participants in the low-threat condition showed a greater preference for the increased eye-size partner than did participants in the high-threat condition (75.0% vs. 15.0%, respectively), $\chi^2(1, N = 40) = 12.2$, $p < .001$, $\varphi = .552$. We predicted this effect, and it nicely replicates the threat effect in the archival studies (Pettijohn & Jungeberg, 2004; Pettijohn & Tesser, 1999) and in Study 1. However, we expected this effect to be more pronounced where the attributions about the other are more consequential, that is, in the interdependent condition. Instead, the effect of threat vanished in the dependent condition, $\chi^2 < 1$. Predictions for choice were based on the notion that attributions mediate the relationship between eye size and choice. We will focus on these attributions next.

Partner Trait Ratings

After participants chose their partner, we gave them the opportunity to rate both potential-partner images on 24 personality traits and on physical attractiveness and similarity to the self. We averaged the eight mature-face trait ratings (strong, mature, expert, competent, dominant, influential, independent, and in control) and then subtracted that average from the average of the eight baby-face trait ratings (warm, naive, kind, agreeable, caring, weak, sociable, and honest) to produce a difference composite rating score for the increased eye-size target stimulus and the decreased eye-size target stimulus. We labeled this difference *neotenous attribution* because positive scores indicated a more baby-faced perception, and because negative scores indicated a more mature-faced perception. These ratings allow a test of the mediational explanation for partner eye-size choice.[9]

FIGURE 2. Study 2—Percentage of participants choosing increased eye-size partner as a function of task outcome and threat.

To test the mediation model, researchers must establish several individual relationships: (a) stimulus eye size must be related to partner choice, (b) stimulus eye size must be related to neotenous attributions, and (c) neotenous attributions must be related to partner choice (Baron & Kenny, 1986). Because partner's eye size was related to choice only in the independent conditions, we restricted our analyses to those conditions. The second relationship, that eye size must be related to neotenous attributions, was established by comparing the neotenous attributions for the increased eye-size stimulus and the decreased eye-size stimulus. A repeated t test revealed that participants' neotenous attributions were higher for the increased eye-size stimulus than for the decreased eye-size stimulus ($M = .103$, $SD = .715$, and $M = -.234$, $SD = .714$, respectively), $t(39) = 2.31$, $p = .026$, $d = .365$.[10]

To assess the third relationship, that neotenous attributions must be related to partner choice, we subjected neotenous attributions to a 2 (stimulus: increased vs. decreased eye-size stimulus, repeated measure) × 2 (threat: high or low) × 2 (partner choice: increased or decreased eye size) ANOVA. Neotenous attributions should be positively associated with choice in the low-threat condition and negatively associated with choice in the high-threat condition. This set of expectations is reflected in the Stimulus × Threat × Eye Choice interaction. This interaction did not approach significance, $F < 1$. Because neotenous attributions were not related to partner choice, the mediation hypothesis fails with the present data.

Other Ratings

Participants also rated the physical attractiveness of the stimulus persons and their own similarity to the stimulus persons. We subjected these ratings to a 2 (stimulus: increased or decreased eye-size stimulus, repeated measure) × 2 (threat: high or low) × 2 (task outcome: independent of or dependent on partner) ANOVA. Consistent with previous literature, participants rated the increased eye-size stimulus higher on physical attractiveness than they did the decreased eye-size stimulus ($M = 4.68$, $SD = .925$, and $M = 4.45$, $SD = 1.0$, respectively), $F(1, 78) = 4.42$, $p = .039$, $\eta^2 = .055$. In addition, there was a significant Stimulus × Threat interaction, $F(1, 78) = 5.45$, $p = .022$, $\eta^2 = .067$. At the low-threat level, participants rated the increased eye-size stimulus higher on physical attractiveness than they did the decreased eye-size stimulus ($M = 4.95$, $SD = .815$, and $M = 4.48$, $SD = 1.20$, respectively), $t(39) = 2.90$, $p < .01$, $d = .458$. But at the high-threat level, participants rated the decreased eye-size stimulus and the increased eye-size stimulus similarly on physical attractiveness ($M = 4.40$, $SD = .955$, and $M = 4.43$, $SD = .781$, respectively), $t < 1$. The analysis produced no significant effects on similarity to the stimulus person, all Fs < 2.7.

Was partner choice related to physical attractiveness or similarity? There was no relationship between choice and ratings of physical attractiveness, $t < 1$. However, participants rated their choices as more similar to themselves than

to their nonchoice partner ($M = 3.69$, $SD = 1.09$, and $M = 2.85$, $SD = .915$, respectively), $t(79) = 7.40$, $p < .001$, $d = .828$.

We also asked participants to note the reasons for their choices. In Study 2, as in Study 1, we coded the reasons into the following categories: random choice, psychological attributes, physical appearance, and similarity.[11] There were no significant effects of either threat or interdependence on the distribution of any of these reasons.

Individual Differences

We divided scores on the three individual difference questionnaires (STAI-T, LOT, and USQ) at the median. We then included each in a 2 (score: high or low) × 2 (threat: high or low) × 2 (task outcome: independent or dependent) log-linear ANOVA of partner eye-size choice. The USQ showed a significant main effect, $\chi^2(1, N = 80) = 4.92$, $p < .05$, $V = .248$: Low-stress participants were more likely to choose the increased eye-size partner than were high-stress participants (57.5% vs. 35.0%, respectively).[12] The STAI-T analysis produced only an STAI-T main effect, $\chi^2(1, N = 80) = 4.63$, $p < .05$, $V = .241$: Low–trait-anxiety participants were more likely to choose the increased eye-size partner than high–trait-anxiety participants (57.5% vs. 35.0%, respectively). There were no significant effects involving the LOT, all χ^2s < 1.9.

Discussion

The independent conditions of Study 2 indicate the strength and the robustness of the threat moderation effect, that is, of the Environmental Security Hypothesis. The present results replicate those of the popular actress study (Pettijohn & Tesser, 1999), the *Playboy* Playmate study (Pettijohn & Jungeberg, 2004), and Study 1. Participants in the low-threat condition showed a greater preference for the increased eye-size partner than did participants in the high-threat condition. Moreover, persons do not have to have any type of personal interaction or dependent relationship with the choice to have their preferences influenced by threat. Indeed, relationships of dependent task outcomes appear to reduce eye-size preferences.

The Environmental Security Hypothesis received further support when we considered individual differences. Participants reporting high stress on the USQ or high trait anxiety on the STAI-T can be construed as being under stress or threat. Participants who were high in stress or high in trait anxiety were more likely to prefer the decreased eye-size partner than were participants low in stress or low in trait anxiety. These relationships echo the experimental results. Participants who are chronically high in stress or anxiety act like participants exposed to laboratory threat: They show a greater preference for the decreased eye-size partner than do participants who are low in stress or trait anxiety.

The Attribution Explanation

In our explanation of the threat moderation effect, we focused on the utility of attributions produced by facial features. From a functional point of view, the attributions associated with neotenous facial features are more useful under secure conditions, and the attributions associated with mature features are more useful under threatening conditions. If this is so, then the threat moderation effect should be stronger when there is some actual relationship between one's outcomes and who one chooses. In spite of its plausibility, the present results dramatically contradicted this expectation. We will briefly explore three reasons for this surprise: One possibility involves an artifact; a second focuses on the nature of the dependence manipulation; and a third indicates that the attribution hypothesis is wrong.

There may have been a ceiling effect. The threat moderation effect was quite strong in the independent conditions, that is, 75% of the low-threat participants and 15% of the high-threat participants picked the increased eye stimulus partner. For the effect to be stronger in the dependent conditions, this spread would have to be even more extreme. There simply is not much room for that to happen. So, a ceiling effect can explain why the dependent conditions are not more extreme than the independent condition. However, a ceiling effect cannot explain why the threat moderation effect is significantly weaker in the dependent condition.

We used a complex manipulation of dependence. The complexity of this manipulation may have caused the threat moderation effect to wash out. In particular, not only was the participant's fate dependent on the partner, but also the partner's fate was dependent on the participant. This circumstance may complicate the participant's motives. For example, under high threat the participant may want to rely on the capable, mature partner, but at the same time he or she might be afraid of causing harm to the mature partner. Or, if the participant feels particularly capable, there might be a tendency to choose the dependent, large-eyed person to protect her. These countervailing tendencies could have reduced differences in preferences. Clearly, future researchers need to independently manipulate the extent to which the self is dependent on the other and the other is dependent on the self. Countervailing tendencies may explain why there is no overall preference for the increased or decreased eye-size partner in the high-threat condition. However, this explanation does not seem to work as well for the low-threat condition where fear of being harmed or harming another is minimal.

We expected a large threat moderation effect in the dependent condition on the basis of our attribution hypothesis. Maybe that hypothesis was wrong. The data from Study 2, on the face of it, contradict the hypothesis. It was not simply that the increased effect failed to emerge. That would be understandable in terms of a ceiling effect, or a lack of power, or unreliable measures, and the like. What we found was a significantly decreased effect in the dependent conditions. The

evidence looks damaging, but perhaps we should not pay too much attention to the dependent conditions because the complexity of the manipulation renders them difficult to interpret.

Let us focus on the independent conditions. Here the threat moderation effect was quite strong. Here, too, however, the attribution explanation fails. We have a measure of the presumed mediating attributions. Consistent with the attribution analysis, the increased and decreased eye-size partners induced different attributions in the expected directions. Disappointingly, however, these attributions were unrelated to choice. Such a failure may be understandable: The traits that we used for the attribution index may have been the wrong ones, the measure may have been unreliable, and the like.

Conclusion

The results of Study 2 provided clear evidence for the threat moderation effect, at least in the independent conditions. The present findings provided little evidence for the operation of the attribution explanation. Can we rule the attribution model out? No. However, as the number of excuses that we need to maintain the attribution explanation increases, our confidence in it must decrease.

GENERAL DISCUSSION

Previous researchers (e.g., Cunningham, 1986; Cunningham et al., 1990, 1995) have documented the positive effect of neotenous facial features on attractiveness and preference. The present work clearly documented the contingent aspects of this relationship. Consistent with the Environmental Security Hypothesis (Pettijohn & Tesser, 1999) and with much of the previous literature, people prefer neotenous female faces under ordinary, nonthreatening conditions. However, it is particularly interesting that this preference for neotenous features is reduced, or even reversed, when the perceiver feels threatened. An increased preference for mature facial features under conditions of threat is also in accord with the Environmental Security Hypothesis and might be new to this literature.

The threat moderation effect is quite strong and general. As noted in the introduction, we (Pettijohn & Jungeberg, 2004; Pettijohn & Tesser, 1999) have observed this effect in a natural setting using an aggregate measure of threat (changes in socioeconomic statistics over time) and an aggregate measure of facial and body feature preferences over time. The present studies demonstrated this effect on the individual level as well as the aggregate level. Threats of weak and strong electric shocks altered individual choices. In Study 2, individual differences in chronic anxiety and current life stress were related to individual choices, but there was no pattern of relationship between social choice and the individual difference measures of anxiety or stress in Study 1. Further, because participants were randomly assigned to threat conditions in the present set of

experiments, we have greater confidence in the causal role of threat in moderating preferences. The present studies also indicate the possibility that the kind of threat that will moderate the effects of facial features on preferences is quite general. In addition to socioeconomic threats, they also include physical threats such as shock, individual differences in chronic anxiety, and recent stressful events.

What seems clear from this program of research is that threat moderates the effect of neotenous and mature facial features on preference: In accord with the Environmental Security Hypothesis, neotenous facial features are relatively more attractive under secure conditions than under threatening conditions. What is less certain is why. Later in the present article we will review the evidence for the attribution explanation and suggest an alternative.

Explaining the Threat Moderation Effect

Attributions played a central role in the original explanation for the threat moderation effect. Researchers assumed that attributions render persons with neotenous faces more functional or attractive when perceivers feel secure and to render persons with mature faces more functional or attractive when perceivers feel threatened. The evidence pertaining to this explanation from Study 1 and Study 2 is mixed.

In Study 1, when we gave participants direct information indicating that a potential choice of partner had the attributes of a baby-faced person or a mature-faced person, the effect of physical facial features had no impact. This supported the attribution explanation. However, information that was irrelevant to neotenous or mature facial features also wiped out the effect of physical facial features. The attribution explanation does not predict this effect. In Study 2, we reasoned that if attributions of the other person that are based on facial features are functional, then participants should be more influenced by facial features when the participants are dependent on the other than when they are independent of that other. The present results contradict this reasoning. They show that participants were more influenced by facial features when choosing a partner who was independent of the self than when choosing a partner on whom the self was dependent. A more direct approach failed as well. Measures of the relevant attributions were related to facial features of potential choices as expected. However, they were unrelated to the actual choices of partner.

The attribution interpretation seems plausible. There is nothing in the present data to definitively rule it out. Indeed, we think it continues to be worth pursuing. On the other hand, we have looked in a few places for support of it and have found relatively little. Thus, we think it prudent to consider alternative explanations as well.

The attribution explanation—at least the way in which we have laid it out—depends on an effortful, perhaps conscious, thought process. Facial features lead to attributions; people judge attributions for functionality for a given level of

threat; the people choose partners on this basis. There is an alternative point of view. Perhaps the effects of facial features are automatic, quick, and implicit. Individuals may be unaware that they are responding to these features. Conscious, cognitive effort actually may interfere with such a process. For example, there is evidence from cognitive psychology that attempts at explicit learning may interfere with implicit learning (Reber, 1989). Perhaps even more relevant is the work of Timothy Wilson and his colleagues (e.g., Wilson & Hodges, 1992). They have found that compared to people who respond with their attitudes or preferences without thought, people who analyze their reasons provide preferences that are of lower quality (Wilson & Schooler, 1991) and are less predictive of their later behavior (Wilson, Dunn, Kraft, & Lisle, 1989).

How well does the conscious-interference alternative account for the present data? This explanation assumes that conscious, effortful thoughts will override the automatic effect of facial features. Consider Study 1. Giving people information about the attributes of another may demand or prompt effortful, conscious thinking about what the other is like. This should reduce the facial-feature effect. That effect in Study 1 was, in fact, low in all of the direct information conditions, including the irrelevant-information conditions. Under the conscious-interference explanation, the information is merely a cue for effortful processing so that the content of the information does not matter. Since the content of the information does matter according to the attribution hypothesis, the conscious-interference hypothesis does a better job of accounting for the irrelevant-information condition in Study 1 than does the attribution hypothesis. If we assume that people become more thoughtful and process information about others effortfully when they are motivated to do so, then Study 2 is also consistent with the conscious-interference hypothesis. Motivation to process should be low when our own outcomes are independent of others but should be high when our own outcomes depend on others (e.g., Berscheid, Graziano, Monson, & Dermer, 1976). Consistent with this explanation, facial features affect preferences in the independent conditions but do not affect preferences in the dependent conditions. Conscious interference may also explain the results of the mediation analysis in Study 2. The effects of facial features on choice are automatic and are not consciously scrutinized. It is only after the choices are made that we ask participants about their attributions. Thus, the attributions are related to facial features but not to the choices. In sum, the idea that the effects of facial features are automatic and that they can easily be overridden by conscious, cognitive effort is post hoc but somewhat promising.

Conclusion

Neotenous female facial features versus mature ones play a role in driving social choice. The role of these features, however, is more complex than previous work might have indicated. Individuals prefer persons with neotenous fea-

tures in secure circumstances. Low-anxiety and low-stress individuals prefer persons with neotenous features. However, high-anxiety and high-stress individuals and threatening conditions tend to reverse these preferences.

NOTES

1. One additional female participant participated in the present experiment, but we discarded her data because of her suspicion of the experimental threat manipulation.

2. The experimenter was blind to which set of photographs and personality descriptions would be presented as stimuli.

3. A total of 66 university students rated the physical attractiveness of potential targets that we presented in black-and-white 5 in. × 7 in. (12.7 cm × 17.8 cm) photographs. By analyses, we determined that the attractiveness ratings for the two target persons that we chose for the present study were similar ($M = 3.72$, $SD = 1.20$, and $M = 3.77$, $SD = 1.17$, respectively) on a 7-point Likert-type scale ranging from 0 (*strongly disagree*) to 6 (*strongly agree*).

4. A total of 47 university students rated the social desirability of 24 personality traits on a 7-point Likert-type scale. Using the mean social desirability rating from each word, we created equivalent pairs of baby-face descriptions, mature-face descriptions, and irrelevant descriptions.

5. We conducted an investigation of these irrelevant trait ratings as a group on data from Study 2. The results revealed that participants did not rate the increased eye-size partner statistically differently from the decreased eye-size partner on a composite of these irrelevant traits, $t(79) = 1.26$, *ns*.

6. Raters initially agreed on 95 (98.9%) of the 96 choice reason statement classifications. The single situation in which raters disagreed was resolved by discussion between the raters.

7. An additional 4 participants took part in Study 2, but we discarded their data because of their suspicion of the experimental procedure.

8. Initially, we conducted a 2 (sex of participant: male or female sex) × 2 (threat: high or low) × 2 (partner's role in the outcome of the task: independent of or dependent on a partner) log-linear ANOVA. As we predicted, neither the main effect for sex of participant nor any of the interaction effects involving the independent variable sex of participant was statistically significant, all χ^2s < .25, indicating that there were no differences between male and female participants with respect to their partner eye-size preferences. Therefore, this variable was removed from future analyses.

9. Although participants made these trait ratings after partner choice, these ratings may indicate the inferences that participants may have made about the potential partners before making a partner choice.

10. This relationship is consistent with previous research that has found neotenous targets (large eyes) to be rated higher on baby-face traits and mature targets (small eyes) to be rated higher on mature-face traits.

11. Two raters initially agreed on 78 (97.5%) of the 80 choice reason statement classifications. The two situations in which raters disagreed were resolved by discussion between the raters.

12. We also found a statistically significant three-way interaction, $\chi^2(1, N = 80) = 4.69$, $p = .03$, $V = .242$, between threat, task outcome, and the USQ individual difference, indicating the possibility that there is a complex association between these three variables and partner eye-size preference. However, we did not explore this higher order interaction because of small cell frequencies.

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