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Volume 14 Reviewers

Faculty mentors
These articles were accepted during the editorial term of Martha S. Zlokovich.
The twofold purpose of the Journal Purpose Statement is to foster and reward the scholarly efforts of undergraduate psychology students as well as to provide them with a valuable learning experience. The articles published in this journal represent primarily the work of the undergraduate student(s). Faculty mentors who deserve recognition, are identified by an asterisk next to their name or on a separate byline.

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In today's technology-centered world, people are no longer required to communicate and form relationships in face-to-face situations alone. In fact, the use of electronic forms of communication, such as text-messaging or online interaction, is rapidly becoming a primary tool for many people to form and maintain many of their relationships. For instance, a recent online survey of 439 college students showed that nearly 20% of college students spent over 20 hours per week online (Burst Media, 2007). This shift in communication impacts several different categories of relationships people have: familial relationships, friendships, romantic relationships, professional relationships, and educational relationships. Consequently, the impact of online communication on building and maintaining relationships is important to understand.

Self-disclosure has been viewed as a key component in developing close relationships (Altman & Taylor, 1973). Jourard and Lasakow (1958, p. 91) defined self-disclosure as “the process of making the self known to other persons.” According to this perspective, self-disclosure builds trust which leads to closer relationships. When one individual takes a risk by disclosing to another individual, the receiver feels as though he or she is trusted. In return, the receiver is more likely to disclose information as well. Trust and security are developed when two people respond to one another positively over repeated interactions, which continually strengthens the relationship. A key element of the relationship is that the individuals involved must perceive that their disclosures are being accepted. Therefore, the process is mutually reinforcing (Bennis, Schien, Berlew, & Steele, 1964).

With the rapid growth of technology, people can now self-disclose using more indirect means like the Internet, and several recent studies have begun to more closely examine self-disclosure during online communication (Chiou, 2006; Punyanunt-Carter, 2006; Valkenburg & Peter, 2007). One of the most common explanations proposed for people's tendency to self-disclose online is the fact that online communication increases anonymity. This anonymity can then produce a state of deindividuation in which others are not seen as individuals; consequently people lose their inner restraints (Chiou, 2006). In other words, people may feel more comfortable with self-disclosure online because others do not necessarily know who they are as individuals and their disclosures online are less likely to produce immediate social repercussions.

Tell Me More: Online Versus Face-to-Face Communication and Self-Disclosure

The purpose of this study was to examine the effect of type of communication (online or face-to-face) on self-disclosure. A group of 58 college students engaged in a conversation either face-to-face or using an instant-messaging system. Those who conversed online reported a significantly higher amount of personal and perceived partner self-disclosure as measured by an adapted version of the Revised Self-Disclosure Scale (Wheeless, 1978) than those who conversed face-to-face. Implications regarding online communication and its impact on counseling, educational, and personal relationships are discussed.

Faculty mentor: Wendy Close, PhD
includes 58 (25 men, 33 women) undergraduate psychology department-sponsored research activity. Participants were recruited through an undergraduate demographic survey on which they reported their age, gender, year in school, and the extent to which they felt they knew their partner before this experiment. Lastly, participants responded to an eight-question demographic survey on which they reported their age, gender, year in school, and the extent to which they felt they knew their partner before this experiment.

In addition, the participants in the online condition used computers in the following manner. The researchers placed 15 laptops in two rooms (A and B) on two different floors. Each computer had a number 1 through 15. Each computer also had a mock instant messaging (IM) account already on the screen. The individual IM accounts on each screen allowed the participant to communicate with only one other account, which was already up on the screen of the corresponding computer in another room on a different floor. Therefore, participants communicated online with the

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<td>The goal of the present research is to gain more clarity regarding the relationship between type of communication and self-disclosure. Specifically, the current study extends previous research in the area by (a) employing an experimental rather than retrospective design, and (b) comparing whether the perception of partner self-disclosure is greater online or face-to-face situation. First, we hypothesized that because online communication increases anonymity (Chiou, 2006), participants in the online group will report higher levels of personal self-disclosure than those in the face-to-face group. Second, based on the concept of reciprocity (Barak &amp; Gluck-Ofri, 2007), we hypothesized that those participating in online discussions would perceive that their conversation partners disclose more to them than those participating in face-to-face discussions.</td>
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<td>Participants were recruited through an undergraduate psychology department-sponsored research activity. Initially, 60 participants completed the study, but 2 participants were not included in the final analyses due to incomplete data. The remaining participants included 58 (25 men, 33 women) undergraduate students attending a small liberal arts college in the Midwest, and the majority of the sample was Caucasian (97%). The participants' ages ranged from 18 to 28 (M = 20.10, SD = 1.23). Two conditions existed: the online communication group and the face-to-face communication group. The participants in the online group consisted of 14 men and 15 women, whose ages ranged from 18 to 28 (M = 20.38, SD = 2.19). The participants in the face-to-face group consisted of 11 men and 18 women, and their ages ranged from 18 to 22 (M = 19.83, SD = 1.23).</td>
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<td>The researchers employed an adapted version of the Revised Self-Disclosure Scale (RSDS; Wheeless, 1978) to determine participants' level of self-disclosure. Nineteen items from the original scale were reworded to be more applicable to the interaction in this particular experiment. Nine items were used to measure the amount and quality of each participant's disclosure in this situation (personal self-disclosure). Sample items include: &quot;In this experience, I often disclosed intimate personal things about myself without hesitation&quot; and &quot;In this experience, I did not often talk about myself.&quot; The remaining 10 items measured the amount and quality of disclosure from the partner in this situation (perceived partner self-disclosure). Sample items included: &quot;In this experience, my partner talked about his/her self-disclosures.&quot; Participants were asked to indicate their agreement with the items on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The participants used five of Aron, Aron, Vallone, and Bator's (1997) Closeness-Generating Questions, which were designed to encourage self-disclosure. One example question is, &quot;If you have to move from where you consider home, where would you go, and what would you miss the most about home?&quot; Lastly, participants responded to an eight-question demographic survey on which they reported their age, gender, year in school, and the extent to which they felt they knew their partner before this experiment.</td>
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person in the other room sitting at the computer with the same number. For instance, the participant seated at computer 1 in Room A communicated online only with the person seated at computer 1 in Room B. Each participant was assigned a gender-neutral pseudonym that appeared at the top of each IM account (e.g., Sam024689753, Taylor035798642, and Jess035798642). In addition, all participants were asked not to reveal their real names to their partners.

**Procedure**

The independent variable was type of communication (online versus face-to-face) and participants were assigned to one of these two conditions as they arrived at the study. We randomly assigned partners only in the face-to-face condition. The dependent measures were personal self-disclosure and perceived partner self-disclosure.

**Online condition.** Participants entered the room and picked a computer by seating themselves. Consequently, pairs were created through convenience sampling. Each pair was given five questions to discuss, and each topic was designed to encourage self-disclosure (Aron et al., 1997). The researchers asked participants not to reveal their names to each other and to stop the conversation and notify the researchers if they suspected that they knew their partner. This, however, did not occur. The researchers then informed the participants to keep conversing until instructed to do otherwise. After 15 min, the researchers stopped the conversations and the participants filled out the survey packet, which included an adapted version of the RSDS (Wheeless, 1978) and a demographic survey. Participants took approximately 3 min to complete these surveys.

**Face-to-face condition.** All participants entered the same room and received an informed consent. The researchers randomly assigned pairs by having participants pick numbers out of a container and pair up with the person with the same number. Participants were asked if they knew their partners (more than just in passing) before this interaction, and if they did, they would have been reassigned. However, this did not happen. Pairs then were given the same choices of topics as the online condition and the same time limit. After 15 min, the researchers stopped the conversations and handed out the survey packets, which contained all the same instruments as the packets for the online group. The participants in both the online and face-to-face groups were given debriefing statements after they handed in their survey packets.

**Results**

For the entire sample, mean response scores for personal self-disclosure on the adapted version of the RSDS (Wheeless, 1978) ranged from 3.56 to 6.56 (M = 5.09, SD = 0.68) on a scale from 1 to 7. The Cronbach alpha for the personal self-disclosure items was .64. An independent t test was conducted to explore the impact of communication group (online or face-to-face) on levels of personal self-disclosure. Mean personal self-disclosure responses for the online group (M = 5.30, SD = 0.66) were significantly higher than the face-to-face group (M = 4.88, SD = 0.65), t(56) = 2.45, p = .02. The partial eta squared statistic was .10, indicating a large effect.

For perceived partner self-disclosure, entire sample mean response scores on a scale from 1 to 7 ranged from 1.90 to 6.10 (M = 4.80, SD = 0.69). The Cronbach alpha for perceived partner self-disclosure items was .71. An independent t test was conducted to explore the impact of communication group (online or face-to-face) on levels of perceived partner self-disclosure. Mean perceived partner self-disclosure responses for the online group (M = 5.02, SD = 0.57) were significantly higher than the face-to-face group (M = 4.58, SD = 0.74), t(56) = 2.49, p = .02. The partial eta squared statistic was .10, indicating a large effect.

**Discussion**

**Type of Communication and Self-Disclosure**

This research study sought to examine the relationship between online or face-to-face communication and self-disclosure. As predicted, the participants in the online communication group reported higher levels of personal self-disclosure and perceived partner self-disclosure than those in the face-to-face group. These results are in line with Tidwell and Walther’s (2002) findings, but are in contradiction to Mallen et al.’s (2003) results, which indicated that those in face-to-face pairs self-disclosed more than those in online pairs. These differences may be due to the fact that Mallen et al.’s (2003) study measured self-disclosure with one item that focused on the amount of self-disclosure. Specifically, they asked participants to rate their own self-disclosure from 1 (no self-disclosure) to 6 (extreme self-disclosure), whereas the present study’s measure contained 9 items that were also meant to assess one’s perception of both the quality and amount of self-disclosure.

Results from the current study suggest that online communication may increase people’s personal self-disclosure in general, helping them along in the early stages of relationship building. Several previous researchers have provided possible explanations for the present results. A common explanation is the anonymity that an online environment provides, which allows people to feel safer self-disclosing (Chiou, 2006). Tidwell and Walther (2002) proposed another
explanation for greater disclosure in an online setting. They noted that many of the ways people get to know others (e.g., reading and interpreting nonverbal cues) are not possible in online communication. Therefore, people communicating online may actually be limited to using self-disclosure as a means to get to know one another. Because this form of communication is fairly commonplace in present times, people may now expect self-disclosure by themselves and others in online communication because no other means of getting to know each other is possible. If this norm of self-disclosure does in fact exist online, it may explain why the online group in this study reported higher personal self-disclosure.

Finally, results indicated that people perceive their communication partners as disclosing more in an online situation than in a face-to-face situation. This suggests that the phenomenon of reciprocity may occur to a greater degree online than face-to-face. Therefore, these findings may serve as another explanation of why people disclose more online in general. The online participants may have felt that their partners were self-disclosing more than the face-to-face participants felt their partners were self-disclosing. In turn, this may have then influenced the online group to self-disclose more to their partners than the face-to-face group felt necessary to disclose to theirs.

Practical Applications and Future Directions
Due to the prevalence of online communication in the world today, the results of this study can be applied to practical situations. This study can contribute to the debate concerning the effectiveness of online counseling (Mallen & Vogel, 2005; Murphy & Mitchell, 1998; Rochlen, Zack, & Speyer, 2004; Young, 2005). Because online communication elicited more self-disclosure, online communication may be an effective venue for forming therapeutic relationships. Online therapy may appeal to and benefit clients for several other reasons, which are discussed extensively in other research articles; therefore, we provide only a brief overview of the benefits here. The anonymity of online communication may make clients feel more open when disclosing to counselors (Chiou, 2006). Furthermore, because the Internet can hide the client’s and therapist’s age, race, other physical features, and clothing style or quality, the harmful assumptions and judgments about others that people often make in person will not exist. This may allow for less biased communication from the client and genuine therapeutic guidance (Rochlen et al., 2004). Despite the possible benefits of online therapy, research on its effectiveness is still needed. Therefore, counselors should practice online counseling cautiously by taking extra ethical precautions, such as ensuring confidentiality, formulating an emergency protocol, and obtaining informed consent for treatment (Casper, 2004).

Furthermore, the present results may also be useful in academic settings. Because online communication elicited more self-disclosure, teachers may consider using it to form closer relationships with their students so they can better meet their students’ needs. Using online communication may make students feel more comfortable asking teachers or other students questions because of the anonymity it can provide. Similarly, online communication may be used in this way for students to assist each other with academic assignments. Naturally, the present study’s results suggest that future research examine whether online communication may be used to increase disclosure and strengthen new business relationships between colleagues as well as personal relationships (familial, romantic, and platonic).

Given that online communication will likely continue to grow rapidly, research about the impact of online communication on self-disclosure and relationships is necessary. Due to the small and racially homogenous sample size, future studies should employ a larger and more ethnically diverse sample. Because this study took place on a small campus of less than 1000 students, the anonymity of online communication may have played a role in producing more self-disclosure in the online group. This may have occurred because participants in the face-to-face group may have guarded their disclosures more than those in the online group if they thought they were likely to see their partners on campus later. This phenomenon may not occur in a larger sample from a bigger university or from a noncollege sample.

Additionally, future researchers should consider other important moderating variables to better understand the relationship between type of communication (online versus face-to-face) and self-disclosure. In particular, it would be helpful to consider the impact of certain personal characteristics, such as age, personality, race, culture, socioeconomic status, intelligence, and writing ability. Furthermore, the present study did not consider the effects of large amounts of self-disclosure on relationships; for example, future studies could examine how and in which situations excessive self-disclosure can harm a relationship. Finally, it would be beneficial to examine how online versus face-to-face communication impacts self-disclosure for particular types of relationships, such as student-teacher, client-therapist, romantic, and familial.

References


Children’s use and redirection of attention continues to be an important topic in the field of child development. Zelazo, Frye, and Rapus (1996) developed the Dimensional Change Card Sort (DCCS) task to explore specific changes in 3- and 4-year-olds’ use and redirection of attention. In the DCCS task, children are asked to sort cards based on the dimensions of shape or color. The cards used in the original task had pictures of red and blue bunnies and boats. In the first aspect of the task, children were asked to sort the cards based on one dimension and 3- and 4-year-olds were both able to perform well. In the next aspect of the task, children were asked to sort cards based on the second dimension. There was no significant difference between the 4-year-olds’ performance on each aspect; however, 3-year-olds continued to sort cards in the second aspect of the task by the rule of the first aspect despite understanding both rules (Zelazo et al., 1996). It is unclear why the developmental shift occurs, and this phenomenon has become the focus of further research.

Zelazo et al. (1996) developed the Cognitive Complexity and Control (CCC) theory to explain that 3-year-olds cannot apply higher order rules, which are necessary in switching from the first aspect in the task to the second aspect. They determined that self-reflection and development of higher order rules help children inhibit perseveration (Happaney & Zelazo, 2003). In addition, children’s perseveration or success is not necessarily a function of the inhibitory processes alone, but also depend on working memory capacity (Munakata, Morton, & Yerys, 2003). CCC theory proposes a hierarchical rule system that is organized into two levels. The top level is a conscious system that controls the lower level, which is an unconscious response to stimuli directed by relational associations that acts as a representational mechanism. Development enables the representational mechanism to maintain increasingly complex hierarchies. The complexity of hierarchies is determined by the number of levels embedded in the rules of that hierarchy (Kirkham, Cruess, & Diamond, 2003). The research on CCC theory has become a predominant explanation for 3-year-olds’ performance on the DCCS task.

Although the CCC theory explained many findings by Zelazo and his fellow researchers (1996), Diamond et al. (2002) found that there is little improvement in younger children’s performance on the DCCS task when a higher order rule reduces the number of rules being presented, contradictory to CCC theory. In their study, 4- and 4 ½-year-olds were given cards with either a sun or a moon and asked to say “night” when given a card with a picture of the sun and “day” when given a card with a picture of a moon. This required the children to use two different rules to complete the task: one regarding the picture of a sun, and one regarding the picture of a moon. In a second part of this study, children were then told to say a word opposite the picture on the card. This required children to use a single rule. Results showed that the use of a single rule did not significantly improve children’s performance, despite the prediction of CCC theory; rather, it suggested that inhibitory requirements are a primary source of diffi-

* Faculty mentor
difficulty in completing rule-related tasks because inhibiting one rule was as hard as inhibiting two rules.

Children were able to respond successfully when the day/night task was modified so that children were asked to assign labels to the moon and sun cards that were not related to the pictures, such as “pig” and “dog.” The researchers concluded that the label given to the stimulus was more important than the individual card itself. Children’s inability to inhibit their initial response to the cards (for example, responding “day” when presented with a picture of a sun) demonstrated that their difficulty resulted from tasks that asked children to pair a stimulus with a contrary label. Tasks that used labels that were not independent of the pictures on the cards allowed the children to inhibit their typical response more easily and thus perform better on the task.

In light of these data, Kirkham and Diamond (2003) developed the Attentional Inertia (AI) theory, proposing that younger children perseverate on the first rule and then cannot attend to a second rule. Children fail the DCCS task because they have trouble (re)focusing their attention to the newly relevant dimension (Kirkham & Diamond, 2003). Three-year-olds, once accustomed to thinking about a stimulus by one dimension, are unable to refocus their attention on another dimension. Munakata et al. (2003) point out that 3-year-olds are able to answer correctly a verbal query about a second dimension, yet are unable to sort by a new rule. It is not certain whether children encode or remember a change in rules, even if they are able to verbalize the rules. Inhibiting the first dimension and focusing on the second dimension requires a greater neural network capacity than that required by the application of a rule with a single dimension (Kirkham & Diamond, 2003; Munakata et al., 2003).

Manipulation of tasks requiring children to inhibit previous knowledge, rules, and perspectives can reduce the need for inhibitory demand. Thus, tasks not requiring children to inhibit natural responses (such as labeling pictures of the sun as “day”) are easier for young children. Success on the DCCS task occurs around age four, which is developmentally around the same age as success on appearance-reality tasks, false belief tasks, tests of spatial perspective, tests of ambiguous figures, conflict tasks, and liquid conservation tasks (Diamond, Carlson, & Beck, 2005).

Zelazo et al. (2003) performed a similar study in which novel stimuli were used in the post-switch task, labeling this variation in the DCCS task the Total Change version. Three- and 4-year-old children were required to sort five cards with red and blue rabbits and boats in the first task, and five cards with yellow and green flowers and cars in the post-switch task. The group performing the Total Change version made more correct responses than the group performing the standard version. Results from both studies show that the new stimuli helped 3-year-old children perform better on the second task. Zelazo et al. (2003) suggest that because children performed well when there were changes in the stimulus dimensions such that different colors and shapes were used in the pre- and post-switch tasks, the majority of 3- to 4-year-olds do not perseverate on a dimension, supporting the theory of CCC. However, according to Rennie, Bull, and Diamond (2004), the complexity of rules remained the same as that of the standard condition for both tasks, because the previously relevant dimensions were no longer present to divert children’s attention from the relevant values of the post-switch task. Rennie et al. (2004) concluded that Zelazo et al.’s (2003) findings are consistent with AI theory rather than CCC theory.

Diamond et al. (2002) also present results that question CCC theory as an explanation for 3-year-olds’ failure to correctly execute the DCCS task. Previous studies demonstrated that manipulations reducing the need for inhibition help children complete the tasks correctly. They write specifically that studies such as Perner and Lang (2002) demonstrated that children can hold in mind multiple rules for the same set of cards if they inhibit the dimensions of sorting. In addition, the absence of target cards (cards used to label the sorting piles) improves performance, and children are able to apply higher-order rules and successfully complete the task because they do not need to inhibit their tendency to match the sorting cards to the target cards (Perner & Lang, 2002).

Kloo and Perner (2005) proposed that target cards provoke 3-year-old children to use a general rule, for example: “Put each card with the target that has the same thing on it.” The results of their study indicate that cognitive flexibility in the ability to think about one object in different ways is crucial for correctly completing the DCCS task. Kloo and Perner (2005) also point out that if novel stimulus cards are used for the post-switch task, children are able to successfully complete the post-switch task, even though they are still required to use higher-order rules. If the experimenter labels the relevant dimension while handing the child the card to sort, the child will demonstrate marked improvement, yet this change in procedure does not change the need for the child’s understanding of the necessary rule structures (Kirkham et al., 2003). Finally, they point out that when dimensions are separated (not pertaining to the same object), such as boats and cats rather than moons and stars, children are able to correctly sort in the post-switch task even though CCC theory proposes that the separate dimensions would not change performance (Kloo & Perner, 2005; Zelazo et al., 2003).
CCC theory and AI theory differ in their explanation of the mechanisms that invoke perseveration in 3-year-olds, but they converge in the assumption that the primary reason for perseveration is that 3-year-olds do not shift attention away from previously relevant stimuli. In support of this contention, Zelazo, Muller, Frye, and Marcovitch (2003) found that children perseverate on a partial change version of the DCCS task. This occurred when the values of the dimensions that were important in the pre-switch phase were retained during the post-switch phase. Red and blue rabbits and boats were sorted by shape in the pre-switch phase, and yellow and green rabbits and boats were sorted by color in the post-switch phase (Muller, Dick, Gela, Overton, & Zelazo, 2006). See Figure 1 for a diagram of the CCC and AI theories.

The goals of the present study were to expand the previous literature concerning the DCCS task and to examine which theory (CCC or AI) best explains the difference in the cognitive function between 3- and 4-year-olds, using a modified DCCS task and the standard DCCS task. We modified the DCCS so that children were asked to sort by the dimensions of color and shape with sets of cards that depicted different shapes in different colors, providing novel stimuli. Although this is a similar procedure to Zelazo et al.'s (2003) Total Change manipulation, we used cards with simple shapes while Zelazo et al. (2003) used cards with complex pictures. In addition, our scoring was more rigid in that we required all 4 responses to be correctly classified for the task to be considered successful; Zelazo et al. (2003) defined a correct trial as being at least 4 correct responses out of 5.

**FIGURE 1**

Summary of CCC and AI theories regarding performance failure on the DCCS task.

![Diagram of CCC and AI theories](image)

**Cognitive Complexity and Control Theory:** 3-year-olds' failure of a second task is due to their inability to use higher-order rules to correctly determine which rules are relevant to the task.

**Attentional Inertia Theory:** 3-year-olds' failure of a second task is due to their inability to refocus their attention on the second task.

The present study requires children to attend to different dimensions in the pre- and post-switch tasks and a new set of cards with different colors and different shapes is provided for the post-switch task. If 3-year-olds are able to refocus their attention on the second task and complete the post-switch card sorting task correctly in the modified version of the task, the results will support the AI theory. If the new set of cards does not aid children in distinguishing between the old rule and the new rule, however, and 3-year-olds fail as they would in the standard DCCS second task (Kirkham & Diamond, 2003), the results will support the CCC theory. We expect that the novel stimuli in the modified version of the task will allow both 3-year-olds and 4-year-olds to successfully complete the second task.

**Method**

**Participants**

Participants were 96 3- and 4-year-old children recruited from three different preschools in Pennsylvania. Fifty-five children were 4 years old and 41 children were 3 years old. Forty-seven of the children were girls, and 49 were boys. There were 34 children in the standard group, (presented with the original DCCS procedure), and 62 children in the modified group (presented with the modified procedure). Preschool teachers distributed letters explaining the study and an informed consent form to the parents of all 3- and 4-year-olds. Children whose parents returned their consent forms were included in the study. We did not include three children's data in our results because they incorrectly answered pre-screening questions. We randomly selected children from one of the three preschools for the standard condition.

**Materials**

The materials consisted of 8 white cards, each with one of the following stimuli on it: (a) green triangle, (b) green square, (c) red triangle, (d) red square, (e) orange star, (f) orange circle, (g) blue star, or (h) blue circle. We used extra red triangle and green square cards as example cards in the shape game to indicate the box in which the cards should be placed, and extra blue star and orange circle cards as the examples in the color game.

**Procedure**

In both the standard and modified conditions, children were tested individually in a quiet room apart from their peers. Participants were brought into the room by the classroom teacher and seated on the floor next to the experimenters. Each test took approximately 5 min. Each child sat in front of two small boxes with an example card attached to each, so that they faced the
Two experimenters were present: one to record the correct or incorrect sorting responses and one to explain the rules of each game and to hand the children the cards. After the child was comfortably situated, the experimenter introduced the card task by saying

What we will be doing today is sorting these cards into two piles. The first game we will play is the shape (color) game. In the shape (color) game we will sort the cards by their shape (color). All of the squares (blue) go in this pile (point to the square/blue card). All of the triangles (orange) will go in this pile (point to the triangle/orange card). Now, can you show me where the squares (blue) go... and where the triangles (orange) go?

We used the final questions of the introduction as a pretest to ensure that the child understood the rules. After children completed this pretest the experimenter handed them four cards, randomly-ordered, one at a time, and asked the children to place each one into the correct pile. We used the orange and blue cards as a set when we asked children to sort by color and the red and green cards as a set when we asked children to sort by shape. The experimenter did not give the children any feedback regarding their performance. In our modified version of the DCCS task, the set of four cards was switched after the first task and replaced with a novel set of four cards with different shapes and colors, and the children were asked to sort the cards using a new dimension. The example cards were also switched to correspond to the second set of cards. In the standard version of the DCCS task, the same four-card set and labels were used in both the pre- and post-switch tasks. Each child’s performance on the second task was calculated by adding the number of cards sorted correctly. The highest possible score on each task was a 4, signifying that the child had correctly categorized all four cards.

Results

A 2 (Age) x 2 (Group) analysis of variance showed a main effect of age for number of cards correctly sorted, F(1, 93) = 5.24, p = .02, such that 4-year-olds, M = 3.24, SD = .96, gave more correct responses than 3-year-olds, M = 2.83, SD = .95. The age x group interaction was marginally significant, F(1,93) = 2.85, p = .05. Figure 2 shows the mean number of correct responses on the post-switch task organized by age and group. Three-year-olds in the standard group performed markedly lower than the 4-year-olds in the standard group, and there was little difference between the performance of 3-year-olds and 4-year-olds in the modified group.

Because we were differentiating between two similar theories, we used a Tukey HSD (p = .05) test, a widely-used post hoc test (Aron, Aron, & Coups, 2006), to examine the means for the post-switch task as the Age x Group interaction (see Figure 2) were nearly significant. Post hoc comparisons using the Tukey HSD test indicated that the mean score for the control condition of the 3-year-olds (M = 2.56, SD = 0.89) was significantly different than that of the 4-year-olds in the control condition (M = 3.44, SD = 0.92). However, the 3-year-olds in the modified condition (M = 3.00, SD = 0.96) did not significantly differ from the 4-year-olds in the modified condition (M = 3.14, SD = 0.98). Thus, it appears that the significant main effect for age was primarily attributable to the difference between the 3- and 4-year-olds in the standard condition.

Discussion

Although the interaction between age and group was only marginally significant, the Tukey HSD test indicated a significant difference on the post-switch task between the 3- and 4-year-old age groups in the standard group, but no significant difference in the performance of the 3- and 4-year-old age groups in the modified group. These findings signify that the differences on the modified task, the novel stimuli, allowed the 3-year-olds to perform comparably to the 4-year-olds.

According to the theory of Attentional Inertia, children perseverate on a particular dimension of information and are unable to effectively switch to new rules. After using a set of rules focused on a single dimension of the cards, 3-year-olds are generally unable to inhibit...
the rules regarding the original dimension in order to sort by a new dimension. Our results are consistent with AI theory. CCC theory predicts that changing the cards would not affect 3-year-olds' performance, because the task still requires the use of multiple rules. CCC theory holds that 3-year-olds are unable to complete tasks using multiple rules. In the modified condition, the 3-year-olds were able to sort comparably to the 4-year-olds, according to the new rule pertaining to a new dimension. Thus, changing the colors and shapes of the cards reduced the 3-year-olds' tendency to perseverate. Our results were similar to those of others (Rennie et al., 2004; Zelazo et al., 2003), because the children in the modified condition made more correct responses than the children in the standard condition.

Zelazo et al. (2003) also found that 3- and 4-year-olds performed better in the modified DCCS procedure. They discussed the issue of children's perseveration of attention to previous rules in the DCCS and subsequent success on the Total Change task (similar to our modified procedure) as being consistent with AI theory. They concluded, however, that CCC theory best explains the phenomenon as it more specifically addresses which children are likely to fail the DCCS task. The authors of this study point out that participants in our modified condition had no need to create a higher order rule or system (as indicated by CCC theory); the second aspect of the modified DCCS task was introduced as "a new game" with no suggestion that the rules of the first aspect would be used again. Without a necessity for higher order rules, the children's perseveration on the first set of rules is still the most immediate reason for failure of the second aspect of the DCCS task.

Many studies (Kirkham et al., 2003; Kloo & Perner, 2005; Perner & Lang, 2002), including the current one, demonstrate that CCC theory does not adequately explain the greater phenomenon of children's perseveration. Whereas the primary focus of the study was the explanation of children's perseveration on the DCCS task, taking these related tasks that manipulate the need for children's attention and use of rules into account (e.g., appearance-reality tasks, false belief tasks, tests of spatial perspective, ambiguous figures, conflict tasks, the day/night task), helps to better differentiate between CCC theory and AI theory.

The present study effectively contributed to the current literature pertaining to young children's performance on the DCCS task. The results of the modified task were consistent with previous research and support the theory of Attentional Inertia, because it improved 3-year-old's ability to correctly perform the post-switch task. It is unclear why 4-year-old participants did not score higher on the card sort tasks as suggested by the literature, or why they failed to improve on the post-switch in the experimental condition. Future researchers should have the children sort more cards for each task in order to avoid a ceiling effect and expand the range of the measure, because a restriction of the range increases the likelihood of Type II error. The additional information from future studies should continue to build on these findings and previous literature in order to better understand processes involved in children's ability to complete the DCCS task. Information gained from this study is meaningful in the general discussion of cognitive development, because updated theories guide effective interventions and instructional methods. Based on this study, interventions consistent with AI theory that help children refocus their attention with new material, either through self-monitoring or adult-direction, deserve further consideration.

References


Stereotype threat is defined as being at risk of confirming a negative stereotype about the group(s) to which one belongs (Steele & Aronson, 1995). In the original study on stereotype threat, Steele and Aronson (1995) found that when African American participants were told that a difficult verbal test was a measure of their intellectual ability, they performed worse than White participants. However, when the test was presented as less reflective of their intellectual ability, African American participants’ performance matched that of White participants. They also found that the stereotype alone, without the diagnostic presentation of the test, impaired performance among African Americans who were asked to report their race on a demographic form before taking the test. Steele and Aronson (1995) suggested that these findings are a result of stereotype-threatened participants “alternating their attention between trying to answer the items and trying to assess the self-significance of their frustration” (p. 809), thereby reducing both speed and accuracy on standardized tests. Since the original study, there have been over 300 studies conducted on stereotype threat. Stereotype threat has been used to help explain the achievement gap between African American and White students. Furthermore, research has shown that stereotype threat influences other domains besides academics.

Roberson, Deitch, Brief, and Block (2003) found that stereotype threat influences feedback seeking and feedback acceptance among African Americans in the workplace. They asked African American professionals to fill out a survey that inquired about solo status (being the only minority member of their work group), stereotype threat, feedback-seeking strategies (directly asking and seeking information about their performance), and feedback discounting (attributing their manager’s evaluation of their performance to the manager’s racial prejudices). Results revealed that there were positive relationships between solo status and perceptions of stereotype threat, stereotype threat and a greater degree of feedback discounting, and stereotype threat and a monitoring strategy for seeking feedback. The authors suggested that there was a positive relationship between solo status and perceptions of stereotype threat because being the only member of a racial group in a company increases the salience of identity group membership, making that minority member more vulnerable to stereotype threat. This finding also helps explain the significant relationship between stereotype threat and the increased use of a monitoring strategy for feedback and feedback discounting because it increases the salience of race and racial stereotypes among interactions of the solo status individuals and their managers.

Bosson, Haymovitz, and Pinel (2004) found that stereotype-threatened gay men demonstrated more nonverbal anxiety than nonthreatened gay men during their interactions with preschool children. Stereotype threat also influences social interactions between minorities and nonminorities (Goff, Steele, & Davies, 2008), and even the performance of nonminorities on the Racial Implicit Association Test (Frantz, Cuddy, Burnett, Ray, & Hart, 2004). In addition, studies have shown that a history of stigmatization is not necessary for individuals to experience stereotype threat (Aronson et al., 1999; Leyens, Désert, Croizet, & Darcis, 1999).
performance was significantly impaired only among women with low scores on the stigma consciousness scale (Pinel, 1999; as cited by Brown & Pinel, 2003) in the stereotype threat condition showed a performance decrement on the math test, whereas the math test performance among women with low scores on the stigma consciousness scale in the same condition was unaffected. Aronson et al. (1999) suggested that people who considered a particular domain important were the ones who were most likely to be affected by stereotype threat. These studies suggest that group identification, stigma consciousness, and the importance of the task, moderate the relationship between stereotype threat and performance outcomes.

Although he did not study stereotype threat in particular, Rotter (1966) examined the influence on performance of another variable, locus of control. Locus of control is defined by the extent to which individuals attribute their performance to internal or external forces (Rotter, 1966). Individuals with an internal locus of control believe that outcomes are contingent upon their own behavior or personal characteristics (Rotter, 1966). Internal locus of control is usually associated with greater academic and vocational achievement, greater persistence, greater ability to delay gratification, less emotional maladjustment, higher self-esteem, and more satisfying interpersonal relationships (Lefcourt, 1992). Individuals with an external locus of control believe that outcomes are a function of chance, luck, fate, or under the control of powerful others (Rotter, 1966). External locus of control is usually associated with lower academic and vocational achievement, less persistence, less ability to delay gratification, more emotional maladjustment, lower self-esteem, and less satisfying interpersonal relationships (Lefcourt, 1992).

Cadinu, Maass, Lombardo, and Frigerio (2006) argued that individuals with an internal locus of control are generally more competent and more motivated to perform well on tasks and are therefore more vulnerable to stereotype threat. The authors also postulated that individuals with an internal locus of control take full responsibility for their own success and failure, making them even more vulnerable to stereotype threat. Cadinu et al. found that, in fact, individuals with an internal locus of control did show a sharper decrease in their performance in the stereotype threat condition compared to individuals with an external locus of control.

Although Cadinu et al. (2006) provided support for the increased stereotype threat effect for individuals with an internal locus of control, research also suggests that individuals with an external locus of control are more vulnerable to social influences, images, and messages (Avtgis, 1998; Fouts & Vaughan, 2002; Nowicki & Strickland, 1973). These findings suggest that individuals with an external locus of control are more likely to be influenced by social factors (e.g., stereotypes) and thus are more susceptible to experiencing stereotype threat. This line of research suggests that individuals with an internal locus of control would have a greater ability to overcome the negative effects of stereotype threat, whereas individuals with an external locus of control would be less able to do so. In fact, this idea was reflected in the original study on stereotype threat:

If the student perceives that a significant portion of the test is within his or her competence, it may preempt or override stereotype threat by proving the stereotype inapplicable. When the student cannot gain this perception, however, the group stereotype becomes relevant as an explanation and may undermine performance. (Steele & Aronson, 1995, p. 810)

This argument suggests that individuals with an external locus of control are more vulnerable to stereotype threat than those with an internal locus of control because they are more heavily influenced by social messages and therefore lack the ability to prove the stereotype wrong, which leads to impaired performance. The present study was designed to examine whether individuals with an external locus of control would perform worse than those with an internal locus of control in the stereotype threat condition. In addition, based on previous research (Lefcourt, 1992), I hypothesized that participants with an internal locus of control would perform better than those with an external locus of control, overall. I also hypothesized that participants of both races in the control condition would perform better than those in the stereotype threat condition.

Method

Participants
Sixty undergraduate students (20 men and 40 women) were recruited for participation in this study. The participants consisted of 28 African American students...
and 32 White students. There were 24 freshmen, 19 sophomores, 9 juniors, and 8 seniors. The majority of the participants were recruited from introductory courses on a small liberal arts college campus in the Midwest. Others were recruited from campus-wide flyers. The treatment of participants was in accordance with the ethical standards of the APA.

**Materials**

In this study, the materials consisted of a consent form, demographic questionnaire, Pettijohn’s (1990) version of Rotter’s locus of control survey (http://198.45.22.27/ connectext/ psy/ ch11/ survey11.mhtml) and an online version of Simon Says (http://www.gizdic.com/ freegames/gamespages/simonsays.htm). The demographic questionnaire asked for the academic classification, race, and gender of the participant. Although Rotter’s locus of control survey was online, students filled out the paper version and then the experimenter entered the information on the website. The survey consisted of 21 questions that were each scored on a 100 point scale, in which 0 represented the strongest external locus of control and 100 represented the strongest internal locus of control. There were five categories of locus of control: very strong external locus of control (0–15 points), strong external locus of control (16–35 points), internal and external locus of control (40–60 points), internal locus of control (65–80 points) or very strong internal locus of control (85–100 points). Participants used their personal laptop computers to play the online Simon Says game. This game requires participants to observe and then repeat increasingly lengthy strings of color response sequences. Participants were provided with a data sheet that had instructions on how to play the game and space to record their scores. Game performance was measured by the median of scores received on three rounds of the Simon Says computer game.

**Design**

The independent variables were type of instructions and the subjects’ locus of control. The two levels of the type of instructions were stereotype threat condition versus no stereotype threat (control) condition. The stereotype threat condition participants were given standard instructions and exposed to stereotype threat based on their race. African American participants were told that Simon Says was a measure of their intellect and Whites were told that Simon Says was a measure of their coordination and rhythm ability. Research in this area suggests that common stereotypes about African American individuals (Jencks & Phillips, 1998) and White individuals (Shipler, 1997) are that they lack intelligence and rhythmic ability, respectively.

**Procedure**

Individuals were tested in one of four group sessions, each of which consisted of 15 participants. Participants entered the classroom and were asked to set their laptop up and complete the consent form. While participants were setting up, the experimenter randomly chose the word “control” or “stereotype threat” out of a bucket. This determined the type of instructions that the participant would receive. Participants were given a demographic questionnaire, Rotter’s Locus of Control survey, and a data sheet. After participants filled out the demographic questionnaire and Rotter’s Locus of Control survey, instructions at the bottom of the survey advised participants to raise their hand for further instructions from the experimenter. The experimenter then told participants to go to the Simon Says webpage on their laptop and play the game for 3 min as a warm up and to record their scores. Once this was completed, participants were instructed by the experimenter to turn the page to the data sheet and read the instructions out loud. The experimenter asked each participant to verbally summarize the results and to mention what the task was assessing (if the participant was in the stereotype threat group). This was done to emphasize the statement designed to induce stereotype threat (stereotypes suggesting that African American individuals lack high levels of intelligence (Jencks & Phillips, 1998) and White individuals lack rhythmic ability (Shipler, 1997)). Once participants read through and summarized the instructions (and the embedded stereotype threat, if they were in the experimental group), participants began to play Simon Says and recorded their scores for three rounds. After participants recorded their scores and any comments or questions they had about the study, the experimenter collected their surveys, questionnaires, and data sheets. Finally, participants were given an opportunity to ask questions about the study and were informed that their name was entered in a drawing for one of seven $10 Walmart gift cards.

**Results**

There were five categories of locus of control, very strong external locus of control (0–15 points), external locus of control (20–35 points), internal and external locus of control (40–60 points), internal locus of control (65–80 points) or very strong internal locus of control (85–100 points) that were collapsed into two categories, more external (0–50) or more internal (51–100), due to the small number of participants in each category. Of the 60 participants, 58 were categorized as more external, and two as more internal. A 2 x 2 x 2 analysis of variance (ANOVA) was conducted to determine the overall effects of race, condition, and locus of control. A 2 x 2
likely to be found. More participants would allow full research should take place in other settings where more people are more likely to be at a university than those work seriously (Lefcourt, 1992), it is possible that these individuals with an external locus of control are highly motivated and take their academic performance seriously, which did not allow for a fair comparison of results between them and people who had an external locus of control. Given that research suggests that individuals with an internal locus of control are highly motivated and take their academic work seriously (Lefcourt, 1992), it is possible that these people are more likely to be at a university than those with an external locus of control. Therefore, future research should take place in other settings where more balanced numbers of individuals from both groups are likely to be found. More participants would allow full use of the entire five-category locus of control scale with adequate numbers of participants in each category.

Although research on locus of control was not supported in this study, findings did confirm that stereotype threat impairs performance. However, research suggests that individuals must know the stereotype of their group, identify themselves as a member of that group, and be concerned about what others will think of their performance on a specific task (Steele & Aronson, 1995). Although participants recorded group membership on the demographic form (e.g., African American or White), there were no data collected on whether or not the participants were familiar with the stereotype about their group or if they considered the task to be important. Furthermore, there were no data collected on how strongly participants identified with their racial group. Therefore, future research should include an objective measure of these three criteria set forth by Steele and Aronson (1995).

Results did support a major finding in the literature (Aronson et al., 1999; Leyens et al., 2000) that a history of stigmatization is not necessary for individuals to experience stereotype threat. African American and White participants were both negatively influenced by stereotype threat. A great deal of research supports the existence of stereotype threat and its existence among all groups. Therefore, it is important to focus on ways to reduce stereotype threat to improve everyone’s performance.

Steele and Aronson (1995) suggested that reframing academic tasks, such as standardized tests, would help reduce stereotype threat. In their original study, they found that changing the assumed diagnosticity of the test contributed to better performance among African Americans. However, it is unrealistic to remove the diagnosticity from tests in educational settings, therefore Quinn and Spencer (2001) suggested that language should be added to the introduction of the test that assures people that the test is fair (i.e., assuring women that a test is gender fair). In addition, research suggests that not emphasizing threatened social identities helped to reduce stereotype threat.

Ambady, Paik, Steele, Owen-Smith, and Mitchell (2004) found that when women were encouraged to think of their positive attributes before taking a math test, they were less likely to experience stereotype threat. Stricker and Ward (2006) found that asking participants to report their demographic information at the end of the testing session reduced the effects of stereotype threat. These studies suggest decreasing the salience of threatened identities reduces the likelihood of experiencing stereotype threat. Research also suggests that encouraging students to affirm themselves helps to reduce stereotype threat. For example, Frantz et al. (2004) found that when White participants were able to affirm their commitment to being nonracist before taking the Racial Implicit Association Test, their performance on the test was less likely to be defined as racially biased. It is important to not only communicate high standards to students, but also to encourage them and let them know they are capable of meeting the standards (Cohen, Steele, & Ross, 1999).

Future research should explore other ways in which the negative effects of stereotype threat can be reduced. Furthermore, research should focus on potential mediators and moderators of stereotype threat and performance. Although some mediators
and moderators, such as fearing the confirmation of a negative belief about your group (Aronson et al., 1999), cognitive load (Cheryan & Bodenhausen, 2000), hypervigilance (Keller & Dauenheimer, 2003), availability of role models (Marx & Roman, 2002; Marx & Goff, 2005), and locus of control (Cadinu et al., 2006), have been identified, further research is needed to investigate these variables and identify other potential variables that may contribute to the relationship between stereotype threat and performance. Once mediator and moderator variables are identified, interventions for reducing the negative effects of stereotype threat can be developed. Although locus of control as a potential moderator variable was not supported in this study, the notion that performance is negatively influenced by stereotype threat and that these effects take place irrespective of race was supported. Therefore, further research should continue attempting to clearly define stereotype threat and its causes, identifying individuals who are vulnerable to it, and finding ways to reduce its negative effects.

References

The ability to produce, perceive, and interpret nonverbally expressed emotions is an enduring and universal human ability. Many theorists have described the evolution of human emotion as a means for social cohesion and, consequently, for the species’ survival (Turner, 1996). The ability to relay essential information nonverbally (through the detection of emotions) may have served as an essential tool for survival and social interaction (Corballis, 1999). As the various complexities of the human faculty evolved, several adaptations (especially the ability to link arbitrary gestures with mental concepts) may have occurred before the physical ability to produce language (Christiansen & Kirby, 2003). This possibility lends to the notion that nonverbal communication may have been the primary method for humans to exchange information before language evolved. Because certain cerebral mechanisms (especially lateral differentiation between the hemispheres) are known to lie behind human communicative processes and the perception of emotion (Gazzaniga, 1985), insight into these biological factors may facilitate a more complete understanding of the evolutionary development and contemporary relevance of nonverbal communication.

Dynamic Versus Static
Darwin (1872) made a pioneering endeavor in the study of emotional expression. He observed physical characteristics (postures and movement patterns) and correlated them with specific emotions. For example, he described the emotion sadness in a physical representation as “motionless, passive, head hangs on contracted chest” (p. 176). The concept of correlating physical qualities with an emotion relates to the idea that the physical representation of emotions is important in communication.

Although much early research in this field focused on identifying emotions in static images (Ekman & Friesen, 1967; James, 1932; Walters & Walk, 1986), many researchers have found that the use of dynamic displays in representing emotion is more realistic and reliable than static body postures (Atkinson, Dittrich, Gemmel, & Young, 2004; De Meijer, 1989; Wallbott, 1998). Indeed, static images cannot portray the three-dimensional quality of authentic communication that, based on the perceiver’s visual perspective, may affect their observation and interpreted meaning (Coulson, 2004).

De Meijer (1989) suggested that full body movements facilitate the communication of emotional states, observing that the trunk is especially effective for these purposes. The trunk particularly reveals the communicator’s “overall readiness to interact and deal with his or her surroundings” (p. 265). The combinations of movements from the whole body, however, collectively reveal a specific emotional state. Additionally, humans

Hemispheric Differences in Identifying Emotionally Expressive Body Movements
This study combined 2 fields of research: the expression of emotions through body movements and hemispheric differences in the perception of emotion. Sixty participants were divided into 6 groups according to visual field exposure (Left, Right, Center) and type of stimuli (Still Image or Video). Each group saw emotion stimuli depicting happiness, sadness, fear, disgust, and anger. Video groups were significantly more accurate in identifying the correct emotion than the Still Images groups. In comparison to the Right Visual Field groups, there was a trend for higher accuracy ratings by the Left Visual Field groups. Male participants were more accurate than the female participants. The results provide support for a right hemispheric superiority in identifying nonverbally expressed emotions.

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are proficient at deriving emotional meanings from the distinctive physical features of various emotional expressions (Wallbott, 1998).

Atkinson et al. (2004) found that because faces and bodies are in motion during social interaction, dynamic portrayals of emotions are more ecologically valid. Previous research also suggests that humans are adept at detecting movement, even when movement patterns are represented solely by a series of light points where the head and major joints of the body should be (Atkinson et al., 2004; Atkinson, Tunstall, & Dittrich, 2007; Grossman et al., 2000; Johannson, 1973). Due to participants' acuity in identifying emotions in dynamic displays, and because humans are especially proficient at detecting movement, Atkinson et al. (2004) developed a set of grey-scale movie clips of actors expressing emotions (happiness, sadness, anger, disgust, fear) using whole-body movements in order to assess participants' ability to identify these emotions. Indeed, participants were readily able to identify the emotions depicted by the full-body movements. The neural mechanisms underlying this ability, however, remain to be studied.

**Lateral Differentiation**

Generally speaking, the left cerebral hemisphere predominates in speech, language abilities, and mathematical skills, whereas the right cerebral hemisphere is superior in visuo-motor tasks. Research also suggests right hemispheric dominance in processing emotional stimuli (Andersen, Garrison, & Andersen, 1979; Gazzaniga, 1985; Ley & Bryden, 1979; Spence, Shapiro, & Zaidel, 1996).

Much of what is known about the lateralization of brain functions comes from the extensive research of Sperry (1968) and Gazzaniga (1985) and their colleagues. Most of the influential work carried out by these researchers has been with split-brain participants. In this unique population, the corpus callosum of the brain was severed, preventing the right and left hemispheres from communicating with each other. Split-brain persons cannot verbally express what their right hemisphere has seen, but may display a nonverbal emotional response such as blushing or smirking based on what their left hemisphere has seen. This finding shows that the right hemisphere interprets emotional meaning from visual stimuli. Studies with these patients have served to illustrate the separate roles of the right versus left cerebral hemispheres, especially the left hemisphere’s proficiency in verbal communication and the right hemisphere’s specialization for emotional functions.

Studies involving participants with hemispheric impairment provide further information on lateralization of brain functions. Damage to the right hemisphere is associated with deficits in depth perception (including perception of three-dimensionality) and spatial ability, such as solving mazes or correctly writing letters; verbal ability is not affected in these cases. When the left hemisphere is damaged, however, patients show little difficulty in spatial tasks. The right hemisphere’s aptitude for spatial awareness may have a role in communication processes, given the fundamentally dynamic nature of human interaction (as discussed previously).

It is possible to also observe the lateralization of brain functions in persons whose cerebral hemispheres are intact. The tachistoscopic technique, a common method in observing lateral specialization, individually presents stimuli to the separate visual fields. In Ley and Bryden’s (1979) study, participants looked at a fixation point through a tachistoscope while static images depicting different emotions appeared on either the right or left visual field (and thus presented to the left and right cerebral hemispheres, respectively). Participants who viewed emotion stimuli in the left visual field (right hemisphere) were superior in identifying the correct emotions. The question remains, however, whether the identification of emotions from dynamic versus static displays is a lateralized function in the brain.

**Emotion-Perception as an Evolutionary Tool**

Atkinson et al. (2004) suggested that the ability to interpret and perceive emotions in others is a “considerable adaptive advantage” in social animals (p. 718). In fact, many researchers have revisited Darwin’s analysis of emotion expression and have applied it to a social context. Hansen and Hansen (1988) found that participants readily selected angry faces in a crowd of happy faces more accurately than happy faces in a crowd of angry faces. Additionally, Aronoff, Wokie, and Hyman (1992) investigated the particular movement patterns of professional dancers that portrayed meanings of “threat” or “warmth.” The authors found that there are particular geometric patterns that convey these meanings and suggested the possibility of a neural mechanism that responds to perceiving them. Chouchourelou, Matsuka, Harber, and Shiffrar (2006) found that participants are highly inclined to detect threatening or angry displays due to their emotional content. The authors suggested that this ability serves an adaptive purpose, because “failing to detect an angry person is a potentially costly error” (Chouchourelou et al., 2006, p. 69). The implication of these studies is that evolution has played a role in human perception of the physical manifestation of emotions.

The main purpose of the present study was to examine cerebral lateralization in identifying emotion-
ally expressive body movements. Due to the inherently social nature of humans (Turner, 1996), the ability to communicate emotional states through dynamic physical representations has remained in the human faculty since the ability first evolved. The lateralization of this ability has yet to be established. Consistent with prior research (Atkinson et al., 2004; Atkinson et al., 2007; De Meijer, 1989; Wallbott, 1998), I hypothesized that emotion stimuli showing full body movements would be easier to identify than images. Additionally, I hypothesized that the right cerebral hemisphere would more easily detect nonverbal emotion expression (Andersen et al., 1979; Buck & VanLear, 2002; Ley & Bryden, 1979; Milner, 1971). Also, I expected that fear and anger would be the most easily identifiable emotions because they help to evaluate potentially harmful adversaries or situations (Aronoff et al., 1992; Chouchourelou et al., 2006; Hansen & Hansen, 1988). Each of the concepts discussed pertain to some of the underlying themes of human functioning, particularly with regard to non-verbal communication.

Method

Participants

The participants were 60 undergraduates (21 men and 39 women) enrolled in Introduction to Psychology classes. The students received course credit for their participation. The range of ages was 17 to 21 years old. All participants had normal or corrected-to-normal vision.

Materials and Procedure

The video stimuli were a subset of those used by Atkinson et al. (2004). The subset consisted of 10 videos, including two videos for each emotion (happiness, sadness, anger, disgust, and fear). A different actor was in each video. The actors were dressed in grey suits (to disguise facial features, clothes demarcations, gender, etc.) and were filmed in front of a black background. Each video lasted approximately 3 s. I obtained one still image from each of the 10 videos (see Figure 1). A response form containing procedural instructions, a list of the five emotions, and sufficient writing space was provided to each participant.

The participants were randomly assigned to six groups (10 per group) based on the type of stimuli (Still Image or Video) and the visual field (Left, Right, Center) in which the stimuli appeared. For example, one group (Right-Still) viewed still images in the right visual field. Each group followed the same basic procedure.

Participants completed this experiment while seated in front of a computer (30 cm x 37.5 cm size monitor). Stimuli appeared via a PowerPoint presentation. A changing shape (circle, heart, rectangle, square, star) was used to maintain participants’ focus on the center of the screen. The videos or still images for the Right Visual Field group appeared on the right side of the changing shape, and the videos or still images for the Left Visual Field group appeared on the left side of the changing shape. Both video and image stimuli remained on the screen for approximately 3 s (the duration of the changing shape). The stimuli for the Center Visual Field group (the control group) appeared without a changing shape in the center of the screen.

Participants were instructed to maintain focus on the changing shape. After each successive slide participants wrote the number of times they saw the shape change and the emotion they believed the image or video portrayed. This procedure continued for a total of 10 images/videos exhibiting the five emotions. The participants’ responses to counting the shapes were calculated to ensure that they maintained focus on the center of the screen.

Statistical Analyses

An ANOVA was performed to assess the main effects and interactions of type of presentation (Still Image versus Video), the visual field of stimulus presentation (Left, Right, Center), and gender on correct identification of the emotion stimuli. A Fisher’s Least Significant Difference post hoc analysis was performed to determine differences between the visual field groups. Also, a repeated measures ANOVA was used to determine if accuracy of emotional label varied according to the emotion being presented. The five different emotions were used as the within-subjects variable.

Results

As predicted, there were significant main effects for type of presentation, $F(1, 48) = 21.96$, $p < .001$, and visual field, $F(2, 48) = 5.05$, $p = .01$, on the total number of correct responses to the emotion stimuli presented. There was also a significant main effect for gender, $F(1, 48) = 2.83$, $p < .01$. There were no significant interactions among these factors (see Tables 1 and 2). Participants were better able to identify emotions when viewing a video clip ($M = 8.07$, $SD = 1.28$) rather than a static image ($M = 5.70$, $SD = 1.90$) of emotions. Regardless of presentation type, when the emotion stimuli appeared in the central visual field (to both cerebral hemispheres), the participants showed the highest number of correct responses ($M = 8.00$, $SD = 1.52$). This total number of correct responses was significantly higher than the number of correct responses reported following presentation of the emotion stimuli to either the right, $M = 5.80$, $SD = 1.88$, $p < .001$, or left $M = 6.85$, $SD = 2.01$, $p < .05$, visual fields. Importantly, the post hoc analysis also revealed a trend
(p = .07) of participants performing more accurately when the emotion stimuli were presented to the left visual field (right hemisphere) rather than the right visual field (left hemisphere). The main effect of gender showed that the male participants were more accurate (M = 7.90, SD = 1.72) than the female participants (M = 6.33, SD = 1.93) in assessing the emotions viewed, again regardless of the presentation type (see Table 2).

Contrary to the original hypothesis, the results of the repeated measures within-subject ANOVA, F(4,56) = 20.83, p < .001, showed that happiness (M = 1.73, SD = 0.48), rather than anger (M = 1.47, SD = 0.70) or fear (M = 1.47, SD = 0.59), yielded the highest number of correct responses (see Table 3).

Discussion
The results of the present study are consistent with previous research on identifying emotion through body movements (Atkinson et al., 2004; Atkinson et al., 2007; De Meijer, 1989; Wallbott, 1998). Due to the dynamic nature of authentic interpersonal communication, participants presented with video clips of an actor portraying an emotion were more accurate in identifying emotions than participants who viewed still images. Also consistent with prior research (Andersen et al., 1979; Buck & VanLear, 2002; Ley & Bryden, 1979; Milner, 1971), the present study lends support for superiority of the right hemisphere in processing nonverbal communication (e.g., emotions). Whereas the left hemisphere is highly involved with aspects of language, this finding is consistent with the notion that the right hemisphere is specialized in processing emotions.

The emotion most accurately identified was happiness. This finding is contrary to the original hypo-

![FIGURE 1](image-url)
Emotionally Expressive Body Movements | Vicaría

esis and findings by Hansen and Hansen (1988), who demonstrated that anger was more readily identifiable than happiness. This discrepancy may be due to the format of the video stimuli. Because the only stimuli to include jumping in the air were those depicting happiness, participants may have more easily detected that emotion. This explanation is in line with the notion that humans are especially proficient in their ability to perceive motion (Grossman et al., 2000).

Although male superiority in identifying emotions in full body movements was not initially anticipated, it is consistent with previous research that describes male superiority on spatial tasks (Halpern, 1992; Prinzel & Freeman, 1995; Sanders, Soares, & D’Aquila, 1982). Indeed, human gesturing to communicate can be considered a type of spatial task. Unfortunately, research on the relationships among spatial ability and social interaction and communication is scarce. Certainly, humans do not need to mentally rotate objects when engaging in conversation; however, the ability to perceive and understand spatial processes is an important factor in communication, especially in nonverbal communication because of the movements involved in talking and gesturing. There is a need for additional research to further investigate this relationship.

The most important aspect of the present study is in the fact that it combined two fields of research to form a novel concept. Although research had indicated that humans are adept at identifying emotions in full body movements and that the right cerebral hemisphere showed superiority for nonverbal abilities, the lateralization of emotion perception from dynamic displays had yet to be investigated. The data provide support for the idea that the expression of emotion is not only a phenomenon perceived differently through right and left visual fields (and thus left and right brain hemispheres), but is also best identified through dynamic body movements. These findings are pertinent because real interpersonal interaction is a dynamic process and hemispheric differences play a fundamental role in humans’ communicative functioning.

Nonetheless, because the present experiment observed these differences in a specific population, undergraduate college students, the results may not generalize to a broader population. This caveat, however, does not undermine the importance of the study, but rather shows the need for replication in different populations. It may also be useful to investigate the act of producing emotions in addition to perceiving them in others. Moreover, it may be of interest to explore other abilities of the right hemisphere, such as creativity, in conjunction with different forms of nonverbal emotional expression such as spontaneous gestures or dance.

The importance of communicating nonverbally has become a focus of research since Darwin’s influential publication on human emotional expression. Although a profound explanation of the evolutionary functions of nonverbal communication goes beyond the scope of the present study, the importance of this enduring human proficiency is significant. Further analysis on the neural mechanisms underlying nonverbal communication may bring more insight into understanding this ability. Universally, the human species is highly adept at perceiving emotion, which must have facilitated adaptation and survival through the course of human history.

References

De Meijer, M. (1989). The contribution of general features of body

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**TABLE 3**

<table>
<thead>
<tr>
<th>Total Correct Responses</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Happiness</td>
<td>1.73 (0.48)</td>
</tr>
<tr>
<td>Sadness</td>
<td>1.40 (0.74)</td>
</tr>
<tr>
<td>Anger</td>
<td>1.46 (0.70)</td>
</tr>
<tr>
<td>Fear</td>
<td>1.46 (0.59)</td>
</tr>
<tr>
<td>Disgust</td>
<td>0.81 (0.70)</td>
</tr>
</tbody>
</table>
Many people can think of a friend or previous romantic partner who has purposely induced jealousy in a partner. Because jealousy can have negative outcomes on romantic relationships, it would be fruitful to understand why individuals would desire to deliberately make partners jealous. However, previous research on jealousy has focused on individuals who experience or express jealousy, linking it to both commitment and attachment style. Therefore, little is known about the factors associated with individuals who intentionally induce jealousy in their partners. In this study, we sought to identify some of the personal variables associated with such individuals.

According to White (1981), romantic jealousy is: a complex of thoughts, feelings, and actions which follow threats to ... the existence or quality of the relationship, when those threats are generated by the perception of a real or potential attraction between one's partner and a (perhaps imaginary) rival. (p. 24)

In order for jealousy to occur, individuals must desire to protect their relationships with partners who they perceive as possessing (Fleischmann, Spitzberg, Anderson, & Roesch, 2005). Guerrero (1998) further described jealousy as the two interrelated processes of experience (i.e., cognitive assessments and emotional reactions) and expression (i.e., actions and interpersonal communication). Evolutionary psychology further posits that jealousy exists as a way of ensuring reproductive success (e.g., Buss, 2000). Because men have paternal uncertainty (i.e., they are never guaranteed that a woman's child is truly their offspring), there is a risk that they might invest valuable resources in raising another man's child. As such, they experience jealousy when their partner engages in sexual infidelity. However, women are certain of their maternal status. What is more important, then, is that they obtain and maintain the valued resources of the man so that their child has the greatest chance of surviving. If their partner were to fall in love with another woman, they would risk losing the partner's resources. As such, women experience jealousy when their partner becomes emotionally involved with another woman (Buss, Larsen, Westen, & Semmelroth, 1992).

Previous research linked the experience and expression of jealousy to a variety of relational qualities. For example, jealous individuals tend to be more committed to their relationships (e.g., Rydell, McConnell, & Bringle, 2004), perceive themselves as possessing poor alternatives to the current relationship (Hansen, 1985), and are less satisfied with their relationships (e.g., Guerrero & Eloy, 1992). Additionally, research suggests that jealousy correlates with individual characteristics, specifically adult attachment styles (Guerrero, 1998).

**Adult Attachment Styles**
Individuals form emotional attachment bonds with others that influence relational behaviors throughout the course of their life. Attachment consists of two main...
dimensions: attachment anxiety and attachment avoidance (Brennan, Clark, & Shaver, 1998). Attachment anxiety is influenced by viewing the self as worthy of love and support or not, and researchers have conceptualized it in terms of dependency or anxiety over abandonment. Individuals high in attachment anxiety require the external validation of others to maintain positive self-regard. Attachment avoidance is influenced by individuals’ view of others as trustworthy and available or unreliable and rejecting, and researchers have conceptualized it in terms of comfort or discomfort with intimacy. Individuals high in attachment avoidance avoid contact with others due to the expectation that others are untrustworthy and rejecting.

Attachment anxiety and attachment avoidance can combine to result in a four-style model of attachment similar to that proposed by Bartholomew (1990) and Bartholomew and Horowitz (1991). Securely attached individuals (low in both anxiety and avoidance) possess a sense of worthiness and an expectation that others are accepting and responsive. Therefore, securely attached individuals are comfortable with intimacy, autonomy, and interdependence. Preoccupied individuals (high anxiety and low avoidance) have a sense of unworthiness yet strive for the acceptance of others. Therefore, preoccupied individuals are obsessed with relationships, are vigilant toward any threat to the relationship, experience higher levels of interpersonal distress, and reach out to others to fulfill dependency needs. Dismissing individuals (low anxiety and high avoidance) have a sense of worthiness but view others as untrustworthy; dismissing individuals are counter-dependent and uninterested in intimacy. Therefore, dismissing individuals report excessive coldness and, instead of a desire to develop attachments, they view themselves as self-sufficient. Fearful individuals (high in both anxiety and avoidance) have a sense of unworthiness and view others as untrustworthy and rejecting; fearful individuals are afraid of intimacy and socially avoidant of others. Therefore, fearful individuals experience higher levels of interpersonal distress and fear rejection.

Jealousy and Attachment Styles
Because jealousy arises from a distressing and threatening situation, it is likely to activate the attachment system in order to manage the feelings and behaviors that stem from relational threat and potential separation (Simpson & Rholes, 1994). Research (e.g., Guerrero, 1998) suggests an association between jealousy and attachment anxiety and attachment avoidance. Individuals high in attachment anxiety experience more jealousy worry and suspicion than individuals low in attachment anxiety. Individuals high in attachment avoidance experience less fear, use fewer relationship-maintaining behaviors, and are more likely to avoid expressing jealousy to their partner. Preoccupied individuals experience the greatest negative affect and engage in more surveillance behaviors of their partner, whereas dismissive individuals feel less fear and sadness than individuals low in attachment avoidance (Guerrero, 1998). Overall, these results indicate that high attachment anxiety, particularly when coupled with low attachment avoidance (i.e., preoccupied attachment style), is most strongly related to jealousy. Due to their dependency and strong need to maintain relationships, preoccupied individuals are more likely to engage in restorative behaviors.

Jealousy Induction
Although considerable research has focused on the characteristics of individuals experiencing jealousy, some individuals purposely evoke feelings of jealousy in their partners. Although relatively little research has examined jealousy induction, there is evidence that both women and men report purposely inducing jealousy, although women induce jealousy at higher rates than men (White, 1980). More recent research suggests that this behavior is more common than previously thought – more than 84% of participants in one study reported using a jealousy-inducing behavior on one or more occasion (Brainerd, Hunter, Moore, & Thompson, 1996). Individuals induce jealousy as a means of satisfying two broad goals: (a) to improve the relationship, boost self-esteem, and increase the positive outcomes (e.g., satisfaction) from a relationship and (b) to punish and control a partner and seek revenge (Fleischmann et al., 2005). Furthermore, White (1980) identified five more specific motives for inducing jealousy: increasing relational rewards, bolstering self-esteem, testing the relationship, seeking revenge, and punishing the partner. Although men and women most frequently reported inducing jealousy to test the relationship, seek revenge, and bolster their self-esteem (Fleischmann et al., 2005; White, 1980), additional research has identified other motives for inducing jealousy, including the desire to achieve positive relational outcomes (e.g., mate retention; Sheets, Fredendall, & Claypool, 1997), to enhance the perception of relationship security and quality (Barelds & Barelds-Dijkstra, 2007), to increase one’s sense of power and control in the relationship (e.g., Brainerd et al., 1996; Bringle, Renner, Terry, & Davis, 1983), and to behave aggressively (Brainerd et al., 1996).

In addition to the five motives identified, White (1980) also identified five techniques or behaviors of jealousy induction: talking about past relationships, talking about current relationships, flirting, dating/sexual contact with another, and lying about the existence of.
Jealousy induction in romantic relationships

Because previous research indicated that attachment is associated with jealousy (e.g., Guerrero, 1998), attachment avoidance is associated with aggression (e.g., Powers, 2000), and that aggression is associated with jealousy induction (Brainerd et al., 1996), we sought to examine the direct association between attachment and jealousy induction. Because individuals with high attachment anxiety (particularly preoccupied individuals) experience the most jealousy and engage in the most aggression (Guerrero, 1998; Powers, 2000), it is likely that an individual with high attachment anxiety would induce jealousy in a partner as a way of testing the partner's commitment to the relationship and to increase relational quality and rewards. Thus, we first hypothesized that individuals high in attachment anxiety would report inducing jealousy in their partners more than individuals low in attachment anxiety.

As noted earlier, individuals high in attachment avoidance avoid expressing jealousy to their partner, experience less relational fear, and use fewer relationship-maintaining behaviors (Guerrero, 1998). Although insecurely attached individuals experience more jealousy (Guerrero, 1998), individuals high in attachment avoidance are uncomfortable with intimacy and tend to avoid committed relationships (e.g., Brennan et al., 1998). Thus, it was unclear whether attachment avoidance would be associated with jealousy induction. Therefore, we posed the following research question: Is attachment avoidance associated with tendencies to induce jealousy?

Preoccupied individuals exhibit higher levels of dependence on others (Bartholomew, 1990); thus, it is likely they have less power and control in their relationships. These individuals obsess over their relationships and depend on others' acceptance to feel worthy. Therefore, they are likely to be more emotionally invested in their relationships than their partners. Because the partners of preoccupied individuals are less invested, preoccupied individuals are worried that their partners will leave the relationship. In turn, preoccupied individuals are likely to induce jealousy as a way of retaining their partner (Sheets et al., 1997). Therefore, we proposed a second hypothesis that individuals with preoccupied attachment would report engaging in the most jealousy-inducing behaviors. In other words, we expected that there would be a significant attachment anxiety by attachment avoidance interaction, such that individuals high in attachment anxiety and low in attachment avoidance would show the highest levels of jealousy-inducing behaviors.

Method

Participants
As part of a larger study, 100 undergraduates (79 women, 21 men) currently involved in a romantic relationship completed an online questionnaire. Eleven participants took a very short (i.e., less than 10 min) or very long (i.e., longer than 60 min) amount of time to complete the survey. Because there was reason to suspect these participants' data may have been invalid (e.g., random responding, acquiescence, distracted while completing the task), we eliminated these cases. The final sample consisted of 89 participants (72 women, 17 men). Participants ranged from 18 to 27 years old (M = 19.8, SD = 1.44). The majority of participants were Caucasian (79.8%), dating exclusively (76.4%), not cohabitating (95.5%), and reported being in love (73.0%). Participants' romantic involvement with their current partner ranged from 1 month to 7 years (M = 18.1 months, SD = 19.3).

Measures
Attachment. The Experiences in Close Relationships (ECR; Brennan et al., 1998) is a 36-item scale consisting of two 18-item subscales designed to measure the degree to which an individual exhibits attachment avoidance (i.e., avoidance of intimacy and attachment anxiety, i.e., anxiety over abandonment). Participants rated each item on a 7-point scale (1 = strongly disagree, 7 = strongly agree). Examples of items measuring attachment avoidance include “just when my partner starts to get close to me, I find myself pulling away” and “I tell my partner just about everything.” Examples of items measuring attachment anxiety include “I worry that romantic partners won’t care about me as much as I care about them” and “I often wish that my partner’s feelings for me were as strong as my feelings for him/her.” Both subscales demonstrated good reliability in the current study (avoidance, α = .95; anxiety, α = .92).

Jealousy induction. Because no known measure of jealousy induction exists, we created 18 items for the purposes of this study. We based the instructions and structure of the items on Pfeiffer and Wong’s (1989) Multidimensional Jealousy Scale, whereas we used White’s (1980) five jealousy-inducing behaviors (i.e., talking about past relationships, talking about current relationships, flirting, dating or sexual contact with another, lying about the existence of a rival) as a guide for the content of the items. Participants responded to these items based on the following instructions: "In the following questions, your romantic partner will be..."
referred to as ‘X.’ Please respond to the following questions by circling the appropriate response.” Participants rated each item on a 7-point scale (1 = strongly disagree, 7 = strongly agree). Sample items for the jealousy induction measure with the relevant content domain included in parentheses include: “I talk with X about my past romantic relationships in order to make X jealous” (talking about past relationships), “I talk with X about my opposite-sex friendships in order to make X jealous” (talking about current relationships), “I flirt with people in front of X in order to make X jealous” (flirting), “I tell X when others express romantic interest (e.g., being asked out on a date, being ‘hit on’) in me in order to make X jealous” (dating/sexual contact with another), and “I falsely tell X that others are romantically interested in me in order to make X jealous” (lying about the existence of a rival). The jealousy induction scale demonstrated good reliability, \( \alpha = .96 \).

Results

We first calculated zero-order correlations to ensure that individuals’ tendency to induce jealousy in their partners was associated with both attachment anxiety and avoidance. Confirming our first hypothesis and providing support for our research question, jealousy induction was positively associated with attachment anxiety, \( r (89) = .36, p < .001 \), and attachment avoidance, \( r (89) = .34, p < .01 \). Attachment anxiety and attachment avoidance were also significantly correlated, \( r (89) = .28, p < .01 \).

To assess our second hypothesis (i.e., individuals with a preoccupied attachment style would be most likely to induce jealousy in their partners), we conducted a hierarchical regression. In the first step, gender was entered as a control variable. In the second step, attachment anxiety and attachment avoidance were entered as predictor variables. In the third step, the centered interaction of attachment anxiety x attachment avoidance was entered as a predictor variable, as suggested by Aiken and West (1991). As shown in Table 1, attachment anxiety (\( \beta = .34 \)) and attachment avoidance (\( \beta = .25 \)) were both unique predictors of jealousy induction (Step 2), and the addition of these constructs significantly improved the predictive ability of the model beyond that of gender, \( \Delta F (2, 85) = 12.65, p < .001 \), \( \Delta \text{adj} R^2 = .21 \). Contrary to expectations, the attachment anxiety x attachment avoidance interaction term was not a significant predictor in Step 3 (\( \beta = .04 \)), nor did it significantly improve the model, \( \Delta F (1, 84) = 0.16, p = .69 \), \( \Delta \text{adj} R^2 = -.01 \). In addition, gender was a significant predictor of jealousy induction after accounting for attachment anxiety and attachment avoidance (\( \beta = .25 \) in Steps 2 and 3), indicating that women induce jealousy in their partners more than men.\(^1\)\(^2\)

Discussion

Although previous research has shown that experienced jealousy is associated with individuals’ attachment style (e.g., Guerrero, 1998), no known research has investigated how attachment styles might influence individuals’ tendencies to induce jealousy in their partners. Thus, the current study extends previous work on jealousy induction by demonstrating that there are attachment style differences in the frequency of jealousy induction from a partner.

Two major findings emerge from the present study. First, individuals with insecure attachments (i.e., high anxiety or avoidance) have an increased tendency to try to induce jealousy in a partner. However, specific attachment styles (i.e., secure, preoccupied, dismissing, fearful) are not related to the likelihood of inducing jealousy in a partner. Taken together, these findings further demonstrate the importance of examining attachment style dimensions instead of attachment categories.

Because individuals high in attachment anxiety require the external validation of others in order to maintain a positive self-regard and ease the anxiety elicited by a fear of abandonment by a partner (e.g., Brennan et al., 1998), it is likely that these individuals induce jealousy as a way of testing their relationship, bolstering their self-esteem, and obtaining a specific reward such as confirmation that the partner is committed. Together with past research showing that the most frequent motivation for inducing jealousy is testing the relationship (Fleischmann et al., 2005; White, 1980), it seems likely that individuals high in attachment anxiety engage in jealousy-inducing behaviors to confirm their partners’ commitment. On the other hand, because individuals high in attachment avoidance are uncomfortable with intimacy and avoid contact with others due to the expectation that others are untrustworthy and rejecting (e.g., Brennan et al., 1998), it is somewhat surprising that attachment avoidance was also a signifi-
Jeffersonian Induction in Romantic Relationships | Whitson and Mattingly

...cant predictor of jealousy induction. However, these individuals avoid dependency and view themselves as self-sufficient. As such, individuals high in attachment avoidance may desire to gain power and control over their partner, as they wish to be less dependent on their partner.

A second main finding to emerge from this study is that attachment anxiety and attachment avoidance were both unique predictors of jealousy induction. Attachment anxiety was more strongly related to jealousy induction than attachment avoidance, suggesting that individuals high in attachment anxiety tend to engage in jealousy-inducing behaviors more often than individuals high in attachment avoidance. However, the fact that both forms of attachment were unique predictors of jealousy induction suggests that the two types of attachment operate differentially. As noted earlier, individuals high in attachment anxiety likely engage in jealousy-inducing behaviors as a way to confirm their partners' commitment. On the other hand, individuals high in attachment avoidance may induce jealousy in a partner out of a desire to gain power and control. Although the current study did not explore motivations for inducing jealousy, it seems plausible that this finding may be explained by such motivations. Future research examining how attachment style is associated with individuals' motivations for inducing jealousy may provide valuable insight into the nature of these relationships.

Replicating previous findings (i.e., White, 1980), the results of the current study indicated that women induce jealousy more frequently than men (see Step 3 in Table 1). However, these results should be taken with caution. In the current study, there were a limited number of male participants ($n = 17$) in comparison to female participants ($n = 72$). Therefore, future research should examine gender differences in jealousy induction in a more gender-balanced sample (also see Footnote 2).

In addition to the imbalance of gender, another limitation of the current study is that it consisted of only undergraduates. This convenience sampling resulted in participants who were relatively young and romantically inexperienced. Thus, the results of this study may not generalize to other populations, such as individuals who may have had more experiences with jealousy and jealousy induction. Because successes and failures with previous jealousy induction strategies are likely to influence one's current behavior, replicating this study with a larger and more diverse sample may provide a clearer understanding of how attachment style is related to jealousy induction.

Although the present study examined only one specific individual difference variable (i.e., attachment style), other individual characteristics may be associated with jealousy induction. For example, future research could examine how jealousy induction is associated with individuals' conceptualizations of love. Because some individuals may view love and relationships as a game that needs to be played (e.g., Hendrick, Hendrick, & Dicke, 1998), it seems likely that individuals' "love styles" could also affect the likelihood of an individual

<table>
<thead>
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<th>TABLE 1</th>
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<tr>
<td>Hierarchical Regression Predicting Jealousy Induction</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Step 1</td>
</tr>
<tr>
<td>Gender (1 = male, 2 = female)</td>
</tr>
<tr>
<td>Step 2</td>
</tr>
<tr>
<td>Gender (1 = male, 2 = female)</td>
</tr>
<tr>
<td>Attachment Anxiety</td>
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<tr>
<td>Attachment Avoidance</td>
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<tr>
<td>Step 3</td>
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<td>Gender (1 = male, 2 = female)</td>
</tr>
<tr>
<td>Attachment Anxiety</td>
</tr>
<tr>
<td>Attachment Avoidance</td>
</tr>
<tr>
<td>Anxiety x Avoidance</td>
</tr>
</tbody>
</table>

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. |
Whitson and Mattingly | Jealousy Induction in Romantic Relationships

engaging in jealousy-inducing behaviors. Although insecurely attached individuals may engage in jealousy-inducing behaviors in order to achieve positive relational outcomes, the behavior is most likely counterproductive. Because jealousy is linked to relational dissatisfaction (e.g., Guerrero & Eloy, 1992), successfully inducing jealousy in a partner may also decrease the partner’s satisfaction with the relationship, in turn increasing the likelihood of the relationship ending. Therefore, individuals who feel as though their romantic partners tend to leave them may engage in jealousy-inducing behaviors that threaten relational satisfaction. Future research could examine how jealousy induction is associated with relational outcomes, such as satisfaction. Relationship therapists could apply these findings to recommend methods of achieving desired relational motives that are more productive than inducing jealousy in a romantic partner.

References

Types of Victimization Experienced by Men and Women That Influence Rape Empathy

In the current study we predicted that four types of victimization experience (sexual contact; attempted rape; sexual coercion; rape) would increase rape empathy for a victim compared with no such experience. We also predicted that women would report greater empathy than men. Participants were 80 men and 70 women undergraduates. Hypotheses were not fully supported. Results showed that only participants who reported having experienced rape were more empathetic than those who reported no victimization, $p = .009$, but that women did report more empathy than men, $p < .0001$. Rape experience may allow one to fully identify with and understand the perspective of a rape victim. Other ways to conceptualize victimization are offered.

In the United States, 17.7 million women and 2.78 million men have reported being victims of attempted or completed rape (Rape, Abuse and Incest National Network [RAINN], 2008). Reported sexual victimization experience has been associated with higher levels of rape empathy for a victim (Ching & Burke, 1999; Deitz, Blackwell, Daley, & Bentley, 1982; Smith & Frieze, 2003). Deitz et al. (1982) defined rape empathy as the capacity to understand the psychological perspective of a rape victim and found it to be associated with jurors' and students' rape trial-related decisions. It is thought that those with victimization experiences have higher rape empathy because they can more easily identify with and understand the perceptions and emotions of rape victims. The present study will contribute to the literature by examining various types of victimization experiences and their influence on rape empathy as reported by men and women.

The literature associating rape empathy with victimization has largely examined victimization as experience with rape. For example, Deitz et al. (1982) created their victimization group by lumping together those who reported they were either raped or had escaped a situation in which they believed rape would have occurred. Ching and Burke (1999) examined rape empathy based on whether participants reported that they had been raped themselves or knew a rape survivor. In both of these studies, the researchers used the word rape when they questioned their participants about their experiences. However, many rape victims do not define or acknowledge their own rape experience as rape (Kahn, Mathie, & Torgler, 1994; Layman, Gidycz, & Lynn, 1996). Thus, some participants who were categorized as having no victimization experience in past studies may actually have been victimized. Koss and Oros (1982) developed the Sexual Experiences Survey (SES), which does not use the term rape, to help capture different types of victimization and those who may not label themselves as victims. Smith and Frieze (2003) used this scale but only categorized victimization as those experiences that met the legal definition of rape. Therefore, previous research is ambiguous regarding (a) whether some potential victims of sexual victimization may have been excluded, and (b) whether other types of sexual victimization experience, in addition to rape, may lead to increased rape empathy for a victim.

The literature has also largely focused on empathy reported by female victims (Deitz et al., 1982; Gidycz et al., 2001; Smith & Frieze, 2003). Although female victims are more prevalent and women report greater levels of victim empathy than men do, men are sexually victimized as well (Deitz et al., 1982; Fiebert & Tucci, 1998; RAINN, 2008; Okun & Osman, 2006; Smith & Frieze, 2003; Struckman-Johnson, 1988). Furthermore, victimized men have reported similar experiences and consequences to victimized women (Larimar, Lyndum, Anderson, & Turner, 1999; Stermac, Del Bove, & Addison, 2004). However, men have typically been excluded from victimization samples in studies examining rape empathy. Although 32% of Ching and Burke's (1999) sample were men, it is not clear what percentage, if any, of their victimization experience group were comprised of men. Thus, victimization...
data from men is lacking in the rape empathy literature (Struckman-Johnson, 1988). We made an effort in the present study to include at least as many men as women in the sample.

The primary purpose of the present study is to examine the influence of four levels of reported sexual victimization experience on rape empathy. Any type of victimization experience may help individuals to identify with and understand the perspective of a rape victim. Thus, we predicted that rape empathy would be greater for individuals who have reported any type of victimization experience relative to those with no such experience.

Given that men and women were included in the current sample, we made a secondary prediction for replication purposes. Past studies have revealed that women are more empathic toward rape victims than men (Ching & Burke, 1999; Dietz et al., 1982; O'Kun & Osman, 2006; Smith & Frieze, 2003). Consistent with these findings, we also predicted that women would report greater levels of empathy than men.

Method

Participants

Participants were 80 men and 70 women undergraduate students taking general psychology at a public university. The large majority of participants (99%) were between the ages of 18 and 22, and 100% were single. Most participants (79%) identified themselves as Caucasian, European, or European American; 12% African or African American; 2% Hispanic or Hispanic American; 3.3% Asian or Asian American; 4% listed themselves as other. Religion was reported as follows: 33% Catholic; 8% Protestant; 4% Jewish; 15% Methodist; 8% Baptist; 3% Lutheran; 21% no religion; 7% other. All participants were randomly selected from a volunteer pool, which was created as an option for fulfilling a requirement for an introductory level psychology course. Those selected were contacted and all respondents agreed to participate. This research adhered to APA ethical standards and was approved by an Institutional Review Board.

Materials

As part of a larger study, Smith and Frieze's (2003) gender-neutral Rape-Victim Empathy Scale (REMV) was modified to measure empathy levels toward women raped by men. This is consistent with the way rape empathy has been measured in the existing literature (Ching & Burke, 1999; Dietz et al., 1982; Gidycz et al., 2001; O'Kun & Osman, 2006; Schewe & O'Donohue, 1993). The REMV is an 18-item, Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree). A sample item from this scale is “I know if I talked to a woman who was raped, I’d become upset.” Smith and Frieze (2003) reported that the Cronbach alpha for this scale was .92 and provided validity information for this scale by demonstrating that it positively correlated with the Questionnaire Measure of Emotional Empathy (QMEE), a well-known general empathy measure. The Cronbach alpha for this scale in the present study was .87. Each participant’s scores on the REMV were summed and divided by 18, so that final scores could range from 1 to 5 with higher scores indicating more empathy.

Following the REMV and filler items, participants also filled out the Sexual Experiences Survey (SES) to measure level of victimization (Koss & Gidycz, 1985; Koss, Gidycz, & Wisniewski, 1987; Koss & Oros, 1982). We slightly modified the items to allow for both men and women to respond. Participants responded yes or no to 10 victimization questions that Koss and her colleagues (1987) created to reflect one of the following four levels of experience (sexual contact; attempted rape; sexual coercion; rape). If they responded no to all 10 questions, they were categorized as having no reported sexual victimization experience (no-victimization). A sample of one of the three items measuring sexual contact from this scale was, “Have you given in to sex play (fondling, kissing, or petting but not intercourse) when you didn’t want to because you were overwhelmed by someone’s continual arguments and pressure?” A sample of one of the two items measuring attempted rape was, “Have you had someone attempt sexual intercourse when you didn’t want to by giving you alcohol or drugs, but intercourse did not occur?” A sample of one of the two items measuring sexual coercion was, “Have you given in to sexual intercourse when you didn’t want to because you were overwhelmed by someone’s continual arguments and pressure?” Last, a sample of one of the three items measuring rape was, “Have you had sexual intercourse when you didn’t want to because someone threatened or used some degree of physical force (twisting your arm, holding you down, etc.) to make you?” Although experience with one item does not necessarily lead to or stem from experience with other items, the Cronbach alpha for the SES in the current study was .74. Koss and Gidycz (1985) reported the same Cronbach alpha for women. Participants were categorized into one of the five groups based on their highest reported level of victimization. The number of participants in each of these five groups, and the victimization rates of men and women, are presented in Table 1.

Procedure

Participants completed surveys in a group classroom setting with approximately 20 to 50 students in the room.
Each participant completed the survey with at least one empty seat on each side. Prior to asking participants to sign consent forms guaranteeing anonymity and confidentiality and to complete the surveys, the researchers informed them verbally and in the consent form that the study was investigating sex-related attitudes and behaviors. After they completed their packets, students placed the questionnaires in an anonymous drop box. As they left the room, an experimenter handed a list of references for counseling options to each participant.

Results

One woman who reported rape was dropped from the following analyses because she was missing data on the REMV. To test the main hypothesis, a one-way ANOVA was performed on the rape empathy scores, followed by the necessary a priori pairwise comparisons conducted between each of the four victimization groups and the no-victimization group. The ANOVA revealed a main effect for type of victimization, $F(4, 144) = 2.71$, $p = .03$, partial $\eta^2 = .07$. The a priori pairwise comparisons revealed a significant difference between the no-victimization group and the rape group, $p = .009$. The no-victimization group did not differ from any other group, although it approached being significantly different from the sexual coercion group, $p = .07$. See Table 1 for a summary of means and standard deviations for rape empathy scores.

A t test was performed to test the secondary hypothesis comparing men and women on their rape empathy scores. As expected, women scored significantly higher than men, $t(147) = 5.85$, $p < .0001$, (one-tailed), $d = .97$. Therefore, women ($M = 3.98$, $SD = .53$) reported being more empathic toward rape victims than men ($M = 3.47$, $SD = .53$).

To explore the data in an alternate way, a Pearson product-moment correlation was performed between the number of items to which participants responded yes on the SES and their REMV scores. A significant positive correlation was found between these two variables, $r = .317$, $p < .0001$ (two-tailed). Higher scores on the SES were related to greater numbers of victimization items answered yes, and higher scores on the REMV indicated greater empathy for rape victims.

Discussion

The main purpose of the current study was to examine the influence of various levels of victimization on rape empathy. We expected that individuals who reported experiencing either sexual contact, attempted rape, sexual coercion, or rape would report greater levels of empathy than those who reported no sexual victimization experience. Unexpectedly, but consistent with the way previous researchers have defined victimization (Smith & Frieze, 2003), reported rape was the only type of victimization that significantly increased rape empathy.

Perhaps one must have the rape experience to fully identify with and understand the perspective of a rape victim. However, it is important to note that the SES categories were based on the highest level of victimization reported, and that the large majority of participants who were categorized into the rape group (highest level) did report at least one other lower-level experience as well. Thus, it may be that a compilation of experiences that include rape rather than rape only, increases empathy. Furthermore, participants did not report how many times each of these experiences had occurred. They simply answered yes or no to “Have you had...” Thus, another way to conceptualize victimization experience that may influence empathy would be to look at the number of times each of these types of experiences occurred. For instance, someone who reports 20 sexual contact or 10 sexual coercion experiences may have equivalent levels of rape empa-

### Table 1

<table>
<thead>
<tr>
<th>Victimization</th>
<th>Women ($n = 69$)</th>
<th>Men ($n = 80$)</th>
<th>Overall ($n = 149$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$n$</td>
</tr>
<tr>
<td>No Victimization</td>
<td>3.81</td>
<td>.60</td>
<td>24</td>
</tr>
<tr>
<td>Sexual Contact</td>
<td>4.01</td>
<td>.39</td>
<td>22</td>
</tr>
<tr>
<td>Attempted Rape</td>
<td>3.88</td>
<td>.62</td>
<td>7</td>
</tr>
<tr>
<td>Sexual Coercion</td>
<td>4.08</td>
<td>.40</td>
<td>14</td>
</tr>
<tr>
<td>Rape</td>
<td>4.19</td>
<td>.51</td>
<td>13</td>
</tr>
</tbody>
</table>

Note. There was a significant difference between the no-victimization group and the rape group ($p = .009$). Higher scores indicate greater empathy.
are not conclusive, they nonetheless suggest that future
terpretation and rape empathy. Although the present results
interpretation experience in future studies may help better our
data from more participants who report victimiza-
tion rates for each type of victimization. Thus, gathering
study are limited by the sample's relatively low reported
victim. Researchers should consider these possibilities
targeted toward a female victim rather than a male
rape empathy measure used in the current study was
that women empathized more than men because the
women to empathize more than men. As expected,
gender difference, it is worth noting here that there
were more men than women in the no-victimization
group (43 vs. 24), while there were more women than
men in the rape group (13 vs. 8). Thus, it is possible
that this gender imbalance could partially explain the
difference in empathy levels found between the rape
and no-victimization groups. Last, it is also possible
that women empathized more than men because the
rape empathy measure used in the current study was
targeted toward a female victim rather than a male
victim. Researchers should consider these possibilities
in future studies including men and women.

Conclusions based on the results of the current
study are limited by the sample's relatively low reported
rates for each type of victimization. Thus, gathering
data from more participants who report victimization
experience in future studies may help better our
understanding of the relationship between victimization
and rape empathy. Although the present results
are not conclusive, they nonetheless suggest that future
researchers consider the importance of investigating
and understanding different types of victimization.
For example, reported rape experience was associated
with an increase in empathy, but attempted rape was
not. Thus, combining these two experiences into one
category may not provide a complete picture of how
victimization can influence rape empathy and other
rape-related constructs. Furthering our knowledge of
empathy and its associated factors is important as they
may impact rape-related medical, judicial, or counseling
decisions (Deitz et al., 1982).

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An emotional response is multidimensional, with perceptual, expressive, and subjective components. These responses can be attributed both to factors that are developmental or “ontogenetic” as well as to factors that are innate or “phylogenetic” (Mühlberger, Wiedemann, Herrmann, & Pauli, 2006). Ontogenetic emotional reactions often stem from associative learning or evaluative conditioning, processes that lead to the formation of likes and dislikes. These learned reactions can arise from firsthand experience (De Houwer, Thomas, & Baeyens, 2001) or because a third party has instructed the learner about the importance of a stimulus (Phelps et al., 2001). Phylogenetic emotional reactions may instead be hard-wired in the brain or may result from learning mechanisms that have been preserved across the course of evolution. For instance, human infants and monkeys will quickly learn to startle at the sight of a snake (DeLoache & LoBue, 2008; Ohman & Mineka, 2001), and rats may be born with fight-or-flight mechanisms triggered by odors of predators that they have never before encountered (Kobayakawa et al., 2007).

Although the behavioral manifestations of the responses elicited by ontogenetic and phylogenetic stimuli appear similar, there is some evidence to suggest that the neurobiological mechanisms yielding those responses may be different. For example, a rat’s freezing behavior in response to a conditioned fear was more reliant on prefrontal regions than was a rat’s ability to freeze in response to an evolutionarily-relevant predator (Canteras, 2003). Even within the same general structure, different subregions may be responsive to ontogenetic versus phylogenetic stimuli; within the mouse olfactory lobe, the glomerular structures that respond to unconditioned odors and lead to an innate fear response are not the same as those that respond to conditioned fear-evoking stimuli (Kobayakawa et al., 2007), and different nuclei of the amygdala have been implicated in innate versus learned fear responses in rats (Thompson, Sullivan, & Wilson, 2008).

These studies suggest that, at least in nonhuman animals, fear responses elicited via phylogenetic means rely on different neural circuitry than those elicited via ontogenetic factors. Although there has not been research directly examining this topic in humans, there have been studies implicating the orbitofrontal cortex (OFC), anterior cingulate cortex (aCC), and other frontal regions with emotional conditioning and associative learning (e.g., Gottfried & Dolan, 2004, O’Doherty, 2007; Rolls & Grabenhorst, 2008). The hypothesis tested in the present study was that these regions would also be active when a person processed stimuli of ontogenetic relevance, even after the affective significance of those stimuli had been well learned. Thus, we expected to see greater aCC and OFC activity during the processing of ontogenetic versus phylogenetic stimuli. Because the aCC and OFC have been implicated in the processing of pleasure as well as fear (Kringelbach, 2005), we also hypothesized that this pattern of activity would hold for both threatening and pleasure-eliciting stimuli. Although our hypotheses were dominated by an interest in frontal-based activity, we used whole-brain imaging procedures that could

* Faculty mentor
reveal differences in other brain regions as well. We were particularly interested in whether the subcortical regions of the amygdala or the basal ganglia, regions frequently linked to arousal and affective processing (Phan, Wager, Taylor, & Liberzon, 2002; Sergerie, Chochol, & Armony, 2008) would show a differential response for ontogenetic versus phylogenetic stimuli. In our experiment, we reanalyzed data from two prior functional magnetic resonance imaging (fMRI) studies (Kensinger, Garoff-Eaton, & Schacter 2007; Kensinger & Schacter, 2008) to examine how neural response differed when participants viewed fear- or pleasure-evoking stimuli of phylogenetic or ontogenetic origin. Stimuli of ontogenetic origin would be items such as guns, car accidents, balloons, or money, because these types of stimuli have an affective connotation that has been learned. By contrast, stimuli of phylogenetic origin would be items such as snakes, fires, lions, babies, or smiling faces, because these items would have evolutionary relevance.

Method

Participants
This experiment reanalyzed data from 29 participants (12 men and 17 women; ages 18-35) from two prior experiments (14 from Kensinger et al., 2007; 15 from Kensinger & Schacter, 2008). All participants were right-handed, native English speakers, and informed consent had been obtained from all participants in a method approved by the Boston College, Harvard University, and Massachusetts General Hospital Institutional Review Boards. Participants were recruited via flyers posted throughout the Boston area, and participants received $25/hour for their participation. All participants were screened to exclude those with a history of neurological trauma or psychiatric disorder. No participant was taking any centrally acting medications.

Materials and Procedure
Materials comprised colored, nameable photo objects (Hemera Technologies, www.hemera.com). We selected images from this dataset if they seemed likely to be classified as positive (e.g., penguin, smiling baby), negative (e.g., snake, grenade), or neutral (e.g., canoe, blender) in valence. Twenty participants, separate from those who participated in the fMRI study but meeting the same eligibility criteria, rated 592 objects that had been selected from the Hemera Technologies database on two dimensions: image valence, referring to how positive or negative an image was, and image arousal, referring to the calming/subduing or exciting/agitating nature of an image, following guidelines outlined by Ito, Cacioppo, and Lang (1998). Participants rated valence and arousal on 9-point Likert-type scales as described in two prior studies (Kensinger et al., 2007; Kensinger & Schacter, 2008). We then separated the rated objects into negative and arousing (valence ratings of less than 3.5 and arousal ratings of greater than 5 on 9-point Likert scales), positive and arousing (valence ratings greater than 5.5 and arousal ratings greater than 5), and neutral and nonarousing (valence ranging between 3 and 6 and arousal less than 5) groups. We excluded images that did not fall into any of these categories.

From these groups, we further classified the objects by evolutionary relevance (ontogenetic or phylogenetic) using our best judgment. “Phylogenetic” picture objects contained features or objects presumed to have been encountered in ancestral environments and thus most likely to elicit unconditioned responses. Such objects included human faces, fangs, stingers, sharp objects, or gory scenes (low valence and fear-relevant) and lush environments, happy infants, or people in seductive poses (high valence and pleasure-relevant). “Ontogenetic” picture objects contained features or objects characteristic of contemporary society and that could not have been encountered in ancestral environments. Such objects included guns, bombs, or car crashes (low valence and fear-relevant) and celebratory scenes with no people, balloons, or trophies (high valence and pleasure-relevant).

We classified neutral picture objects (medium valence, low arousal) into organic and man-made groups to provide controls for phylogenetic and ontogenetic object groups respectively. We included these neutral object groups in our experiment in order to rule out possible processing differences between organic and man-made objects, such as those due to object complexity differences, as causes for differential activity between phylogenetic and ontogenetic object types. Two hundred and nine out of the total 592 picture objects were successfully classified as fear-phylogenetic, pleasure-phylogenetic, fear-ontogenetic, pleasure-ontogenetic, neutral-organic, or neutral-man-made, and we restricted analyses to these items. If the classification of certain objects proved ambiguous, or if certain objects did not fit neatly in previously mentioned categories, we omitted these objects from the analyses.

Study Procedure
We presented a series of nameable, colored objects for 1 sec each to participants while in the fMRI scanner. Participants made either a size decision about whether each object, in the real world, would fit inside a filing cabinet drawer (in Kensinger & Schacter, 2008) or about whether the object was a living thing (in Kensinger et al., 2007). The goal of having a task was to
assure that the participant was attending to each item, and these particular tasks were chosen because they did not focus the participants on an evaluation of the affective meaning of the objects. Following the item’s presentation, a fixation cross (+) appeared for a variable duration (range of 5–13 sec) to provide different delays between the start of the sampling of brain images and start of stimulus presentations, or “jitter,” required to isolate the hemodynamic response to each event.

**Image Acquisition**

We used a 3.0 Tesla Siemens Allegra MRI scanner to acquire structural images of the brain and to provide information about changes in the blood-flow response to different regions of the brain as participants viewed the photo objects. To gather the structural images of the brain, we used a multiplanar rapidly acquired gradient-echo (MP-RAGE) sequence. To provide the information about the changes in blood-flow response, we gathered functional images using a T2*-weighted echo-planar imaging (EPI) sequence (TE = 30 msec, FOV = 200 mm; flip angle = 90°). Twenty-eight axial-oblique slices (3.2 mm thickness, 0.6 mm skip between slices), aligned along the anterior commissure/posterior commissure line, were acquired in an interleaved fashion. The parameters were identical in the two studies from which data were analyzed except that in Kensinger et al. (2007) the repetition time (TR) was 2000 msec and in Kensinger and Schacter (2008) it was 3000 msec. This discrepancy has to do with how often “snapshots” of the blood-flow response were taken (i.e., every 2000 msec vs. every 3000 msec), but because the blood-flow response is quite sluggish (blurring over approximately 6 seconds), this discrepancy should not have influenced the results.

**Data Analysis**

We conducted preprocessing and data analysis within Statistical parametric mapping software “SPM2” (Wellcome Department of Cognitive Neurology, www.fil.ion.ucl.ac.uk/spm). The functional data underwent standard preprocessing. This preprocessing takes steps to minimize the noise created by a number of different sources: by participant head motion, by the order in which different “slices” of the brain are imaged, and by variability in the size and shape of participant brains.

We specified six different types of events for each participant based upon previous classifications: fear-phylogenetic, fear-ontogenetic, pleasure-phylogenetic, pleasure-ontogenetic, neutral-phylogenetic, and neutral-ontogenetic. Fear objects had high arousal scores and low valence scores, pleasure objects had high arousal scores and high valence scores, and neutral objects had low arousal scores and medium valence scores. For every participant, and on a voxel-by-voxel basis (a voxel is similar to a pixel, but is in three dimensions rather than two), we conducted an event-related analysis in which all instances of a particular event type were modeled through convolution with a canonical hemodynamic response function. These data were entered into second-level, random-effects group analyses.

We conducted group comparison analyses to reveal regions with at least a 5-voxel extent and a peak voxel significance of $p < .001$. To characterize the patterns of hemodynamic response within regions revealed in the contrast analyses, we created regions of interest (ROIs) that included all significant voxels within a 5-mm sphere (using the ROI toolbox implemented in MarsBar; Brett, Anton, Valabregue, & Poline, 2002). The hemodynamic time course for each individual participant and for each condition type (relative to fixation baseline) was extracted. We performed statistics on the sum of the signal changes occurring between 3 sec and 12 sec poststimulus onset, and these sums appear in the figures.

We presented all activations in neurological coordinates (i.e., activity on the right hemisphere is presented on the right side of the brain images). We reported voxel coordinates in Talairach coordinates (from Talairach & Tournoux, 1988). These coordinates reflect the most significant voxel within a cluster of activation.

**Results**

**Behavioral Results**

We analyzed object ratings to make sure that fear-phylogenetic, fear-ontogenetic, pleasure-phylogenetic, and pleasure-ontogenetic objects had comparable arousal scores to each other and significantly higher arousal scores than neutral-phylogenetic and neutral-ontogenetic objects. We also made sure that fear-phylogenetic and fear-ontogenetic objects had comparably low valence scores, that neutral-phylogenetic and neutral-ontogenetic objects had comparably high arousal scores, and that pleasure-phylogenetic and pleasure-ontogenetic objects had comparable valence scores (Table 1). To make these comparisons, a repeated-measures ANOVA was conducted for (a) valence ratings and (b) arousal ratings (based on the earlier data gathered from 20 participants who did not participate in the current experiment). Each ANOVA included object type (phylogenetic, ontogenetic) and emotion type (fear, happy, neutral) as factors. In both ANOVAs, there was no main effect of object type, nor an interaction with object type ($p > .15$), revealing that the object type did not influence the valence or arousal...
ratings of the stimuli. A similar repeated-measures ANOVA conducted on the reaction times that it took each participant within the MRI study to respond to each stimulus also revealed no main effects or interactions; therefore, importantly, the reaction time did not differ between ontogenetic or phylogenetic event subtypes (p > .15; Table 1). Thus, differences in the amount of time processing the stimuli should not have confounded our results.

**fMRI Results**

The first analysis used an ANOVA to specifically examine regions that showed an interaction between emotion type (fear, neutral) and evolutionary relevance (ontogenetic, phylogenetic), showing a stronger response for items that were both fear-relevant and of ontogenetic origin. To be considered significant, regions had to consist of at least 5 contiguous voxels with an F > 3.5, p < .001. This analysis revealed that activity within a region spanning the left aCC and OFC (Talairach coordinates -16, 39, -2) responded more to ontogenetic compared to phylogenetic fear-relevant stimuli. This region did not show a comparable effect for the neutral stimuli, thereby ruling out that this response was a more general response to man-made as opposed to natural objects (see Figure 1). Similar patterns of activity were revealed within regions of the right aCC (Talairach coordinates: 20, 47, -2) and dorsal PFC (Talairach coordinates: 16, 60, 0).

A second analysis examined regions that showed an interaction between emotion type (fear, neutral) and evolutionary relevance (ontogenetic, phylogenetic), because of a stronger response for items that were both fear-relevant and of phylogenetic origin. At the standard threshold typically used in fMRI research for this type of interaction analysis, F > 3.5, p < .001, no regions showed this pattern of response. At a lowered threshold, F > 3.0, p < .005, regions of the lingual gyrus (Talairach coordinates: -2, -70, -12) and right dorsal striatum (Talairach coordinates: 4, 14, 12) demonstrated the interaction.

The third analysis examined regions that showed an interaction between emotion type (pleasure, neutral) and evolutionary relevance (ontogenetic, phylogenetic), with a stronger response to stimuli that were both pleasurable and also ontogenetic (all regions revealed were significant at values of F > 3.5, p < .001). As with the fearful stimuli, pleasure-ontogenetic stimuli elicited disproportionate activity in comparison to pleasure-phylogenetic stimuli or to any type of neutral stimulus in a cluster spanning the right OFC/aCC (Talairach coordinates: 32, 42, -6).

A fourth analysis examined regions that showed an interaction between emotion type (pleasure, neutral) and evolutionary relevance (ontogenetic, phylogenetic), with a stronger response to stimuli that were both pleasurable and also phylogenetic (all regions revealed were significant at values of F > 3.5, p < .001). Also similar to the regions revealed for the analysis of fearful stimuli, activity within the left fusiform gyrus (Talairach coordinates: -42, -40, 0) and the left dorsal striatum (Talairach coordinates: -16, 6, 8) was enhanced for phylogenetic compared to ontogenetic pleasure-evoking stimuli, but showed no differential response for man-made versus organic neutral stimuli.

Notably absent from these analyses was activity within the amygdala. To examine whether the amygdala might respond to all affective stimuli regardless of their evolutionary relevance, we conducted a conjunction analysis to reveal the regions that were elicited by fear- and pleasure-evoking stimuli of both ontogenetic and phylogenetic relevance. This conjunction analysis required neural activity to be present in four contrasts: fear-ontogenetic versus neutral, fear-phylogenetic versus neutral, pleasure-ontogenetic versus neutral, pleasure-phylogenetic versus neutral. The p value required for

**TABLE 1.**

Mean (SE) Valence Ratings, Arousal Ratings, and Reaction Times as a Function of the Valence and Evolutionary Category of Stimuli.

<table>
<thead>
<tr>
<th></th>
<th>Fear-Evoking</th>
<th>Pleasure-Evoking</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ontogenetic</td>
<td>Phylogenetic</td>
<td>Ontogenetic</td>
</tr>
<tr>
<td>Valence</td>
<td>2.31 (.08)</td>
<td>2.25 (.05)</td>
<td>6.61 (.2)</td>
</tr>
<tr>
<td>Arousal</td>
<td>6.76 (.15)</td>
<td>6.68 (.17)</td>
<td>6.71 (.16)</td>
</tr>
<tr>
<td>Reaction time</td>
<td>2.05 (.09)</td>
<td>2.07 (.10)</td>
<td>2.00 (.09)</td>
</tr>
</tbody>
</table>
each individual contrast entered into the conjunction analysis was thresholded at a liberal \( p < .01 \), but this specification yielded a conservative \( p \) value for the four-way conjunction \( (p < .0001) \). This conjunction analysis did reveal activity within the left amygdala (Talairach coordinates: -20, 0, -18), suggesting that this region responds to all high-arousal affective stimuli regardless of valence or evolutionary relevance.

**Discussion**

The results of this experiment supported our hypothesis that stimuli whose affective relevance was ontogenetic would be processed with more aCC/OFC activity than stimuli whose affective relevance was of phylogenetic origin. This disproportionate frontal-based response to ontogenetic stimuli held for both fear- and pleasure-evoking stimuli, suggesting that the aCC/OFC’s tie to ontogenetic affective stimuli is not valence-specific.

A plethora of studies have implicated these frontal regions in the ability to learn the affective import of information: Individuals with damage to the aCC and OFC have difficulties learning the affective value of stimuli, and healthy individuals show robust aCC and OFC activity as they learn about affective contingencies (e.g., O’Doherty, 2007; Rolls & Grabenhorst, 2008). Our results suggest that these same structures that initially allow individuals to acquire affective knowledge continue to be active when individuals later process those stimuli. Even though an individual may have learned the affective qualities (e.g., that money is pleasurable and guns are threatening) of ontogenetic objects long ago, the brain regions that were likely involved in learning those associations seem to be continually active when processing that information.

This disproportionate involvement of the aCC/OFC in the processing of ontogenetic stimuli may provide greater flexibility in a person’s response to that information. It is well known that the OFC can be important for shaping, and reshaping, affective contingencies (Gottfried & Dolan, 2004). For instance, the OFC has been implicated in top-down regulation of affective responses to emotional faces and aversive odors (Floresco & Ghods-Sharifi, 2007; Haber, Kim, Mailly, & Calzavara, 2006), and both the aCC and OFC have been tied to the regulation of emotion and social behavior (Bachevalier & Loveland, 2006; Rudebeck, Bannerman, & Rushworth, 2008).

If affective neural circuits that correspond to ontogenetic associations are more susceptible to frontal cortical modulation than those circuits that correspond to phylogenetic associations, then this phenomenon may shed light on the efficacy of psychological therapy in distinct contexts. Our findings could explain, for example, why fewer phobias occur toward ontogenetic stimuli whereas the majority of phobias are based on fears for natural, or phylogenetic, contexts or objects (Mühlberger et al., 2006). Ontogenetic associations leading to related phobias may be more easily extinguished because they elicit more orbitofrontal activity (Gottfried & Dolan, 2004). Furthermore, our findings suggest that cognitive behavioral therapy (CBT) could prove most useful for patients with phobias for ontogenetic objects (Mühlberger et al., 2006) because such objects already elicit activity in regions like the orbitofrontal cortex, a region thought to be important in extinguishing conditioned stimulus-conditioned response associations (Gottfried & Dolan, 2004), emotional regulation, and cognitive reappraisal (Bachevalier & Loveland, 2006; Rudebeck et al., 2008). Although patients with phylogenetic phobias, like arachnophobia (fear of spiders) or acrophobia (fear of heights), may show some improvement as a result of CBT or similar...
therapies, perhaps their treatment plan should also include the administration of psychotropic drugs such as benzodiazepines that could mitigate certain aspects of the innate fear response.

In addition to fear-ontogenetic objects, pleasure-ontogenetic objects such as a hundred dollar bill are also likely to elicit more variable and malleable cognitive and affective responses that are a consequence of increased frontal cortical activity at the time and context of learning and processing. Regardless of the implications of the distinction, our results emphasize that the frontal regions tied to affective learning and to the ability to sculpt emotional reactions are disproportionately active during the processing of ontogenetic stimuli.

In contrast to the enhanced frontal activity for ontogenetic stimuli, when stimuli were of phylogenetic origin, activity tended to increase within the dorsal striatum. This subcortical region has been tied to the bottom-up processing of emotionally-salient stimuli; through its rapid afferents with other subcortical regions, including the midbrain and amygdala, this region plays an important role in the ability to respond quickly to affective stimuli (e.g., Bowers et al., 2006; LeDoux, 2000). Thus, in stark contrast to ontogenetic stimuli, whose processing seems to be characterized by enhanced activity within regions tied to top-down, flexible affective responding, processing of phylogenetic stimuli seems to be linked to a more bottom-up system that is less defined by frontal cortical modulation and better suited for a direct, more automatic motor response. The relatively nonplastic nature of phylogenetic affective circuits in the brain may explain why certain behaviors, such as smiling, frowning, laughing, or crying are identical across all cultures and even exhibited by individuals born blind (Prohovnik, Skudlarski, Fullbright, Gore, & Wexler, 2004).

It is interesting to note that although the putamen, a region of the dorsal striatum, was associated with the processing of phylogenetic stimuli of either positive or negative valence, there was a laterality difference. Right putamen activity was stronger for negative phylogenetic stimuli whereas left putamen activity was stronger for positive phylogenetic stimuli. It is sometimes true that right-lateralized activity is stronger for negative stimuli (or withdrawal emotions) whereas left-lateralized activity is stronger for positive stimuli (or approach emotions), but these dissociations are often strongest within prefrontal regions. However, there have also been instances where these distinctions have been revealed within subcortical regions (Davidson, 1992; Murphy, Nimmo-Smith, & Lawrence, 2003). It is possible that processing of phylogenetic stimuli is most likely to occur within the subset of regions that are specialized for processing stimuli of a particular valence; in other words, if right-lateralized regions are specialized for processing negative stimuli, those regions may be more likely to show an enhanced response to negative phylogenetic stimuli.

In contrast to the aCC/OFC and putamen – regions that responded differentially based on the evolutionary import of stimuli – the amygdala responded more consistently to all affective stimuli. This finding is consistent with studies that have implicated the amygdala in broad, arousal-based processing and with a growing body of literature suggesting that amygdala activity is not directly tied to the type of affective experience elicited by a stimulus (e.g., Phan et al., 2002; Sergerie et al., 2008). Instead, the amygdala may serve as a core part of the affective processing network, recruited regardless of stimulus valence or evolutionary origin. Although previous research has supported the tie between amygdala activity and the processing of both positive and negative information (Anderson et al., 2003; Garavan, Pendergrass, Ross, Stein, & Risinger, 2001; Hamann, Ely, Hoffman, & Kilts, 2002), to our knowledge this is the first study to directly tease apart its response to stimuli of phylogenetic and ontogenetic origin. Of course, because the current fMRI methods did not have sufficient spatial resolution to tease apart activity within different nuclei of the amygdala, it remains possible that different nuclei of the amygdala may play a role in different forms of affective processing, as described by LeDoux (2000), and may have activity that is modulated by the evolutionary importance of a stimulus.

Conclusion

To gain insight into the interplay of nature and nurture in the shaping of human emotional responses, we conducted an imaging experiment to determine if and how separate brain regions underlie affective processing of phylogenetic and ontogenetic objects. Our results show that the processing of ontogenetic objects is characterized by frontal cortical regions thought to play roles in cognition and emotional regulation. The processing of phylogenetic objects, on the other hand, is characterized by activity in more ancient subcortical regions. This activity may result from robust “fight or flight” and approach circuits that are less influenced by cognition, proved crucial for the survival and reproduction of ancestral people, and are somehow represented in the human genome. The frontal cortical activity elicited by ontogenetic object processing may support more malleable and variable stimulus-response associations for objects that are emotionally ambiguous from an evolutionary perspective.
References


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