

Love at First Fright: Partner Salience Moderates Roller-Coaster-Induced Excitation Transfer¹

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This study examined the effects of residual nervous system arousal on perceptions of sexual attraction. Researchers approached individuals (males, $n = 165$; females, $n = 135$) at amusement parks as they were either waiting to begin or as they had just gotten off a roller-coaster ride. Participants were shown a photograph of an average attractive, opposite-gendered individual and asked to rate the individual on attractiveness and dating desirability. Participants were also asked to rate their seatmates' levels of attractiveness. Consistent with the predictions of excitation transfer theory, for males and females riding with a nonromantic partner, ratings of attractiveness and dating desirability toward the photographed individual were higher among persons exiting than entering the ride. Among persons riding with a romantic partner, there were no significant differences in attractiveness or dating desirability ratings between persons entering and exiting the ride. The findings are discussed in terms of the potential moderator effects of a salient romantic partner on excitation transfer.

KEY WORDS: excitation transfer; sexual attraction; gender; residual arousal; sexual arousal; misattribution theory.

INTRODUCTION

Excitation transfer theory, as first described by Zillman (1971), posits that residual excitement from a previous arousing stimulus or situation may serve to intensify a later emotional state. Inherent to this theory is the well-established fact that sympathetic nervous system arousal does not terminate abruptly with the cessation of the eliciting conditions, but rather it declines relatively slowly, resulting in a certain degree of arousal residue (Cantor, Zillmann, & Bryant, 1975; Zillmann, Katcher, & Milavshky, 1972). It is during this period of residual excitement that an individual who is exposed to a subsequent emotion-provoking situation may misattribute the residual excitement to their current situation. By doing so, their experience of the subsequent emotional state may be

intensified. Whether or not this excitation transfer occurs is largely dependent upon whether environmental cues from the original source of arousal are readily apparent. Excitation transfer is unlikely to occur when the individual causally connects the residual state of excitation to the prior inducing source (e.g., Cantor & Zillmann, 1973).

For over three decades, excitation transfer theory has been empirically applied to the domain of sexual arousal and attraction (for review, see Foster, Witcher, Campbell, & Green, 1998). Nervous system activation, elicited via such diverse means as anger induction (Barclay & Haber, 1965), startle-response (Dienstbier, 1979), emotional role-play (Aron, 1970), anxiety films (Dutton & Aron, 1989), shock threat (Dutton & Aron, 1974), fear-arousing situations (Allen, Kenrick, Linder, & McCall, 1989; Dutton & Aron, 1974), and exercise (Allen et al., 1989; Cantor et al., 1975; Meston & Gorzalka, 1996; White, Fishbein, & Rutstein, 1981; White & Kight, 1984), has been shown to subsequently enhance perceptions of sexual attractiveness or desirability. In a few studies, dependent measures have included subjective indices, such as sexual content written in response to Thematic Apperception Test-like stimuli (e.g., Aron, 1970; Barclay & Haber, 1965; Dutton & Aron,

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1974), or behavioral indices, such as postexperimental contact with research interviewers (Dutton & Aron, 1974), but most studies have focused on arousal-induced changes in levels of romantic attraction, physical attractiveness, or liking toward an opposite-gendered confederate. To our knowledge, only one study has assessed the degree to which excitation transfer may occur among real-life romantic partners in real-life arousal scenarios (Cohen, Waugh, & Place, 1989). Cohen et al. (1989) found that, compared with premovie levels, couples leaving a high-arousal movie engaged in more affiliative behaviors than did couples leaving a low-arousal movie. To our knowledge, no study has examined whether physiological arousal influences attraction ratings similarly for males and females. This is surprising given that research suggests important gender differences may exist in the cognitive interpretation of sexually relevant physiological cues (for review, see Meston, 2000). Specifically, it has been suggested that males may focus more on physiological cues and females more on contextual cues when assessing their levels of sexual arousal (Meston, 2000).

This study used a real-life situation (riding a roller-coaster) to examine the effects of residual nervous system activation on perceptions of sexual attraction in both males and females. Based on previous research of this nature, it was predicted that the residual arousal experienced by men and women who had just completed a roller-coaster ride would serve to intensify their subsequent experience of sexual attraction. Novel to this study, it was predicted that to whom the transfer would be directed toward would differ depending on the presence or absence of a salient romantic partner. Salience here refers to a romantic partner who was standing in line and riding the roller-coaster with the participant, or riding with and walking away with the participant. In other words, we define "partner salience" as having a romantic partner in close visible proximity during the ride. For persons who did not have a salient romantic partner, excitation transfer would be expressed in terms of higher ratings of attractiveness and dating desirability toward an anonymous photographed individual. This would be consistent with previous studies that have shown that physiologically aroused participants report greater romantic attraction for unfamiliar targets compared with nonaroused participants when tested individually (for review, see Foster et al., 1998). For persons who did have a salient romantic partner, it was predicted that the excitation transfer would be expressed in terms of elevated ratings of attractiveness toward their romantic partner. That is, because their romantic partner was nearby, we expected that they (their partners) would serve as a more likely cue for sexually-relevant emotions to be projected toward than would a

photograph of an opposite-gendered stranger. Cohen et al. (1989) found that residual arousal increased behavioral measures of interpersonal attraction (frequency of talking and touching) between romantic partners. We speculated that ratings of partners' physical attraction, a central component of romantic attraction (Hatfield & Sprecher, 1986), would also be increased subsequent to an arousing event.

Specifically, the following predictions were made: (1) among individuals who were *not* riding with a romantic partner, those who were exiting the roller-coaster would endorse higher ratings of attractiveness and dating desirability towards the photographed opposite-gendered individual than would persons entering the ride and ratings of seatmate attractiveness would not significantly differ between those entering and exiting, and (2) among individuals who *were* riding with a romantic partner, those who were exiting the ride would endorse higher ratings of attraction towards their romantic partner than would persons entering the roller-coaster and there would be no difference between those entering and exiting on ratings of attractiveness or dating desirability toward the photographed individual.

METHOD

Participants

The participants were 135 females and 165 males. Because attractiveness ratings were assessed using opposite gender photographs, data from individuals who rated their sexual orientation as homosexual (males, $n = 11$; females, $n = 9$) were excluded. Because the purpose of the study was to examine the extent to which residual nervous system arousal would transfer to ratings of interpersonal attraction, it was necessary to ensure that individuals about to enter, and those who were exiting the roller-coaster ride, differed in levels of nervous system arousal. Among individuals who were about to enter the ride, those who endorsed "6" or "7" to the question "Which of the following best describes your heart rate?" (approximately equal to or greater than 2 *SDs* above the mean; 1 = *very slow*; 7 = *very fast*) were excluded from further analyses ($n = 10$). This procedure was used to minimize the possibility that certain individuals about to enter the roller-coaster were already in a heightened state of nervous system arousal due to, for example, anticipatory anxiety or having recently completed another, equally arousing theme park ride. Among individuals who had just completed the ride, those who rated their heart rate as "1" or "2" (approximately equal to or less than 2 *SDs* below the mean) were excluded from further analyses ($n = 14$). This procedure was used to minimize

the possibility that certain individuals may not have found the roller-coaster experience particularly arousing due to, for example, habituation from having previously ridden on numerous other theme park rides. Data from five participants were eliminated from further analyses because it was not clear from their answers whether their seatmate could be considered romantic or unromantic.

The final sample consisted of four groups of participants: males entering the ride ($n = 59$), males exiting the ride ($n = 79$), females entering the ride ($n = 45$), and females exiting the ride ($n = 68$). Mean age ($+/- SDs$), percentage in a relationship, and mean length of relationship by group are presented in Table I. Separate 2 (Sex) \times 2 (Time: Entry vs. Exit) ANOVAs showed the four groups of participants did not differ significantly on age or mean length of relationship (calculated on those in a relationship). The four groups of participants were further divided into those who were and those who were not sitting beside a romantic partner on the roller-coaster ride (or those who were about to/not about to sit beside a romantic partner). Individuals sat in two-seater compartments either alone or with a seatmate. Seatmates such as boyfriend/girlfriend, husband/wife, or lover were considered romantic partners. Seatmates such as parent, sibling, child, niece/nephew, or same-gendered friend were considered nonromantic partners. Among persons sitting with romantic partners, 49% were sitting with a boyfriend/girlfriend, 48% with a husband/wife, 1% with a fiancé, and 2% with a lover/significant other. Among those sitting with a nonromantic partner, 7% were riding alone, 1% with a parent, 7% with

a child, 3% with a relative, 18% with a sibling, and 64% with a same-gendered friend or stranger.

Design and Procedure

Data were collected at two theme parks in Texas: Six Flags at Texas in Arlington and Six Flags at Texas in San Antonio. Data were collected in Arlington on one occasion and in San Antonio on three occasions. Male ($n = 5$) and female ($n = 5$) interviewers approached men and women for interview as they waited in line to ride a roller-coaster or approximately 5 min after they finished riding a roller-coaster and were about to leave the area. All persons who appeared to be at least 18 years of age were approached. Interviewers introduced themselves to prospective subjects: "Hello, my name is [pseudonym] and I'm from The University of Texas at Austin. We're conducting a study on perceived attractiveness that will take approximately 2 min to complete and would be completely confidential. Your name would not be recorded on any of our questionnaires. Would you be willing to take a few minutes to participate in the study?" If the individual expressed interest but looked as though he/she may be 25 years old or less, the interviewer asked, "May I ask how old you are?" If the prospective participant was less than 18 years old, he/she was told, "I'm afraid that you must be at least 18 years old to participate. Thank you for your time." Estimated retrospectively, approximately 90% of all people approached agreed to participate in the

Table I. Participant Characteristics by Group

	Males entering ($n = 59$)	Males exiting ($n = 79$)	Females entering ($n = 45$)	Females exiting ($n = 68$)
Mean age (SD)	27.1 (6.3)	30.2 (9.0)	28.0 (8.0)	27.49 (7.0)
Age range	19–47	18–66	18–50	18–45
Percent in relationship	74.5	80.6	79.5	90.3
Mean length of relationship (in yrs)	6.2	6.9	6.3	5.9
Length of relationship		<i>n</i> (%)		
<1–5 months	3 (8)	3 (5)	1 (3)	6 (11)
6–11 months	3 (8)	2 (3)	4 (11)	1 (2)
1–2 years	7 (19)	12 (21)	3 (9)	9 (16)
3–5 years	10 (28)	14 (24)	14 (40)	18 (32)
6–10 years	6 (17)	13 (22)	6 (17)	13 (23)
>10 years	7 (19)	14 (24)	7 (20)	9 (16)
			Mean (SD)	
Nervous System Arousal				
Composite	3.7 (1.1)	4.3 (0.9)	4.0 (0.9)	4.5 (1.1)
Heart rate	3.1 (1.1)	4.1 (1.0)	3.7 (1.0)	4.7 (1.2)
Breathing rate	3.3 (1.3)	4.0 (1.1)	3.7 (1.1)	4.4 (1.4)
Perspiration	4.5 (1.8)	4.6 (1.7)	4.7 (1.7)	4.4 (1.7)

Note: Mean length of relationship and length of relationship variables were calculated on persons who reported being in a relationship. Nervous system arousal ratings were based on an item response format of 1 to 7.

study. Of the approximate 10% who did not participate, the majority were either below the age of 18 (and therefore disqualified) or declined because they did not have enough time to complete the study before they began the ride. Because there were relatively short line-ups to begin the ride, this led to a somewhat smaller sample size of participants about to enter ($n = 104$) than exit the ride ($n = 147$).

Prospective participants who were at least 18 years old and who provided verbal consent were shown a black and white photograph of a person of the other gender. All male subjects were shown the same photograph of a female and all female subjects were shown the same photograph of a male. The male and the female in the photographs were approximately 22 years of age and both had brown hair and brown eyes. Using the same photographs, previous research reported average ratings of attractiveness for both the photographed male and female (4.72 and 4.84 for the male and females, respectively, on a Likert scale of 1 to 10) (Graziano, Jensen, Campbell, Shebilske, & Lundgren, 1993). Participants were told: "Please take a look at this photograph and complete this questionnaire." The questionnaire prompted the subjects to answer the following four attractiveness (1 item) and dating desirability (3 items) questions from "1-not at all," to "7-very much": 1) "How attractive would you say this person is?," 2) "If you were single, how much would you like to ask him/her on a date?," 3) "If you were single, how much would you like him/her to ask you on a date?," and 4) "If you were single, how much would you like to kiss him/her?" Males rated the photographed female; females rated the photographed male. A dating desirability composite was formed by calculating the mean of the latter three items (reliability coefficient $\alpha = .92$).

Participants were then asked to complete a questionnaire that measured demographic information (age, gender, relationship status, and sexual orientation), seatmate status ("Who sat/will sit next to you on this ride?"), attractiveness of seatmate ("How attractive would you rate the person who sat/will sit next to you on this ride?"), perceptions of anxiety about the ride, and three subjective ratings of nervous system arousal: 1) "Which of the following best describes your breathing rate?" (1 = *very slow* to 7 = *very fast*); 2) "Which of the following best describes your heart rate?" (1 = *very slow* to 7 = *very fast*), and 3) "Which of the following best describes the degree to which you are perspiring?" (1 = *not at all* to 7 = *a great deal*). A nervous system arousal composite was computed by calculating the mean of these latter three items (reliability coefficient $\alpha = .61$). Physiological measures of nervous system arousal were not taken in the experiment for both logistical reasons and because

we did not want to direct the participants' attention toward their physiological responses and, by doing so, lower the chances for excitation transfer to occur (Reisenzein & Gattinger, 1982).

To help ensure confidentiality of responses, when the participant completed the questionnaires they were instructed to fold their answer sheets in half and deposit them into a large blank envelope that held numerous other participants' answers. If during the interview the participant's companion/s attempted to view the participant's answers, they were told: "Please don't look at his/her answers. We would like the responses to be as confidential as possible." Male and female interviewers alternated between interviewing participants who were waiting in line and interviewing participants who had completed the ride. Interviewer gender was recorded on all subject answer sheets and the data were coded as to whether the researcher was of the same or opposite gender. Preliminary analyses showed no effect of the relation between experimenter and participant gender. Thus, the data were collapsed across this variable.

RESULTS

Subjective Ratings of Nervous System Arousal

Mean nervous system arousal ratings by group are presented in Table 1. A 2 (Sex) \times 2 (Time: Entry vs. Exit) ANOVA conducted on nervous system arousal composite scores indicated significantly higher ratings among individuals exiting versus entering the ride, $F(1, 244) = 16.14$, $p < .001$. Females reported significantly higher levels of nervous system arousal than did males, $F(1, 244) = 5.13$, $p = .024$. The significant main effect for time supports the assumption that autonomic nervous system arousal was increased with exposure to a roller-coaster ride in this study.

Ratings of the Photographed Male/Female

Mean (\pm SEMs) ratings of the photographed individual's attractiveness and dating desirability by group and seatmate status are presented in Figs. 1 and 2. Separate 2 (Sex) \times 2 (Time: Entry vs. Exit) \times 2 (Seatmate: Romantic vs. Nonromantic) ANOVAs were conducted on attractiveness ratings (1 item) and the composite measure of dating desirability. Results revealed a significant interaction between time and seatmate for rating of attractiveness, $F(1, 221) = 4.53$, $p = .035$, and a significant interaction between time and seatmate for ratings of

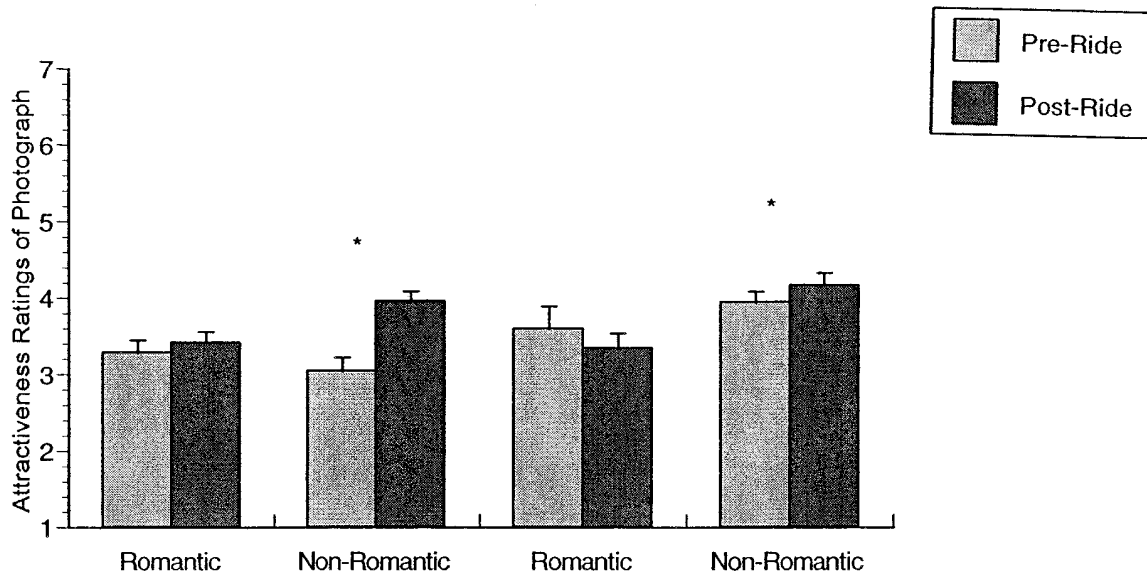


Fig. 1. Mean ratings (+/- SEMs) of the photographed individual's attractiveness by group and seatmate status.

dating desirability, $F(1, 221) = 3.93, p = .049$. Follow-up analyses indicated that, among individuals who were riding with a nonromantic partner, ratings of both attractiveness and dating desirability were higher among those exiting than those entering the roller-coaster ride, $t(135) = -2.48, p = .014, t(135) = -2.56, p = .012$, respectively. Effect sizes estimated using Cohen's d were .45 and .44 for attractiveness and dating desirability, respectively.

Among persons riding with a romantic partner, there were no significant differences in attraction ratings or dating desirability between individuals entering and exiting the ride. These findings are consistent with the hypothesis that residual arousal from riding a roller-coaster would enhance ratings of attraction toward the photographed individual but only among persons who did not have a nearby salient romantic partner.

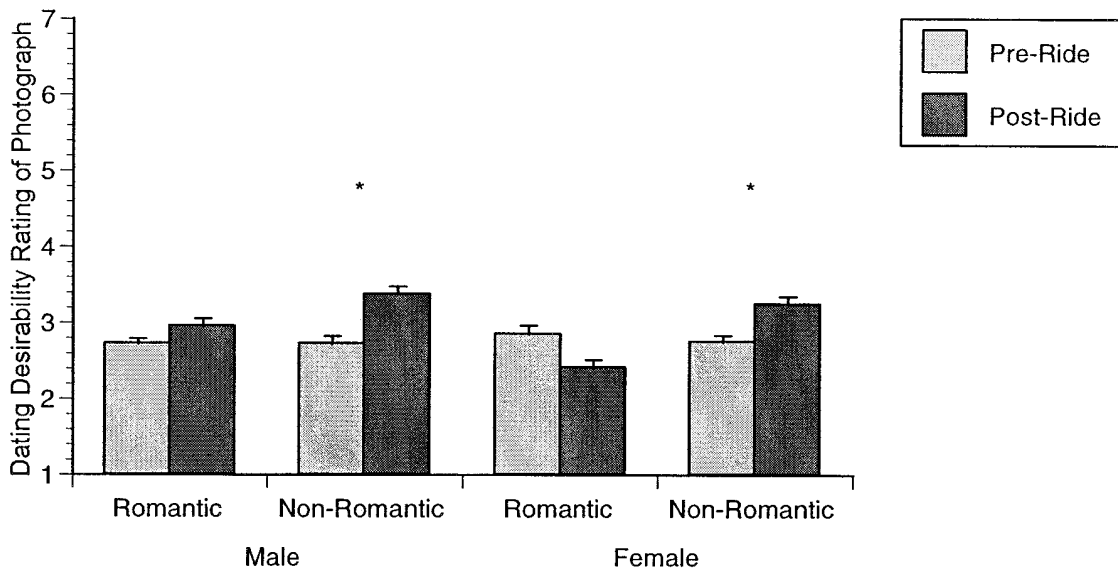


Fig. 2. Mean ratings (+/- SEMs) of the photographed individual's dating desirability by group and seatmate status.

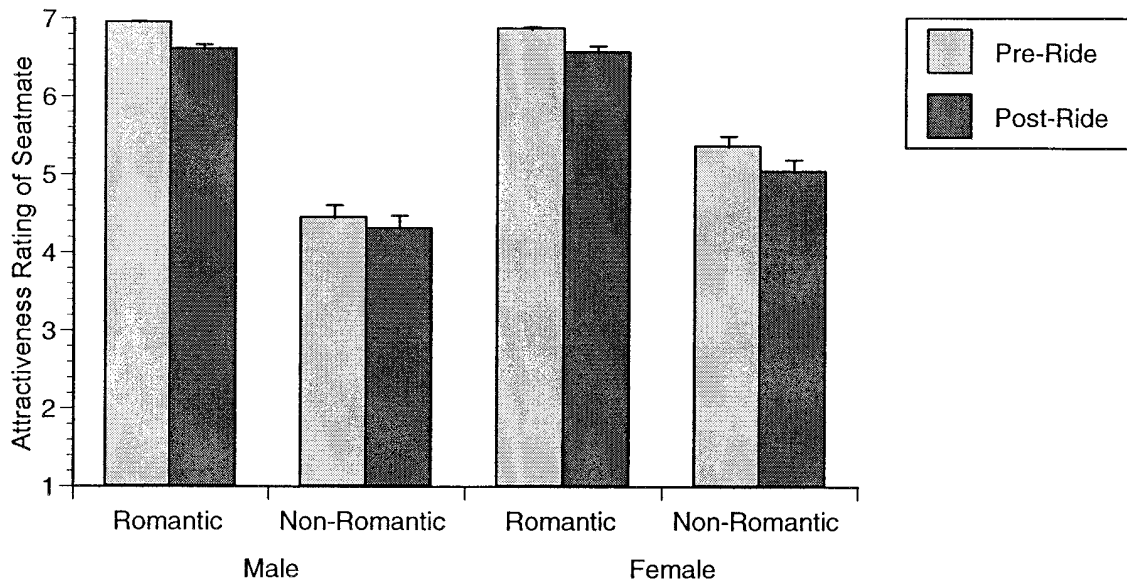


Fig. 3. Mean ratings (+/- SEMs) of seatmate attractiveness by group and seatmate status.

Ratings of Seatmate

Fig. 3 presents mean (+/- SEMs) ratings of seatmate attractiveness by group and seatmate status. A 2 (Sex) \times 2 (Time: Entry vs. Exit) \times 2 (Seatmate: Romantic vs. Nonromantic) ANOVA conducted on ratings of seatmate attractiveness (1 item) yielded a significant main effect for seatmate, $F(1, 221) = 82.24, p < .001$, and a significant interaction between seatmate and sex, $F(1, 221) = 3.93, p = .049$. Among persons riding with (or about to ride with) a nonromantic partner, females rated their seatmate as significantly more attractive than did males, $t(124) = -2.22, p = .028$. Among persons riding with (or about to ride with) a romantic partner, there were no significant differences in ratings of seatmate attractiveness between males and females. The interaction between seatmate and time was not significant ($F < 1$). This finding is inconsistent with our hypothesis that residual arousal from riding a roller-coaster would enhance ratings of seatmate attractiveness among persons riding with a romantic partner. In fact, as can be seen in Fig. 3, ratings of seatmate attractiveness were actually lower postride than prairie among persons riding with a romantic partner. Exploratory analyses indicated that when collapsed across gender this decrease was significant, $t(102) = 2.16, p = .033$.

DISCUSSION

Among persons riding with a nonromantic seatmate, ratings of attractiveness and dating desirability toward a

photographed individual were substantially higher among those who had completed, versus those about to begin, a roller-coaster ride. These findings are interpretable within the framework of excitation transfer theory in that residual arousal from riding a roller-coaster intensified participants' later experience of attraction. Previous studies have also found enhanced subjective perceptions of sexual attraction following a variety of arousal induction techniques (see Foster et al., 1998). Most studies have assessed the effects of arousal on male participants' perceptions of female attractiveness; this study is one of only a few to note these findings among females.

An alternative explanation for the above finding warrants mention. It may be the case that ratings of attraction toward the photographed individual were higher in persons who had completed versus those who were about to begin the roller-coaster ride due to an "anxiety relief" (Wolpe, 1978) experience rather than a misattribution of residual excitation. That is, the possible build up of nervous tension and perhaps even negative affect experienced by persons waiting to board the roller-coaster ride may have suppressed perceptions of attraction toward the photographed individual. Alternatively, or in addition, the "relief" experienced from having completed the ride may have led to heightened mood that, in turn, enhanced perceptions of attractiveness. Inconsistent with this explanation is the finding that ratings of attractiveness given by persons about to enter the ride were slightly below and slightly above the scale midpoint for males and females, respectively (males = 3.34; females = 3.78, on a Likert scale of 1 to 7). Previous research using the same photographs

reported attractiveness slightly below the scale midpoint for males and females (males = 4.72; females = 4.84, on a Likert scale of 1 to 10) (Graziano et al., 1993). If it were the case that preride anxiety suppressed ratings of attractiveness, one would expect the ratings to be considerably lower than those found under neutral (i.e., nonanxiety) laboratory conditions (e.g., Graziano et al., 1993).

Novel to this study is the finding that among persons riding with a romantic partner, perceptions of attraction were not greater in participants exiting versus those entering the ride. In other words, the presence of a romantic partner may have inhibited the misattribution of arousal to the photographed individual. We predicted that instead of increasing ratings toward the photographed person, among those riding with a romantic partner, the residual excitement would enhance perceptions of their seatmate's attractiveness. Contrary to these predictions, however, ratings of seatmate attractiveness were not higher among those persons exiting versus entering the ride. One explanation for this null finding is that objectively people may have simply looked less attractive post-roller-coaster ride. Sweating, messy hair, and "postanxiety expressions" may have made partners appear less physically attractive and this may have overridden any potential residual arousal enhancement of attraction. This would be consistent with the fact that ratings of partner attractiveness were actually lower among those persons exiting compared to those entering the ride.

It is also possible that persons riding with a romantic partner were more aware of the source of their arousal than were persons riding with a nonromantic partner. Romantic partners may have been more inclined post-ride to talk about how nervous or frightened they were on the ride than were persons riding alone or with a nonromantic seatmate. If so, the connection between their heightened arousal and having just gotten off of a roller-coaster would have been readily apparent to them. This feasibly could have interfered with arousal transference from occurring in person riding with a romantic partner given that excitation transfer is unlikely to occur when cues from the original source of arousal are evident (Cantor & Zillmann, 1973).

A third possible explanation for why residual arousal did not enhance perceptions of seatmate attractiveness among romantic partners is that, although we attempted to have participants keep their responses hidden from their seatmates, participants may have been concerned that their partners would read their responses and/or be interrogated later regarding their ratings. Consequently, individuals both entering and those exiting the ride may have given unrealistically high ratings of partner attractiveness. Consistent with this speculation is the fact that 75% of males both entering and exiting the ride and 89% of females

entering and 77% of those exiting rated their partners as "6" or "7" out of 7 on attractiveness. Of course, it may also be the case that partners did, in fact, believe that their seatmates were highly attractive (i.e., deserving of a 7/7 rating). Either way, the range restriction noted in these data render this particular finding difficult to interpret.

Consistent with the above speculation is the possibility that among long-term romantic partners arousal misattribution may be expressed in ways other than attractiveness ratings. Cohen et al. (1989) reported increases in affiliative behaviors such as talking and touching among couples that had just viewed a high-arousal suspense thriller compared with couples who had viewed a low-arousal movie. Possibly, among familiar persons transference is more likely to show up behaviorally in terms of desire for affection and intimacy than subjectively in terms of altered perceptions of attractiveness. Of course, it may also be the case that the effects of excitation transfer on perceptions of attractiveness are minimal, if at all apparent, among real-life romantic partners. Other factors known to influence interpersonal attraction, such as attitude similarity, personality, religion, intelligence, and social status (e.g., Buss & Barnes, 1986; Keller & Young, 1996), may play a more influential role in assessing attractiveness among long-term dating partners than the more subtle consequences of residual arousal. In other words, many factors are likely considered when rating the "attractiveness" of a romantic partner. Perhaps, then, excitation transfer plays a role in enhancing interpersonal attraction only among unfamiliar persons where less concrete information about the person is available.

A number of study limitations warrant mention. First, a within-participants design would have allowed us to examine the causal effects of residual arousal on perceived attraction. The rollercoaster ride was of short duration (5–10 min), however, and thus we were concerned that post-ride ratings would be highly influenced by preride ratings. The between-participants design enabled us to control for the influence of memory, but was nonetheless subject to other limitations. Specifically, we were unable to control for potential group differences that could account for the pre/postride differences in attraction ratings. While we found no significant differences between groups on age or length of relationship, other potential group differences such as relationship satisfaction or participant attractiveness may well have influenced the results.

Second, we defined "salient partners" in this study as those partners who were in close visible proximity to the participant during the ride. Some of the participants who were riding with a nonromantic seatmate did, however, report being in a relationship. Even though their romantic partners were not in close *visible* proximity while

participating in the experiment, participants may have been thinking about their romantic partner while on the ride and during the study and, if so, “mental salience” may have inhibited excitation transference from occurring in these individuals. While it is unlikely that this would have changed the general pattern of results, it could have artificially lowered the excitation transfer effect size among nonromantic seatmates. Unfortunately, the small sample size of participants when divided by sex, entry versus exit, and romantic versus nonromantic seatmate status, precludes examining whether there are further differences between these groups when broken down by relationship status.

In conclusion, we found that arousal from riding a roller-coaster was associated with increased ratings of attractiveness and dating desirability toward a photograph of an opposite-gendered individual, but only for persons who were not accompanied by a romantic partner. These findings extend past research of this nature by noting that real-life residual arousal may enhance sexually-relevant ratings in females, and by noting that for males and females this effect is moderated by whether or not a romantic partner is present. Future research that assesses other avenues of interpersonal attraction such as feelings of closeness, intimacy, desire for affection, and sexual activity may help to better understand whether misattribution of arousal can serve to enhance sexually-relevant perceptions of real-life dating partners.

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