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Capturing the Interpersonal Implications of Evolved Preferences? Frequency of Sex Shapes Automatic, but Not Explicit, Partner Evaluations

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Abstract

A strong predisposition to engage in sexual intercourse likely evolved in humans because sex is crucial to reproduction. Given that meeting interpersonal preferences tends to promote positive relationship evaluations, sex within a relationship should be positively associated with relationship satisfaction. Nevertheless, prior research has been inconclusive in demonstrating such a link, with longitudinal and experimental studies showing no association between sexual frequency and relationship satisfaction. Crucially, though, all prior research has utilized explicit reports of satisfaction, which reflect deliberative processes that may override the more automatic implications of phylogenetically older evolved preferences. Accordingly, capturing the implications of sexual frequency for relationship evaluations may require implicit measurements that bypass deliberative reasoning. Consistent with this idea, one cross-sectional and one 3-year study of newlywed couples revealed a positive association between sexual frequency and automatic partner evaluations but not explicit satisfaction. These findings highlight the importance of automatic measurements to understanding interpersonal relationships.

Keywords

relationship satisfaction, automatic processes, implicit attitudes, evolved preferences, sex, open materials

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From a theoretical standpoint, the frequency with which couples engage in sexual intercourse should be an important predictor of overall relationship evaluations. Although offspring can result from a single act of intercourse, there is reason to believe repeated intercourse in a committed relationship provides the greatest probability of successful reproduction (Grebe, Gangestad, Garver-Apgar, & Thornhill, 2013; Lorenz, Demas, & Heiman, 2015). Not only can repeated acts of sexual intercourse increase the long-term commitment that is ideal for child-rearing (Grebe et al., 2013), they also improve the chances of conception by increasing overall immune-system functioning (Lorenz et al., 2015). Accordingly, humans should have evolved a preference to engage in sex with their committed partners relatively frequently, and previous research suggests that such a preference indeed exists (Baumeister, Catanese, & Vohs, 2001; Schmitt, 2005). Given that relationship satisfaction should serve as a barometer of the extent to which people meet their evolved preferences (Meltzer, McNulty, Jackson, & Karney, 2014a; Shackelford & Buss, 1997), couples should be more satisfied with their relationships to the extent they engage in more frequent sex.

Nevertheless, studies assessing the association between sexual frequency and general relationship satisfaction have yielded ambiguous results. Although the frequency with which couples engage in sex has been positively associated with relationship satisfaction in numerous

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cross-sectional studies (e.g., Bodenmann, Ledermann, & Bradbury, 2007; Call, Sprecher, & Schwartz, 1995; Donnelly, 1993; Muise, Schimmack, & Impett, 2016), other cross-sectional studies have failed to document such associations (Heiman et al., 2011; Hurlbert & Apt, 1994). More important, longitudinal and experimental research, which provide a better test of causal effects of sex on satisfaction, have revealed no significant effects of sexual frequency on subsequent relationship satisfaction (Loewenstein, Krishnamurti, Kopsic, & McDonald, 2015; McNulty, Wenner, & Fisher, 2016; Schoenfeld, Loving, Pope, Huston, & Štulhofer, 2016). For example, McNulty et al. (2016) used two 4-year, eight-wave longitudinal studies of 207 married couples to demonstrate that sexual frequency did not positively predict changes in self-reported marital satisfaction from one wave of the study to the next. Likewise, Loewenstein et al. (2015) used a 3-month experimental study of 130 married couples to demonstrate that doubling the frequency with which couples engaged in intercourse had no positive effect on self-reported marital quality.[1]

But before concluding that sexual frequency has no implications for relationship evaluations, it is worth reconsidering how sexual experiences should manifest in interpersonal evaluations. So far, research on the association between sex and relationship satisfaction has relied exclusively on explicit reports of satisfaction. However, McNulty and Olson (2015) outlined a dual-process model of relationships that explains why explicit measures may not capture the implications of phylogenetically older evolved preferences. They argued that preferences for partner and relationship qualities that evolved in ancestral species, such as the preference for sexual intercourse, evolved before the capacity for complex deliberative reasoning that exists in humans. But with sufficient motivation and opportunity, these newer deliberative-reasoning processes allow humans to override their automatic inclinations while making explicit judgments and decisions (Fazio & Olson, 2014). Explicit reports of relationship satisfaction, then, likely reflect deliberately held beliefs regarding the extent to which sex is important to relationship satisfaction more than they reflect any evolved preferences for sex. For example, some individuals may desire to believe, and thus conclude, that their relationship is healthy despite infrequent sex, whereas other individuals may face cultural values that lead them to believe that sexual frequency is unimportant for relationship quality despite having frequent sex.

Although the ultimate reasons for any link between sex and relationship satisfaction may escape deliberative reasoning, the more proximate mechanism of such links should nevertheless emerge rather automatically. Most notably, the numerous positive affective responses that sexual intercourse produces (Carmichael et al., 1987; Sbarra & Hazan, 2008; Young & Wang, 2004) should automatically become more strongly associated with the partner as the frequency of sex increases. Indeed, a growing body of work indicates that attitudes assessed at the implicit level accurately track experiences with a given person, perhaps even better than do attitudes assessed explicitly (Betsch, Plessner, Schwieren, & Gütig, 2001; Epstein, 1994; Fazio & Olson, 2014; Jones, Olson, & Fazio, 2010; McNulty & Olson, 2015; Murray, Holmes, & Pinkus, 2010; Olson & Fazio, 2001, 2006). For example, Olson and Fazio (2006) used an evaluative conditioning paradigm to demonstrate that pairing pictures of Black targets with positive stimuli (and White targets with negative stimuli) reduced automatic but not explicit prejudice toward Blacks. Likewise, Murray et al. (2010) provided evidence for the same process in a more naturalistic interpersonal setting by showing that daily conflicts between newlywed couples predicted automatic evaluations better than they predicted explicit reports of marital satisfaction. Just as we argue that beliefs and motivations regarding the importance of sex for relationships can obscure associations between sexual frequency and explicit relationship satisfaction, these authors argued that motivated processes can obscure the association between conflict and explicit, but not automatic, interpersonal evaluations. In sum, automatic evaluative responses may be a broad proximate mechanism that promotes a host of adaptive responses, such as engaging in sex and avoiding conflict and rejection, and deliberate reasoning may at times override these automatic processes.

Overview

We used two studies of married couples to examine the association between sexual frequency and both automatic partner attitudes and explicit marital satisfaction. Given that humans have likely evolved to prefer repeated acts of sex in the context of committed relationships, and given that sex thus tends to produce numerous positive affective responses, we predicted that greater sexual frequency would be associated with more positive automatic attitudes toward the partner but would be unrelated to explicit relationship satisfaction.

Study 1

Method

Participants. Participants were drawn from a broader study of 120 newlywed couples (1 same sex, 119 opposite sex). Data collection was initially planned for 12 months, but was extended for 1 additional month to increase sample size. Neither member of 6 couples reported the couple's sexual frequency, 6 individuals did not complete the

measure of automatic partner attitudes, and an additional 6 individuals made errors on 20% or more of the trials on the automatic-partner-attitudes measure. These 24 individuals were thus excluded from analyses on the basis of an a priori decision. Participants were recruited via (a) community newspapers and bridal shops in northern Florida, (b) letters sent to couples in the area that had recently applied for marriage licenses, and (c) Facebook advertising. Participants were eligible if they (a) had been married for fewer than 3 months, (b) were at least 18 years old, and (c) spoke English (to ensure comprehension of questionnaires).

Husbands had a mean age of 31.82 years (*SD* = 9.95) and had completed 16.07 years of education (*SD* = 2.34). Seventy-one percent were employed full time, and 20% were full-time students. The mean income reported by these husbands was $29,768 per year (*SD* = $25,173). Twenty-four percent of husbands had been married at least once before their current relationship. Wives had a mean age of 29.69 years (*SD* = 7.70) and had completed 16.41 years of education (*SD* = 2.40).[2] Sixty-two percent were employed full time, and 21% were full-time students. The mean income reported by wives was $30,021 per year (*SD* = $49,946). Twenty-one percent of wives had been married at least once before their current relationship. Seventy-nine percent of husbands and 75% of wives self-identified as Caucasian. Twenty-five percent of couples had children.

Procedure. After enrolling in the study, couples were scheduled to attend a laboratory session and e-mailed a link to Qualtrics.com, where they individually completed surveys before their laboratory session. These questionnaires included reports of the frequency with which they had engaged in sex over the prior 4 months and several explicit measures of marital satisfaction. At their laboratory sessions, participants were photographed and then completed a computerized evaluative priming task that assessed their automatic attitudes toward their partner, as well as a variety of tasks beyond the scope of the current analyses. Couples were compensated $100 for completing the surveys and session.

Measures

Explicit marital satisfaction. In an attempt to be comprehensive, we used three different measures of explicit relationship satisfaction as well as the average of all three measures. The first measure was a version of the Semantic Differential (Osgood, Suci, & Tannenbaum, 1957), which required spouses to rate their perceptions of their marriage on 7-point scales between 15 pairs of opposing adjectives (e.g., *bad–good, dissatisfied–satisfied, unpleasant–pleasant*). This version of the Semantic Differential thus yields scores from 15 to 105, with higher scores reflecting higher levels of marital satisfaction. Reliability was high (husbands: α = .94, wives: α = .91). One husband did not complete this measure.

The second measure was the Quality Marriage Index (Norton, 1983). This scale required spouses to indicate their level of agreement with five items that describe the general quality of their marriage (e.g., "We have a good marriage") using a 7-point scale (1 = *very strong disagreement*, 7 = *very strong agreement*), and to rate their overall marital quality on a 10-point scale (1 = *very unhappy*, 10 = *perfectly happy*). Items were summed, so scores could range from 6 to 45, with higher scores reflecting higher levels of marital satisfaction. Reliability was high (husbands: α = .94, wives: α = .90).

The third measure was the Kansas Marital Satisfaction Scale (Schumm et al., 1986). This three-item measure uses a 7-point scale (1 = *very unsatisfied*, 7 = *very satisfied*) to assess spouses' global evaluations of their relationship by requiring them to indicate their agreement with the following items: (a) "How satisfied are you with your partner?" (b) "How satisfied are you with your relationship with your partner?" and (c) "How satisfied are you with your marriage?" The items were summed, and higher scores reflected higher levels of marital satisfaction. Reliability was high (husbands: α = .91, wives: α = .86).

In addition to using each measure in separate analyses, we created a composite measure that averaged across all three, after first standardizing each measure. Reliability of this composite was high (husbands: α = .94, wives: α = .92).

Sexual frequency. Participants reported the number of times they had engaged in sexual intercourse with their partner over the prior 4 months.[3] We used these reports to create two indices—one based on individuals' own reports and a second based on the average of both partners' reports. When one member of the couple did not report sexual frequency, the partner's report was used as the average of the couple's reports. Husbands reported having sex 31.48 times (*SD* = 23.36) over the 4-month period, wives reported having sex 29.07 times (*SD* = 22.47), and couples' average sexual frequency was 30.56 times (*SD* = 21.50). The correlation between partners' reports was .72 (see Table 1), and the absolute-agreement single-measures intraclass correlation coefficient (ICC) was .71.

Automatic partner attitudes. During their laboratory session, participants completed an evaluative priming task to measure their automatic attitudes toward their partner (see McNulty, Olson, Meltzer, & Shaffer, 2013). The task, modeled after one developed by Fazio, Jackson, Dunton, and Williams (1995), implicitly measures participants' self- and partner evaluations, as well as their evaluations of a set of opposite-sex strangers.[4]

Table 1. Correlations Between Variables in Study 1

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Semantic Differential	**.45****	.85**	.76**	.93**	−.07	−.00	.07	.12	.07	−.22*	−.37**	−.17
2. Quality Marriage Index	.85**	**.55****	.81**	.95**	−.14	−.08	.00	.13	.02	−.19*	−.41**	−.16
3. Kansas Marital Satisfaction Scale	.83**	.85**	**.40****	.92**	.03	.07	.02	.18	.01	−.10	−.31**	−.14
4. Explicit satisfaction aggregate	.94**	.95**	.94**	**.51****	−.06	−.00	.03	.16	.03	−.18*	−.39**	−.17
5. Individuals' estimate of sexual frequency	−.08	−.09	−.02	−.07	**.72****	.94**	.17	.11	−.13	.21*	.12	−.00
6. Couples' estimate of sexual frequency	−.11	−.07	−.05	−.08	.94**	**—**	.15	.10	−.09	.20*	.16	.05
7. Automatic partner attitudes	.02	−.05	.04	−.01	.13	.09	**.13**	.33**	.06	−.11	−.08	.13
8. Automatic self-attitudes	−.16	−.24*	−.17	−.20*	.04	.07	.17	**.03**	.45**	.01	−.07	.23*
9. Automatic attitudes toward strangers	−.10	−.14	−.18	−.15	−.03	−.01	.16	.02	**.04**	.03	−.05	.24*
10. Neuroticism	−.18	−.15	−.11	−.15	−.00	.05	−.12	−.07	−.03	**.03**	.35**	.25**
11. Depression	−.14	−.12	−.17	−.15	−.01	−.05	−.06	.10	−.01	.21*	**.09**	.20*
12. Explicit self-esteem	−.03	.02	.09	.03	.02	.00	.02	.12	−.05	.13	.08	**−.03**

Note: Correlations for husbands appear below the diagonal, correlations for wives appear above the diagonal, and correlations between partners appear on the diagonal in boldface.
*$p < .05$. **$p < .01$.

Each spouse completed three blocks of 48 trials each. In each block, they indicated the valence of eight positive and eight negative words that appeared in random order. The first block was an orientation block, during which spouses responded to the stimulus words after seeing a neutral prime (a row of asterisks) that appeared for 315 ms before each word. Participants were asked to indicate as quickly as possible whether the stimulus word was positive or negative by pressing a designated key on the computer keyboard.

The second and third blocks were the critical trials, during which spouses responded to the same words, but this time, those words were preceded by a 300-ms photo prime. Participants were told to pay attention to the pictures but to continue to respond to the meaning of the word. Three types of photos were used: (a) photos of the participant, (b) photos of his or her partner, and (c) photos of attractive opposite-sex strangers. Individuals appeared in one of four orientations in each photo: (a) a frontal view of the face, (b) a profile view of the face, (c) a frontal view of the entire body while standing, and (d) a frontal view of the entire body while sitting. During each of these critical trials, one photo preceded each word, and photos appeared in random order.

The time it took participants to indicate whether the target words were positive or negative was recorded. An index of spouses' automatic attitudes toward their partners was formed by subtracting the average time it took them to respond to positive words from the average time it took them to respond to negative words following exposure, in both cases, to picture primes of their partner. Thus, higher scores indicate slower reactions to negative words relative to positive words and thus more positive automatic evaluations of the partner. Separate indices were created in the same fashion for pictures of participants themselves and attractive opposite-sex strangers (used as covariates in supplemental analyses—see the next section). Implicit measures are generally reliable (Cunningham, Preacher, & Banaji, 2001), and the evaluative priming measure may be particularly reliable when people categorize the primes consistently (see Olson & Fazio, 2003), as people may be likely to do with pictures of a spouse. Further, any unreliability in this implicit measure should attenuate associations between sexual frequency and automatic partner attitudes. The distribution of these scores was relatively normal (skewness = .45, kurtosis = 0.49).

Covariates. We assessed and controlled for several potential confounds. Indices of each partner's automatic self-attitudes and automatic attitudes toward opposite-sex strangers were created by subtracting average reaction time to positive words from average reaction time to negative words following exposure to pictures of participants themselves and of opposite-sex strangers, respectively; these covariates also accounted for individual differences in response latencies generally. Neuroticism was assessed using the 60-item Neuroticism subscale of the International Personality Item Pool (IPIP; Goldberg, 1999; husbands: α = .95, wives: α = .96). Depressive symptoms were assessed with the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961; husbands: α = .81, wives: α = .87). Lastly, explicit self-esteem was assessed using the 10-item Rosenberg (1965) Self-Esteem Scale (husbands: α = .87, wives: α = .89).

Results

Correlations between variables appear in Table 1. To test the hypothesis that sexual frequency is related to automatic partner attitudes, we estimated 2 two-level models using the HLM computer program (Version 7.01; Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2013). In the first model, we regressed automatic partner attitudes onto individual estimates of sexual frequency over the prior 4 months and onto a dummy code of participants' gender (0 = male, 1 = female) at Level 1. We included a random intercept in the second level of the model to account for the nonindependence of partners' data. To avoid capitalizing on the fact that self-reports may be biased by individual factors (e.g., memory, definitions of sex), we created a second model to estimate the association between automatic partner attitudes and the mean of both partners' reports by regressing automatic partner attitudes onto an intercept and onto a grand-mean-centered dummy code of participant gender at Level 1. We then regressed the Level 2 intercept formed from that model onto the mean of both partners' reports of sexual frequency in the second level of the model.

Results (see Table 2) were consistent with predictions. Both individuals' and couples' estimates of sexual frequency were positively associated with automatic partner attitudes, though the effect involving couples' estimates was only marginally significant. Neither effect was moderated by participant gender—for individual estimates: b = 0.03, SE = 0.12, $t(69)$ = 0.30, n.s.; for couple estimates: b = 0.06, SE = 0.13, $t(103)$ = 0.44, n.s. Notably, after controlling for (a) automatic self-attitudes, (b) automatic attitudes toward opposite-sex strangers, (c) neuroticism, (d) depression, and (e) explicit self-esteem, we found that individuals' estimates of sexual frequency remained significantly positively associated with automatic partner attitudes, b = 0.17, SE = 0.07, $t(65)$ = 2.54, p = .014, effect-size r = .30, and couples' estimates became significantly positively associated with automatic partner attitudes, b = 0.13, SE = 0.06, $t(110)$ = 2.04, p = .043, effect-size r = .19.

Table 2 also displays the results of analyses in which each measure of explicit marital satisfaction was regressed onto either individuals' or couples' estimates of sexual

Table 2. Results of Hierarchical Linear Models of Sexual Frequency as a Predictor of Automatic and Explicit Interpersonal Evaluations in Study 1

	Predictor					
	Individuals' estimate of sexual frequency			Couple's estimate of sexual frequency		
Outcome	*b*	*r*	*df*	*b*	*r*	*df*
Automatic partner attitudes	0.15* (0.07)	.26	70	0.12† (0.06)	.18	110
Explicit evaluations						
Semantic Differential	−0.06 (0.09)	.08	73	−0.07 (0.10)	.07	111
Quality Marriage Index	−0.13 (0.08)	.19	74	−0.08 (0.11)	.07	111
Kansas Marital Satisfaction Scale	−0.01 (0.09)	.02	74	0.00 (0.09)	.00	111
Aggregate	−0.07 (0.09)	.10	74	−0.05 (0.10)	.05	111

Note: Standard errors are given in parentheses.
†$p < .10$. *$p < .05$.

frequency in the same manner. As can be seen, neither measure of sexual frequency was significantly associated with any of the explicit measures of marital satisfaction.

Discussion

Study 1 provided preliminary evidence that sexual frequency is associated with automatic but not explicit attitudes toward one's partner. Individuals' and couples' estimates of the number of times couples engaged in sex over the prior 4 months predicted more positive automatic partner attitudes, but both were unrelated to explicit marital satisfaction. That is, consistent with the idea that automatic evaluations may better capture the implications of meeting evolved interpersonal preferences, these results indicated that participants who had sex with their partners more frequently were more likely to have positive automatic attitudes toward their spouses, and those effects did not emerge on their explicit reports.

Nevertheless, the cross-sectional nature of Study 1 left conclusions vulnerable to an alternative interpretation: It is possible that more positive automatic attitudes predict more frequent sex. Although participants reported the frequency of sex that occurred prior to the measurement of their automatic partner attitudes, it might be that (a) participants' automatic partner attitudes influenced their reports of sexual frequency or (b) participants' earlier automatic partner attitudes, which were not assessed and controlled for, influenced the frequency with which they had sex. To address both possibilities, we employed a longitudinal design in Study 2 to examine the association between sexual frequency and *changes* in automatic partner attitudes. We expected sexual frequency to predict changes in automatic partner attitudes but not changes in explicit reports of relationship satisfaction.

Study 2

Method

Participants. Participants in Study 2 were 112 individuals (56 newlywed couples) drawn from a broader longitudinal study of 270 individuals (135 newlywed couples). The initial sample size was limited to the maximum number of couples that could be recruited during a 1-year time frame. Participants were recruited in east Tennessee using the same methods as in Study 1 (with the exception that there was no Facebook advertising). They were also prescreened using the same criteria as in Study 1, with the additional requirements that their current marriage was their first marriage, that each partner had completed at least 10 years of education, and neither partner had children.

The current analyses were limited to 112 of these newlyweds because they were the only ones who completed the laboratory portion of the sixth wave of assessment, which was the only assessment that included a second measure of automatic evaluations. The individuals involved in the broader study who did not complete this wave of measurement (a) had divorced ($n = 22$), (b) had discontinued their participation ($n = 16$), (c) were unable to schedule a laboratory session (e.g., because they had moved from the study location) but completed questionnaires through the mail ($n = 34$), or (d) did not respond to the solicitation ($n = 86$). The individuals who participated at this wave of data collection did not differ from those who did not participate on any of the primary baseline measures examined here.

At baseline, the husbands examined here had a mean age of 26.5 years ($SD = 4.6$) and had completed 16.8 years of education ($SD = 2.4$). Seventy percent were employed full time, and 30% were full-time students. Individuals reported on income ranges, rather than exact

income, and the median income range reported by husbands was $25,001 to $30,000 per year. Wives had a mean age of 24.4 years (*SD* = 3.8) and had completed 19.4 years of education (*SD* = 2.1). Fifty-four percent were employed full time, and 32% were full-time students. The median income range reported by these wives was $10,001 to $15,000 per year. Eighty-eight percent of husbands and 91% of wives self-identified as Caucasian.

Procedure. At baseline, all 270 newlyweds (135 couples) attended a laboratory session. Before that session, they were mailed a packet of questionnaires to complete at home and bring with them to their appointment. This packet included a consent form approved by the local institutional review board and self-report measures of sexual frequency, marital satisfaction, and various individual-differences variables that served as covariates, as well as a letter instructing spouses to complete all questionnaires independently of their partner and to bring their completed questionnaires to their upcoming laboratory session. At the session, both members of the couple were photographed and completed measures of automatic partner attitudes. Couples were paid $80 for participating in this phase of the study.

As part of the broader aims of the study, couples were recontacted by phone or e-mail every 6 to 8 months and asked to complete various self-report measures, including the frequency with which they had engaged in sex with their partner over the past 6 months. The fifth of these follow-ups (Time 6), which occurred approximately 3 years after baseline, was another laboratory session that resembled the first. Before that session, couples were once again mailed self-report measures of sexual frequency and marital satisfaction that they completed at home. At this second session, couples were once again photographed and completed the same measures of automatic self- and partner evaluations. Couples were paid $80 for participating in this phase of the study.

One wife at baseline and one wife at the 3-year follow-up experienced equipment failures on the evaluative priming assessment. Of the remaining 110 individuals, two husbands and three wives at baseline and one additional husband at the 3-year follow-up made errors on 20% or more of the trials of the evaluative priming assessment and were thus excluded from analyses, which left a total of 104 individuals for all analyses involving automatic attitudes.

Measures

Sexual frequency. At each wave of measurement, participants provided a numerical estimate of the number of times they had engaged in sex with their partner over the prior 6 months, which was the interval between longitudinal assessments. We used a mean of the reports provided between the baseline session and the fifth follow-up (Times 2–6) as an estimate of the frequency with which couples had engaged in sex over the prior 3 years. Once again, we conducted two sets of analyses—one based on these individual estimates and a second based on a couple-level estimate that was averaged across partners. Over the duration of the study, husbands reported having sex an average of 54.84 times (*SD* = 50.62) over every 6-month period, wives reported having sex 53.41 times (*SD* = 50.74), and couples' estimates averaged 55.36 times (*SD* = 49.27). The cross-spouse correlation between these average reports was .83 (see Table 3), and the absolute-agreement single-measures ICC was .88.

Explicit relationship satisfaction. Before both laboratory assessments, participants completed the same three measures of explicit marital satisfaction used in Study 1 (all αs > .85). Once again, we conducted analyses using all three as well as their aggregate. Reliability of the composite was again high (at Time 1—husbands: α = .84, wives: α = .93; at Time 6—husbands: α = .88, wives: α = .95).

Automatic partner attitudes. Automatic partner attitudes were assessed using the same procedure as in Study 1. Both assessments (baseline and Time 6) used photographs of the partner taken at the corresponding session. The distribution of these scores was once again relatively normal (at Time 1: skewness = .10, kurtosis = 0.47; at Time 6: skewness = .77, kurtosis = 2.6).

Covariates. The same potential confounds examined in Study 1 were assessed in Study 2. Indices of each partner's automatic self-attitudes and automatic attitudes toward opposite-sex strangers were again created by subtracting average reaction time to positive words from average reaction time to negative words following exposure to pictures of participants themselves and of opposite-sex strangers, respectively.[5] Neuroticism was again assessed using the Neuroticism subscale of the IPIP (Goldberg, 1999; husbands: α = .77, wives: α = .72). Explicit self-esteem was again assessed using the 10-item Rosenberg (1965) Self-Esteem Scale (husbands: α = .80, wives: α = .84). Depression symptoms were assessed using the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977; husbands: α = .82, wives: α = .84).

Results

Correlations between measures appear in Table 3. To test the prediction that spouses' sexual frequency would predict changes in their automatic partner attitudes, we again estimated 2 two-level models using the HLM 7.01 computer program. In the first model, we regressed spouses' automatic partner attitudes at Time 6 onto their automatic

Table 3. Correlations Between Variables in Study 2

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. T1 Semantic Differential	**.37****	.82**	.80**	.93**	−.05	.02	−.11	−.23*	−.29**	.23**	.21*	.22*	.40**	.35**	.42**	.40**	.09
2. T1 QMI	.76**	**.35****	.82**	.94**	−.08	.04	−.06	−.15	−.27**	.19*	.20*	.20*	.43**	.41**	.47**	.45**	.02
3. T1 KMS	.72**	.85**	**.34****	.93**	−.02	.04	−.03	−.03	−.22*	.14	.22**	.19*	.44**	.44**	.52**	.48**	.08
4. T1 explicit aggregate	.90**	.94**	.93**	**.39****	−.05	.04	−.07	−.14	−.27**	.20*	.23**	.22*	.46**	.44**	.51**	.49**	.07
5. T1 automatic partner attitudes	.04	.06	.01	.04	**−.00**	.29**	−.01	.09	.22*	−.26**	.06	.11	.17	.10	.11	.13	.35*
6. T1 automatic self-attitudes	−.01	−.02	−.03	−.02	.21*	**.02**	−.08	.01	.10	−.07	.07	.11	−.12	−.20	−.15	−.16	.41**
7. T1 automatic other attitudes	−.09	−.03	−.08	−.07	.11	−.01	**−.12**	−.14	−.05	−.00	.02	.00	−.02	.04	−.01	.00	−.13
8. T1 neuroticism	−.24**	−.27**	−.22*	−.26**	.05	.13	.14	**−.03**	.44**	−.41**	−.05	−.02	−.21	−.12	−.18	−.17	−.01
9. T1 depression	−.20*	−.24**	−.23**	−.24**	.01	−.10	.06	.52**	**.13**	−.52**	−.02	−.01	−.11	−.06	−.06	−.08	.13
10. T1 explicit self-esteem	.36**	.33**	.30**	.36**	.06	.03	−.04	−.54**	−.63**	**.19***	−.07	−.07	.27*	.30*	.21	.27*	−.06
11. T6 couples' sexual frequency	.22**	.20*	.16	.21*	−.03	−.05	−.04	−.01	.03	−.03	—	.96**	.10	.12	.08	.10	.08
12. T6 individuals' sexual frequency	.25**	.24**	.19*	.25**	−.01	−.06	−.03	.02	.05	−.05	.96**	**.83****	.07	.08	.05	.07	.11
13. T6 Semantic Differential	.47**	.34**	.45**	.45**	−.12	−.14	−.04	−.27*	−.23*	.25*	.06	.09	**.37****	.90**	.94**	.97**	.15
14. T6 QMI	.48**	.40**	.45**	.47**	−.05	−.08	−.01	−.24*	−.27	.20	.18	.21	.88**	**.38****	.90**	.96**	.08
15. T6 KMS	.37**	.26*	.45**	.39**	−.07	−.12	.00	−.17	−.14	.27	.15	.19	.83**	.79**	**.35****	.97**	.17
16. T6 explicit aggregate	.47**	.35**	.48**	.46**	−.09	−.12	−.02	−.24*	−.23	.26	.13	.17	.96**	.94**	.93**	**.40****	.14
17. T6 automatic partner attitudes	.15	.22	.14	.18	.15	.24	.01	.06	.00	.15	.02	.04	−.07	−.15	−.01	−.08	**.32***

Note: Correlations for husbands appear below the diagonal, correlations for wives appear above the diagonal, and correlations between partners appear on the diagonal in boldface. Correlations are from assessments made at Time 1 (T1) and at a follow-up assessment at Time 6 (T6; 3 years later); estimates of sexual frequency at Time 6 were averaged from estimates made at Times 2 through 6. KMS = Kansas Marital Satisfaction Scale, QMI = Quality Marriage Index.
*$p < .05$. **$p < .01$.

Table 4. Results of Hierarchical Linear Models of Sexual Frequency as a Predictor of Changes in Automatic and Explicit Interpersonal Evaluations in Study 2

	Predictor					
	Individuals' estimate of sexual frequency			Couples' estimate of sexual frequency		
Outcome	*b*	*r*	*df*	*b*	*r*	*df*
Changes in automatic partner attitudes	0.13* (0.06)	.31	43	0.08† (0.05)	.23	53
Changes in explicit evaluations						
Semantic Differential	0.00 (0.05)	.01	70	0.01 (0.06)	.03	70
Quality Marriage Index	0.04 (0.05)	.10	70	0.07 (0.05)	.17	70
Kansas Marital Satisfaction Scale	0.04 (0.07)	.07	70	0.03 (0.06)	.06	70
Aggregate	0.01 (0.05)	.03	70	0.02 (0.05)	.05	70

Note: Standard errors are given in parentheses.
†$p < .10$. *$p < .05$.

partner attitudes at baseline and onto their individual estimates of sexual frequency, as averaged over the intervening 3 years, as well as onto a grand-mean-centered dummy code of participant gender at Level 1. We also included a random intercept in the second level of the model to account for the nonindependence of partners' data. To again protect against capitalizing on self-report bias, we created a second model to regress spouses' automatic partner attitudes at Time 6 onto their automatic partner attitudes at baseline and onto a grand-mean-centered dummy code of participant gender at Level 1. We then regressed the Level 2 intercept from that model onto the mean of both partners' reports of sexual frequency averaged across the 3 years. Given that some couples completed more of the intervening assessments than did others, we also controlled for the number of assessments completed by each couple on the Level 2 intercept in both models. Additionally, to ensure that any changes in performance on the associative priming task were not due to changes in attitudes toward the positive and negative words themselves, we also controlled for the difference in reaction times to the words in the orientation block when examining changes in automatic partner attitudes.

Results (reported in Table 4) were consistent with predictions and consistent with the results of Study 1. Individuals' estimates of sexual frequency were significantly positively associated with changes in automatic partner attitudes, and couples' estimates of sexual frequency were marginally positively associated with changes in automatic partner attitudes. As in Study 1, neither effect was moderated by participant gender—for individuals' estimates: $b = 0.05$, $SE = 0.18$, $t(42) = 0.27$, n.s.; for couples' estimates: $b = -0.00$, $SE = 0.21$, $t(43) = -0.02$, n.s. Also as in Study 1, controlling for (a) automatic self-attitudes, (b) automatic attitudes toward opposite-sex strangers, (c) neuroticism, (d) depression, and (e) explicit self-esteem did not alter these results—for individuals' estimates: $b = 0.12$, $SE = 0.06$, $t(38) = 2.04$, $p = .048$, effect-size $r = .31$; for couples' estimates: $b = 0.08$, $SE = 0.05$, $t(53) = 1.74$, $p = .087$, effect-size $r = .23$.

Table 4 also displays the results of analyses in which each measure of explicit marital satisfaction was regressed onto either individuals' or couples' estimates of sexual frequency in the same manner. As can be seen, neither measure of sexual frequency was significantly associated with changes in any of these measures of explicit marital satisfaction.

General Discussion

The current studies demonstrate that sexual frequency predicts spouses' automatic but not explicit interpersonal evaluations. In Study 1, reports of the number of times couples engaged in sex over the past 4 months predicted participants' automatic evaluations of their partners but not their explicit evaluations. In Study 2, this same association emerged longitudinally: Reports of the number of times couples engaged in sex over a 3-year interval predicted changes in participants' automatic partner evaluations but not their explicit evaluations over that same interval. Providing confidence in the key effect, this finding emerged in two independent studies, using both individual and couple estimates of sexual frequency, as well as three different measures of explicit relationship satisfaction.

Several limitations of this research should be considered until these results can be replicated and extended. First, the measure of sexual frequency was relatively coarse, which makes it possible that these reports were biased by individual-differences factors that explain these associations, such as memory or definitions of sex. Although the supplemental analyses using the average of couple members' reports helps assuage such concerns, any such individual differences may highlight key features of sex that are particularly likely to be associated with

automatic partner evaluations. For example, it may be that high-quality sex or sex that results in orgasm was most memorable, most likely to get reported, and most likely to be associated with automatic attitudes. Future research, perhaps using more precise daily measures of sex, may benefit from addressing these issues. Second, both studies relied on newlywed couples. Given that the effects of sexual frequency on automatic attitudes may be different for couples in different phases of their relationship, future research may benefit from examining such associations in other samples. Likewise, in line with the evolutionary perspectives that guided this research, future research may also benefit by examining whether these effects are stronger when sex occurs during the fertile window than during nonfertile periods. Finally, although Study 2 employed a longitudinal design, which helps assuage concerns regarding the direction of effects, and although both studies demonstrated that the effects were robust to several potential confounds, both studies were correlational, and thus causal conclusions should be drawn with caution.

These limitations notwithstanding, these results have important theoretical implications. Most notably, they help to reconcile ambiguous findings concerning the association between sexual frequency and relationship satisfaction and thereby highlight the potential importance of automatic evaluations to research on evolved partner preferences. Indeed, recent research has challenged the assumption that people are more satisfied to the extent that they meet partner preferences that likely evolved in ancestral species (e.g., Eastwick, Luchies, Finkel, & Hunt, 2014). Although subsequent research (Meltzer et al., 2014a, 2014b) has demonstrated that such preferences can shape even explicit reports, the current work suggests the value of implicit measures to such lines of research. In fact, implicit measures of both preferences and evaluations may yield the strongest associations between partner preferences that evolved before deliberative thought and subsequent relationship evaluations (see McNulty & Olson, 2015). Future research may benefit by systematically examining the extent to which automatic measures are indeed better at capturing the implications of a variety of evolved preferences, such as those involved in partner choice.

These findings also have important implications for understanding relationships more broadly. The fact that more frequent sex, an activity that associates the partner with positive affect, produces more positive automatic partner evaluations is important to understanding the sources of automatic partner evaluations. Although automatic partner evaluations play a crucial role in relationship development (see McNulty et al., 2013), very little is known about their sources. As noted earlier, Murray et al. (2010) demonstrated that one source of more negative automatic evaluations is conflict. Indeed, just as sex associates the partner with positive affect, conflict associates the partner with negative affect. Taken together, these two studies suggest that, just like automatic attitudes in other domains (Betsch et al., 2001; Jones et al., 2010; Olson & Fazio, 2006), automatic partner attitudes may more purely index pleasing and displeasing interpersonal events. Such findings suggest that partner attitudes can be evaluatively conditioned in the same manner as other attitudes (e.g., Olson & Fazio, 2001, 2006). And the fact that such automatic evaluations eventually predict behavior when the opportunity to control them (e.g., the presence of self-regulatory resources) is low (Fazio & Olson, 2014) may explain why they ultimately give rise to explicit evaluations (McNulty et al., 2013; for a related discussion, see McNulty & Olson, 2015).

Action Editor

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Author Contributions

A. L. Meltzer designed the study hypotheses. J. K. McNulty designed the studies and oversaw data collection. M. A. Olson designed the implicit measures. L. L. Hicks and J. K. McNulty conducted data analyses. L. L. Hicks and J. K. McNulty prepared the first draft of the manuscript, and all authors contributed to and approved the final version of the manuscript for submission.

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The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Open Practices

All materials have been made publicly available via the Open Science Framework and can be accessed at https://osf.io/rk6up/. The complete Open Practices Disclosure for this article can be found at http://pss.sagepub.com/content/by/supplemental-data. This article has received the badge for Open Materials. However, as noted by Finkel, Eastwick, and Reis (2015), publicly sharing data from studies of romantic couples risks violating participants' confidentiality, as one spouse may identify his or her partner's data using knowledge or reasonable guesses about that partner's responses to certain questions. For this reason, we chose not to apply for an Open Data badge. More information about the Open Practices badges can be found at https://osf.io/tvyxz/wiki/1.%20View%20the%20Badges/ and http://pss.sagepub.com/content/25/1/3.full.

Notes

1. Although Loewenstein et al.'s (2015) article focuses mostly on the effects of the manipulation on self-reported mood, the first author confirmed that there were no effects of the manipulation on marital quality (personal communication, July 21, 2015).
2. Both partners in the same-sex couple were included in wives' descriptive statistics.
3. The analyses in Study 1 were cross-sectional analyses taken from the first time point in a longitudinal study. A 4-month interval between time points was established as part of the broader goals of the study; therefore, participants reported their sexual frequency in the 4 months prior to the beginning of the study.
4. The same-sex couple evaluated same-sex strangers.
5. In a prior study based on this sample (McNulty, Baker, & Olson, 2014), automatic self-attitudes were used to predict changes in automatic attitudes toward the partner. Demonstrating that sexual frequency predicted changes in automatic partner attitudes independent of this control confirms that the current findings are empirically distinct from the findings reported in that previous article.

References

Baumeister, R. F., Catanese, K. R., & Vohs, K. D. (2001). Is there a gender difference in strength of sex drive? Theoretical views, conceptual distinctions, and a review of relevant evidence. *Personality and Social Psychology Review*, *5*, 242–273.

Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry*, *4*, 561–571.

Betsch, T., Plessner, H., Schwieren, C., & Gütig, R. (2001). I like it but I don't know why: A value-account approach to implicit attitude formation. *Personality and Social Psychology Bulletin*, *27*, 242–253.

Bodenmann, G., Ledermann, T., & Bradbury, T. N. (2007). Stress, sex, and satisfaction in marriage. *Personal Relationships*, *14*, 551–569.

Call, V., Sprecher, S., & Schwartz, P. (1995). The incidence and frequency of marital sex in a national sample. *Journal of Marriage and the Family*, *57*, 639–652.

Carmichael, M. S., Humbert, R., Dixen, J., Palmisano, G., Greenleaf, W., & Davidson, J. M. (1987). Plasma oxytocin increases in the human sexual response. *The Journal of Clinical Endocrinology & Metabolism*, *64*, 27–31.

Cunningham, W. A., Preacher, K. J., & Banaji, M. R. (2001). Implicit attitude measures: Consistency, stability, and convergent validity. *Psychological Science*, *12*, 163–170.

Donnelly, D. A. (1993). Sexually inactive marriages. *Journal of Sex Research*, *30*, 171–179.

Eastwick, P. W., Luchies, L. B., Finkel, E. J., & Hunt, L. L. (2014). The predictive validity of ideal partner preferences: A review and meta-analysis. *Psychological Bulletin*, *140*, 623–665.

Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist*, *49*, 709–724.

Fazio, R. H., Jackson, J. R., Dunton, B. C., & Williams, C. J. (1995). Variability in automatic activation as an unobtrusive measure of racial attitudes: A bona fide pipeline? *Journal of Personality and Social Psychology*, *69*, 1013–1027.

Fazio, R. H., & Olson, M. A. (2014). The MODE model: Attitude-behavior processes as a function of motivation and opportunity. In J. W. Sherman, B. Gawronski, & Y. Trope (Eds.), *Dual-process theories of the social mind* (pp. 155–171). New York, NY: Guilford Press.

Finkel, E. J., Eastwick, P. W., & Reis, H. T. (2015). Best research practices in psychology: Illustrating epistemological and pragmatic considerations with the case of relationship science. *Journal of Personality and Social Psychology*, *108*, 275–297.

Goldberg, L. R. (1999). A broad-bandwidth, public-domain, personality inventory measuring the lower-level facets of several five-factor models. In I. Mervielde, I. J. Deary, F. De Fruyt, & F. Ostendorf (Eds.), *Personality psychology in Europe* (Vol. 7, pp. 7–28). Tilburg, The Netherlands: Tilburg University Press.

Grebe, N. M., Gangestad, S. W., Garver-Apgar, C. E., & Thornhill, R. (2013). Women's luteal-phase sexual proceptivity and the functions of extended sexuality. *Psychological Science*, *24*, 2106–2110.

Heiman, J. R., Long, J. S., Smith, S. N., Fisher, W. A., Sand, M. S., & Rosen, R. C. (2011). Sexual satisfaction and relationship happiness in midlife and older couples in five countries. *Archives of Sexual Behavior*, *40*, 741–753.

Hurlbert, D. F., & Apt, C. (1994). Female sexual desire, response, and behavior. *Behavior Modification*, *18*, 488–504.

Jones, C. R., Olson, M. A., & Fazio, R. H. (2010). Evaluative conditioning: The "how" question. In M. P. Zanna & J. M. Olson (Eds.), *Advances in experimental social psychology* (Vol. 43, pp. 205–255). San Diego, CA: Academic Press.

Loewenstein, G., Krishnamurti, T., Kopsic, J., & McDonald, D. (2015). Does increased sexual frequency enhance happiness? *Journal of Economic Behavior & Organization*, *116*, 206–218.

Lorenz, T. K., Demas, G. E., & Heiman, J. R. (2015). Interaction of menstrual cycle phase and sexual activity predicts mucosal and systemic humoral immunity in healthy women. *Physiology & Behavior*, *152*, 92–98.

McNulty, J. K., Baker, L. R., & Olson, M. A. (2014). Implicit self-evaluations predict changes in implicit partner evaluations. *Psychological Science*, *25*, 1649–1657.

McNulty, J. K., & Olson, M. A. (2015). Integrating automatic processes into theories of relationships. *Current Opinion in Psychology*, *1*, 107–112.

McNulty, J. K., Olson, M. A., Meltzer, A. L., & Shaffer, M. J. (2013). Though they may be unaware, newlyweds implicitly know whether their marriage will be satisfying. *Science*, *342*, 1119–1120.

McNulty, J. K., Wenner, C. A., & Fisher, T. D. (2016). Longitudinal associations among relationship satisfaction, sexual satisfaction, and frequency of sex in early marriage. *Archives of Sexual Behavior*, *45*, 85–97.

Meltzer, A. L., McNulty, J. K., Jackson, G., & Karney, B. R. (2014a). Men still value physical attractiveness in a long-term mate more than women: Rejoinder to Eastwick, Neff, Finkel, Luchies, and Hunt (2014). *Journal of Personality and Social Psychology*, *106*, 435–440.

Meltzer, A. L., McNulty, J. K., Jackson, G. L., & Karney, B. R. (2014b). Sex differences in the implications of partner physical attractiveness for the trajectory of marital satisfaction. *Journal of Personality and Social Psychology*, *106*, 418–428.

Muise, A., Schimmack, U., & Impett, E. A. (2016). Sexual frequency predicts greater well-being, but more is not always better. *Social Psychological & Personality Science*, *7*, 295–302.

Murray, S. L., Holmes, J. G., & Pinkus, R. T. (2010). A smart unconscious? Procedural origins of automatic partner attitudes in marriage. *Journal of Experimental Social Psychology*, *46*, 650–656.

Norton, R. (1983). Measuring marital quality: A critical look at the dependent variable. *Journal of Marriage and the Family*, *45*, 141–151.

Olson, M. A., & Fazio, R. H. (2001). Implicit attitude formation through classical conditioning. *Psychological Science*, *12*, 413–417.

Olson, M. A., & Fazio, R. H. (2003). Relations between implicit measures of prejudice: What are we measuring? *Psychological Science*, *14*, 636–639.

Olson, M. A., & Fazio, R. H. (2006). Reducing automatically activated racial prejudice through implicit evaluative conditioning. *Personality and Social Psychology Bulletin*, *32*, 421–433.

Osgood, C. E., Suci, G. J., & Tannenbaum, P. H. (1957). *The measurement of meaning*. Urbana: University of Illinois Press.

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1*, 385–401.

Raudenbush, S. W., Bryk, A. S., Cheong, Y. F., Congdon, R. T., & du Toit, M. (2013). HLM for Windows (Version 7.01) [Computer software]. Lincolnwood, IL: Scientific Software International.

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NJ: Princeton University Press.

Sbarra, D. A., & Hazan, C. (2008). Coregulation, dysregulation, self-regulation: An integrative analysis and empirical agenda for understanding adult attachment, separation, loss, and recovery. *Personality and Social Psychology Review*, *12*, 141–167.

Schmitt, D. P. (2005). Sociosexuality from Argentina to Zimbabwe: A 48-nation study of sex, culture, and strategies of human mating. *Behavioral & Brain Sciences*, *28*, 247–275.

Schoenfeld, E. A., Loving, T. J., Pope, M. T., Huston, T. L., & Štulhofer, A. (2016). Does sex really matter? Examining the connections between spouses' nonsexual behaviors, sexual frequency, sexual satisfaction, and marital satisfaction. *Archives of Sexual Behavior*. Advance online publication. doi:10.1007/s10508-015-0672-4

Schumm, W. R., Paff-Bergen, L. A., Hatch, R. C., Obiorah, F. C., Copeland, J. M., Meens, L. D., & Bugaighis, M. A. (1986). Concurrent and discriminant validity of the Kansas Marital Satisfaction Scale. *Journal of Marriage and the Family*, *48*, 381–387.

Shackelford, T. K., & Buss, D. M. (1997). Marital satisfaction in evolutionary psychological perspective. In R. J. Sternberg & M. Hojjat (Eds.), *Satisfaction in close relationships* (pp. 7–25). New York, NY: Guilford Press.

Young, L. J., & Wang, Z. (2004). The neurobiology of pair bonding. *Nature Neuroscience*, *7*, 1048–1054.