



Evolution, motivation, and the mating/parenting trade-off

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ABSTRACT

An evolutionary perspective on motivation implies an inverse relation between two motivational systems – one that regulates mate acquisition and the other that regulates parental care-giving. Study 1 ($N = 2252$) used correlational methods to test whether an inverse relation manifests at the level of chronic individual differences. Results revealed that short-term mating orientation (STMO) was inversely associated with a nurturant disposition toward children, but was positively associated with a protective disposition toward children. Studies 2 and 3 used experimental methods to test whether the inverse relation manifests at the level of temporary cognitive accessibility. Study 2 ($N = 92$) revealed that women (but not men) reported lower levels of STMO following an experimental procedure designed to activate the parental care motivational system. Conversely, results from Study 3 ($n = 308$) suggest that both men and women reported lower levels of tender emotional responses towards infants following an experimental procedure designed to activate the mate acquisition motivational system. Together, these results provide novel evidence bearing on the psychological manifestations of a mating/parenting trade-off, while also implicating additional variables that may affect the nature of these manifestations.

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From an evolutionary perspective, motivation is not simply conceptualized in terms of subjective experiences (e.g., needs), but is instead typically conceptualized in terms of underlying mechanisms that evolved to regulate behavior (Schaller, Kenrick, Neel, & Neuberg, 2017; Tooby, Cosmides, Sell, Lieberman, & Sznycer, 2008). Specific motivational systems are activated by the perception of functionally relevant stimuli. Once activated, they facilitate specific affective and attitudinal responses that, in ancestral environments, were likely to have been adaptive. Working within this framework, Kenrick and colleagues identified a set of “fundamental” motivational systems that are likely to have evolved in response to specific selection pressures, and that have unique implications within specific domains of social interaction (e.g., Kenrick, Griskevicius, Neuberg, & Schaller, 2010; Neel, Kenrick, White, & Neuberg, 2016).

In this article we focus specifically on two of these evolutionarily fundamental motivational systems: The mate-acquisition motivational system and the parental care-giving motivational system. We examine the possibility that there is a kind of psychological “tug of war”

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that exists between these two motivational systems, such that when one motivational system is more strongly activated, the other motivational system may be inhibited. This general thesis, and the specific hypotheses that follow from it, emerge from an application of basic principles of *life history theory* (Del Giudice, Gangestad, & Kaplan, 2016).

Life history theory and the mating/parenting trade-off

Life history theory draws upon evolutionary principles to predict organisms' developmental trajectories and behavioral strategies. Central to life history theory is the assumption that there is a finite supply of bioenergetic resources available to organisms; so, when resources are invested in the development or deployment of any specific physiological mechanism, those resources are unavailable for investment in other mechanisms. Though organisms differ in the total amount of resources they have available for investment (e.g., organisms with larger energy budgets can invest more than others into all systems; Reznick, Nunney, & Tessier, 2000), no organism's energy budget is unlimited. Developmental trajectories and behavioral strategies are therefore characterized by trade-offs.

One fundamental trade-off is between somatic growth and reproductive effort: When resources are allocated to building somatic tissue, investment in reproductive mechanisms is correspondingly withdrawn; and vice versa. Furthermore, even within the broad category of reproductive effort there is another fundamental trade-off. This is the trade-off between mating effort and parenting effort: When resources are allocated to mechanisms involved in the production of new offspring, there is a corresponding withdrawal of investment in mechanisms involved in the provision of parental care to existing offspring; and vice versa.

This mating/parenting trade-off manifests most obviously in cross-species comparisons. (E.g., some species produce many offspring and provide minimal parental care, whereas other species produce relatively few offspring and invest more resources in the provision of parental care.) The mating/parenting trade-off also manifests in specific kinds of within-species differences. Among humans, this trade-off is evident in well-documented sex differences, in which women not only exhibit relatively greater dispositional inclination toward parental caregiving but also relatively lower inclination toward the acquisition of new mates (Buckels et al., 2015; Jackson & Kirkpatrick, 2007). The trade-off is also evident in psychological changes that occur when people become parents. The onset of parenthood not only triggers greater investment in parental care-giving mechanisms, it also is associated with reduced investment in mating mechanisms – which is evident not only in behavioral changes but in hormonal changes as well, among both mothers and fathers (Gray, Kahlenberg, Barrett, Lipson, & Ellison, 2002; Kuzawa, Gettler, Huang, & McDade, 2010).

If indeed the development or deployment of a motivational system devoted to mating effort occurs at the strategic expense of the development or deployment of a motivational system devoted to parental care, then – in addition to the broad categorical differences between men and women and between parents and nonparents – there may be, more generally, a mutually inhibitory relationship between the mate acquisition and parenting motivational systems. There are two conceptually distinct ways in which such a psychological tug-of-war might manifest, each with different empirical implications. One manifestation occurs on a developmental timescale and implies a negative relation between chronic activation of the mate acquisition and parental care-giving motivational systems. The other manifestation pertains not to development, but to deployment: The temporary activation

of mating motives may temporarily inhibit activation of the parental care motivational system, and vice versa.

Developmental processes and chronic individual differences

Individuals differ in the extent to which specific motivational systems are chronically activated. These individual differences can be measured with self-report questionnaires assessing specific goals, attitudes, and affective responses (Beall & Tracy, 2017; Neel et al., 2016). For example, there are relatively stable individual differences in the extent to which the parental care-giving motivational system is chronically activated. One self-report measure assessing these individual differences – which are observed among non-parents as well as parents – is the *parental care and tenderness* scale (PCAT; Buckels et al., 2015). PCAT is comprised of multiple subscales that assess protective and nurturant behavioral inclinations toward young children as well as the extent to which the perception of young children elicits the distinct emotional response – tenderness – that signifies activation of the parental care-giving motivational system (Kalawski, 2010). There are also individual differences in the extent to which the mate acquisition motivation system is chronically activated. In many studies, this individual difference has been assessed with the *short-term mating orientation* (STMO) subscale of the sociosexual orientation inventory (SOI; Jackson & Kirkpatrick, 2007). A high level of STMO is characterized by positive attitudes toward sexually promiscuous behaviors, and is thus indicative of an underlying motivational mechanism regulating mate acquisition behavior, and also indicative an investment in mating effort.¹

Although these individual differences may have some genetic basis, they also appear to develop in response to environment influences. An extensive literature on phenotypic plasticity reveals that input from the environment guides the manner in which bioenergetic resources are allocated during development (e.g., Gluckman, Hanson, Spencer, & Bateson, 2005). Some of this research identifies specific aspects of individuals' early environment that disposes them toward an enduring life history strategy characterized by increased investment in mating mechanisms (Del Giudice, 2009; Ellis, 2004). Other developmental circumstances may dispose individuals toward increased investment in parental care mechanisms (Cabeza De Baca, Figueredo, & Ellis, 2012; Del Giudice, 2009). If indeed the development of mating mechanisms occurs at the strategic expense of the development of parental care mechanisms – as implied by the mating/parenting trade-off – there is a straightforward implication for chronic individual differences in motivational tendencies: A negative correlation between the chronic activation of the mate acquisition and parenting motivational systems.

Obliquely consistent with this hypothesis is evidence that individuals differ along coordinated suites of traits that correspond to “fast” vs. “slow” life-history strategies – a broad distinction that incorporates but is not specific to the distinction between mating effort and parenting effort (Figueredo et al., 2005). A more direct test of the hypothesis was reported by Neel et al. (2016) who, as part of a larger investigation into individual differences across a wide range of social motives, assessed parents' ($N = 665$) motivational inclinations to provide care to their children as well as their motivational inclinations toward mate acquisition. Results revealed a weak negative correlation. Beall and Schaller (2014) employed a different set of measures to test the hypothesis on a sample comprised by both parents and non-parents ($N = 305$), and found – among men but not women – a negative correlation between

individual differences in STMO and individual differences in tender emotional responses to infants. This effect among men held when statistically controlling for additional variables (parental status, LTMO) that could potentially produce spurious relations between STMO and parental tenderness.

These findings are intriguing, but rather preliminary. To more rigorously test the hypothesized negative relation between chronic activation of the mate acquisition and parenting motivational systems – and to test whether this relation might differ between men and women and between parents and nonparents – it will be useful to employ Beall and Schaller's (2014) methodological strategy on a substantially larger sample of participants. In doing so, it will also be useful to employ a more comprehensive measure of parental care-giving motives – one that not only assesses tenderness responses but also assesses protective inclinations that are conceptually distinct yet also central to the motivational psychology of parental care (Buckels et al., 2015; Fessler, Holbrook, Pollack, & Hahn-Holbrook, 2014; Hahn-Holbrook, Holt-Lunstad, Holbrook, Coyne, & Lawson, 2011). Study 1 was designed to accomplish these objectives.

Temporary activation and inhibition of motivational systems

Just as motivational inclinations vary across individuals, they vary across situations too. The mere perceptual appraisal of functionally-relevant stimuli is often sufficient to activate a specific motivational system. The mate acquisition motivational system may be temporarily activated by the mere perception of sexually attractive individuals or by events that connote potential opportunities for mating relationships (e.g., Baker & Maner, 2008; Griskevicius, Cialdini, & Kenrick, 2006; Maner et al., 2005). The parental care-giving system may be temporarily activated – even among nonparents – by the mere perception of infants, or by other stimuli that merely mimic the features of infants (such as cute kittens or puppies) or by events that connote the potential need to provide care (e.g., Eibach & Mock, 2011; Gilead & Lieberman, 2014; Glocker et al., 2009; Sherman, Haidt, & Coan, 2009).

Activation of each motivational system is characterized by specific affective and attitudinal responses that facilitate the expenditure of either mating effort or parenting effort (Beall & Tracy, 2017). Activation of the mate acquisition system is indicated by positive attitudes toward mate-seeking behavior and also by the emotional experience of sexual arousal (or lust), which facilitates sexual behavior as well as a variety of other behaviors that may increase the likelihood of successful mate acquisition (e.g., Ariely & Loewenstein, 2006; Ronay & von Hippel, 2010). In contrast, the signature emotion associated with the parental care-giving system is tenderness – a specific kind of compassionate response that is elicited by infants and other individuals who appear vulnerable and in need of protective, nurturant care (Kalawski, 2010). Activation of the parental care-giving system is also indicated by careful and protective attitudes more generally (Eibach & Mock, 2011; Gilead & Lieberman, 2014).

If, as implied by the mating/parenting trade-off, the context-specific activation of one of these motivational systems occurs at the strategic expense of the other system, then (a) activation of the parenting motivational system may temporarily inhibit activation of the mate acquisition system, and (b) activation of the mate acquisition system may temporarily inhibit activation of the parental care-giving system. Although several studies have used experimental manipulations that temporarily activate the parental care system and have tested its consequences (e.g., Eibach & Mock, 2011; Gilead & Lieberman, 2014; Sherman

et al., 2009), no experiments have directly tested whether its activation consequently inhibits the activation of attitudes or affective responses associated with mate acquisition. Similarly, while many studies have used experimental manipulations to temporarily activate the mate acquisition motivational system and have documented consequences for a wide range of psychological outcomes (e.g., Griskevicius et al., 2006; Li, Kenrick, Griskevicius, & Neuberg, 2012; Maner et al., 2005), we know of no published experiments that have directly tested whether its activation consequently inhibits the activation of attitudes or affective responses associated with the parental care system. Studies 2 and 3 were designed to fill these empirical gaps.

Overview of current studies

Study 1 employed correlational methods to test whether there is an inverse relationship between chronic individual differences in activation of the mate-acquisition and parental care-giving motivational systems. Participants completed measures assessing STMO as well as LTMO, and also completed the PCAT questionnaire (which containing five different subscales assessing both tender and nurturant responses toward children as well as inclinations to protect children from harm. Data were obtained from a large ($N = 2252$) and demographically diverse sample, allowing us to test hypothesized relations, and also to test whether those relations differed between men and women, and between parents and nonparents.

Studies 2 and 3 employed experimental methods to test whether the temporary activation of one motivational system would temporarily inhibit activation of the other. Study 2 tested the hypothesis that temporary activation of the parental care system has an inhibitory effect on attitudes favoring sexually promiscuous behavior (as assessed by STMO). Study 3 tested the hypothesis that temporary activation of the mate acquisition system has an inhibitory effect on parents' and non-parents' tenderness responses to babies.

Study 1

To assess chronic activation of the parental care-giving system, participants completed the PCAT questionnaire (Buckels et al., 2015), which – across five subscales – assesses nurturant and protective attitudes toward small children. To assess chronic activation of the mate-acquisition system, participants completed a self-report measure of STMO (Jackson & Kirkpatrick, 2007). We also assessed and statistically controlled for LTMO, which correlates with both PCAT and STMO (Beall & Schaller, 2014) – and so could potentially produce a spurious relation between them – but is not directly indicative of either mating effort or parenting effort (Neel et al., 2016).

Method

Participants

Participants were 2252 residents of the United States (972 men, 1280 women; 930 parents, 1322 non-parents; $M_{\text{age}} = 35$ years [$SD = 12.08$]) who completed the measures described below. (Subsamples of participants completed additional measures as well; these additional measures are not germane to the goals of this investigation, and so are not described below.)

Over approximately two years (April 2014–June 2016) participants with an approval rating of over 98% were recruited through Amazon.com's Mechanical Turk website in exchange for a modest monetary payment (\$0.25 - \$0.50 USD depending on the subsample). Procedures were administered and completed online, on the SurveyMonkey.com website.

Short-term and LTMO

Participants completed twenty items from the revised SOI (Jackson & Kirkpatrick, 2007). Ten of these items assess STMO (sample item: "I can easily imagine myself being comfortable and enjoying 'casual' sex with different partners"); ten additional items assess LTMO (sample item: "I would like to have a romantic relationship that lasts forever"). Participants responded to these items by indicating their agreement on a 7-point rating scale (1 = Strongly disagree; 7 = Strongly agree). We computed mean responses to each of the two sets of items, in order to create separate composite indices of STMO and LTMO (Cronbach's alphas = .95 and .94, respectively).

Parental care and tenderness

Participants also completed the 25-item PCAT questionnaire (Buckels et al., 2015). The PCAT questionnaire includes ten items describing scenarios involving babies and to which participants respond by rating how much tenderness they feel in response to each scenario (1 = No tenderness at all; 5 = A lot of tenderness), as well as fifteen additional self-descriptive items to which participants respond by rating their agreement on 5-point ratings scales (1 = Strongly disagree; 5 = Strongly agree).

In accordance with past research on the PCAT questionnaire (Buckels et al., 2015), we computed five different subscale scores, each of which was calculated as the mean response across five items. These subscales can be summarized as follows: (a) Tenderness aroused in situations involving generally positive stimuli (*Tenderness-Positive*; e.g., "A newborn baby curls its hand around your finger"); (b) tenderness aroused in situations involving negative stimuli (*Tenderness-Negative*; e.g., "You hear a child crying loudly on an airplane"); (c) liking of children (*Liking*; e.g., "I think that kids are annoying" [reverse-scored]); (d) caring responses toward children (*Caring*; e.g., "When I see infants, I want to hold them"); and (e) protective responses regarding children (*Protection*; e.g., "I would hurt anyone who was a threat to a child"). Cronbach's alphas for these five subscale scores ranged from .85 to .90.

Demographic information

All participants also completed a brief questionnaire assessing demographic details, including their age, their sex, and whether or not they had any children.

Results

Five preliminary regression analyses were conducted that included three demographic variables (sex, parenthood, age) as predictors of each of the PCAT subscale scores. Results revealed statistically significant effects of age on two subscale scores (Liking and

Tenderness-Negative; both p 's < .01). Results also revealed effects of sex and parenthood on all five subscale scores (p 's < .001). Therefore, in the primary analyses reported below, we statistically controlled for any effects of age, sex, and parenthood.

An additional preliminary analysis revealed a negative correlation between short-term and LTMO scores (STMO and LTMO; $r = -.34$, $p < .001$). Therefore, in the primary analyses reported below, we also statistically controlled for LTMO.

These primary analyses were five regression analyses, each of which included a different PCAT subscale as the dependent variable. For each analysis, five variables were entered simultaneously as predictors: age, sex (binary coding: Males = -1 ; Females = 1), parenthood (binary coding: Non-parents = -1 , Parents = 1), LTMO, and STMO. The unique effects associated with the first four of these predictor variables are not germane to the conceptual goals of the present investigation and so are not reported in detail here. (In general, results revealed higher PCAT subscale scores among older individuals, women, parents, and people with higher levels of LTMO.) What is germane are the unique relations between STMO and each of the five PCAT subscale scores. These results are summarized in Table 1.

These results reveal three things. First, there was no relation between STMO and the Tenderness-Positive subscale score ($\beta = -.01$, $p = .75$). Second, STMO was *negatively* related to the Tenderness-Negative, Liking, and Caring subscale scores (β 's = $-.14$, $-.09$, and $-.10$, respectively; p 's < .001). Third, there was a *positive* relation between STMO and the Protection subscale ($\beta = .08$, $p < .001$).

In addition to statistically controlling for sex and parenthood (as was done in the analyses reported immediately above), it may also be illuminating to examine the relations between STMO and PCAT subscale scores separately among male parents ($n = 316$), male non-parents ($n = 656$), female parents ($n = 614$), and female non-parents ($n = 666$). Therefore, we conducted five follow-up regression analyses within each of these four demographic categories. Each regression analysis included age, LTMO, and STMO as predictor variables. Table 2 summarizes the unique relations between STMO and each PCAT subscale score separately among male parents, male non-parents, female parents, and female non-parents. These results reveal that the pattern of relations described above (negative relations between STMO and Tenderness-Negative, Liking, and Caring; a positive relation between STMO and Protection) generally emerged among all four of these demographic categories; close examination of confidence intervals offers no compelling evidence that the magnitudes of any of these effects differ meaningfully between any of these demographic categories.

Table 1. Study 1: Relations between short-term mating orientation (STMO) and each subscale of the parental care and tenderness questionnaire (PCAT), as indicated by standardized regression coefficients (controlling for age, sex, parental status, and long-term mating orientation).

PCAT subscale	Relation with STMO		
	β	[95% CI]	p
Tenderness-positive	-.01	[-.05, +.04]	.75
Tenderness-negative	-.10	[-.14, -.05]	<.001
Liking	-.14	[-.19, -.10]	<.001
Caring	-.09	[-.13, -.05]	<.001
Protection	+.08	[+.04, +.12]	<.001

Note: $N = 2252$.

Table 2. Study 1: Relations between short-term mating orientation (STMO) and each subscale of the parental care and tenderness questionnaire (PCAT) within subsamples defined by sex and parental status, as indicated by standardized regression coefficients (controlling for age and long-term mating orientation).

PCAT subscale		Male participants		Female participants	
		Parents	Non-parents	Parents	Non-parents
Tenderness-positive	β [95% CI]	-.06 [-.18, +.05]	.00 [-.07, +.08]	+.03 [-.06, +.11]	-.03 [-.11, +.05]
Tenderness-negative	β [95% CI]	-.06 [-.18, +.06]	-.11** [-.18, -.03]	-.08 [†] [-.17, .00]	-.12** [-.20, -.04]
Liking	β [95% CI]	-.18** [-.30, -.06]	-.15*** [-.23, -.07]	-.13** [-.22, -.05]	-.14** [-.21, -.06]
Caring	β [95% CI]	-.19** [-.31, -.07]	-.09* [-.16, -.01]	-.11* [-.19, -.03]	-.08 [†] [-.16, .00]
Protection	β [95% CI]	+.07 [-.05, +.19]	+.14*** [+0.07, +.22]	+.05 [-.03, +.14]	+-.01[-.07, +.09]

[†] $p < .05$; ** $p < .01$; *** $p < .001$; [†] $p < .10$.

Discussion

Study 1 used correlational methods to test whether there is an inverse relationship between chronic activation of the mate acquisition and parenting motivational systems. The results provide informative corroboration of results reported previously (Beall & Schaller, 2014; Neel et al., 2016), while also revealing novel findings that highlight an important limitation associated with those prior results.

Corroboration is provided by results showing that (even when controlling for plausible confounding variables) individual differences in STMO were inversely related to individual differences in liking for children, caring responses to children, and the tendency for tender emotions to be aroused by the presence of children in ostensibly unpleasant contexts. These negative relations were of similar magnitude, regardless of whether participants were male or female, or whether they were parents or non-parents.

In addition to these negative relations, individual differences in STMO were *positively* associated with individual differences in protective responses regarding children. Protective responses represent an important – and conceptually distinct – facet of the parental care motivational system (Buckels et al., 2015; Hahn-Holbrook et al., 2011) that has not previously been examined in relation to STMO. This unexpected finding suggests a possible overlap in the mechanisms associated with the mate acquisition motivational system and protective parental attitudes; this overlap does not appear to exist between the mate acquisition motivational system and nurturant parental attitudes. We will return to this intriguing implication in the General Discussion, below.

Before doing so, we report the results of Studies 2 and 3, which – rather than testing correlations between chronic individual differences – were experiments designed to test whether temporary activation of the parenting motivational system causes temporary inhibition of the mate acquisition motivational system, and vice versa.

Study 2

STMO is typically employed as it was in Study 1 – as a measure of dispositional inclinations to acquire multiple mates. But it is also context-sensitive: STMO may be temporarily higher or lower, depending on the specific circumstances that individuals are in when they complete the measure (e.g., Murray, Jones, & Schaller, 2013). Therefore, in Study 2, we employed STMO as a dependent variable, and tested whether it is temporarily reduced when the parental care-giving system is temporarily activated.

In order to temporarily activate the parental care system, we drew upon previous research indicating the parental care system – and the emotional experience of tenderness that accompanies it – may be triggered by the visual perception of cute baby animals (Sherman et al., 2009). We designed an experimental manipulation such that, prior to completing the measure of STMO, participants in a key experimental condition were presented with images depicting cute kittens and puppies in apparent need for care.²

Method

Participants

Participants were 92 undergraduates at the University of British Columbia (42 men, 50 women; all non-parents; $M_{\text{age}} = 20$ years [$SD = 2.08$]) who were recruited through the university's human subject pool in exchange for extra credit in a psychology course and who completed the measures described below. Participants were randomly assigned to one of two experimental conditions.

Experimental manipulation

Participants were presented with a set of ten photographs, each of which was accompanied by a brief caption. (The participant viewed these stimuli over the course of two minutes, while the experimenter waited in a separate room.) These stimuli differed across two experimental conditions – one (the *Abandoned Pets* condition) that was designed to activate the parental care motivational system, and the other (the *Abandoned Furniture* condition) that was designed to serve as a control condition.

Participants in the *Abandoned Pets* condition were presented with photographs depicting cute puppies and kittens. (Stimulus photos were obtained from the internet on the basis of Google Images searches for “cute” or “adorable” puppies or kittens.) Each photo was accompanied by a caption suggesting that the animal was in need of care (e.g., “Found abandoned”; “Brown dog needs a home”).

Participants in the control condition (the *Abandoned Furniture* condition) were presented with photographs depicting pieces of household furniture (also obtained from the internet). Each photo was accompanied by a caption that was either identical (e.g., “Found abandoned”) or analogous to (e.g., “Brown couch needs a home”) the captions that were used in the *Abandoned Pets* condition.

Measures of Short-term and LTMO

Immediately following the manipulation, participants completed twenty items from the revised SOI (Jackson & Kirkpatrick, 2007; see Study 1 for details). As in Study 1, we computed separate composite indices of STMO (Cronbach's $\alpha = .77$) and LTMO (Cronbach's $\alpha = .86$). The measure of STMO served as the primary dependent variable.³

Individual Difference Measures

Participants then completed a set of questionnaires assessing individual differences. These included: a brief measure assessing demographic information (e.g., age, sex, parenthood);

an 18-item questionnaire assessing Need for Cognition (Cacioppo & Petty, 1982); and the 25-item PCAT questionnaire (Buckels et al., 2015). Analyses were conducted to test whether any of the primary results (reported below) were moderated by either Need for Cognition or PCAT. There was no evidence of meaningful moderating effects, and so these variables are not discussed further.⁴

Manipulation check

Finally, over the course of two minutes, participants were again presented with the ten photographs of pets/furniture that they had seen at the outset of the study (and which comprised the experimental manipulation). After viewing these stimuli, they were asked to “rate how much you experienced each of the following emotions while looking at the set of photographs.” Participants provided ratings for: *Tenderness, Caring, Responsibility, Anxiety, Sadness, Pride, Affection, Happiness, Compassion, Fear, and Disgust*; ratings were made on 6-point scales (1 = Not at all; 6 = Very much). We computed the mean rating of Tenderness, Caring, Affection, and Compassion in order to create a composite index (Cronbach’s alpha = .93) of the extent to which a tender emotional response was aroused by the slide-show. This measure served as a check on the success of the experimental manipulation. (Due to an experimenter error, one participant failed to complete this measure.)

Results

We conducted a 2 (Experimental Condition) × 2 (Sex) ANOVA on the manipulation check measure in order to assess whether the experimental manipulation was successful in arousing an emotional response (tenderness) indicative of the parental care-giving system, and to examine whether its effects might differ between men and women. Results revealed a significant main effect of condition: Compared to the Abandoned Furniture control condition ($M = 2.47$), greater tenderness was aroused in the Abandoned Pets condition, ($M = 4.96$), $F(1, 87) = 139.65, p < .001$. This effect was statistically significant effect among both women, $F(1, 48) = 125.54, p < .001$, and men, $F(1, 39) = 34.43, p < .001$. However, there was also a statistically significant interaction between experimental condition and sex, $F(1, 87) = 8.50, p = .005$. Examination of means revealed that the experimental manipulation had a greater impact on the manipulation check measure among women (M ’s = 2.20 and 5.20 in the Abandoned Furniture and Abandoned Pets conditions, respectively) than among men (M ’s = 2.91 and 4.73).

Did the experimental manipulation influence self-reported STMO? Means bearing on that question are presented in Table 3 and reveal that, compared to the Abandoned Furniture control condition, participants reported lower levels of STMO in the Abandoned Pets condition. LTMO was negatively correlated with STMO ($r = -.36, p = .001$), and so we included

Table 3. Study 2: Mean short-term mating orientation within each experimental condition.

	Abandoned furniture condition	Abandoned pets condition
Total sample	3.75 (1.47)	3.24 (1.52)
Male participants	3.93 (1.26)	3.83 (1.66)
Female participants	3.64 (1.60)	2.57 (1.02)

Note: Standard deviations are in parentheses.

LTMO as a covariate in a 2 (Experimental Condition) \times 2 (Sex) ANOVA on STMO. Results revealed that, in addition to the significant effects of the covariate ($p = .001$) and of sex ($p = .041$; men report relatively higher levels of STMO), the effect of the experimental manipulation on STMO was statistically significant, $F(1,87) = 7.86, p = .043$.

Sex did not significantly moderate the main effect of experimental condition on STMO, $F(1,87) = 2.30, p = .133$. Nonetheless, given results on the manipulation check, it seemed prudent to examine the effects of the experimental manipulation on STMO separately for women and men. (Relevant descriptive statistics are presented in Table 3). For each sex separately, we conducted an ANOVA on self-reported STMO, with the experimental manipulation as the sole independent variable and LTMO included as a covariate. For both women and men, the effect of the covariate was statistically significant (both p 's $< .03$). However, only among women was there also a statistically significant effect of the experimental manipulation, $F(1,47) = 13.30, p = .008$. Among men, the effect of the experimental manipulation was negligible, $F(1,39) = 0.15, p = .704$.

We conducted additional analyses to test whether the effects documented above generalized also to LTMO. To do so, we conducted a 2 (Experimental Condition) \times 2 (Sex) ANOVA on LTMO, with STMO included as a covariate. Results revealed no evidence of any effect of the experimental manipulation on LTMO, $F(1,87) = .587, p = .446$. Analogous analyses conducted on each sex separately also failed to reveal any effects of the experimental manipulation on LTMO (p 's = .541 and .613 for women and for men, respectively).

Discussion

The results of Study 2 provide the first empirical evidence that that temporary activation of the parenting motivational system may inhibit activation of the mate acquisition motivational system. Compared to women in a control condition, women who had been presented with photographs depicting abandoned puppies and kittens (a set of stimuli that aroused a tenderness response emblematic of the parental care motivational system) consequently reported lower levels of STMO.

It is notable that this effect was specific to STMO only; no such effect occurred on LTMO. STMO is defined by an attitudinal interest in pursuing sexual relationships with multiple mates, which is indicative of a mate acquisition motive and also connects straightforwardly to the underlying biological concept of mating effort. In contrast, LTMO is defined by an attitudinal interest in maintaining a single enduring relationship, which is less indicative of the mate acquisition motivational system, and also less clearly connected to the concept of mating effort (Neel et al., 2016). This result – the specificity of the effect to STMO – is therefore consistent with the logic of the mating/parenting trade-off.

In contrast to these results among women, there was no effect of the manipulation on STMO among men. This non-effect among men might simply reflect the finding (on the manipulation check) that the experimental manipulation was less effective in activating the parental care motivational system among men. But it is worthwhile also to consider the possibility that the inhibitory effect on mating attitudes truly occurs more readily among women than among men. A sex difference of this sort has been documented in other research on mating attitudes (increased disease threat is associated with reduced inclinations toward short-term mating among women, but not among men; Murray et al., 2013; Schaller & Murray, 2008). Perhaps these results reflect an analogous phenomenon. We discuss this possibility at greater length in the General Discussion.

Study 3

Whereas Study 2 tested whether temporary activation of the parental care system inhibits activation of the mate-acquisition system, Study 3 was designed to test whether temporary activation of the mate acquisition motivational system inhibits activation of the parental care system. To assess the latter, we focused on the emotional response – tenderness – that is associated with this particular motivational system (Kalawski, 2010). Participants were presented with an image of a cute infant and reported their emotional responses to it; the magnitude of self-reported tender emotions served as the primary dependent variable. We tested whether this tenderness response was temporarily reduced following procedures designed to temporarily activate the mate-acquisition motivational system.

Previous research indicates that the activation of the mate-acquisition system (as indicated by sexual arousal) occurs when people imagine sexually provocative scenarios (e.g., Chivers & Timmers, 2012). We designed an experimental manipulation such that, prior to completing the dependent measure, participants in a key experimental condition imagined themselves in a sexually arousing situation.

Method

Participants

Participants were 308 self-identified heterosexual residents of the United States (144 men, 164 women; 133 parents, 175 non-parents; $M_{\text{age}} = 37$ years [$SD = 12.50$]) who completed the measures described below. (These participants made up one of the subsamples included for analysis in Study 1.) Participants were recruited through Amazon.com's Mechanical Turk website in exchange for a payment of \$0.30 USD. Procedures were administered and completed online, on the SurveyMonkey.com website.

Experimental manipulation

The experimental manipulation was adapted from a procedure that has been previously used as an experimental induction of sexual arousal (Chivers & Timmers, 2012). Participants were presented with a photograph accompanied by a brief narrative vignette. The nature of the photograph, and its accompanying vignette, differed across two experimental conditions – one (the *Attractive Stranger* condition) that was designed to activate the mate acquisition motivational system, and the other (the *Neighborhood Walk* condition) that was designed to serve as a control condition. (See Supplemental Online Material for experimental materials used in Study 3).

Participants in the *Attractive Stranger* condition were presented with a photograph depicting a highly physically-attractive person of the opposite sex. Accompanying the photograph was a narrative describing an imagined situation in which the participant meets the pictured opposite-sex stranger, flirts with them, and eventually engages in a sexual act with them. The exact wording of this narrative necessarily differed depending upon whether participants were male or female, but the thematic content and narrative trajectory was highly similar. For both sexes, the narratives were 178 words long and described initial physical contact with the opposite-sex stranger at approximately the halfway point of the narrative (70 words before contact for female participants; 74 words before contact for male participants).

Participants in the control condition (the Neighborhood Walk condition) were presented with a photograph depicting a suburban neighborhood. Accompanying the photograph was a narrative describing an imagined situation in which the participant takes a leisurely stroll through the neighborhood and notices various things along the way. This narrative was identical in length to the erotic narratives in the Attractive Stranger condition (178 words).

The effectiveness of this manipulation was tested on a separate sample of 45 men and 63 women recruited from the same population. These participants were randomly assigned to either the Neighborhood Walk or the Attractive Stranger condition and then asked to rate, on 6-point scales (1 = Not at all; 6 = Very much), the extent to which they experienced various emotions while imagining the scenario. Included were ratings of *Sexually aroused* and *Lustful*. We computed the mean of these two ratings (Cronbach's alpha = .96) to create a composite index of the extent to which mate acquisition motives had been temporarily activated. A 2 (Experimental Condition) \times 2 (Sex) ANOVA revealed that, compared to the Neighborhood Walk condition ($M = 1.42$), greater sexual arousal was elicited in the Attractive Stranger condition, ($M = 4.68$), $F(1,104) = 193.41, p < .001$. There was no interaction between experimental condition and sex, $F(1,104) = 0.34, p = .56$. These results indicate that the experimental manipulation was effective in activating the mate acquisition motivational system, among both men and women.

Measure of parental tenderness

Following the manipulation, participants were presented with a photograph depicting a cute human baby. (The photograph was one of several stimulus photographs used successfully in previous research assessing tenderness responses to infants; see Beall & Schaller, 2014). Participants were asked to "rate the extent to which you experience the following emotions while viewing the photograph of this baby (above)." On 6-point rating scales (1 = Not at all; 6 = Very much), participants provided ratings for: *Tenderness, Caring, Responsibility, Anxiety, Sadness, Pride, Affection, Happiness, Compassion, Fear, and Disgust*. We computed mean ratings of Tenderness, Caring, Affection, and Compassion in order to create a composite index (Cronbach's alpha = .94) that served as the primary dependent variable.

Individual difference measures

Participants completed a set of questionnaires assessing individual differences. These included: a brief measure assessing demographic information (e.g., age, sex, parenthood, sexual orientation); the 25-item PCAT questionnaire (Buckels et al., 2015); and 20 items from the revised SOI (Jackson & Kirkpatrick, 2007) which allowed us to compute measures of both STMO and LTMO (see Study 1 for details).

Results

Did the experimental manipulation influence parental tenderness? Descriptive statistics (means and standard deviations) within conditions are presented in Table 4 and reveal that, compared to the Neighborhood Walk control condition, participants in the Attractive

Table 4. Study 3: Mean parental tenderness within each experimental condition.

	Neighborhood walk condition	Attractive stranger condition
Total sample	4.46 (1.19)	3.87 (1.57)
Male participants	4.33 (1.27)	3.68 (1.57)
Female participants	4.56 (1.13)	4.06 (1.56)

Note: Standard deviations are in parentheses.

Stranger conditions reported lower levels of emotions indicative of parental tenderness. We conducted a 2 (Experimental Condition) \times 2 (Sex) ANCOVA on those results; covariates were five individual difference variables that past work has shown to be related to either sexual arousal or parental tenderness: STMO, LTMO, PCAT (aggregated across all subscales), age, and parenthood. Results revealed an effect of one covariate: Higher PCAT scores predicted greater tenderness responses to the photograph of the cute infant ($p < .001$). Of greater conceptual interest, there was a statistically significant main effect of the experimental condition, $F(1,306) = 13.80, p < .001$.

There was no significant interaction between experimental condition and sex, $F(1,306) = 1.44, p = .23$. Nonetheless, given the results obtained in Study 2, it seemed prudent to examine the effects of the experimental manipulation on tenderness responses separately for women and men. For each sex separately, we conducted an ANCOVA with the experimental manipulation as the sole independent variable and PCAT as the sole covariate. (As STMO, LTMO, age, and parenthood had no effect on tenderness responses in the primary analysis, they were not included as covariates in the follow-up analyses reported here). Results are inferentially identical whether these variables are included as covariates or not). Among men, the effect of the experimental manipulation was statistically significant, $F(1,145) = 8.62, p = .004$. Among women, this effect was marginally significant, $F(1,169) = 3.87, p = .051$. (See means in Table 4).

Discussion

The results of Study 3 complement those of Study 2, and provide the first empirical evidence that temporary activation of the mate acquisition motivational system inhibits activation of the parental care-giving motivational system. Compared to people in a control condition, people who had imagined an erotic encounter with an attractive stranger (a procedure that aroused a sexual arousal response indicative of the mate acquisition motivational system) consequently reported a more muted tenderness response to a cute human baby. This effect emerged most clearly among men, but the effect appears among women too; and – given that there was no interaction between sex and experimental condition – there is no compelling statistical basis to conclude that there is a sex differences in the magnitude of these effect.

General discussion

According to the biological principles of life history theory, there is a fundamental trade-off between mating effort and parenting effort. The three studies reported here tested two conceptually distinct ways in which that trade-off might manifest at a psychological level of analysis. All studies yielded results consistent with these hypothesized manifestations but

also yielded additional results that pose a challenge to these seemingly straightforward hypotheses, suggesting that a more nuanced approach must be taken to understand how the mating/parenting trade-off might manifest psychologically.

Chronic individual differences

Study 1 focused on chronic individual differences. Results revealed that (even after statistically controlling for potential confounding variables) there was an inverse relationship between STMO and dispositional inclinations to experience tender, caring responses to young children. Similar findings have been reported previously (Beall & Schaller, 2014; Neel et al., 2016), but these new results extend those previous findings in several ways. For one thing, these new results emerged from a substantially larger sample, allowing for more confident conclusions about the nature the effects and their generalizability across subsamples. This is important because, whereas previous studies either tested this inverse relationship only among parents (Neel et al., 2016) or obtained the inverse relationship only among men (Beall & Schaller, 2014), these new results reveal similar inverse relations among both parents and nonparents and among both men and women. Thus, at the level of chronic individual differences, neither sex nor parental status appears to meaningfully moderate the inverse relation between dispositional inclinations toward mate acquisition and nurturant care-giving.

In addition to assessing individual differences in *nurturant* responses, Study 1 also assessed individual differences in *protective* responses to children. No previous research attended directly to this conceptual distinction, and it is a distinction that appears to matter: Whereas STMO was negatively correlated with nurturant responses, it was *positively* correlated with protective responses.

This intriguing finding suggests that, while the abstract concept of a mating/parenting trade-off is relatively simple and straightforward at a purely logical level, it is more complicated when applied to actual psychological processes. The provision of parental care involves a wide range of behavioral responses that are psychologically distinct. Nurturant behaviors tend to be directed toward children themselves, whereas protective behaviors may often be directed toward potentially-dangerous objects within a child's environment. Nurturant behaviors are typically associated with tender emotions (which are experienced as affectively rewarding) and may be the product of physiological substrates that evolved specifically because of their implications for offspring survival. In contrast, protective behaviors are often associated with more negative emotions (e.g., fear, disgust, anger) and may be the product of a different suite of physiological substrates that had rather different evolutionary origins. Thus, the motivational psychology of parental care may be comprised by two distinct physiological mechanisms, one of which corresponds to nurturant parental responses and the other that corresponds to protective parental responses. This implies that when bioenergetic resources are allocated to the development of physiological mechanisms involved in mate-acquisition, development of mechanisms involved in nurturant parenting may be constrained; but development of mechanisms involved in protective parenting may actually be facilitated.

Through what underlying mechanisms might these different relations emerge? Some clues are provided by research on the neurochemical correlates of mating behavior and parental responses of various kinds. Of particular relevance is research on testosterone.

Testosterone is associated with short-term mating behavior (van Anders, Hamilton, & Watson, 2007), and it is also associated with self-protective behavior (e.g., aggression toward sources of threat; Montoya, Terburg, Bos, & van Honk, 2012). This link between testosterone and self-protection extends also to the protection of children. One study on men showed that, in the absence of the opportunity to provide nurturant care, the sound of a crying baby was associated with temporarily increased levels of testosterone (van Anders, Tolman, & Volling, 2012). Additional findings with women have been interpreted as “consistent with the proposal that increases in testosterone level may increase women’s motivation to engage in protective behaviors” (Hahn, DeBruine, Fisher, & Jones, 2015; p. 18). Thus, there appears to be some overlap in the hormonal substrates associated with the mate acquisition motivational system and *protective* parental responses; this neurochemical overlap does not appear to exist between the mate acquisition motivational system and *nurturant* parental responses. On the contrary, the provision of nurturant care to infants appears to be associated with decreased levels of testosterone (van Anders et al., 2012). In fact, there is some evidence that testosterone suppresses the oxytocin neural system that is associated with parent-child attachment and the provision of nurturant care (e.g., Okabe, Kitano, Nagasawa, Mogi, & Kikusui, 2013; Rilling, 2013).

Temporary activation and inhibition

Whereas Study 1 focused on chronic individual differences (of the sort that may result from developmental processes), Studies 2 and 3 focused on temporary activation and inhibition.

Results from Study 2 indicated that – among women but not men – the temporary arousal of a care-giving motivational state consequently inhibits self-reported inclinations toward short-term mating. Results from Study 3 indicated that – among both men and women – temporary arousal of a mate acquisition motivational state consequently inhibits self-reported tenderness responses towards infants.

Might the sex difference obtained in Study 2 be meaningful? Although interpretation of that effect is complicated by the results obtained on the manipulation check, there are plausible reasons to suspect that the inhibitory effect documented in Study 2 among women (but not among men) might reflect an actual sex difference in this particular manifestation of the mating/parenting trade-off. Relative to men, women are anatomically constrained in the number of offspring that they can produce; and so, historically, the reproductive benefits associated with short-term mating strategies were lower for women than for men. These (relatively modest) benefits that accrued to women might have been readily outweighed by temporary increases in either the costs associated with short-term mating or the benefits associated with alternative reproductive strategies. In contrast, the (larger) benefits that accrued to men would have been less readily outweighed by temporary changes in circumstances. If the regulatory mechanisms that govern mate-seeking behavior evolved to be responsive to these costs and benefits, the implication is that women’s inclinations toward short-term mating may be readily inhibited in response to temporary circumstances that activate other motivational systems, whereas men’s inclinations toward short-term mating may be more resistant to such inhibition. This possibility is intriguing; but, before drawing any such conclusion, it will be important to replicate the results of Study 2 (with, ideally, a larger sample of both women and men).

A similar sort of cost/benefit analysis might be applied to the phenomenon tested in Study 3 – inhibition of parental tenderness by activation of the mate-acquisition system – but in this case, the logical implication would be that men – not women – would be expected to show a stronger effect. The reasoning is as follows: Historically, the reproductive benefits associated with parental care-giving were lower for men than for women. These (relatively modest) benefits that accrued to men might have been readily outweighed by temporary increases in either the costs associated with parental care-giving or the benefits associated with other behavioral strategies; whereas the (larger) benefits that accrued to women would have been less readily outweighed by temporary changes in circumstances. If the regulatory mechanisms that govern parental care-giving behavior (and the arousal of associated emotions such as tenderness) evolved to be responsive to these costs and benefits, the implication is that men’s “parental” responses to infants may be readily inhibited in response to the activation of other motivational systems, whereas women’s responses may be more resistant to such inhibition. Again, the possibility is intriguing. And, in this case, the relevant data (results from Study 3) provide no compelling support.

Indeed, overall, while all three studies provide some evidence that there may be some sort of psychological “tug of war” between motivational systems that govern mating effort and parenting effort, only one of them offers any evidence to suggest any sex difference in the nature of these mutually inhibitory relations.

Concluding remarks

Life history theory weaves together basic principles of genetic evolution, developmental biology, and behavioral ecology. It has been highly influential across the biological sciences, and is a conceptual cornerstone of evolutionary psychology (Del Giudice et al., 2016). A burgeoning body of research has begun to apply life history theory to a wide range of social psychological phenomena (e.g., Griskevicius, Tybur, Delton, & Robertson, 2011; Neuberg & Sng, 2013; Simpson, Griskevicius, & Kim, 2011; White, Li, Griskevicius, Neuberg, & Kenrick, 2013; Williams, Sng, & Neuberg, 2016). The research reported here contributes to this body of research.

We have employed a concept that is central to the logic of life history theory: Trade-offs. We have focused on one particular trade-off that is a key feature of life history theory – the trade-off between mating effort and parenting effort. Additional trade-offs also figure prominently in life-history theory. Indeed, even more fundamental than the mating/parenting trade-off is the trade-off between somatic growth and reproduction. (Bioenergetic resources that are allocated to development and maintenance of a living body cannot be allocated to the reproductive task of creating additional living bodies, and vice versa.) This trade-off too may have implications for inhibitory relations between motivational systems. For instance, investment of resources in the gustatory system (which governs appetitive behavior that is essential to somatic growth and maintenance) or to various self-protective systems (which protect the body from predators and infectious diseases) may limit the resources available to invest in reproductive systems (including systems associated with mate acquisition as well as parental care-giving). If so, then just as there may be an oppositional relation between the mate acquisition and parenting motivational systems, both of those systems might plausibly have oppositional relationships between systems associated with appetite or self-protection.

Of course, even if these subtle tug-of-wars exist at a broad conceptual level of analysis, it remains unclear as to exactly how they might manifest at the level of actual psychological phenomena. As our results indicate, the mere concept of a life history trade-off is, by itself, insufficiently nuanced to predict the complexity of empirically-documented psychological outcomes. Additional cost/benefit considerations may need to be taken into account as well (as is typical when applying evolutionary principles to psychological phenomena), along with a careful conceptual analysis of relevant motivational systems and the psychological substrates of those systems. Employing evolutionary psychological principles in this way has the potential to yield new insights about nonobvious relations between internal motivational systems, and their associated psychological, emotional, and physiological responses.

Notes

1. STMO is often contrasted with a different SOI subscale that assesses *long-term mating orientation* (LTMO). LTMO focuses not on sexual behavior but instead assesses individuals' attitudes toward enduring long-term relationships such as marriage. Also, although long-term bi-parental relationships may have historically been beneficial to offspring outcomes, LTMO specifically assesses attitudes toward long-term relationships, and not toward their ostensible reproductive benefits. As such, empirical evidence indicates that LTMO is not directly indicative of either the mate acquisition motivational system or the parental care motivational system, but instead corresponds to a conceptually distinct set of psychological concerns pertaining to mate retention (Neel et al., 2016).
2. Why not use photographs of actual human infants rather than baby animals? Given the population from which participants were obtained (university students in their late teens and early 20s) the perception of human infants may arouse a complicated set of psychological responses – characterized not only by approach-oriented “parental” emotions such as tenderness but also by more avoidance-oriented emotions and cognitions based on personal circumstances that make the prospect of parenthood impractical and/or unappealing. The perception of baby animals is likely to arouse the former, but is less likely to arouse the latter.
3. Participants also completed an additional measure, informed by previous research showing that individuals with a greater chronic STMO tend to place a somewhat higher priority on the physical attractiveness of a potential mate (Simpson & Gangestad, 1992). Thus, if the experimental manipulation did temporarily influence STMO, it might also – as an indirect causal consequence – have some (presumably weaker) effect on preferences for highly attractive (compared to less attractive) mates. To test this additional hypothesis, participants were shown 10 images of opposite-sex individuals (5 of whom were moderately attractive and 5 who were less attractive) and rated how desirable each target individual was as a potential short-term mate. Based on these ratings, we computed an index indicating the magnitude of the preference for physically attractive mates. Results revealed no statistically significant effects of the manipulation on this measure assessing possible indirect consequences of its hypothesized effect on STMO.
4. By assessing PCAT as well as STMO, LTMO, and demographic variables, we were able to conduct regression analyses that mimicked those reported in Study 1 and that assessed the unique relationship between STMO and each PCAT subscale. No statistically significant effects of STMO were observed on any of the five PCAT subscales (β 's ranged from $-.19$ to $.04$, p 's $> .10$) nor were these results significantly moderated by experimental condition. Given the relatively small sample employed in Study 2, as well as the inclusion of experimental procedures that influenced STMO (see Results, below), these particular results are probably less informative than those reported in Study 1.

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