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Are Negative Postcoital Emotions a Product of Evolutionary Adaptation? Multinational Relationships With Sexual Strategies, Reputation, and Mate Quality

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Negative postcoital emotions (NPEs) are understood as a disorder by some authors, but little is known about their evolutionary significance, etiology, and prevalence. We surveyed samples from the United States, Canada, Brazil, and Norway to test predictions regarding the following evolutionary hypotheses: Three groups of NPEs exist, related to (a) having a lesser or (b) a greater perceived desire for bonding and commitment than one's partner, or to (c) the maintenance of sexual reputation. Additionally, (d) we hypothesized a Sex by NPE dimension interaction, whereby men have higher levels of NPEs related to a lesser perceived desire for bonding relative to women, and women have higher levels of NPEs related to greater perceived desire for bonding relative to men. Results corroborated the existence of the 3 dimensions of NPEs, and the associations found between them and indicators of mating effort, attachment anxiety, relationship satisfaction, and mate quality supported most predicted design features across samples. The hypothesized sex differences were supported in all samples. We argue that NPE factors have an important functional basis in sexual strategies, and the factor comprising guilt, shame, and related emotions facilitates the maintenance of sexual reputation. The capacity to experience NPEs appears to have evolutionary functions, and we question its classification as pathological, considering the *harmful dysfunction* theory of pathology. Finally, we report prevalence data indicating that NPEs are much more common than previously speculated, with frequencies that were highly comparable across samples.

Keywords: cross-national, harmful dysfunction, negative postcoital emotions, sex differences, sexual strategies

Positive and negative valences are a fundamental feature of most theories of emotions (Barrett, 2006; Nesse & Ellsworth, 2009): emo-

tions are understood as either pleasurable or aversive, because they are products of adaptive mechanisms selected to respond to situations

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containing either threat or opportunity (Nesse, 1990). The transition from sexual intercourse to the postcoital time interval (Kruger & Hughes, 2010), which is the time after sexual intercourse that individuals in a couple may spend together and interact, has been shown to sometimes elicit several negative emotions in some individuals (Bird, Schweitzer, & Strassberg, 2011; Burri & Spector, 2011; Campbell, 2008) both with and without orgasm having been reached (Burri & Spector, 2011).

Awareness about negative postcoital emotions (NPEs) is neither recent nor rare (see Kinsey, 1953; Bird et al., 2011), however current data about NPEs are limited and disparate for each sex. Two recent studies investigated the prevalence and several possible predictors of female postcoital sadness and tearfulness (Bird et al., 2011; Burri & Spector, 2011) and mood swings (Burri & Spector, 2011); lifetime prevalence was 32.9% (Bird et al., 2011), and 7.7% experienced such emotions in a persistent way (Burri & Spector, 2011). NPEs are speculated to be even more common in men, based largely on clinical data (Sadock & Sadock, 2008). Moreover, reasons for regret, disappointment (Campbell, 2008; Paul & Hayes, 2002), shame, and guilt (Campbell, 2008) have been studied in both sexes after short-term sexual encounters. Nevertheless, the prevalence of such emotional experiences is still unknown, and those studies did not focus in the postcoital time interval only.

A comprehensive characterization of this phenomenon is still much in need, to investigate the prevalence of emotions other than sadness, tearfulness and mood swings, and whether NPEs are (a) one set of emotions, (b) different groups of emotions, or (c) emotions that are independently triggered. Also lacking is evidence of whether or not NPEs are evolutionary predictable, adaptive responses to specific mating contexts and sex-specific stable adaptive problems, as can be studied from an evolutionary psychological perspective (Buss, 1995; Buss & Schmitt, 1993).

Association of sexual difficulties with postcoital sadness and tearfulness seems to be small in size (Bird et al., 2011). Classification of NPEs, therefore, appears not likely to be subsumed to already-existing postcoital conditions. Thus another challenge is to explore the etiology of NPEs, especially considering that overall

psychological distress and reports of past sexual abuse seem to explain only a small portion of variance of postcoital sadness and tearfulness in women (4.1% and 2.5% respectively; Bird et al., 2011).

Some authors suggest the classification of NPEs as a sexual disorder (Prabhakar & Balon, 2010; Sadock & Sadock, 2008), and there are reports of clinical treatment of NPEs (Friedman, 2009). Nevertheless, in accordance with the *harmful dysfunction* definition of disorder (Kennai, 2003, 2011; Wakefield, 1999, 2007), we propose that a full understanding of NPEs and whether they ought to be classified as disorder should take into account evidence of evolutionary function or dysfunction, in addition to any evidence of personal or interpersonal nuisance. Suffering or negative affect, by itself, is not enough to classify NPEs as a disorder, and emotions perceived as negative or distressing may occur to help solve adaptive problems (see Kennai, 2011).

Relations between NPEs and attachment styles have been previously explored (e.g., Brennan, Clark, & Shaver, 1998; Gentzler & Kerns, 2004); however, NPEs were assumed to be a one-factor variable. To our knowledge, no other studies have been conducted on the possible associations between NPEs and human sexual strategies, rendering an analysis of functionality with previous data impossible. We hypothesize that NPEs have a functional basis, and will, therefore, attempt this analysis in the current paper.

Evolutionary Significance of Negative Postcoital Emotions

Animals often undergo profound behavioral changes following mating activity in ways that are adaptive (Clyne & Miesenböck, 2009), and for humans that may be a prime time for bonding and for the establishment or reinforcement of commitment (Kruger & Hughes, 2010).

It has been shown that postcoital emotional changes occur both in men and in women. After first-time sexual intercourse, a negative change in perceptions of the partner's sexual attractiveness has been shown to occur mostly in men, especially in those who have had the greatest number of sex partners (Haselton & Buss, 2001). This affective shift probably had adaptive functions in facilitating the reduction of the

risks to men of making maladaptive commitments, and it is an integral part of male short-term mating psychology (more about sexual strategies in Buss & Schmitt, 1993).

In contrast, after short-term sexual encounters, women, compared to men, have reported greater levels of vulnerability, dependency (e.g., Townsend, 1995; Townsend, Kline, & Wasserman, 1995), love, emotional involvement, and commitment (Haselton & Buss, 2001), and females are more likely to engage more in postcoital behaviors related to bonding than men (Hughes & Kruger, 2011). Overall, females also report a more negative affective response than men when anticipating sexual rejection after a one-night stand (de Graaf & Sandfort, 2004). These postcoital emotional shifts may provide women with the motivation needed to pursue long-term commitment, as a way of gaining access to resources and paternal care for her offspring. In fact, women report experiencing a greater willingness to get involved in short-term sexual encounters when there is a chance of forming a long-term relationship (Shackelford, Goetz, LaMunyon, Quintus, & Weekes-Shackelford, 2004), and when the potential partner is described as having good parental skills (Surbey & Conohan, 2000). Sex differences also seem to exist in the satisfaction with postcoital interactions, supporting hypotheses derived from evolutionary theory on reproductive strategies (Kruger & Hughes, 2010).

Sexual interactions can also lead to regret, shame, self-blame, and guilt in men and women at least partially for different reasons (Campbell, 2008; Galperin et al., 2013; Kennair, Bendixen, & Buss, 2015; Paul & Hayes, 2002; Townsend, 1995; Townsend & Wasserman, 2011), and they appear to sometimes be activated during the postcoital time interval (Paul & Hayes, 2002). Recent studies have indicated that, whereas men more than women regret poorly chosen sexual inactions (i.e., not having done something that they wish they had), women more than men regret poorly chosen sexual actions (i.e., having done something that they wish they had not; Galperin et al., 2013; Kennair et al., 2015). Regret, along with shame, guilt, and remorse (emotions which have received less attention in studies on postcoital contexts), are hypothesized to regulate social reputation, facilitating social reincorporation, and to appease others after transgressions of

social standards (for a review, see Fessler, 2004). It is important to examine the postcoital activation pattern of such emotions, as sexual reputation is an essential component of social reputation for both sexes (Buss & Schmitt, 1993; Campbell, 2008; Srivastava & Beer, 2005).

Aims and Hypotheses

Groups of Negative Postcoital Emotions

Different adaptive problems encountered recurrently in different situations throughout evolutionary history are likely to have led selection to favor the activation of different sets of emotions that facilitate advantageous solutions to each problem (Barrett, 2006; Nesse, 1990; Nesse & Ellsworth, 2009). Based on this premise, we expect different groups of NPEs to exist, which should correspond to different evolutionarily-recurrent postcoital contexts. Assuming that throughout human evolutionary history, in the postcoital time interval the optimal amounts of bonding and commitment were different for each sex and for individuals with different sexual strategies, we propose that groups of NPEs may be adaptive responses elicited by a perceived mismatch with sexual partners in desire for bonding and commitment in the following ways:

Hypothesis I: One group of NPEs should be related to having a *lesser* desire for bonding and commitment than one's partner, facilitating detachment from unwanted relationships. Emotions such as disgust for one's partner, irritability, a need to be alone, and apathy are predicted to be in this group.

Hypothesis II: A second group of NPEs should be related to a *greater* desire for bonding and commitment than perceived in one's partner, helping to secure investment and commitment from the partner. Emotional states such as feeling rejected, a need to be comforted or for reassurance, insecurity, and feeling like crying (considering that, although crying is not an emotion, it has been argued to signal need, attachment, and helplessness; Hasson, 2009; Miceli & Castelfranchi, 2003) are predicted to be in this group.

Additionally, sexual interactions sometimes involve factors that can jeopardize one's social

reputation, such as the impression that one has been too promiscuous and easy, involvements with partners of much lower mate value, infidelity and a fear of being detected, rejection, and so forth. Considering that, we propose that another group of emotions has been selected:

Hypothesis III: A third group of NPEs should be related to the maintenance or the recuperation of social reputation after sexual intercourse, including emotions such as remorse, shame, and guilt.

Sex Differences in NPEs

Although all groups of NPEs should be an integral part of both sexes' behavioral repertoire, considering the sex differences reviewed above we propose the following:

Hypothesis IV: Sex differences congruent with the Sexual Strategies Theory (Buss & Schmitt, 1993; Buss, 2003) will be found for NPEs. We predict that the first and second groups of NPEs will be differentially activated in the sexes. Specifically, we predict that men will report a more positive *difference* than women in their experiences of the groups of NPEs related to a lesser and a greater desire for bonding than one's partner; that is, men's levels of the first hypothesized factor of NPEs minus their levels of the second hypothesized factor of NPEs are predicted to be greater than women's levels of the first factor of NPEs minus their levels of the second factor of NPEs (and by necessity the reverse would be expected for women).

Here we follow the logic forwarded by Sagarin and colleagues (Sagarin, 2005; Edlund & Sagarin, 2009; Sagarin et al., 2012) developed for studies of sex differences in jealousy, whereby interactions of Participant Sex by Jealousy type (sexual vs. emotional) are considered the most relevant test of the evolutionary hypothesis of sex differences, and we argue that analyses of sex differences on NPE factors ought to consider the Participant Sex by NPE factor interaction as the main test as well. This logic is based on the fact that reproductive competition is mainly intrasexual, and thus evolutionary theory does not imply that selection pressures boosted men's levels of NPEs related to a lesser desire for bonding above wom-

en's, or that selection pressures boosted women's levels of NPEs related to greater desire for bonding above men's (Sagarin et al., 2012). Finally:

Hypothesis V: The overall frequency and intensity of the third group of NPEs, potentially related to the maintenance or recuperation of social reputation after sexual intercourse, should not present sex differences, as recent studies indicate that the relevant locus of sex differences in this domain is in the *reasons* for presenting regret and related emotions. In other words, sexual reputation should be a concern for both sexes and as such elicit guilt, shame, remorse, and related emotions similarly.

Evolutionary and Social Predictors of the Factors of NPEs

Our third aim is to examine the differential relationships of the groups of NPEs with mating effort, relationship satisfaction, and differences in mate value beyond the effects of sex (i.e., not explained by sex differences, but rather by potentially adaptive individual differences and by life contexts). This aim follows from the proposition that potentially adaptive variation in sexual strategies exists also within each sex (e.g., Bailey, Kirk, Zhu, Dunne, & Martin, 2000; Buss & Hawley, 2010; Figueredo et al., 2004; Gangestad & Simpson, 2000), and from the basic premise that within-individual variation in the experience of emotions can occur depending on the life context of the individual, which includes one's relationship status and satisfaction with one's romantic relationship.

Mating effort refers to the amount of energy, time, or other key resources invested in competing for and retaining short-term mates.¹ One of the most common trade-offs in animals is that between mating effort and parental effort, which refers to the amount of resources invested

¹ As Rowe et al. (1997) stress, the word *mating* is used somewhat euphemistically in this context, as the term *mating effort* refers to investments in obtaining and retaining short-term sexual partners. To make this explicit, some authors call this *promiscuous mating effort* instead (Gwynne, 1984), and specify that *non-promiscuous mating effort* is positively associated with, or a component of, parental effort, and decreases the probability of the individual seeking and reproducing with other partners. In line with most of previous literatures, we will refer to promiscuous mating effort simply by the term mating effort.

in rearing and defending the offspring (Magrath & Komdeur, 2003; McGlothlin, Jawor, & Ketterson, 2007), and usually also refers to retaining a long-term mate, which facilitates the survival of the offspring (Gwynne, 1984; Rowe, Vazsonyi, & Figueredo, 1997). Another important trade-off is that between reproductive effort and somatic effort (Magrath & Komdeur, 2003), which refers to resources devoted to the continued survival of the individual organism. Trade-offs such as these two are central to human individual differences in what is known as life history speed: a continuum that varies from fast to slow (Ellis, Figueredo, Brumbach, & Schlomer, 2009; Pianka, 1970; van Schaik & Isler, 2012), where fast life history is characterized by traits such as high mating effort, early onset of reproduction, and impulsivity, and slow life history by traits such as high parental effort, community building, and somatic maintenance.

Several constructs commonly assessed in evolutionary and social psychology are indicators of mating effort. Sociosexual orientation, which refers to the degree of promiscuity in one's desire, attitudes, and behavior (Penke & Asendorpf, 2008; Simpson & Gangestad, 1991), has been understood as an indicator of the mating effort versus parental effort trade-off (Penke & Asendorpf, 2008; Simpson, Wilson, & Winterheld, 2004). Adult romantic attachment styles have also been argued to reflect that trade-off, rather than reflecting only attachment processes per se (Kirkpatrick, 1998; Kruger & Fisher, 2008), especially the avoidant-versus-secure attachment continuum (Jackson & Kirkpatrick, 2007). Overall mate value influences and is also associated with reproductive strategies (Penke & Asendorpf, 2008; Schmitt, 2005), with higher levels leading to higher discriminating behavior toward prospective romantic partners (Buss & Schmitt, 1993; Edlund & Sagarin, 2010), and thus mate value is a positive component of slow life history and is inversely related to mating effort (Olderbak, Gladden, Wolf, & Figueredo, 2014).

Individuals with higher mating effort are more likely to get involved in sexual activities with partners with whom there are mismatches in desire for commitment and in general mate value (Figueredo & Wolf, 2009 demonstrated that faster life history individuals disassortatively mate more strongly), to get involved in

sexual infidelity (Mattingly et al., 2011), to perpetrate and to be a victim of sexual harassment (Kennair & Bendixen, 2012; Mouilso & Calhoun, 2012; Perilloux, Duntley, & Buss, 2011), to experience postcoital dissatisfaction, low levels of postcoital bonding (Kruger & Hughes, 2010), and higher levels of negative emotions in romantic relationships (Simpson, 1990), and to be seen as too easy and promiscuous (Buss & Schmitt, 1993; Campbell, 2008). These correlates of mating effort negatively impact one's social reputation. Moreover, faster life history individuals report not only lower levels of relationship satisfaction (Olderbak & Figueredo, 2009; Olderbak & Figueredo, 2010), but also lower postcoital satisfaction and less postcoital bonding with their partner (Kruger & Hughes, 2010), as a result of a mismatch with their partner in desire for bonding. Additionally, negative affect in general is positively associated with mating effort (Kirsner, Figueredo, & Jacobs, 2009), negatively associated with mate value (Kirsner et al., 2009), and is considered a component of fast life histories (Figueredo et al., 2004). Considering all these known associations, we propose the following:

Hypothesis VI: NPEs should be more frequent and more intense in individuals with higher mating effort. This should apply to all three NPE factors, for the reasons outlined above. Beyond the effects of mating effort, the residuals of the indicators that compose the mating effort factor should predict NPE factors only weakly, as is expected when the direct effects of a general factor are substantial.

High levels of investment in long-term relationships do not require the expression of neediness or insecurity with one's relationship, as demonstrated by the observation that attachment avoidance is more strongly associated with mating effort than attachment anxiety (Fernandes, Woodley, Hutz, & Kruger, 2015; Hazan & Shaver, 1987; Jackson & Kirkpatrick, 2007). Considering that in the postcoital time interval attachment avoidance predicts lower proclivity to establish relationship commitment and attachment anxiety predicts postcoital neediness (see Kruger & Hughes, 2010 for an empirical test), we propose the following:

Hypothesis VII: The group of NPEs of avoidance of bonding should be more strongly associated with mating effort than the group of NPEs of neediness and clinging. Still, we expect NPEs of this latter type to present at least a weak positive relationship with mating effort because individuals with high attachment anxiety appear to engage in impulsive short-term mating while showing a heightened desire for long-term relationships and romance (see Del Giudice, 2009), and also because individuals with low mating effort are likely to be already successfully bonded and to have higher relationship satisfaction, thus it is unlikely that they would benefit from romantic neediness. This hypothesis, by necessity, also derives the testable prediction that NPEs of neediness and clinging are especially related to attachment anxiety, which is to be expected based on the findings that those with higher attachment anxiety tend to experience lower postcoital satisfaction and long more for connection after sex (Kruger & Hughes, 2010).

Another important putative predictor of NPEs is relationship satisfaction. Dissatisfaction with one's relationship can be experienced for different reasons, such as perceiving an imbalance in commitment and in investments desired by each partner, having an unfaithful partner, or one who uses intense mate-retention tactics; as such, relationship satisfaction has been proposed to signal that the one is incurring costs that outweigh the benefits propitiated by the relationship (Shackelford & Buss, 2000). Considering that the many negative emotions are argued to have evolved to signal threats to one's fitness, we propose the following:

Hypothesis VIII: All groups of NPEs should be negatively related to relationship satisfaction, as dissatisfaction can be triggered by many different causes of fitness threats, and we aim to examine this prediction with individuals who are currently in a relationship.

Finally, we aim to test whether disparities in mate value between the partners predict the frequency and the intensity of NPEs. Mate value includes many qualities that tend to co-

vary (Kirsner et al., 2003). Romantic involvement with individuals of low mate value can lead to fitness costs, therefore we propose the following:

Hypothesis IX: NPEs related to avoidance of bonding should be experienced by individuals of higher perceived mate value than their partner after sexual involvement. Moreover, getting involved with and committing to partners of lower perceived mate value may strongly jeopardize one's reputation, consistent with previous findings (Paul & Hayes, 2002); we thus expect higher levels of the group of NPEs related to the maintenance of reputation to be exhibited by individuals of higher perceived mate value than their partner. The specific variance of self-rated mate value and of the perceived mate value of one's partner should present weak residual effects.

Method

Participants

Four samples from different countries were used for the present study. We recruited participants from Brazil, the United States, Canada, and Norway. Individuals who were not fluent in the respective language used in the questionnaire in each of these countries or who were younger than 18 years of age were excluded from participation in the study. Among those who took part in the data collection, criteria for inclusion in the analyses were as follows: being exclusively or mostly attracted to individuals of the opposite sex, having had sexual intercourse, and being up to 30 years of age, because of the well-known reproductive changes that occur in the 30s (e.g., Dabbs, 1990; Dunson, Baird, & Colombo, 2004), and as changes at this age in the refractory period after sexual intercourse in males have also been identified (Dunn & Trost, 1989). This study was approved by appropriate institutional ethics boards in all countries included.

Comparisons between Brazilian, Norwegian, American, and Canadian populations may be of interest when testing potential human universals related to sexual strategies and sex differences. This is especially because of differences found between these countries regarding conceptual-

izations of the development of heterosexual encounters (DeSouza & Hutz, 1996), female acceptance of male sexual advances, openness to displays of nudity and sexuality, female subordination to men (DeSouza, Pryor & Hutz, 1998), acceptance of female sexuality (Træen, 1994), and overall liberal attitudes toward sexuality (Bjerke, Williams, & Wathne, 1989; Widmer, Treas, & Newcomb, 1998). Moreover, according to the Global Gender Gap Report (Bekhouch, Hausmann, Tyson, & Zahidi, 2013), in 2011 and 2012, when most of the data collection for the current paper were conducted, Norway was considered the second and then the third most gender-equal country of 135, the United States the 17th then the 22nd, Canada the 18th then the 21st, and Brazil the 82nd then the 62nd.

Brazilian sample. Participants were 517 individuals (70.2% females), students and otherwise, from all five regions of Brazil (34.8% from the Southeast, 33.6% from the South, 29.1% from the Northeast, and 2.5% from other regions). Male participants' mean age was 23.6 ($SD = 3.0$), and female participants' was 23.3 ($SD = 2.9$); 55.2% of males and 62.6% of the females reported being currently involved in a committed relationship.

Midwestern-American sample. Participants were 349 students from two public Midwestern universities in the United States (65.6% females). Male participants' mean age was 19.4 years ($SD = 1.5$), and female participants' was 19.6 ($SD = 2.0$); 40.9% of males and 57% of females reported being currently involved in a committed relationship.

Anglo-American sample. Participants were 374 individuals (76% females), students and otherwise, drawn from all regions and divisions of the United States specified by the United States Census Bureau, and from seven of the 13 Canadian provinces and territories. Male respondents' mean age was 22.1 ($SD = 3.8$), and female respondents' was 21.5 ($SD = 3.5$); 55% of males and 59% of females reported being currently involved in a committed relationship, and 11.6% of the males reported having at least one child, whereas 18.7% of the females reported having one or more children. 34% of participants were from the South of the U.S., 23% from the West, 26% from the Midwest, 12% from the Northeast, and the remaining 5% from the Southern provinces of Canada.

The most represented Census Bureau divisions of the United States were division 5 (South Atlantic) with 24%, division 9 (Pacific) with 19%, and division 3 (East North Central) with 18%.

Norwegian sample. Participants were 533 students (73% females) from a Norwegian university. Students from different subjects and campuses were recruited. Male respondents' mean age was 21.9 ($SD = 2.4$), and female respondents' was 21.3 ($SD = 1.8$); 49% of males and 55.7% of females reported being currently involved in a committed relationship. Students at this university provide a strongly homogenous group (Grøntvedt & Kennair, 2013), almost all being ethnic Norwegian, middle class, and secularized state church Protestants or nonbelievers.

Data for the 19 Canadian individuals who volunteered to participate in the Anglo-American data-collection wave were included in the same sample instead of excluded because (a) no significant ($p < .05$) differences were identified when comparing these participants to the American participants in any trait assessed in this study; (b) as extensively reviewed in the literature (see Grabb & Curtis, 2005), there are only very weak differences between American and Canadian cultures in general and in psychosocial dimensions; (c) Gender Gap Reports (see above) indicate that the U.S. and Canada have strikingly similar gender inequality patterns; and (d) all Canadian participants included in Sample 3 were from provinces that border the United States. Participants from the exclusively Midwestern-American sample were not combined with those from this broader Anglo-American wave of data collection even though the latter included other Midwestern-American participants, as sampling procedures were considerably different in these two waves: All participants from the exclusively Midwestern-American sample, but not from the Anglo-American sample, were university students, course credits were awarded for participants of the Midwestern-American sample whereas no incentive or compensation was offered for those in the Anglo-American sample (see Procedures), and the questionnaire filled out in the Midwestern-American sample included additional scales intended for parallel studies (not included in this manuscript). Perhaps partly as a consequence, significant ($p < .05$) differences of moderate

effect size were identified for several traits (see Measures and Results for a description of these traits) between the Midwestern-American and the Anglo-American samples: sociosexual orientation, $t(639.52) = 2.39$, attachment anxiety, $t(578.29) = 2.57$, life history speed, $t(597.17) = 4.16$, self-rated mate value, $t(659) = 6.41$, perceived partner mate value, $t(662.04) = 4.18$, and the intensity of experiences of the NPE factor related to greater perceived desire for bonding and commitment than one's partner, $t(566.53) = 2.43$.

Measures

Initial questions sought background information regarding sex, age, sexual orientation, relationship status, and previous sexual experiences. To measure the frequency and the intensity of NPEs, we created an inventory containing 23 negative emotions (see Table 1, and the Results section for an analytical description of their factorial pattern), based on well-known

taxonomic categorizations of emotions (Ortony & Turner, 1990; Shaver, Schwartz, Kirson, & O'Connor, 1987). Three of the 23 emotional states included were not present in these categorizations, and we incorporated them in the inventory as we considered them to be relevant to the study of interpersonal relationships: need to be alone, need to be comforted (which are relatively common in social relationships and may reflect the quality of bonds and one's disposition toward them), and mental confusion (a mental state that is relatively common after intense or potentially traumatic situations, such as sexual assault; Dunmore, Clark, & Ehlers, 1999). Synonyms or near-synonyms of any NPEs already present in the inventory were not added, to avoid inflating their factorial associations. Moreover, some near-synonyms (such as fear and dread) differ from each other in meaning because of intensity (e.g., Flexner, 2003; Merriam Webster, 2010), a dimension that we ex-

Table 1
Principal Axis Factor Analysis of the NPEs Intensity Scale (Oblimin Rotation)

Negative postcoital emotions	Factor loading		
	Need for bonding	Maintenance of reputation	Avoidance of bonding
Need to be comforted	.72	-.06	-.01
Feeling of worthlessness	.70	.21	-.03
Tearfulness or feeling like crying	.67	-.11	.01
Feeling of helplessness	.64	.01	.14
Sadness	.60	-.03	.19
Feeling rejected	.59	.12	.04
Loneliness	.56	.09	.17
Insecurity	.52	.23	-.02
Fear	.39	.24	.03
Mental confusion	.36	.19	.22
Uneasiness	.27	.21	.27
Shame	.15	.76	.00
Guilt	.07	.69	.06
Self-disgust	.17	.56	.12
Remorse	-.03	.50	.29
Irritability	.04	-.12	.69
Need to be alone	-.05	.04	.63
Disgust for partner	-.11	.20	.63
Anger	.19	-.03	.59
Apathy or emotional blunting	.05	.04	.51
Pity	.02	.14	.44
Frustration	.21	.06	.40
Agony	.27	-.04	.37

Note. Items with preferential loadings on a particular factor and which were thus included in the estimation of that factor are highlighted in bold. Items that presented factor loadings < .30 on all factors, or between .20 and .40 in more than one factor, were not included in the estimation of any factor.

plicitly assessed (see below). We included two versions of the Negative Postcoital Emotions inventory in measurements in all samples, with 5-point Likert-type scales. The first version assessed the overall frequency (based on all current and past relationships) of NPEs experiences (where 1 represented *never*; and 5, *all the time*), whereas the second assessed the intensity of the emotions experienced (where 1 represented *no intensity*; and 5, *extremely intense*). Intensity was reported based only on the last occasion the participant experienced NPEs.

The Sociosexual Orientation Inventory—Revised (SOI-R; Penke & Asendorpf, 2008) was employed as a measure of sociosexuality, which is an indicator of mating effort, in all samples. This corresponds to the level of sociosexual unrestricted, or willingness to engage in uncommitted sexual relationships, in three domains: past behavioral experiences, sexual desire, and attitudes toward uncommitted sexual interactions, and scores on the three subscales can be summed to create a global measure of sociosexual orientation (Penke & Asendorpf, 2008). The 5-point version developed by Penke and Asendorpf (2008) was used, which might be more appropriate for samples with less test-experienced participants (although a 9-point version was also made available and has similar internal consistency). Cronbach's alpha was .89 in the Brazilian sample, .86 in the Midwestern-American sample, .68 in the Anglo-American sample, and .85 in the Norwegian sample.

The Experiences in Close Relationships Scale-Short Form (ECR-S; Wei, Russell, Mallinckrodt, & Vogel, 2007) was employed as a measure of attachment styles. This taps two factors: avoidant and anxious attachment. Attachment avoidance is defined as involving fear of interpersonal intimacy and dependence, and reluctance to self-disclose to romantic partners, and is an indicator of mating effort (Fernandes et al., 2015; Jackson & Kirkpatrick, 2007). Attachment anxiety is understood as including excessive need for approval from the romantic partner, fear of abandonment or rejection, and distress when one's partner is unavailable (Wei et al., 2007). Participants were instructed to think of their past and current partners altogether. Cronbach's alpha was .67 for Attachment avoidance, and .75 for Attachment anxiety in the Brazilian sample; .66 and .83 in the Midwestern-American sample; and .73 and .78

in the Anglo-American sample. This scale could not be used in data collections in the Norwegian sample due to time constraints imposed by the in-class data-collection design, and thus other more specific measures of mating effort (such as sociosexual orientation and relationship commitment) were prioritized for the data collection in this sample. Considering that attachment anxiety is only weakly associated with sociosexual preferences (Hazan & Shaver, 1987; Jackson & Kirkpatrick, 2007), and that in all samples it presented consistently very low and nonsignificant correlations with the Mini-K ($r < .10, p > .05$), we did not consider it as an indicator of mating effort, and as such only attachment avoidance was included in the estimation of the mating effort factor.

The Mate Value Inventory (MVI-7, Kirsner et al., 2003) was used in two forms to measure both the perceived personal mate value and the perceived mate value of a real sexual partner in all samples. This scale corresponds to a one-factor proxy for genetic quality and estimates one's bargaining power in the mating marketplace, assessing many components of mate quality (Kirsner et al., 2003) without unduly focusing on just one component (Edlund & Sagarin, 2010). Overall mate value is associated with various sexual-strategy traits (e.g., Penke & Asendorpf, 2008), with higher levels leading to higher discriminating behavior toward prospective romantic partners (Buss & Schmitt, 1993; Edlund & Sagarin, 2010). Self-rated mate value is strongly associated with indicators of sexual strategies and mating effort, being sometimes included as a life history indicator (Olderbak et al., 2014). Respondents who reported having already experienced one or more NPEs were instructed to think of the last partner with whom they experienced NPEs. The other participants were instructed to think of their current partner or last partner. Cronbach's alpha for the Personal mate value form was .77, and .89 for the Partner mate value form in the Brazilian sample; .87 and .92 in the Midwestern-American sample; .87 and .90 in the Anglo-American sample; and .78 and .91 in the Norwegian sample.

The Mini-K Life History Strategy Short Form (Figueredo et al., 2006), whose validity as a psychometric measure of life history speed was recently demonstrated in a psychometric meta-analysis (Figueredo et al., 2014; see also

Figueredo et al., 2015), was used in the Brazilian, Midwestern-American, and Anglo-American samples, but data collection with this scale was not possible in the Norwegian sample due to time constraints imposed by the in-class data-collection design, and thus other more specific measures of mating effort (such as sociosexual orientation and relationship commitment) were prioritized for the data collection in this sample. The Mini-K is a short form of the Arizona Life History Battery (Figueredo, 2007), which also includes insight, planning and control, mother/father relationship quality, family social contact and support, friends social contact and support, experiences in close relationships, general altruism, and religiosity as measures. Life history speed has the mating effort-parental effort trade-off as a central component (Figueredo et al., 2004; Stearns, 1992). Cronbach's alpha was .78 in the Brazilian and Midwestern-American samples, and .82 in the Anglo-American sample.

We adapted nine additional items from the Satisfaction and the Commitment factors of the Relationship Questionnaires (Rusbult, 1983) and used them to assess satisfaction with an ongoing relationship, and perceived personal commitment to it (an indicator of mating effort) in the Brazilian, Anglo-American, and Norwegian samples. Inclusion of these scales for data collection in the Midwestern-American sample was not possible due to time constraints imposed by student participation, and thus other measures with more extensive demonstrations of validity in the Anglophone literature were prioritized for the data collection in this sample. Only individuals currently involved in a relationship, casual or otherwise, were instructed to answer these items. Cronbach's alpha for the Satisfaction factor were .84 and .80 in the Brazilian and Norwegian samples respectively; and for the Commitment factor they were .83 and .80 in the Brazilian and Norwegian samples respectively.

Procedures

Instruments used in the Brazilian sample were translated to Brazilian Portuguese by a bilingual researcher, back-translated to English by a second bilingual researcher, and finally the necessary adjustments were made by a native speaker of American English. Instruments used in the Norwegian sample were translated to the

Norwegian language by two bilingual researchers. Participants responded to 205 questions and items in the Brazilian and Anglo-American samples, 200 in the Midwestern-American, and 125 in the Norwegian sample, taking around 40 minutes to complete the questionnaire in the first three samples, and around 20 to 25 minutes in the Norwegian sample. Most studies indicate that survey length and data quality are not associated (for a comprehensive review see Rolstad, Adler, & Rydén, 2011), thus we have not taken into consideration the different survey lengths across samples.

Of those who initiated the online questionnaires for the Brazilian, Anglo-American, and Midwestern-American samples, 74%, 64%, and 100% completed the process respectively, whereas 96% of those who initiated the pen-and-paper questionnaire for the Norwegian sample completed it.

We forwarded a call for participants for the Brazilian sample to Brazilian universities, advertised it on Laboratory of Measurement's website (<http://www.ufrgs.br/psico-laboratorio/>), and forwarded it to its followers on social networks. Participants in the Midwestern-American sample took part in the study in exchange for course credits, and as data collection in the other samples was conducted by Brazilian and Norwegian researchers no incentives or compensations were offered, in conformity with the local laws of these countries. All participants were informed that participation in the survey was completely voluntary and anonymous.

As discussed and demonstrated by many authors (e.g., Cole, Bedeian, & Feild, 2006; Davidov & Depner, 2011; Fouladi, McCarthy, & Moller, 2002; Gwaltney, Shields, & Shiffman, 2008; Meade, Michels, & Lautenschlager, 2007; Riva, Teruzzi, & Anolli, 2003), the comparability of results found with online and paper-and-pencil modes of data collection is extremely high across psychological phenomena measured, therefore this is extremely unlikely to affect the validity of the data-collection in the Norwegian sample compared to others.

We aimed to collect data for at least 300 participants in each sample, considering that, although many sex differences in emotional experiences present moderate to large effect sizes, some have been identified to be small (e.g., Campbell, 2008; Haselton & Buss, 2001; Hughes & Kruger, 2011), and the relationships

among some of the variables included in this study have been identified to be small in magnitude by meta-analyses (see Figueredo et al., 2014); as such, smaller samples sizes would make it difficult to differentiate between non-significant effects and small but consistent effects, inducing Type II errors.

Results

The Factor Structure of NPEs

Principal Axis Factor analysis was conducted using direct oblimin rotation to examine the factorization of NPEs on a general dataset that combined all samples. The *frequency* of NPEs was reported based on all previous sexual experiences combined and this does not inform us about the extent to which the emotions co-occurred (i.e., the extent to which they were activated in conjunction as opposed to in different circumstances or with different partners), whereas the *intensity* of NPEs experienced was reported based only on the last event in which at least one NPE was experienced, and this is informative not only of co-occurrence but also of the similarity of the magnitude with which the NPEs were simultaneously activated; we thus used the data on the intensity of NPEs for the factor analysis. Three factors were extracted according to both Horn's (1965) parallel analysis and Kaiser's (1960) eigenvalue higher than 1.0 criterion, with eigenvalues 7.74, 1.37, and 1.22 (a fourth factor had an eigenvalue of .86, and a minimum of 1.12 was necessary for it to be extracted according to parallel analysis), accounting for 49.13% of the variance in the intensity of NPEs ($KMO = 0.94$; $\chi^2 = 13,134.96$, $df = 153$, $p < .001$). We computed coefficients of comparability (Everett, 1983; Everett & Entrekin, 1980; Nunnally, 1978) among the three samples for each factor, and also between men and women in the dataset containing all samples combined. The coefficient of comparability is a measure of the equivalence between factors extracted from different samples, being especially useful to compare the factor pattern of different populations (Everett & Entrekin, 1980) and to determine the number of reliable factors to be extracted across samples (Everett, 1983), and is calculated based on the weights of each item on factor scores rather than based on the items' factor loadings, thus providing a more direct

measure of factor comparability than the commonly-used coefficients of congruence (Everett, 1983; Everett & Entrekin, 1980). There was a high level of comparability for each sample pairing and between men and women for all three factors (coefficient of comparability $\geq .90$ for all factors), indicating that factor structures are highly similar across samples and sexes.

The three factors appeared to be related to (a) need for bonding (the term *neediness NPE factor* will be used to refer to this common factor), comprising eight emotions; (b) maintenance of reputation (the term *reputation-maintenance NPE factor* will be used to refer to this common factor), comprising four emotions; and (c) avoidance of bonding (the term *avoidance NPE factor* will be used to refer to this common factor), comprising six emotions (see Table 1), supporting the predictions made for Hypotheses I, II, and III regarding which emotions would be activated in conjunction. Correlations were .52 between factors 1 and 2, .64 between factors 1 and 3, and .53 between factors 2 and 3. Cronbach's alpha for the intensity of the neediness NPE factor was .89, .89, .88, and .83 in the Brazilian, Midwestern-American, Anglo-American, and Norwegian samples respectively; .79, .91, .86, and .84 for the intensity of the reputation-maintenance NPE factor; and .78, .81, .85, and .68 for the intensity of the avoidance NPE factor. Regarding the factors based on the frequency of NPEs experienced, Cronbach's alpha was .86, .92, .88, and .84 for the neediness NPE factor in the Brazilian, Midwestern-American, Anglo-American, and Norwegian samples, respectively; .80, .92, .90, and .85 for the reputation-maintenance NPE factor; and .74, .88, .84, and .69 for the avoidance NPE factor.

Sex Differences in the NPE Factors

The predicted Participant Sex by NPE factor interaction (considering the avoidance NPE and the neediness NPE factors) was found in all samples (see Figure 1). This was the case both for frequency and for intensity of NPEs, supporting predictions made for Hypothesis IV.

We also conducted within-sex analyses comparing the neediness and the avoidance NPE factors to further test the sex differences predicted in Hypothesis IV:

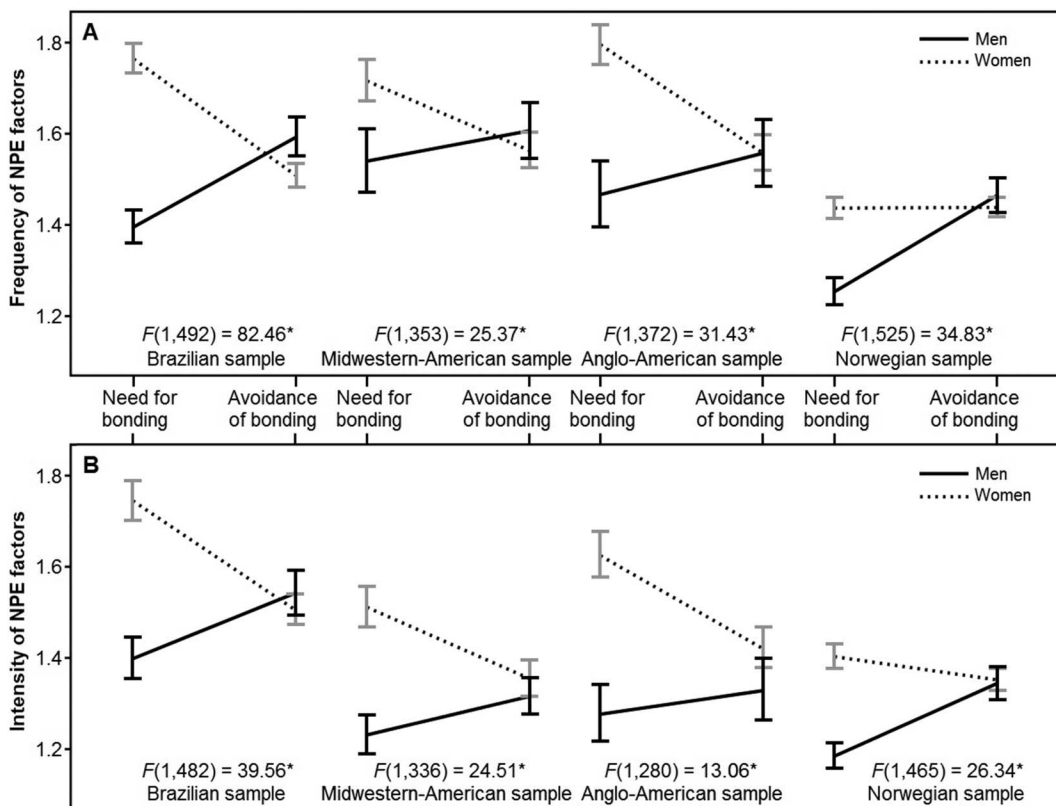


Figure 1. Sex by NPE factor interactions by sample. Panel A displays interactions based on frequency of NPE factors, and Panel B based on intensity of NPE factors. Bars represent ± 1.0 standard error of the mean. Entries marked with an asterisk indicate significant ($p < .05$) interaction.

Regarding frequency, women scored significantly ($p < .05$) higher in the neediness NPE factor than in the avoidance NPE factor in the Brazilian sample, $t(342) = 9.25$, Cohen's $d = .46$; in the Midwestern-American sample, $t(232) = 5.81$, $d = .23$; and in the Anglo-American sample, $t(282) = 7.98$, $d = .34$; but not in the Norwegian sample, where women scored equally in both factors within a margin rounding error (1.437 and 1.438, respectively), $t(383) = .09$, $d = .00$. Men scored significantly ($p < .05$) higher in the avoidance NPE factor than in the neediness NPE factor in the Brazilian sample, $t(150) = 4.77$, $d = .40$; in the Midwestern-American sample, $t(121) = 2.01$, $d = .09$; in the Norwegian sample, $t(142) = 6.61$, $d = .51$; and this effect was borderline significant ($p =$

.05) in the Anglo-American sample, $t(90) = 1.98$, $d = .13$.

Regarding intensity, women scored significantly ($p < .05$) higher in the neediness NPE factor than in the avoidance NPE factor in the Brazilian sample, $t(333) = 6.88$, $d = .34$; in the Midwestern-American sample, $t(224) = 5.08$, $d = .25$; in the Anglo-American sample, $t(215) = 5.41$, $d = .29$; and in the Norwegian sample, $t(340) = 2.29$, $d = .11$. Men scored significantly ($p < .05$) higher in the avoidance NPE factor than in the neediness NPE factor in the Brazilian sample, $t(149) = 3.03$, $d = .25$; in the Midwestern-American sample, $t(112) = 2.74$, $d = .19$; and in the Norwegian sample, $t(125) = 5.23$, $d = .44$; but not significantly in the Anglo-American sample, $t(65) = 1.55$, $d = .10$.

Evolutionary and Social Predictors of the Factors of NPEs

To be able to test the predictive power of mating effort and its indicators on NPE factors, we first examined the factorial pattern of putative indicators of mating effort assessed: Sociosexual orientation, attachment avoidance, relationship commitment, overall life history speed, and one's own mate value. These variables presented moderate to high loadings on a common factor examined with Principal Axis Factoring (with oblimin rotation) in all four samples (see Table 2), and only one factor was extracted in all samples according to Horn's (1965) parallel analysis. As the Midwestern-American and Norwegian samples had one and two mating effort indicators missing, respectively, before proceeding we assessed whether there was a high comparability between the factors computed with missing indicators and the factor built with all five mating effort indicators. The three versions of the mating effort factor presented extremely high consistency among themselves (Cronbach's alpha = .97 in the Brazilian sample, .98 in the Anglo-American sample, which are the samples in which all three versions could be computed), thus indicating they measured the same latent construct. Moreover, the coefficient of comparability among the three versions of the mating effort factor ranged from .89 to .98, corroborating their high equivalence. We thus employed multivariate imputation (Figueredo, McKnight, McKnight, & Sidani, 2000) to build the common factor in the Midwestern-American and Norwegian samples.

We proceeded to test the predictive power of the mating effort factor, its components, relationship satisfaction, the difference in mate value between the respondents and their part-

ners, one's mate value, and one's partner's mate value upon the NPE factors. Hierarchical general linear model (GLM) analyses were conducted in a combined dataset containing all samples, with each of the three factors of NPEs as outcome variables, for frequency and intensity of NPEs separately. To also examine similarities and differences among the samples and between the sexes, we introduced discrete variables that categorized the four samples and categorized the sexes as the first predictors in the GLM analyses. This approach is also frequently used in cross-population level studies and in comparative studies that aim to assess the true evolutionary associations between traits, eliminating the influence of similarity within categories that is attributable to shared historical, geographic, or cultural features (Pagel & Harvey, 1988; Stearns, 1983, 1992; see Mace & Pagel, 1994 for a detailed discussion of the applications of phylogenetic controls to studies with human populations). Applying this to our GLM analyses thus permitted avoiding an inflation of the predictive power of the independent variables that would follow from including samples from partially-different cultural or historical origins in the same analytical models. We entered the categorical variables in the GLM analyses nested within each other: The first categorical variable separated the samples from countries that are highly developed and where settlement colonization by Germanic peoples was predominant from the only sample from a developing country with history of exploitative colonization by Iberian peoples (Brazil). The second categorical variable separated North-American samples from the sample from the only European country included (Norway). Finally, the third categorical vari-

Table 2
Principal Axis Factor Analysis of Indicators of the Mating Effort Factor
(Oblimin Rotation) in Each Sample

Indicator	Factor loading			
	Brazilian	Midwestern-American	Anglo-American	Norwegian
Sociosexual orientation	.47	.44	.54	.52
Attachment avoidance	.57	.66	.68	—
Relationship commitment	-.73	—	-.81	-.69
Mini-K	-.57	-.69	-.62	—
Mate value self-rated	-.51	-.44	-.51	-.28

able separated the Midwestern-American sample from the Anglo-American sample. Sex was entered as the last categorical variable. The mating effort factor was then entered in the hierarchical GLMs as the first continuous predictor.

Because the variables included in the mating effort factor have theoretically highly comparable levels of data aggregation, are not parts of one another, and are likely to influence each other mutually rather than in a clear sequence, we entered all of them directly after the mating effort factor, each in a separate hierarchical GLM, rather than entering all of them in the same model but in an arbitrary order. This is because the latter procedure would produce only the residual effects of the mating effort indicators entered after the other ones, rather than producing the effects of all mating effort indicators residualized only against the categorical variables and against the mating effort factor. When including relationship commitment and satisfaction in the GLMs, only those participants who were currently in a relationship (committed or otherwise) and who filled out the NPE scales thinking about their current relationship were selected, as the commitment and satisfaction

scales measure those constructs with regard to an ongoing relationship. Interaction terms between the categorical and the continuous independent variables were entered after all main effects to examine whether important differences exist among samples and between the sexes in the magnitude with which the continuous variables predict the frequency and the intensity of NPE factors. Considering that these interaction terms were numerous ad hoc tests, as opposed to the hypothesis-driven tests of the main effects being examined with each of the continuous constructs, we created sets of interactions, each set involving the interactions between a continuous construct and each of the four categorical variables, and examined the significance of the effects of each of these sets of interactions up on the NPE factors. Only significant interaction terms within a set that presented a significant effect upon an NPE factor were considered significant interaction effects. This functions as a correction for multiple comparisons and is intended to reduce the likelihood of incurring Type I errors for ad hoc tests.

Table 3 displays the results of GLMs with the frequencies of the NPE factors as outcome variables. In Hypothesis V we predicted that men

Table 3
Semipartial Correlations From Hierarchical General Linear Models Predicting the Frequency of NPE Factors

Predictor	Order	NDF, DDF	Semipartial correlation		
			Need for bonding	Maintenance of reputation	Avoidance of bonding
Major historical/economic group	1	1, 1650	-.087*	.005	-.032
Continent	2	1, 1650	-.188*	-.101*	-.075*
Region	3	1, 1650	-.008	.033	.050*
Sex	4	1, 1650	-.203*	-.052*	.019
Mating effort factor	5	1, 1650	.243*	.280*	.316*
Sociosexual unrestricted	6 (a)	1, 1648	-.079*	-.020	.013
Slow life history strategy	6 (b)	1, 1095	.043	.060*	.058*
Commitment to the relationship	6 (c)	1, 487	.022	-.010	-.058
Attachment avoidance	6 (d)	1, 1095	.048	.096*	.072*
Attachment anxiety	6 (e)	1, 1095	.294*	.211*	.139*
Satisfaction with the relationship	6 (f)	1, 487	-.194*	-.127*	-.113*
Difference in mate value	6 (g)	1, 1471	.060*	.134*	.095*
Mate value – self	7 (g)	1, 1471	-.116*	-.070*	-.038
Mate value – sexual partner	8 (g)	1, 1471	-.051*	-.007	-.014

Note. Order reflects the position of each predictor in the hierarchical GLMs, with different letters indicating predictors that were entered in alternative, separate analyses as they were on an equivalent level of data aggregation. *Major historical and economic group* compares the scores of the North-American and Norwegian samples against those of the Brazilian sample. In *Continent*, the Norwegian sample is compared with North-American samples. In *Region*, the Midwestern-American sample is compared with the Anglo-American sample. *Sex* compares males' scores on NPE factors to those of women.

* $p < .05$.

and women would present similar patterns of activation in the maintenance of reputation factor, however women reported higher frequency of the reputation-maintenance NPE factor than men, even though this effect was considerably small in magnitude. In line with Hypotheses V and VI, the mating effort factor positively predicted the frequency of all NPE factors, and it predicted the avoidance of bonding factor more strongly than the need for bonding factor (Fisher's $z = 2.28$, $p < .05$). Residual attachment avoidance positively predicted the avoidance and the reputation-maintenance NPE factors beyond the mating effort factor, and similarly to the effects of mating effort upon the NPE factors, residual sociosexual unrestrictedness was less positively associated with the neediness NPE factor than with the avoidance NPE factor (Fisher's $z = 2.65$, $p < .05$), and was even negatively and significantly associated with the neediness NPE factor. Residual life history speed, however, had effects that were contrary to the mating effort factor, as it positively predicted the reputation-maintenance and the avoidance NPE factors. As can be observed, however, overall the predictive power of all residual mating effort indicators, entered after the relatively moderate effects of the mating effort factor, was small, in line with Hypothesis VI.

Attachment anxiety positively predicted the frequency of all three NPE factors beyond the effects of mating effort, with stronger effects on the neediness NPE factor than on the avoidance NPE factor (Fisher's $z = 3.82$, $p < .05$) in line with Hypothesis VII. Satisfaction with the relationship negatively predicted all three NPE factors beyond the effects of mating effort, supporting Hypothesis VIII. The perceived difference in mate value between the participants and their partners was a positive predictor of the frequency of all NPE factors beyond mating effort, and this effect was strongest on the reputation-maintenance NPE factor and weakest on the neediness NPE factor, in line with Hypothesis IX (note, however, that these effects were weak), with a significant difference between the predictive power of that independent variable upon these two NPE factors (Fisher's $z = 2.03$, $p < .05$). Self-rated mate value and the perceived mate value of one's partner negatively explained additional variance in part

of the NPE factors, but these effects were weak, as predicted in Hypothesis IX.

All NPE factors were more frequently experienced by participants from the North-American than by those from the Norwegian sample, the neediness NPE factor was more frequent in the Brazilian than in other samples, and the avoidance NPE factor was more frequent in the Midwestern-American than in the broader Anglo-American sample. As expected, the neediness NPE factor was more commonly experienced by women than men, as can also be observed in Figure 1, whereas the avoidance NPE factor was only slightly, but nonsignificantly, more frequent in men than in women.

Also with regard to the frequency of NPE factors, some significant ($p < .05$) interactions were detected between the continuous variables and the variables categorizing the samples by geography and culture, explaining additional variance of the frequency of NPE factors beyond the main effects reported in Table 3. The interaction terms were entered in the GLMs after the main effects reported above. The expected positive effect of the mating effort factor upon the NPE factors was weaker in the Norwegian than in the North-American samples (semipartial $r = -.068$ for the neediness NPE factor, $-.054$ for the reputation-maintenance NPE factor, and $-.085$ for the avoidance NPE factor), and weaker in the Midwestern-American than in the Anglo-American sample for the avoidance NPE factor (semipartial $r = -.051$). Slow life history speed predicted the reputation-maintenance NPE factor more positively in the North-American and Norwegian samples than in the Brazilian sample (semipartial $r = .058$). Commitment to relationship predicted the neediness and the reputation-maintenance NPE factors more positively in the North-American and Norwegian samples than in the Brazilian sample (semipartial $r = .147$ for the neediness NPE factor; $.106$ for the reputation-maintenance NPE factor). Finally, one's perceived mate value predicted the neediness NPE factor more positively in the Norwegian than in the North-American samples (semipartial $r = .061$).

The only continuous variable that significantly ($p < .05$) interacted with sex was the mating effort factor, with the expected positive effect of this later predictor upon NPE factors stronger for women than for men (semipartial $r = -.092$ for the neediness NPE factor, $-.095$

for the reputation-maintenance NPE factor, and $-.063$ for the avoidance NPE factor).

Table 4 displays the results of GLMs with the *intensity* of the NPE factors as outcome variables. Overall these results were highly similar to the patterns observed with the frequencies of the NPE factors. In Hypothesis V we predicted that men and women would present similar patterns of activation in the maintenance of reputation factor, however women reported higher intensity of the reputation-maintenance NPE factor than men, even though this effect was considerably small in magnitude. Again the effects of the mating effort factor and the residual effects of attachment anxiety were the strongest. In line with Hypothesis VI, mating effort was positively related to all NPE factors, and this relationship was strongest for the avoidance NPE factor, supporting Hypothesis VII. Also line with this hypothesis, residual attachment anxiety better predicted the neediness NPE factor than other factors (Fisher's $z = 2.12$, $p < .05$ compared with the effects of attachment anxiety on the intensity of the reputation-maintenance NPE factor; Fisher's $z = 4.39$, $p < .05$ compared with the effects on the intensity of the avoidance

NPE factor). Sociosexual unrestricted presented a negative and significant association with the neediness NPE factor beyond the effects of mating effort again, and paradoxically commitment to one's relationship was positively associated with the avoidance NPE factor beyond the effects of mating effort; the residual effects of components of mating effort upon NPE factors were weak however, in line with Hypothesis VI. Relationship satisfaction negatively predicted the neediness and the reputation-maintenance NPE factors, but not the avoidance NPE factor, thus partially supporting Hypothesis VIII. Self-rated mate value but not partner mate value negatively explained additional variance in part of the NPE factors, and these significant effects were weak, lending partial support to Hypothesis IX.

The neediness and the reputation-maintenance NPE factors were more intensely experienced by participants from the North-American than by those from the Norwegian sample, the neediness and the avoidance NPE factors were more intense in the Brazilian than in other samples, and the neediness NPE factor was more intense in the broader Anglo-American than in

Table 4

Semipartial Correlations From Hierarchical General Linear Models Predicting the Intensity of NPE Factors

Predictor	Order	NDF, DDF	Semipartial correlation		
			Need for bonding	Maintenance of reputation	Avoidance of bonding
Major historical/economic group	1	1, 1528	-.159*	-.028	-.131*
Continent	2	1, 1528	-.082*	-.071*	-.014
Region	3	1, 1528	-.064*	.018	-.031
Sex	4	1, 1528	-.207*	-.053*	-.013
Mating effort factor	5	1, 1528	.211*	.246*	.274*
Sociosexual unrestricted	6 (a)	1, 1526	-.057*	-.010	.009
Slow life history strategy	6 (b)	1, 1035	-.021	.021	.009
Commitment to relationship	6 (c)	1, 466	.049	.011	.130*
Attachment avoidance	6 (d)	1, 1035	.003	.046	.016
Attachment anxiety	6 (e)	1, 1035	.296*	.209*	.112*
Satisfaction with relationship	6 (f)	1, 466	-.103	-.101	-.023
Difference in mate value	6 (g)	1, 1397	.093*	.143*	.101*
Mate value – self	7 (g)	1, 1397	-.112*	-.082*	-.074*
Mate value – sexual partner	8 (g)	1, 1397	.001	.021	.008

Note. Order reflects the position of each predictor in the hierarchical GLMs, with different letters indicating predictors that were entered in alternative, separate analyses as they were on an equivalent level of data aggregation. *Major historical and economic group* compares the scores of the North-American and Norwegian samples against those of the Brazilian sample. In *Continent*, the Norwegian sample is compared with North-American samples. In *Region*, the Midwestern-American sample is compared with the Anglo-American sample. *Sex* compares males' scores on NPE factors with those of women.

* $p < .05$.

the Midwestern-American sample. As expected, the neediness NPE factor was more intensely experienced by women than men, but as can also be observed in Figure 1, whereas the difference in the intensity of the avoidance NPE factor between men and women was negligible and not statistically significant.

Just as observed with the frequency of NPEs, with regard to the intensity of NPE factors, some significant ($p < .05$) interactions were detected between the continuous variables and the variables categorizing the samples by geography and culture, explaining additional variance of the intensity of NPE factors beyond the main effects reported in Table 4. However these interactions were fewer in number than those detected with the frequency of NPE factors are outcome variables. The expected positive effect of the mating effort factor on the avoidance NPE factor was weaker in Norwegian and North-American samples than in the Brazilian one (semipartial $r = -.089$), and weaker in the Norwegian than in the North-American samples (semipartial $r = -.065$). The effect of relationship commitment on the neediness NPE factor was stronger in Norwegian and North-American samples than in the Brazilian one (semipartial $r = .125$). One's own perceived mate value predicted all three NPE factors less negatively in the Norwegian than in the North-American samples (semipartial $r = .094$ for the neediness NPE factor, .075 for the

reputation-maintenance NPE factor, and .093 for the avoidance NPE factor).

Also as observed with the frequency of NPEs, few interactions with sex were detected when predicting the intensity of NPE factors. The expected positive effect of the mating effort factor on the neediness and reputation-maintenance NPE factors was stronger for men than for women (semipartial $r = .070$ for the neediness NPE factor, and .059 for the reputation-maintenance NPE factor). As interactions between mating effort and sex were identified both when predicting the frequency and the intensity of NPEs, we ran a post hoc analysis to assess whether men and women had different variances in mating effort, as range restriction is known to be an important factor in the attenuation of correlations (Hunter & Schmidt, 2004). Levene's test for equality of variances indicated that indeed men presented a larger variance in mating effort scores than women, $F(2, 1656) = 3.58$, and this was borderline significant ($p = .05$).

Prevalence of NPEs

As an exploratory assessment of the overall frequencies of NPEs across samples and sexes, Table 5 displays the percentage of participants who have never, rarely, sometimes, often, and all the time experienced at least one negative emotion after intercourse. Note that these esti-

Table 5
Percentages of Participants by Sample and Sex Who Reported Having Never, Rarely, Sometimes, Often, or All the Time Experienced One or More of the Twenty-Three NPEs

Sample and sex	Percentage of participants who have experienced one or more NPEs				
	Never	Rarely	Sometimes	Often	All the time
Brazilian					
Males	16.08	15.38	44.76	19.58	4.20
Females	11.25	16.25	42.19	22.50	7.81
Midwestern-American					
Males	17.50	26.67	39.17	10.83	5.83
Females	11.26	22.51	40.26	20.35	5.63
Anglo-American					
Males	20.69	18.39	34.48	13.79	12.64
Females	11.61	14.98	32.58	26.97	13.86
Norwegian					
Males	16.31	29.08	43.26	10.64	.71
Females	13.56	27.13	48.40	10.64	.27

mates do not refer to the mean frequency with which participants have experienced all of the negative emotions assessed, but are rather based on the NPE or NPEs with the highest frequency reported by each participant. Mean frequencies for each factor of NPEs are examined and compared in analyses presented above.

Women reported experiencing more recurrent NPEs than men in all samples, and these effects were significant ($p < .05$) in the Midwestern-American sample, $t(349) = 2.17$, Cohen's $d = .24$; and in the Anglo-American sample, $t(352) = 2.48$, Cohen's $d = .30$; but not in the Brazilian sample, $t(461) = 1.76$, Cohen's $d = .18$; or in the Norwegian sample, $t(515) = .76$, Cohen's $d = .07$.

Finally, on noticing apparent age differences between the samples we examined this in detail as post hoc analyses. The age of the participants in the Midwestern-American sample was significantly ($p < .05$) lower than that in the Brazilian sample, $t(827.58) = 23.20$; in the Anglo-American sample, $t(571.22) = 10.17$; and in the Norwegian sample, $t(772.22) = 23.20$. Age was higher in the Brazilian sample than in the Anglo-American sample, $t(711.65) = 7.54$; and in the Norwegian sample, $t(868.42) = 12.98$. No significant differences in age were detected between Norwegian participants and those in the Anglo-American sample, $t(542.76) = .93$.

Discussion

This study provides the first comprehensive examination of the relationships between a large array of negative postcoital emotions (NPEs) and both Sexual Strategies Theory and the adaptive importance of social reputation. This is also the first study to investigate the existence of different groups of NPEs, examining whether data on them are indicative of mechanism failure and pathology or of predictable adaptive function.

Three dimensions of NPEs seem to exist in all populations studied, with the sets of emotions comprised in each factor corresponding extremely closely to the three factors that we hypothesized. Each dimension of NPEs comprises a group of emotions that, together, might have been selected to deal with adaptive problems hypothesized to have occurred in the postcoital time interval during the evolutionary history of the human lineage. To test that, we

examined whether each dimension would provide evidences of design features consistent with evolutionarily-informed hypotheses.

Design Features of the Three Dimensions of NPEs

All three factors of NPEs were more frequent and more intense in individuals of higher mating effort. This suggests that adaptive problems that posed threats to one's fitness following sexual intercourse were more common in individuals who invested more heavily in short-term sexual relationships, and NPEs were likely to motivate actions to avoid those threats. Mating effort was more strongly related to the avoidance NPE factor, intermediately related to the reputation-maintenance NPE factor, and more weakly to the neediness NPE factor, in line with predictions, and indicating that the most common NPEs activated in individuals who prioritize short-term relationships are emotions such as a need to be alone, disgust for one's partner, irritability, apathy, anger, and pity, which are frequently experienced in conjunction. This group of emotions is likely to have motivated and facilitated one's extraction from unwanted romantic commitments and prior to heavy investment (see also Haselton & Buss, 2001). The residual effects of the specific indicators of mating effort upon NPE factors were weak, confirming that they are related to NPEs mainly through the common factor, and the residual effects were mostly in line with the effects of the mating effort factor.

Attachment anxiety was the principal predictor of the neediness NPE factor both in the cases of frequency and intensity, and only a weak predictor of the avoidance NPE factor, also in line with hypotheses. This suggests that the neediness NPE factor is, to a considerable degree, an expression of one's worries about being abandoned by one's partner and worries that one's feelings for a partner are not reciprocated, and is likely to be a mechanism to elicit relationship commitment and additional investment from romantic partners. In line with this, as expected, emotions of the neediness NPE factor were frequently linked to a behavioral signal: Tearfulness. Crying and tears may function as an honest signal of helplessness (Miceli & Castelfranchi, 2003), informing that one is vulnerable, and eliciting attention, empathy, and

support (Hasson, 2009). However, it was a limitation of this study not to explore whether the emotions that we summarize under the term 'need for bonding' are sometimes intended to elicit empathy and support from individuals other than one's sexual partner, perchance sometimes functioning as a need for bonding and support from family, friends, or other romantic partners.

It was expected that the reputation-maintenance and the avoidance NPE factors would be positively predicted by the difference in mate value between the participants and their partners, as committing to partners of lower mate value after short-term liaisons might inflict costs to one's reputation. However these relationships were not strong, even though the difference in mate value was a stronger positive predictor of frequency and intensity of these two NPE factors than of the neediness NPE factor. Finally, we also predicted that relationship satisfaction would be negatively related to the frequency and intensity of all NPE factors, and although this was corroborated, the magnitude of these associations was small beyond the effects of mating effort. It should also be noted that, as they are likely to be less temporally stable traits than the others assessed in this study (for a comprehensive analysis of the stability of life history and personality traits, see Figueredo, Cabeza de Baca, & Black, 2014), relationship satisfaction and the perception one has of one's partner may be reduced, at least temporarily, after experiencing NPEs, especially those related to the reputation-maintenance and the avoidance NPE factors. In other words, it is difficult to confidently interpret the order of causation for the relationship between these less stable traits and NPEs in the present study.

NPEs of the reputation-maintenance NPE factor shared several design features with the avoidance NPE factor and with the neediness NPE factor, presenting associations with other psychological variables that were intermediate in magnitude between those found for the neediness NPE factor and for the avoidance NPE factor. Even so, it consistently figured as a separate factor in all samples, with emotions that have traditionally been seen as facilitators of maintenance or recuperation of social reputation (Fessler, 2004). Some yet unexplored reasons could conceivably help explain the exis-

tence of such a dimension as separate from the other two. For instance, besides promoting the maintenance of social reputation, the emotions comprised in that factor may also have served, over evolutionary history, to facilitate reparation and compensation of harm inflicted on others (Fessler, 2004; Ghorbani, Liao, Çayköylü, & Chand, 2013). In the postcoital time interval, those emotions perhaps helped to prevent the dissolution of valued relationships, such as preventing the break-up of a long-term relationship after one has perpetrated sexual infidelity, or preventing severe punishment after having carried out coercive sexual intercourse. This possibility is still to be explored.

NPEs were on average more common and more intensely experienced in the Brazilian sample, and the Norwegian sample presented the smallest frequencies and intensity of NPEs, however these sample differences were small in magnitude compared the main effects of mating effort and attachment anxiety. Additionally, only weak interactions were detected between the samples and the continuous predictors of the NPE factors, with most interactions being non-significant, suggesting that the nomological net of NPEs is highly cross-cultural, in spite of the differences between the countries studied regarding their biocultural histories, attitudes toward and conceptualizations of the development of sexual encounters, female acceptance of male sexual advances, openness to displays of nudity and sexuality, female subordination to men, acceptance of female sexuality, and overall liberal attitudes toward sexuality (see the Method section).

The only predictor of NPE factors to present significant interactions with sex was mating effort, suggesting that the frequency and the intensity of NPEs are more strongly related to mating effort in men than in women. These latter interactions were possibly attributable to the range restriction identified in women's mating effort across the samples, as this is known to attenuate the magnitude of correlations (Hunter & Schmidt, 2004).

Differences in NPEs Between the Sexes

Participant Sex by NPE factor interactions (which are arguably the main test of sex differences; see Edlund & Sagarin, 2009; Sagarin, 2005; Sagarin et al., 2012) were confirmed in all

cultures both for frequency and intensity of NPEs, indicating that men, relative to women, experience the avoidance NPE factor more frequently and more intensity than the neediness NPE factor, and women the reverse. Within-sex simple effects also generated substantial evidence for each of these types of NPEs being more prominent in one of the sexes. That suggests that sex differences in NPEs are in line with the main differences in sexual strategies between the sexes (Buss & Schmitt, 1993), and in accordance with previous findings of several sex differences in the postcoital time interval (e.g., Campbell, 2008; Haselton & Buss, 2001; Kruger & Hughes, 2010; Townsend et al., 1995). Both dimensions of NPEs, however, appear to be to some degree important for both sexes. It should also be noted that a significant, albeit considerably weak, sex difference was found for the frequency and intensity of the factor including shame, guilt, self-disgust, and remorse, with women on average reporting higher scores than men, indicating that, at least among young adults, threats to sexual reputation are to a small extent more frequent and intense for females than for males. This suggests that the sexes differ not only in terms of the reasons for experiencing these emotions (e.g., Galperin et al., 2013; Kennair et al., 2015), but also in terms of their frequency and intensity, even though the sex differences in this factor of NPEs are very small.

To our knowledge, this is the first study to date investigating prevalence of NPEs in men. Contrary to what had been predicted based on clinical information in the psychiatric literature (Sadock & Sadock, 2008), men did not report overall higher levels of NPEs than women in any NPE factor, and actually the opposite was observed for two of the three factors. Noticeably, the percentages of individuals who reported having already experienced NPEs in this study (the percentage of men who have already experienced one or more NPEs at least once was between 79% and 84%, and the frequency was between 86% and 89% among women, depending on the sample) are much higher than previous estimates (Bird et al., 2011; Burri & Spector, 2011), which is most likely attributable to our participants having been asked about a considerably larger number of negative emotions.

Status of NPEs as a Disorder

In accordance with the “harmful dysfunction” analysis of disorder (Kennair, 2003, 2011; Wakefield, 1999, 2007), we argue that the results of this study lack indications of NPEs being pathological. Importantly, the present study provides evidences that the dimensions of NPEs are part of and are likely to facilitate the mode of functioning and the ultimate goals of different sexual strategies, besides motivating efforts to maintain or regain social reputation. Harmfulness alone (i.e., suffering) is not a sign of pathology. Additionally, a considerable part of individuals afflicted with NPEs is not distressed by them (Burri & Spector, 2011), thus NPEs may sometimes be neither harmful nor evolutionarily dysfunctional. However, we do not imply that all experiences of NPEs are functional, because in some individuals the threshold for their activation might be abnormal and maladaptive, or gain settings for NPEs may be upregulated (see Nesse, 2009; Tooby & Cosmides, 1990). That possibility has not yet been explored. Nevertheless, it is safe to conclude that the results herein presented provide evidence that the *capacity* to experience NPEs shows signs of having evolved functions and, consequently, does not show signs of disorder.

Limitations, Future Directions, and Concluding Remarks

Some limitations qualify the results presented. First, although the Brazilian sample and the Anglo-American sample were not restricted to students and were nationally broad, participants from Norway and from the Midwestern-American sample were local students and were young adults. Therefore, the results may not be largely representative of the cultures of these countries. Second, given that we conducted the assessment of levels of NPEs on a 5-point Likert-type scale, and that sample means centered between 1 and 2 with a relatively small variance, a greater level of precision would have been possible with the use of more points, and the findings that we discussed might actually underestimate the magnitude of the sex differences and correlations between NPEs and other variables.

It is unlikely that the age differences between samples impacted the results importantly: age

was not significantly correlated to any NPE factor when using the frequency of experiences of NPEs even though the total sample surpassed 1700 participants, and only very weakly predicted the intensity of the NPE factors related to need for bonding and to avoidance of bonding ($r = .07$ in both cases; $p < .05$), not significantly predicting the intensity of the NPE factor related to the maintenance of reputation.

It is important to note that moderate to substantial positive correlations (see Kotrlík & Williams, 2003) were detected between the three NPE factors, as they each share around a third of their variance with each other factor. It is thus likely that certain postcoital situations may trigger more than one kind of adaptive problem, each dealt with by different groups of emotions to a certain degree. Future research should explore which possible scenarios lead to the activation of more than one, as opposed to a specific, NPE factor.

Our study provides initial cross-cultural evidence of the existence of three groups of negative postcoital emotions (NPEs), each with specific design features that are largely congruent with evolutionarily-informed hypotheses. The capacity to experience NPEs appears to have a functional rather than a dysfunctional basis in sexual strategies and maintenance of sexual reputation, not being liable to classification as a disorder. This study also reinforces the still underexplored importance of the postcoital time interval to reproductive success and the understated importance of postcoital emotional and behavioral tendencies in the nomological net of sexual strategies and life history strategies. Based on the magnitude of the positive interrelations among the NPE factors, it can be argued that a single higher-order NPE factor exists with three partially differentiated subfactors, although here we detail that the neediness, the reputation-maintenance, and the avoidance NPE factors present considerably different design features, as they were differentially related to most of the predictors we examined, and clear sex differences were identified.

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