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Author
Scelza, Brooke A

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Original Article

Jealousy in a small-scale, natural fertility population: the roles of paternity, investment and love in jealous response

Brooke A. Scelza *

Department of Anthropology, University of California, Los Angeles (UCLA), Los Angeles, CA 90095–1553, USA

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ABSTRACT

Evolutionary scientists have predicted a universal sex difference in response to different forms of infidelity, with men expected to be more upset than women by a sexual infidelity when both a sexual transgression and an emotional transgression occur. Although this finding has proven to be robust, the vast majority of studies have occurred in industrialized countries and student populations. Here I present the first test of the jealousy hypothesis among a small-scale, natural fertility population, the Himba of Namibia. In this population, the majority of both men and women report greater distress over a sexual infidelity, with men reaching an almost unanimous consensus (96%). Despite the skew for both men and women, there is a significant sex difference in the direction predicted by the evolutionary hypothesis, providing further support for this view. The increased risks of both pregnancy and paternity loss that occur in this natural fertility population may help to explain why these results differ from previously studied populations. More broadly, these data suggest that both the type and the intensity of jealousy expressed may be facultative responses and that further investigation of correlates related to life history trade-offs, forms of investment, and the sexual division of labor can help us to understand the inter-cultural variation in jealous response.

1. Introduction

Traditional interpretations of sexual selection theory in humans predict that men and women will respond differently to threats of infidelity (Symons, 1979; Daly, Wilson, & Weghorst, 1982; Buss, Larsen, Westen, & Semmelroth, 1992). Men, it is thought, will tend to be more upset than women by sexual infidelity, reflecting a mating strategy that aims to increase paternity certainty, which is critical to successfully moderating investment in offspring. Women, on the other hand, are expected to be more upset than men by emotional infidelity, which is thought to reflect the reliability of future male support and therefore represents the female strategy of garnering reliable investment from men. Men and women are thought to have benefited reproductively from both emotional and sexual jealousy; however, because only men experience uncertainty of parentage, and women carry a larger investment burden than men (due to pregnancy and lactation), the sex difference in jealous response is thought to be largely impervious to cultural variation and local norms (Buss, Larsen, & Westen, 1996; Buss & Haselton, 2005). For example, even where the majority of both men and women are more upset by one type of infidelity than the other, men are expected to be more upset than women by sexual infidelity.

Meta-analyses of jealousy studies show strong support for this prediction using both forced choice (Harris, 2003) and continuous (Sagarin et al., 2012) measures. However, the supposition of universality is premature, as it has yet to be tested in a population that deviates significantly from the social norms and sexual stereotypes of the industrialized world. The vast majority of studies come from W.E.I.R.D (Western, Educated, Industrialized, Rich and Democratic) societies (Henrich, Heine, & Norenzayan, 2010), mainly university populations. Studies conducted in non-western settings are also almost exclusively conducted with undergraduates (e.g. Buss et al., 1999 in Korea and Japan, Geary, Rumsey, Bow-Thomas, & Hoard, 1995 in China, Fernandez, Sierra, Zubeidat, & Vera-Villarroel, 2006 in Chile, and Brase, Caprar, & Voracek, 2004 in Romania). To date, there are no studies that have been published using data from respondents from a small-scale society or natural fertility (non-contracepting) population.

University samples differ markedly, and in important ways, from the majority of extant human societies and from the types of societies that existed for most of human history. Therefore, it is crucial to examine jealous response in more representative samples before making broad generalizations about human behavior on the basis of the existing evidence. For example, although student respondents may be sexually active, they have widespread access to contraception and are rarely married or have children. The reproductive stakes of infidelity are therefore much lower than they would be in other populations where sex is more likely to result in pregnancy and to have long-term consequences. Similarly, the social consequences of infidelity among young adult student populations might also differ from those in small-scale societies. In small-scale societies individuals

* Corresponding author.
E-mail address: bscelza@gmail.com.

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are often in very close contact with their partner's kin, and they may be subject to formal punishments if their infidelities become known (Betzig, 1989). Finally, the typical level of paternal investment varies greatly across societies, and certain types of fathering such as direct care are generally greater in W.E.I.R.D. populations (Whiting & Edwards, 1988; Cabrera, Tamis-LeMonda, Bradley, Hofferth, & Lamb, 2000; Pleck & Masciadrelli, 2004). Given that behavioral responses such as jealousy could be conditioned on local mating vs. parenting trade-offs (as predicted by Buss and colleagues in their original paper, but never explicitly tested), the jealous response of a typical western male will not necessarily be observed among men in societies where paternal investment is lower. Similarly, female jealous responses could also be conditional on typical levels of paternal investment within a given society. For these reasons, studies of jealousy in small-scale, natural fertility populations are crucial to understanding the range of responses men and women express in response to threats of infidelity, and to determining the plausibility of a universal sex difference in jealous response.

In addition to providing a strong test of the prediction that there will be a universal sex difference in jealous response, this study also explores the range of evolutionarily relevant factors that are expected to affect jealous response. This will build upon the general notion that jealousy is a facultative response, and expands upon previous work from other disciplines, which has focused largely on the influences of personal experience.

Non-evolutionary studies of jealousy have shown that factors such as relationship experience (Murphy et al. 2006) experience with infidelity (Harris, 2002; Edlund, Heider, Scherer, Farc, & Sagarin, 2006; Johnson, 2006; Sagarin et al., 2012), and sexual orientation (Harris, 2002; DeSouza, Verderane, Taira, & Otta, 2006; Sagarin et al., 2003) are important moderators of how people perceive jealous threats. We also know from previous work that there is significant variation in the magnitude of the sex difference that is seen, as well as variation in how upset men and women are to different types of jealousy when it is measured continuously (Harris, 2003). For example, in Buss and colleagues' original study of American undergraduates, 60% of males reported more distress to a sexual infidelity than an emotional one, compared to only 17% of women (Buss et al., 1992); however, in both Germany and the Netherlands the majority of both men and women report more distress to the hypothetical emotional infidelity, and the differences between the sexes are less pronounced than they are in the U.S. sample (Buunk, Angleitner, Oubaid, & Buss, 1996). Similarly, in Romania men and women also had very comparable responses, with 36.6% of men and 30% of women being more upset by a sexual infidelity (Brase et al., 2004).

If jealousy is a facultative response, it could be conditional upon either individually specific context and behavior or group-level norms (Buunk & Hupka, 1987; Geary et al., 1995) and the evidence discussed above seems to point to a role for both. However, once again we are currently limited in our ability to see the full spectrum of variation because of similarities in the populations where jealousy tests have been run. Whether the triggers of variation in western cultures are the same as those in other places is currently unknown, but there is good reason to believe that they might differ. While in western societies, romantic love, commitment and marriage are largely intertwined, these phenomena are often separate, or at least more complexly related, in societies that have polgyny, arranged marriage and frequent divorce or infidelity. As mentioned above, levels of paternal investment and female reliance on male resources are also quite variable, and these can affect intra-population sex differences as well as cross-cultural averages.

Here I present the first test of the Buss jealousy hypothesis from a small-scale, natural fertility population, the Himba of northwest Namibia. The Himba were chosen because they differ from previously studied populations in three key ways. First, the Himba are a non-contraceptive using population. In interviews with 50 women, only 30% had ever heard of a modern method of contraception, and only 14% had ever used contraception, with none currently using. Second, the Himba profess to have very high rates of infidelity and have one of the highest reported rates of extra-pair paternity in the world (Scelza, 2011), reflecting a prevalent risk of paternity uncertainty for men. Relatedly, infidelity is normatively permitted for both men and women, representing a very different level of social acceptance than is found in typical western populations. Third, paternal investment by Himba men is relatively low. The majority of wealth is inherited matrilaterally, brideprice paid for sons' marriages is low compared to other African pastoralists, and direct care by fathers is minimal.

Given this suite of cultural traits, the Himba are predicted to differ from previously studied populations in the following ways: *(i) Himba men will exhibit more distress over sexual infidelity than men in other populations*. This is because of the high level of reproductive risk that occurs in a natural fertility population, coupled with the local behavioral norms for frequent infidelity and autonomy in female mate choice; *(ii) Himba women will exhibit less distress over emotional infidelity than their same-sex counterparts in other populations*. This is because Himba women expect less investment from males than is typical in western populations. Therefore, to the extent that emotional infidelity by men predicts diversion of resources from their wives, Himba women have less to lose as a result of emotional infidelity than western women. In addition, the frequent occurrences of arranged marriage and divorce may be associated with looser emotional bonds between couples, making emotional infidelity a weaker cue for investment than is seen in other cultures; *(iii) A significant sex difference in jealous response will still exist, with men being more upset by sexual infidelity than women*. Despite the predictions that both sexes will be more likely to skew their responses toward sexual infidelity, men should still be more upset than women because they face uncertain parentage, which women do not, and because there is some reliance of women on male resources.

A set of variables relating to individual relationship status will be used to determine any predictors of intra-population variation. These will include current marital status, number of marriages, and whether the current (or last in the case of those currently single) relationship was a love match or an arranged marriage. Age and number of children will also be evaluated as these are linked to reproductive value and reproductive success respectively. I am not making *a priori* predictions about the direction of the effects these variables will have, as this is an exploratory study.

2. Methods

The standard protocol of a forced choice short vignette experiment is used in order to facilitate comparisons with existing studies. Specifically, the present study was designed as a replication of Buss et al. (1999). This particular iteration of the forced choice model was chosen because it was designed to address concerns about the possibility of a "double-shot" or "logical beliefs" effect (Buss et al., 1996). These hypotheses suppose that emotional jealousy and sexual jealousy are not perceived as independent by participants, and that because men are more likely to believe sexual infidelity implies emotional infidelity and women the opposite, a sex difference could result because emotional infidelity signifies two indiscretions for women and sexual infidelity two indiscretions for men (DeSteno & Salovey, 1996; Harris & Christenfeld, 1996). To solve this dilemma, Buss and colleagues designed a study explicitly stating that both kinds of infidelity had occurred and asked participants to choose which of the two was most distressing (Buss et al., 1999). That statement was used here, and reads:

Imagine that your partner both fell in love with another person and had sexual intercourse with that person. Which aspect of your partner's involvement would upset you more?

A. Sexual Intercourse
B. Falling in love

Participants were recruited from public gathering places within the Omuhonga Basin (n = 100). All interviews were conducted outside, but out of earshot of other Himba. Any man or woman who was 15 years or older was eligible for the study, although we aimed to recruit equal numbers of men and women.

While the forced-choice format was standardized for all participants, along with a few basic demographic questions, a number of men and women were interviewed either previously or concomitantly about their reproductive and marital histories in a more detailed manner (n = 44), as part of a broader project on Himba life histories. These interview data were used to construct some of the relationship variables used in this study. One difference between this methodology and that typically used in jealousy studies is that the data here were collected in face-to-face interviews rather than through more anonymized questionnaires. While it is possible that this study design could affect participant responses, it was necessary in that study participants were almost all illiterate and so could not fill out a questionnaire by themselves. However, in previous interviews with Himba men and women, participants spoke freely about infidelity, jealousy and marital relationships. No one declined to answer the vignette question or expressed any discomfort toward the subject matter, indicating that we can have high confidence in the reliability of participant responses. The forced-choice vignette and oral interviews were both conducted with the help of a research assistant in the local language of *Otjiherero* and the vignette script and question were translated and back-translated by two native speakers before the study commenced. Participants received a small food item in exchange for their time. This study was conducted with approval from the UCLA Office of Human Research Protection (#10-000238) in addition to local research permissions. Oral consent was obtained in lieu of written permission given that most participants cannot read or write *Otjiherero*.

3. Results

A total of 100 participants completed the vignette experiment (see Table 1 for details). The majority of both Himba men (96%) and women (66%) reported being more distressed by sexual infidelity than by emotional infidelity (Fig. 1). These results were fairly consistent for each sex across age categories, current marital status, number of children and current engagement in an extra-marital affair (Table 1). One-sample t-tests show that both sexes were significantly above chance in choosing sexual infidelity as more upsetting (Men: $t = -16.08$, $df = 48$, $p < 0.001$. Women: $t = -2.50$, $df = 50$, $p = 0.016$.). However, the standard sex difference persists in these data, and is highly significant with men much more likely to be upset by the sexual infidelity than women ($\chi^2 = 13.89$, $df = 1$, $p < 0.001$).

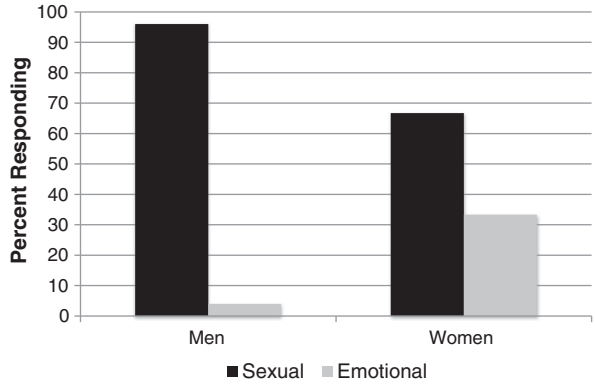

Fig. 1. Percent of men and women reporting that they were most distressed by either a sexual or an emotional infidelity in a scenario where both indiscretions occurred.

Due to the uniformity in men's responses (only 2 out of 49 respondents reported being more upset by the emotional infidelity), statistical analyses of the influence of independent variables on male responses could not be completed. However, it should be noted that the men in this sample varied greatly in terms of a number of relevant characteristics including current marital status, level of polygyny, the presence of an extra-marital lover, and having at least one wife who was a "love match" (Table 1).

Women's responses to the vignette were more varied and so warranted analysis of predictive covariates. Pairwise correlations of jealous response with current marital status, number of marriages, number of children, current involvement in an extra-marital affair and age were all non-significant, despite variation across women in all these categories (Table 1). The only significant association was with whether the current or most recent marriage was a "love match" (Fig. 2). Women who were in love matches were significantly more likely to report being more distressed by an emotional infidelity ($\chi^2 = 4.45$, $df = 1$, $p = 0.035$). In addition, women who were currently engaged in an extra-marital affair themselves were almost three times more likely to be upset by a sexual infidelity (Table 1), though this difference was not statistically significant.

Table 1
Demographic Characteristics of Study Sample: Ratios of jealous response (sexual or emotional infidelity as most upsetting) shown in parentheses.

	Men	Women
Marital Status		
Married	78% (36:2)	40% (13:7)
Not Married	22% (11:0)	60% (20:10)
Age Category		
15–25	10% (5:0)	24% (7:5)
26–40	45% (21:1)	27% (11:3)
41–60	22% (10:1)	27% (9:5)
>60	23% (11:0)	22 (7:4)
Number of Children		
0	7% (3:0)	8% (3:1)
1–3	28% (11:1)	37% (11:7)
4–6	30% (13:0)	45% (16:6)
7–10	19% (7:1)	10% (2:3)
>10	16% (7:0)	0
Current Extramarital Partner (n = 66)		
Yes	44% (14:1)	59% (14:5)
No	56% (19:0)	41% (7:6)

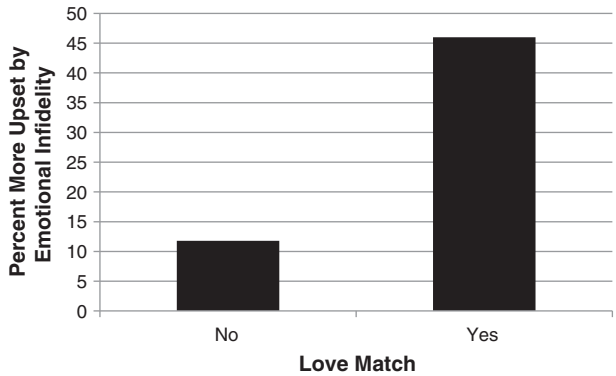

Fig. 2. Percent of women reporting that they were more upset by an emotional infidelity than a sexual infidelity, dependent on whether their current or most recent marriage was a "love match" (Yes) or an arranged marriage (No).

4. Discussion

Himba men and women both report being significantly more distressed over a hypothetical sexual infidelity than an emotional one. These results are consistent across age categories, current marital status, parity and current involvement in an extra-marital affair. These are the highest levels of distress over sexual infidelity ever reported for either sex, as well as one of the few studies that show the majority of both men and women being more upset by sexual infidelity. For comparison, in Buss and colleagues' (1999) study using the same vignette that was used here, only with American, Korean and Japanese students, 33% to 61% of men were more distressed by the sexual infidelity compared to 96% among the Himba. The women in that study ranged from 13% to 27% who were more distressed by the sexual infidelity, compared to 66% among Himba women. Despite the similarity among Himba men and women, men were considerably more likely to choose the sexual infidelity as more distressing than are women in this sample, lending support to the hypothesis that a universal sex difference exists in jealous response.

4.1. Paternity loss and paternal investment as they relate to jealousy

The high skew men exhibit, with almost all the male participants reporting greater distress over a sexual infidelity, is likely due at least in part to the increased risk of paternity loss that occurs from infidelity in a natural fertility population. This risk is particularly high among the Himba, who normatively permit infidelity by both men and women, and where this behavior is reported to be common. Although there were no systematic open-ended questions in this study, any comments that participants made were recorded opportunistically. The explanations that Himba men provided for why they chose sexual infidelity as more distressing point to paternity loss, and the concomitant misallocation of resources. One man said, "When a man has sex with your wife, it means he eats your cattle, your things," referring to the resources that must now be given to the children from his wives' affairs. Several men equated sexual infidelity with "damage" as in, "It's fine if she loves someone else. If there's no sex, there's no damage." While it is somewhat ambiguous as to what the damage they refer to is, one interpretation is that this refers to potential paternity loss. Because the term is used exclusively in association with sexual infidelity, it is less likely that they are referring to damage to the emotional bonds of marriage.

Interestingly, some men also appear to temper their jealousy according to the relational context of the event. In particular, how infidelity relates to their status, and the respect and friendship they have with other men. A few men stated that they would be less upset if the man who had sex with and/or fell in love with their wife was a friend or ally. One states, "If he was on my side and he had sex with her, I would be fine. If he was not in favor of me [*friends*] I would feel upset." Another man explains that there are social rules associated with sexual infidelity that should be followed in order to respect the husband. For example, "Sometimes the wife has a boyfriend, and he comes in the evening. The next morning he leaves early [*typically before dawn*]. But sometimes the wife has a boyfriend and he comes and sleeps and then he stays at the compound [*into the morning*]. That one makes me more upset." Another states more simply, "When someone has sex with my wife and doesn't respect me, it makes me unhappy." These statements are supported by certain norms in Himba culture related to marriage and reproduction. In addition to the normative acceptance of at least some regularity in extra-marital sex by both men and women, the Himba also engage in wife-lending. Typically, this occurs when the head of the host household offers a visiting man the option to sleep in the hut of one of his wives (however, the wife always has the option to decline). This formalized process, referred to as *oupanga*, traditionally occurs among men who are classificatory cross-cousins, but in practice they tend to be men who are close friends or age-mates (Gibson, 1956).

The greater risk of pregnancy from a sexual affair may also explain why the majority of female respondents also found the sexual infidelity to be more distressing. The greater the chance that a man can impregnate the woman he has an affair with, the greater the likelihood that he will divert some resources away from his wife and her children. In particular, Himba women reported fears that it was sex, and not love, that put their husbands at greater risk of leaving them. One woman said, "For the culture it's fine [*referring to the Himba's liberal sexual norms*] but for me I don't like it when he goes off to have sex with someone else because he could leave me and never come back," while another reported, "If he has sex with someone else he might drop me. To fall in love is fine." Further support for this explanation comes from life history interviews previously conducted with Himba men and women. Women have reported that they have received resources from their lovers to help care for the children of these affairs. One said, "He should buy some stuff or give some cows. Sometimes when he [*the extra-pair partner*] is traveling this side, he leaves one goat at a compound and he tells someone to tell the child [of the affair] to come pick it up." Men's life histories also show that they sometimes go on to take as second and third wives the women they have fathered children with out of wedlock, which would also divert resources away from the children of the first wife.

The responses of Himba women in this study challenge the previously held assumption that emotional infidelity is a better indicator of male resource diversion than sexual infidelity. It may be that emotional infidelity is a better predictor of the loss of certain kinds of male investment, such as direct care, but is less tightly linked to other more obligatory investments. For example, while a man who is having a love affair may spend less time with his wife's children, he may still provide the same level of material goods, and continue to be obligated to pass his wealth on to his legitimate children when he dies. However, a man who has a sexual affair and fathers a child through that union may be obligated to provide some resources for that child, even if he spends very little time with the child and never had an emotional attachment to the child's mother. Therefore, in societies where fathering involves a high level of direct care, emotional infidelity may be the best proxy for diversion of investment, but where paternal care consists mainly of resource provisioning or the transfer of wealth, sexual infidelity may signal a greater loss. To better understand the links between paternal care and jealous response, a broader study than the one reported here is needed, including data from a range of societies that vary in both the level and the forms of paternal investment that are normatively performed.

4.2. Jealousy in love matches

The one exception to the bias toward sexual infidelity seen in these data was that Himba women involved in a "love match," (defined as a marriage where the husband and wife chose each other, as opposed to a marriage arranged by kin) were more likely to report that emotional infidelity was more upsetting. These women explained their choice by saying things like, "Love [*is worse*] because falling in love is a big deal." Love match marriages are qualitatively different than arranged marriages, in that the couple chose to be together. Previous work has shown that mothers report children born into arranged marriages are more likely to be fathered by extra-marital affairs than those born into love matches, indicating increased fidelity in these marriages (Scelza, 2011). If women in love matches were on average more closely bonded to their partners, this might explain why they would feel more distressed by an emotional infidelity than a sexual one. These women may be more similar to the women in W.E.I.R.D. samples, who also almost always have chosen their relationship partners. Once again, a larger cross-cultural study that evaluates

various parameters of marriage, particularly those related to the level of partner choice, would further illuminate how jealousy manifests in different kinds of relationships.

4.3. Study limitations and future directions

The forced choice method was employed in this study because it requires that participants rank the two types of infidelity, which most clearly tests the evolutionary hypothesis about a universal sex difference. However, this format has some significant limitations. Most importantly, it masks the level of distress participants report that they would experience in response to each type of infidelity as well as the degree of difference between the two types of infidelities in the magnitude of distress they elicit. Some evolutionary studies of jealousy have dismissed this limitation, stating that what matters is the presence of a sex difference, not where the two types fall on a continuous scale. But these factors become important in a broader evolutionary study that aims to understand how life history and demographic factors, such as the level and types of paternal care or the level of dependence women have on male resources, affect jealous response. While continuous measures were not used in this study, free response data suggest that the Himba differ significantly from many previously studied societies, in that they do not claim to be very upset by infidelity. Many respondents said things like, "Both are fine," or "Neither makes me upset" before choosing one of the two infidelities as worse. Further study of the Himba as well as other small-scale societies should explore the connections between continuous ratings of jealousy and societal factors related to investment and male–female relations.

Thus far much of the debate over jealousy has focused on whether a universal sex difference exists, on methods (forced choice vs continuous measures), on how responses are analyzed (interactions vs raw numbers), and on variation between individuals within a population, given their traits and life experiences. There has been much less focus on inter-population differences. Those studies that do look at cross-cultural differences (e.g. Buunk et al., 1996; Buss et al., 1999; Fernandez et al., 2006) point to some trends in variation, but they do not offer *a priori* predictions grounded in evolutionary theory about jealous behavior. As we move forward with cross-cultural work on this topic it would be helpful to use existing theory about life history trade-offs to generate predictions about the expected intensity of jealous response and the magnitude of any sex difference.

There are several society-level features that are likely to affect the intensity of jealous response. For example, societies that have high levels of normative paternal investment should have males who exhibit more jealousy. Among women, the level of dependence on male resources should also be associated with jealous response, with greater levels of jealousy expected in cultures where female dependence is high. Existing support for these predictions comes from studies that have continuous measures of jealousy.

In addition to these general predictions, there are specific cultural traits that might be associated with increases in specific types of infidelity by either men or women. For example, sexual infidelity should be more distressing to both men and women in places where contraceptive use is rare. This is because the risk of pregnancy affects both the potential misallocation of investment by men if their wives become pregnant through an affair, and diversion of resources by husbands if they impregnate someone other than their wife. As the data in this study indicate, the type of investment males provide may also affect the type of jealousy women are most likely to be upset by. Where fathers invest mainly via material transfers, women may be more upset by sexual infidelities, whereas where direct care by fathers is prominent, emotional infidelity may be more upsetting to women. Men's jealousy may also differ depending on how they invest. When paternal care provided is less divisible, for example protecting the household from intruders or reading a book to children, a man may be less upset by sexual infidelity because the cost of misallocating investment to a child who is not his own is lower. The corresponding prediction, that in cultures where investment emphasizes divisible forms of care (e.g. paying dowry or brideprice or household provisioning) men will exhibit greater sexual jealousy, should also be supported.

Conversely, increased distress over emotional infidelity may be more common in men and women in cultures where marital stability is valued (i.e. divorce is rare) and where both parents contribute significantly to the direct care of offspring. The data presented here also suggest that romantic love may play a role in the level of distress over emotional infidelity. In societies where marriages are arranged, both partners may report greater distress over sexual infidelity, whereas in societies where partners choose each other, both may be more upset by emotional infidelity. There is some evidence to support this conclusion, in that emotional infidelity is more upsetting to both men and women in many Western cultures, where partner choice is normative. However, we lack sufficient samples from societies with arranged marriage to make any conclusive statements about this prediction.

Holding constant the general expectation that men will be more upset than women by sexual infidelity there are two ways that the magnitude of a sex difference can be decreased: 1) by a higher proportion of women reporting distress over sexual infidelity or 2) by a higher proportion of men expressing distress over emotional infidelity. Using the predictions laid out above, we should expect that natural fertility populations will have smaller sex differences because more women will report greater distress over sexual infidelity. Sex differences will also be smaller in societies where male investment is high and divorce rates are low, because a higher frequency of males should report being more upset by an emotional infidelity.

In addition to these more quantifiable variables, detailed ethnographic knowledge about investment patterns and gender relations will help us to understand why certain types of jealous response are prominent in one or both sexes in a given context. Studies such as these should not be seen in opposition to those looking for a universal sex difference, in fact they might build support for such a prediction. Instead, they address a complementary set of questions about the plasticity of jealous behavior both within and between the sexes that will help to move us forward in understanding jealousy as part of the human condition.

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