Original Article

Partner preferences in the context of concurrency: What Himba want in formal and informal partners

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ABSTRACT

Research on human mate preferences that distinguishes between short- and long-term partners has been conducted mainly in industrialized societies, where multiple mating and concurrent partnerships are stigmatized. However, cross-culturally, there is significant variation in the frequency and the level of acceptance of such relationships. Furthermore, the dichotomy between short- and long-term partnerships does not fully describe the diversity in actual extra-pair behavior, which ranges from single sexual encounters to multi-year love affairs. Here we present another comparison, between formal (marital) and informal (non-marital) partners, which we feel better captures this diversity. We assess the traits that men and women prefer in each type of partner among Himba pastoralists, where concurrent partnerships are common and accepted for both sexes. We situate our findings in relation to three main explanations for concurrent partnerships: dual-mating, trading-up and multiple investors. We find some similarities with the existing literature in the traits that are listed as important, including physical attractiveness, wealth and intelligence. Our evidence suggest that Himba men follow a dual strategy, preferring hard-working wives and attractive girlfriends. Women's preferences align most strongly with a multiple investors explanation, most clearly articulated through their preferences for wealthy husbands and generous boyfriends. Limited support is also found for a dual-mating strategy in women. These findings suggest that local cultural norms and ecologies modulate mate preferences in important ways.

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1. Introduction

The evolutionary literature on mate choice, which is anchored primarily in the work of Bateman (1948), and Trivers (1972), focuses largely on sex differences in the types of partners that people prefer. At the broadest scale, these differences can be simplified as representing the different adaptive problems that men and women face in securing a partner. Theory in evolutionary psychology builds on the supposition that men are faced with reproductive constraints (the number of fertile partners they can attract) while women are constrained by the amount of resources they can obtain for themselves and their children (Buss & Schmitt, 1993; Gangestad & Simpson, 2000). This has led to a standard series of predictions, namely that men are generally said to prefer cues of fertility (e.g. youth and physical attractiveness), while women prefer partners with traits that cue wealth (e.g. earning potential, ambition, status). These predictions are frequently supported in empirical tests (Buss, 1989; Shackelford, Schmitt, & Buss, 2005).

To date, there have been only a few studies of mate preferences within small-scale societies, and their findings are less consistent.

Among the Mayanga, in a study that looked only at women's preferences, both hunting ability and wealth were correlated with desirability as a husband, in accordance with standard predictions (Koster, 2011). Among Shuar hunter-horticulturalists, there were no sex differences reported in the relative importance of physical attractiveness or access to resources (Pillsworth, 2008). Resource-related traits were ranked relatively high for both men and women among Shuar, while physical attractiveness ranked near the bottom for both sexes. Similarly, among Hadza hunter-gatherers, there was no sex difference in the ranking of physical attractiveness, which was highly desired by both sexes (Marlowe, 2004). However, a greater percentage of men than women cited fertility as an important trait in a spouse. Both men and women also ranked foraging ability highly, with women ranking it significantly higher than men in importance. Speculation on patterns from this small number of studies is necessarily suspect, but some trends should be noted. Physical attractiveness appears to be variable in its importance to men, whereas women favor cues linked to resources more commonly. In opposition to the standard evolutionary psychology predictions, women and men don't always differ in their ranking of physical attractiveness, and men in these cultures place importance on women's ability to accrue resources. To further explore preference patterns, and their exceptions, we need greater breadth in the types of places where partner preferences are studied (Henrich, Heine, & Norenzayan, 2010).

A limitation of the studies that have been conducted in small-scale societies is that they all focus on preferences for long-term partners. Within evolutionary psychology more broadly however, there is a large literature focused on how men's and women's preferences differ depending on whether they are being asked about a long-term or a short-term partner (Buss & Schmitt, 1993; Greiling & Buss, 2000). For men, some preferences, like physical attractiveness, are predicted to be relatively invariant to context. But men are predicted to prefer cues of sexual receptivity more strongly in short-term partners and cues of fidelity more strongly in long-term partners. For women, resources are thought to be important in partners of both types, but cues for immediate resource transfers (e.g. generosity, gift-giving) should be preferred more strongly in short-term partners and cues for more general ability to accrue resources in long-term partners (Buss & Schmitt, 1993). A competing view hypothesizes that women will favor cues of genetic quality in short-term partners and signals of high investment potential in long-term partners (Pillsworth & Haselton, 2006).

The distinction between long-term and short-term mating is meant to distinguish between fleeting and non-committal affairs and longer, more cooperative unions where couples typically co-reside, raise children together and coordinate their production. Marriage is clearly the most common form of the latter. However, "short-term" does not fully capture the diversity of partnerships that occur outside of marriage. Affairs can range from one-night stands to multi-year relationships that produce multiple children. Non-marital relationships can also occur outside of marriage, and while some of these eventually lead to marriage (e.g. dating), many, some might argue most, do not. The emotional tenor of these unions also varies. For example, equating love with long-term and sex with short-term relationships is too simplistic. The existing label of "short-term" not only fails to capture this variation, it biases readers to think about these relationships as devoid of investment or commitment. In order to more fully appreciate the potential benefits associated with non-marital relationships, we need new language to describe them.

Here we introduce an alternative dichotomy that we feel better captures some of these nuances: formal versus informal partnerships. Formal partnerships, mainly marriage, not only have the cooperative functions described above, they come with a set of recognized rights and responsibilities between partners. These include some degree of fidelity and rights to paternity (though social norms condoning infidelity vary across cultures), rights to household wealth, both for daily consumption and in terms of inheritance for spouses and their children, and often a customary set of behaviors that guides how couples and their kin should interact. Informal partnerships are not beholden to these norms, and many of the rules that dictate how lovers should behave relate more to the obligations of the lovers to their spouses than they do to each other. Resources transferred to informal partners come in the form of "gifts" rather than obligations. Informal partnerships can be either concurrent with formal ones (e.g. affairs) or they can be pre-marital or inter-marital relationships that may eventually become formalized.

In this study we use the contrast between formal and informal partnerships to understand partner preferences among Himba pastoralists. We begin by discussing the expected preferences of men and women using the three major frameworks for understanding partner preferences: dual-mating theory, trading-up, and the accrual of multiple investors, and make predictions about how men's and women's preferences might differ across relationship contexts. Following a description of Himba marital and non-marital partnerships, we present data from a trait ranking study on partner preference.

1.1. Women's preferences

Much of the work on mate preferences across contexts in humans (e.g. long-term and short-term partnerships) has focused on women. Some theories, like dual-mating, were designed specifically as a way

of understanding women's relationship goals and motivations, while others, like "trading-up" and "multiple investors," are not designed to speak exclusively about women, but are rarely used to understand men's preferences.

The "dual mating strategy" addresses the specific challenge that women face in needing both resource security and "good genes" for their offspring (Gangestad & Haselton, 2015; Pillsworth & Haselton, 2006). In this scenario, it is predicted that women will seek explicitly different things from their formal and informal partners (Table 1). In their marital partners they should favor traits linked to trust and reliability, traits linked to resource potential such as wealth or industriousness, and evidence of emotional bonding such as mutual affection and compatible personalities. In their informal partners, they are predicted to be looking for traits that reflect good health, stamina and other physical characteristics that would be favorable if passed on to their children. Existing evidence for dual-mating comes mainly from western populations and much of the work has focused on changes in women's preferences and behavior across the menstrual cycle, with women shifting toward preferring traits that cue genetic quality at high fertility (for a recent review, see Gildersleeve, Haselton, & Fales, 2014).

A second theory explaining women's partner preferences has been referred to alternately as "trading-up" or more recently "mate switching" (Buss, Goetz, Duntley, Asao, & Conroy-Beam, 2017; Halliday, 1983; Jennions & Petrie, 2000). One of the most understandable reasons a person might take on a new partner is when that person offers a significant improvement upon their current situation. A woman might "trade-up" for a new partner with more resources, a warmer disposition or whose interests are more compatible with her own. Trading-up can occur through either infidelity or divorce. In the former case, one might assess the potential of a new partner during an affair, and decide whether to leave their current partner based on the outcome of the trial period. In the latter case, one might leave their partner without having a specific new partner in mind, but knowing something about the quality of potentially available partners compared to their current partner. The trading-up hypothesis predicts that future mate choice is dependent on the relative quality of current and potential extra-pair mates, and that trading up may be a method to screen for desired traits in informal partners. This suggests that women who engage in trading up should not exhibit a difference in the traits they prefer in formal and informal partners (Table 1).

There is some evidence for "trading up" across species, including in guppies (Pitcher, Neff, Rodd, & Rowe, 2003); crickets (Bateman,

Table 1
Comparison of approaches to understanding partner preference for formal and informal mates.

Theoretical approach	Men	Women
Trading-up	- Similar preferences for formal and informal partners - Prioritize indicators of fertility more in informal partners	- Similar preferences for formal and informal mates
Dual strategies	- Prioritize indicators of industriousness more in formal partners - Prioritize indicators of fidelity more in formal partners - Prioritize indicators of fertility more in informal partners	- Prioritize cues of "good genes" in informal partners - Prioritize cues of wealth and industriousness in formal partners
Multiple investors	- Prioritize indicators of good parenting/-industriousness in all partners	- Prioritize indicators of resource accrual in all partners and indicators of resource transfer (generosity) in informal partners

Gilson, & Ferguson, 2001), newts (Gabor & Halliday, 1997) and rock-wallabies (Spencer, Horsup, & Marsh, 1998). However, experiments in other species failed to find evidence that female choice is linked to trading up (Klemme, Eccard, & Ylönen, 2006; Prokop, Jarzębowska, Skrzynecka, & Herdegen, 2012). Studies in humans remain rare. In the US, following a non-marital birth women are more likely to select new partners with higher economic capabilities, suggesting that some assessment of the value of new partners relative to old partners is taking place (Bzostek, McLanahan, & Carlson, 2012). Greiling and Buss (2000) report that women view the ability to find and secure a better partner as a benefit of extra-pair mating, and that they report being more interested in extra-pair partners when their current partner is less successful. Supporting evidence also comes from studies showing relationship dissatisfaction as driving female infidelity (Glass & Wright, 1992). A recent review has brought new interest for this theory among humans (Buss et al., 2017), but more data are clearly needed to determine the importance of trading-up in human relationship dynamics.

A third explanation for having concurrent formal and informal relationships is the ability to acquire resources independently from multiple partners. That is, women who engage in simultaneous relationships would have more investors to draw from, which in turn would either increase the total amount of resources available to them, or reduce stochasticity in their access to resources over time (Hrdy, 2000; Walker, Flinn, & Hill, 2010). Resources could include food, money, medical care or other material goods. This approach has been presented as one possible explanation for partible paternity in South American groups (Ellsworth, Bailey, Hill, Hurtado, & Walker, 2014; Walker et al., 2010). In these societies, where multiple men can claim paternity rights to a single child, children with multiple social fathers have higher rates of survival (Beckerman & Valentine, 2002; Hill & Hurtado, 1996). This hypothesis is further supported by findings that males of high wealth and status, and males that are highly skilled in resource procurement, are likely to have more extramarital partners and children (Kaplan & Hill, 1985; von Rueden, Gurven, & Kaplan, 2011), indicating that they may be preferred as extramarital partners because of the resources they invest [though alternatively, these preferences might align with a signaling hypothesis, where the resources provided are secondary to the information women receive about men's quality (Hawkes & Bliege Bird, 2002; Smith, 2004)].

If the primary reason for women seeking simultaneous partnerships is for resource gains, then women should seek partners who are wealthy, skilled, industrious or high-status. Because in formal (marital) partnerships there are expectations that wealth will be shared between spouses, cues of wealth should be most important. However, in informal partnerships, where resource transfers are often optional and variable, women should value generosity, in addition to cues of resource access or potential.

1.2. Men's preferences

Compared to the literature on women's mate preferences, and female choice more generally, there have been fewer studies of men's preferences across contexts. Instead, focus has been placed on how much effort men should put into short-term partnerships based on their quality, and therefore how successful they are likely to be given women's preferences (Gangestad & Simpson, 2000). However, Sexual Strategies Theory (SST) does offer some general guidelines for how men's preferences for long-term and short-term partners might differ. Men are expected to have generally lower acceptable standards for a short-term partner in order to maximize the number of potential partners, whereas they should be very discriminating when choosing a long-term partner, in whom they will likely invest heavily (Buss, 2000). While men should favor both cues of both fertility and reproductive value in both types of partners, some studies have shown that men place more emphasis on women's bodies (a cue of current fertility), as

opposed to their faces (a cue of reproductive value), in short-term mating contexts (Confer, Perilloux, & Buss, 2010). Men should also favor cues of fidelity in long-term partners, to protect themselves against misallocated investment (Buss, 2000).

Dual-mating theory does not apply directly to men, as men's long-term partners do not typically invest in their children from other partners. However, some dualism in men's preferences should be expected across contexts. Given that men face the problem of misallocated investment through cuckoldry, they should favor cues of fidelity more in formal partners than in informal ones, where their parental obligations are much lower and less obligatory (Buss, 2000). Men may also favor traits in formal partners that are useful to him in maintaining his own status and resources. A hard-working wife would be beneficial not only in raising their children, but also in helping to build wealth for their homestead, whereas a hard-working girlfriend could benefit the children he has by her, but would otherwise benefit either her father or her husband's household, depending on where she resides. In one of the few studies to test this, male university students in New Zealand preferred resource-related traits and traits like trustworthiness and warmth more in long-term partners, while favoring attractiveness more in short-term partners (Fletcher, Tither, O'loughlin, Friesen, & Overall, 2004). Other data also show male preferences for long-term partners who are resourceful. Hadza men preferred women who are good foragers (Marlowe, 2004) and Shuar men also highly favored resource-related traits in their female partners (Pillsworth, 2008).

Like dual-mating, the literature on "trading up" has generally focused on women's strategies. However, the logic could also apply to men, who would similarly "trade-up" for partners who are higher in quality (in relevant traits) than their current ones. In a study of homogamy between first and second marital partners in The Netherlands, men were found to marry more educated women in the subsequent marriage (Gelissen, 2004). The same study showed that men married women with a larger age gap in second marriages, reducing homogamy, but also "trading-up" for women of higher reproductive value. Therefore, unlike with women, where we don't expect differences in their trait rankings between types, men who are trading-up might value proxies of age and fertility more highly in short-term partners.

The multiple investor hypotheses could also apply to men, if they can benefit by having their children spread across multiple mothers and family units. In this case, the man capitalizes on investment from his partners, and in the case of male-controlled resources, *their* formal partners. This might be useful in environments where resources are stochastic at the level of families. In this case, a man can better ensure that some of his children will be protected if his own resources fail in a given year. This prediction relies on the assumption that these benefits would outweigh the risk of perpetual low investment by the social fathers of his biological children. Therefore, we might expect more support for a multiple investors explanation in men when women's production is critical to child survival because the risks of low investment by social (but not biological) fathers would be minimized. Evidence for the multiple investor hypothesis in men is scarce, but this is due in large part to a dearth of studies on the topic.

2. Methods

2.1. Study population

This study was conducted as part of a larger project on partner choice and multiple mating conducted in northwestern Namibia with Himba living in the Omuhonga basin. The Himba are semi-nomadic pastoralists, although recently, and particularly in the Omuhonga basin, women have begun planting gardens, primarily of maize and millet, that supplement the milk and meat in their diet (Bollig, 2009). Access to the market economy is still relatively limited, with the exception of livestock sales. Electricity and running water are still absent from the

community. However, most adults now have cell phones and a small number of men have vehicles.

Households are polygynous and consist of extended families, ranging in size from 8 to 25 individuals. Marriages are all arranged, though in some cases couples "choose each other" and then get formal permission to marry from their families. Polygyny is common, but co-occurs with a high degree of female autonomy (Scelza, 2015). Divorce is frequent, and can be initiated by either spouse. Additionally, concurrent partnerships are common for men and women, married and unmarried, and numerous cultural norms permit and protect the maintenance of these informal unions (Scelza, 2013). Informal partnerships range from brief encounters to lengthy relationships that span the births of multiple children. In a preliminary, unpublished study of the prominence of informal partnerships (n = 134), 84% of married men and 63% of married women reported having at least one current informal partner. Informal partnerships occur with both unmarried individuals and those who are married to someone else, though the latter is treated with much more secrecy than the former. This practice results in a relatively high rate of extra-pair paternity, with women reporting that 17% of children are the result of extra-pair relationships (Scelza, 2011). Both men and women freely discuss these partnerships with same sex individuals, kin, and even on occasion with their spouses. The regularity of extra-pair relationships and the openness with which Himba men and women speak about them make this an ideal group to examine how preferences vary between formal and informal partnerships.

2.2. Procedures

In order to determine culturally appropriate traits to be used in the trait-ranking task, we held two single-sex focus groups, each consisting of 3–5 members. In the context of discussions about marriage and extra-pair partnerships, focus group participants discussed what they were looking for in partners, the dynamics of each type of relationship, as well as other topics such as arranged marriage, jealousy and the norms and obligations associated with marriage. Members were asked to free list traits they considered important when assessing potential mates. We did not ask participants to make separate lists for formal and informal partners. Instead, we focused on getting their general impressions about what they were looking for in a partner. The focus groups were supplemented by informal discussions with men and women at our camp and when we were visiting other camps, to gain clarification and additional information. We used these discussions to generate separate lists of culturally relevant traits for men and women to sort. The final lists each had seven traits, of which five were overlapping (Table 3).

Next, we recruited adult men and women to rank the traits for formal and informal partners. Trait-cards were laid out in front of participants, and each trait was read aloud. Participants were asked which trait they thought was most important to have in a husband/wife. That card was removed and laid out in a separate location, and the process continued until all traits had been ranked. Their final ranking was then read aloud and participants had the opportunity to make changes. Because the number of traits being ranked was small, changes to the final rankings were rare. After formal partners were ranked, all cards were replaced, and the entire process was repeated. This time they ranked the traits in order of what they thought was most important to have in a lover. This method is preferable to rating each trait individually, or to free listing traits individually, because it allows for prioritization in mate preferences, resulting in a relative rank across all traits (Pillsworth, 2008). However, as opposed to more commonly used rating methods, which score each trait on a multi-point scale, the ranking method does not allow individuals to treat traits equally. Respondents are forced to order the traits, without ties. All interviews were conducted in Otjiherero with the aid of a local translator.

2.3. Analysis

Average rank for each sex/group was calculated (see Table 3). Multilevel Bayesian ordered categorical models were used to predict rank, and to assess the effects of partner type, age and marital status. An initial model (M1) included a varying intercept for trait type and a varying intercept for respondents by trait type (e.g. participant 1's rankings for attractiveness received a unique intercept). This was compared to a secondary model (M2), which included whether a formal or informal relationship was rated as a binary predictor, with varying slopes for each trait. Finally, a third model (M3) evaluated the effect of participant age and marital status, again as varying slopes by trait, with interactions for relationship type. See Supplementary materials for full model details. This approach allows for all trait rankings, differences in rankings between formal and informal partners, and individual level effects to be analyzed in a single model for each sex. As an alternate approach, the same models were used to predict rank as a continuous outcome, but results were very similar to the ordered categorical models, so only the categorical results are presented here. Model fit was evaluated using model comparison with the Widely Applicable Information Criterion (WAIC). Posteriors for the slopes of each trait by partner type were evaluated to determine whether partner type moderated trait rankings. Similarly, posteriors for the random slopes for age, marital status, and marital status by partnership type were evaluated to determine whether these individual level predictors impact rankings. Analyses were run in R 3.3.2 (R Core Team, 2016), and fit in Stan using the *rethinking* package (Mcelreath, 2016a, 2016b). Models ran in three chains of 10,000 iterations per chain, with a warm-up sequence of 5000 iterations. Convergence was assessed by the Gelman-Rubin convergence diagnostic.

3. Results

A total of 77 individuals completed the trait-ranking task, resulting in 546 trait ranks by women and 532 trait ranks by men (Table 2). A little more than half of the participants were currently married. To get a sense of how common having a non-marital partner was in this sample, we used responses from another survey, which 73.7% of the men and 48.7% of the women in this sample had also answered. The relevant survey question was whether they currently had a lover. For married individuals, this occurred through affairs. For unmarried individuals, this was a girlfriend or boyfriend. For both men and women, 100% of married individuals reported having a lover, while there was more variability among unmarried individuals of both sexes (Table 2). Because fewer women than men in the sample had completed this survey, their results may be less representative. This may be particularly true because none of the postmenopausal women in our sample had taken the survey, and these women are much less likely to have lovers, regardless of marital status.

Trait rankings for men and women are listed in Table 3. Men preferred hard-working wives and attractive girlfriends. The second

Table 2
Demographics of sample population.

	Men (n = 38)	Women (n = 39)
Age in years: mean ± SD	39.1	36.3
Age category: N (%)		
18–25	8 (20.5)	8 (20.5)
26–40	17 (43.6)	21 (53.8)
>40	14 (35.9)	10 (25.7)
Marital status	55.2	61.5
(% Currently married)		
Presence of a lover (%)[a]	85.7	89.5
Married	100	100
Unmarried	73.3	81.8

[a] This question was asked of 73.7% of the men and 48.7% of the women in this sample who separately filled out another survey on informal partnerships.

highest rank trait in both categories was "respectful." Women also highly valued respect in both their husbands and their lovers. In addition, they ranked wealth highly for husbands and generosity highly for boyfriends. Descriptive statistics for all traits are shown in Table S1.

Results of the model comparison indicate addition of the binary predictor of relationship type greatly increases model fit. For men, the model that included random slopes for age in marital status by trait (M3) yielded the lowest WAIC value, while for women, addition of these variables did not improve out-of-sample deviance. For ease of comparison, the full model is represented in the final results (see Table 4).

Examination of the slopes for relationship type by trait indicates that, for some traits, relationship type modulates the predicted rank. As shown in Fig. 1, for women, distributions for the predictor in "generous" and "attractive" deviate substantially and negatively from zero, indicating that, in informal partners, these traits are ranked more highly, while the opposite is true for "hardworking" and "wealthy," which are predicted to be ranked more highly in formal partners. In men, distributions for the predictor "hardworking," and "fertile" deviate substantially and positively from zero indicating that these traits are preferred in formal partners, while the opposite is true of "smart," "good in bed," and "attractive" which are predicted to be ranked more highly in informal partners. The effects of standardized age and marital status had little effect on predicted rankings. For men, increased age predicts increased preference for "fertile" but decreased preference for "attractive" irrespective of partner type (Fig. S4), but age and marital status had no effect on rankings for any other traits, nor did the age or marital status by relationship type interaction impact rankings in any trait. Similarly for women, age, age by relationship type, marital status, and marital status by relationship type had no impact on predicted rank for any traits. Marital status did impact predictions of rank for "wealth" in women, so that married women were more likely to rank "wealth" higher irrespective of partner type, (Fig. S5), but other traits indicated no relationship. Posterior means and percentile intervals for age, marital status, and relationship interactions are located in Tables S3–4.

4. Discussion

There are two critical components of the trait ranking results that can shed light on how preferences differ between men and women, and between formal and informal partnerships. The first is the ordered ranking of traits (Table 3). These results tell us what traits are most important to each sex, and in each type of partnership. The second component is how trait rankings differ when they are being evaluated for each partnership type (Fig. 1 and Figs. S2–3). These results tell us whether people are looking for the same or different types of partners in formal and informal relationships. We use the combination of these two results to evaluate how preferences relate to strategies.

Table 3
Traits for each group listed by mean rank.

Rank	Men		Women	
	Wife	Girlfriend	Husband	Boyfriend
1	Hard-working*	Attractive*	Wealthy*	Respectful
2	Respectful	Respectful	Respectful	Generous*
3	Fertile*	Smart*	Hard-working*	Wealthy
4	Smart	Polite	Smart	Hard-working
5	Polite	Hard-working	Generous	Smart
6	Attractive	Fertile	Attractive	Attractive*
7	Good in bed	Good in bed*	Good in bed	Good in bed

* Indicates posterior for slope of trait by relationship type interaction deviates appreciably from zero, so that indicated traits are predicted to be ranked more highly in this relationship category. See Fig. 1. Full posterior details are located in the Supplementary material.

Table 4
Model comparison results.

Model	WAIC	Weight	SE
♂ M1	1942.4	0.00	23.24
♂ M2	1819.6	0.37	31.16
♂ M3	1818.6	0.63	31.85
♀ M1	1898.8	0.00	31.39
♀ M2	1869.1	0.88	32.30
♀ M3	1873.1	0.12	32.17

4.1. Himba men prefer hardworking, fertile wives and attractive girlfriends

There are some clear differences in the traits that Himba men prefer in their formal and informal partners. Men prefer hard-working wives and attractive girlfriends. The change in rank between contexts shows this most clearly. "Hard-working" drops in rank from 1st in wives to 5th in girlfriends, while attractiveness rises from 6th place in wives to 1st in girlfriends (Table 3). Model results indicate that these rank changes are meaningful. This difference fits with local norms about the value of women's productive labor. As one man reports, "You need a wife who can help with collecting water and wood, make the fire, wash clothes, who is hard-working." In contrast, when describing what they want in a girlfriend, one man says, "It's the heart that wants. It doesn't matter if they are hard-working or lazy, just if you love them." Another man says, "It's up to you to see which one you think is beautiful." It might seem surprising that men rank physical attractiveness so low in their marital partners, but this makes sense in the context of Himba norms about sex and infidelity. The men discuss the trade-off that they perceive between having a pretty wife and one who is industrious. "If you have a pretty girl it's not good because she won't work hard and take care of the animals. You need to have the one who can work." In light of the high level of female autonomy that Himba women have, which allows them to move relatively freely between their marital and natal homes, divorce at will and maintain lovers, having a wife who is attractive may be perceived to affect how often she is at home, or how dedicated she is to her husband and his compound.

Although physical attractiveness is not highly preferred in wives, fertility (translated as "to have children" in *Otjiherero*) was ranked significantly higher for wives (4th) than girlfriends (6th). This was contrary to our expectations, as we predicted that attractiveness would be a proxy for fertility and the two traits would be ranked similarly. Instead, we found that preferences for these two traits diverged, with attractiveness being very important in a girlfriend, and fertility being significantly more important in a wife. These findings do not clearly map onto any of the three models for partner preferences we described above. Both the "trading up" hypothesis and the dual strategies approach predict that fertility and attractiveness would both be relatively more important in informal partners. The multiple investors approach would predict that both traits would be ranked fairly low, especially compared to traits like being "hard-working." Once again, understanding the local context can help to make sense of this finding. Among Himba, as with most pastoralists, child labor is highly valued, and having large families equates with high status for men. One elder man sums this up as follows:

> You marry so that she can build the compound and have children with you. So that when you are gone, the people will know that those children are for you. Also, children help and take over the compound. They call me "Father of W—." They will call me with the name of my children.

The children born to girlfriends don't "count" as theirs, they belong either to the woman's husband, if she is married, or to her father if she's not. Therefore, men do not get a direct status boost from having children outside of marriage. This is not to say that it doesn't matter to men whether their girlfriends have children. Most men keep track of how many children they believe they have fathered outside of marriage,
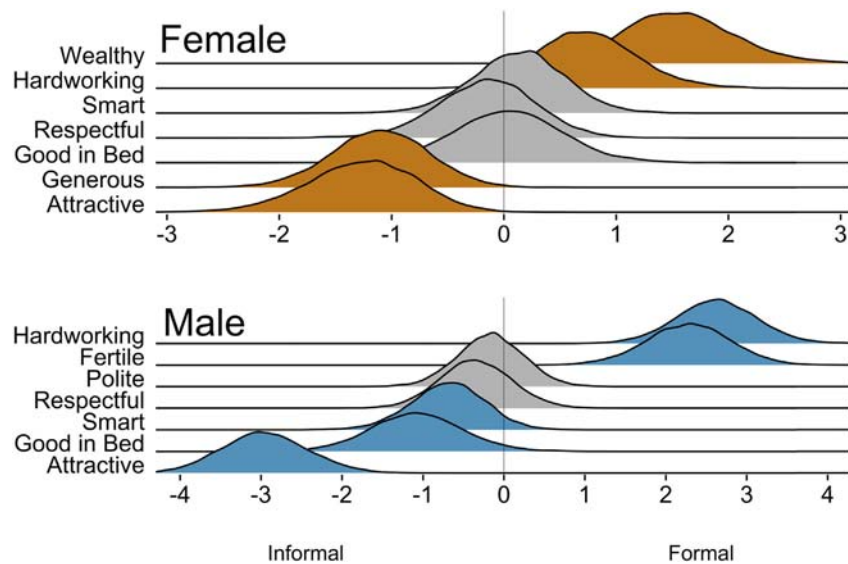
Fig. 1. Density distributions of the posterior for the effect of relationship type by trait type, where informal relationship = 1, from the full model m3. Colored plots indicate parameters where the posterior distribution deviates appreciably from zero. Positive distributions that fall on the right-hand side of the plot indicate traits where a higher rank is predicted for formal relationships (wives/husbands) relative to informal ones (boyfriends/girlfriends). Negative distributions falling on the left indicate the opposite pattern.

and they often provide for them. But for both practical and reputational reasons, social fatherhood is more important than biological fatherhood for Himba men. Therefore, we see the trait "fertility" as indicating two kinds of benefits that men can accrue, greater reproductive success and the status and labor that children bring to his household (i.e. both genetic and social benefits). Both of these benefits would be important in a marital partner. However, in an informal partner, where children are being reared and providing their labor to another household, only the genetic benefits of fertility would be relevant. This might help to explain why "attractiveness" was given priority in informal partners and "fertility" prioritized in wives.

This finding was somewhat fortuitous, as most studies of mate preferences include attractiveness, but do not directly mention fertility. Here, because both words were brought up in focus group discussions, we included both in the rankings. While we expected the traits to be ranked similarly, our results highlight the ways in which the social context of mating and parenting can influence people's preferences. We don't see this as a divergence from evolutionary predictions; rather, we see it as an unexpected opportunity to highlight the different kinds of benefits that men (and women) see children as bringing. It also serves to highlight the importance of incorporating ethnography into psychological studies of mate preferences. We hope that this finding inspires future work that continues to disambiguate these ideas.

The other traits that men mention shed further light on the roles of formal and informal partnerships among men. Respect is ranked highly in both contexts. While this is a somewhat nebulous descriptor, men most commonly relate it to treating your partner well. Both men and women discuss the rituals that they engage in (e.g. women putting ochre on their husbands), which showcase their commitment to one another. They also discuss rules for infidelity. Although having a lover is accepted, these relationships should be discrete and never embarrass one's spouse, and one's formal partner should take priority. In this context, respect may relate to meeting these types of social norms.

Intelligence also ranks highly in both contexts for men; higher than women rank intelligence for either husbands or boyfriends. Curiously, men rate intelligence as more highly valued in girlfriends than wives, and results of the model demonstrate that this difference is statistically meaningful. This is surprising, given that men speak about the role that women play in advising them about both household matters and livestock management. "The wife can share knowledge about how to manage your goats, when to sell them." The lower ranking for intelligence in

wives may be the result of the dependence of traits, so that preference for fertility and hard-working drives down the preference for intelligence, instead of the trait being inherently less preferred in wives. Conversely, extra-pair relationships, particularly when the girlfriend is married, can involve a level of subterfuge to meet cultural norms, and as such, intelligence may be highly valued in these relationships.

The effects of age and marital status on men's preferences are minimal in this study, although inclusion of these variables increases model fit. Only age yielded a meaningful result, where older men exhibit greater preference for fertility, while younger men exhibit greater preference for attractiveness (see Fig. S4). This may reflect differences between older and younger men in their mating markets. Himba men tend to partner with women who are their own age or younger than them, sometimes substantially younger, and age gaps widen as men age. Because older men are more likely to have menopausal and peri-menopausal women included in their set of potential partners, they may exhibit stronger preferences for fertility. Younger men might share these preferences, but they may not have risen as high in their rankings because choosing between high-fertility and low-fertility women is a more uncommon occurrence for them.

4.2. Himba women prefer wealthy, hardworking husbands and generous boyfriends

Himba women's preferences show some support for dual-mating theory, but align most strongly with the multiple investors hypothesis. They appear to be keenly attuned to the different ways that resources flow in formal and informal partnerships. In their preferences, this results in high rankings for wealth and being hardworking (a potential proxy for wealth generating potential) in husbands, but in boyfriends, generosity takes precedence over wealth. In a multi-layered explanation, women in the focus group explained this distinction. First, they expressed the importance of having a husband with resources. "You can love a man when you see he is wealthy. Sometimes you can have a husband who has nothing. People will say, 'why do you have that husband?' You need to have a husband who can feed you. That makes you feel happy." They then discuss the difference between being a man's wife and being his girlfriend, "Yes, you can love him, but when he's with you, his things are for his wife." Another woman explains this in the context of polygyny, "Better that he has a girlfriend [than another wife]. When he buys a bag of maize, it must be separated between the

wives, but when you are alone, you are the leader. That girlfriend is in the bush." But then, they discuss the value they place on receiving resources from a boyfriend, "You need to eat two times. From the husband and the boyfriend. When a man doesn't have cows or goats, he won't have a girlfriend. 'You sleep with a poor man. What did you eat from him?' people will say, if your boyfriend is poor." Finally, they emphasize the role of generosity in a boyfriend, "You cannot ask him for anything. Just if he *wants* to give you something." [emphasis ours] The men report the same pattern, "We give a lot [the men in the group all laugh about how much they give]. We give ourselves because we love them. Not because they ask." To summarize, while resources are primary to both formal and informal partnerships, the traits that link to those resources differ in the two contexts. Because husbands are obligated to share their resources with their wives, it is their raw wealth that matters most. However, informal partners are not obligated in this way. How much they give is a matter of how generous they are (or in the views of men, how much they feel they need to woo their partner). As one woman put it, "If you have a boyfriend who is wealthy, but he is stingy, what good is he?".

As with men, being respectful was highly ranked for both contexts, in fact it was the trait that women desired most in a boyfriend, and was second only to wealth for husbands. The meaning of the term is somewhat ambiguous. It is linked to generosity and fairness, but also to generally treating a person well. In informal interviews women related being respectful both to handling affairs discretely (and favoring the wife) and also to keeping up with their responsibilities as household head and provider. Further studies could clarify how the role of respect differs in formal and informal contexts.

There was a substantial difference in rank for attractiveness, with women preferring good-looking boyfriends more than good-looking husbands. However, these rankings placed attractiveness as 6th of 7 traits for both contexts. Therefore, while we can't rule out dual-mating as a potential strategy that Himba women use, there is limited evidence for it in this study. It is possible, however, that this study underestimates the importance that women place on attractiveness in one or both contexts. In a study that contrasted stated and revealed preferences for long-term partners among the Shuar, attractiveness rose in importance when people were asked to rate specific partners (who had been scored for attractiveness) as opposed to ranking listed traits (Pillsworth, 2008).

Women's preference rankings did not clearly reflect a "trading-up" strategy, in that there were significant differences in what they wanted in a husband compared to a boyfriend. Nevertheless, marital histories from Himba women reveal that mate-switching does happen, though currently we do not have evidence that these switches are "trading-up" and if they are, in what ways. In reproductive histories, several women reported that they had at least one child with a man, either through an affair or out-of-wedlock, and later went on to marry that man. This was sometimes explained as a kind of trial period, which would fit with the idea that women are trying to ensure that their next partner would indeed be an upgrade from their current one. However, the trials that women describe also relate to accrual of resources, as boyfriends provide gifts of various types during this informal period. This conflates the multiple investors and trading-up explanations. The more immediate goal of having a lover concurrent with a husband might be to accrue resources from multiple men, but this provides the opportunity to evaluate whether that person might be a better formal (marital) partner than their current husband and "trade-up" if he is.

As with men, the effects of age and marital status on preference rankings are minimal, and in women, inclusion of these covariates did not improve out of sample deviance in the model comparison. However, results from the full model do indicate that marital status impacts predicted rankings of wealth, so that married women were more likely to give a higher rank to wealth, independent of relationship type. This relationship further illustrates the importance of resource diversion in both formal in informal partners. Married women are more likely to have multiple dependent children and foster children, and to be

centrally involved in subsistence tasks like gardening and caring for livestock. As such, married women would be expected to prioritize resources in a potential relationship, which would be of greater value in provisioning their family. Conversely, unmarried women are more likely to reside with their own parents and extended family, and have decreased demands for provisioning. Future studies could focus on how the number of dependent children, household demands for resources, and wealth help to shape women's preferences for wealth and resource accrual from formal and informal partners.

4.3. Limitations and future directions

While we believe that our use of ranking culturally relevant traits was most appropriate for a non-literate non-industrialized population, in that it forces prioritization of traits and avoids problems associated with multiple Likert-scale ratings, this procedure does have several drawbacks. Traits were limited to those deemed relevant as the result of focus groups, but it is likely that many other traits are also important in addition to those used here. Additionally, ranked data can be difficult to analyze, and our statistical approach doesn't fully account for non-independence in rankings between partner types. We included only simple co-variates as part of this analysis, but the use of additional covariates including relationship satisfaction, wealth and status, perceived quality, and others may mediate perceptions of importance for different traits. Additionally, we are measuring general preferences and cultural norms as part of this study, while actual behaviors and perceptions of individuals associated with these characteristics may differ. Future studies should seek to meld stated preference to actual behavioral outcomes. Finally, while we highlight several relevant theories of mate choice, and view these approaches as overlapping and non-exclusive, the methods used here cannot explicitly test all of the distinctions between them. Future work building on these results will be better able to evaluate contrasts between these theories.

Despite these limitations, the results from this study highlight important distinctions in preferences between formal and informal partners, and indicate how utilizing a mix of ethnographic knowledge and evolutionary theory leads to a more detailed understanding of stated preferences. These results add to a growing body of knowledge on formal and informal partnerships, and highlight several future areas of exploration. In particular, more research is needed on formal and informal partnerships outside of industrialized countries, particularly in populations with more permissive sexual relationships. Such research is needed to better understand the utility of these relationships, particularly for women. Exploring the productive, reproductive, and social benefits of maintaining simultaneous formal and informal partnerships will yield a better understanding of human mate choice more generally.

5. Conclusion

The study of mate preferences within evolutionary psychology and anthropology has relied largely on parental investment theory to generate predictions. We follow in that tradition here; however, in both the design of this study and our interpretations of the results, we have used ethnographic insights to understand how culture, ecology and biology interact to generate preferences in this particular setting. In terms of study design, this meant re-framing the traditional way in which researchers have distinguished partnerships. For our purposes, the formal-informal dichotomy better encompasses the range of non-marital partnerships that exist among Himba, and brings to light important considerations about how resources and obligations flow inside and outside of marriage. Second, the combination of focus group interviews, trait rankings and behavioral data allow us to understand how preferences relate to everyday life among Himba better than any one would have on their own. As such, we see this study as a template for combining the approaches of evolutionary psychology and human behavioral ecology in a productive way.

Acknowledgements

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.evolhumbehav.2017.12.005.

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