



Original Article

Hunter-gatherer males are more risk-seeking than females, even in late childhood

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ABSTRACT

Observed economic and labor disparities between the sexes may, in part, result from evolved sex differences in risk preferences. Using incentivized economic games, we report on sex differences in risk preferences in the Hadza, a population of hunter-gatherers. One game played in 2010 ($n = 233$) found that more Hadza males than females prefer to gamble for a chance to earn more maize rather than settle for a sure, but smaller, amount. Similarly, a second game played in 2013 ($n = 102$) found that male Hadza gamble a greater proportion of honey for a chance to earn more compared to female Hadza. Effect sizes are small to medium. We find weak evidence that risk-taking increases in men as their mating opportunities increase. In both games, the sex difference widens throughout childhood and is greatest among adolescents; though note that child samples are small. We explore developmental trends further using observational data on food returns in children ($n = 357$). Our data suggest that while the mean number of calories boys bring to camp remains stable with age, the variance in their caloric returns increases. Among girls, the variance remains stable with increased age. Both the economic games and food return data are consistent with the sexual division of labor wherein boys, beginning in late childhood, begin to target riskier foods. To the extent that the Hadza allow us to make inferences about long-standing patterns of human behavior, we suggest that sex differences in risk preferences may have been present long before agriculture and the modern work environment.

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1. Introduction

Financial and labor disparities are observed between the sexes in all types of societies. Men typically attain more powerful, higher earning positions (Blau & Kahn, 2000; DiPrete & Buchmann, 2013; Bertrand & Hallock, 2001), despite the fact that in some societies and sectors women are, on average, more educated (Altbach, Reisberg, & Rumbley, 2009; Vincent-Lancrin, 2008). In 2014 for example, women working full-time earned about 79% of what men did (Blau & Kahn, 2016). While decompositions of the gender wage gap illustrate the importance of a variety of factors, a sizable disparity between men and women's pay remains unexplained by traditional economic variables (Blau & Kahn, 2016). As such, some researchers have suggested that labor inequalities may, in part, result from innate sex differences in psychological preferences such as willingness to compete, initiate negotiations, or take on risk (e.g., Apicella & Dreber, 2015; Babcock, Gelfand,

Small, & Stayn, 2006; Croson & Gneezy, 2009; Eckel & Grossman, 2008; Powell & Ansic, 1997; Saad, 2011).

While sex differences for some preferences, such as competitiveness, are generally large and robust, the results for risk-taking have been more heterogeneous, though most studies report a sex difference (for detailed review, Niederle, *in press*). Byrnes, Miller, and Schafer (1999) conducted a meta-analysis of 150 studies spanning three decades that compared men and women in various types of risk-taking behavior (e.g., driving and gambling). While the majority of risk categories showed a sex difference, many of the effects were small. Using a hypothetical questionnaire, where evolutionarily typical risks were presented using modern frames, Wang, Kruger, and Wilke (2009) found that men reported more risk-taking in all domains studied. Eckel and Grossman (2008) and Croson and Gneezy (2009) provide two broad reviews of studies that ask individuals to either make decisions between alternatives that vary in monetary risk or to make valuations of risky payoffs. Both reviews conclude that men generally exhibit higher levels of risk-taking but acknowledge that less consistent evidence is found when gambles are framed as losses. However, two more recent surveys of sex differences in risk-taking that analyzed studies with different methods of eliciting risk preferences reached markedly different

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conclusions about the existence of sex differences, suggesting that the method of elicitation may account for heterogeneity of the findings (Charness & Gneezy, 2012; Filippin & Crosetto, 2016).¹ The latest and most comprehensive survey of the literature (e.g., Niederle, *in press*) concludes that while sex differences in risk do likely exist, the difference may not be substantial in all settings.

A few cross-cultural examinations have been conducted. Charness and Gneezy (2012) assembled data from a number of studies, including students living in Sweden, USA and Turkey and villagers from China, India and Tanzania, and conclude that in 90% of the experiments men make relatively larger investments in risky assets. Cárdenas, Dreber, Von Essen, and Ranehill (2012) find that boys, ages 9–12, in both Sweden and Colombia were more risk-taking than their female counterparts. Similarly, Buser, Niederle, and Oosterbeek (2014) report that Dutch male high school students chose a significantly more risky lottery than did girls. Finally, a survey conducted with nearly 7000 university students, largely studying economics, from 53 different countries find significant and robust differences between men and women in their propensity to take risks in the gain domain (Rieger, Wang, & Hens, 2014). The opposite finding emerged when looking at losses. In this domain, women were less risk-averse. Again, this finding is not particularly surprising given the inconsistent results previously reported when gambles are framed as losses (e.g., Croson & Gneezy, 2009).

Although there is growing and admirable interest in how individuals living in small-scale societies make decisions involving risk, the majority of studies have relied on Western populations and students, leaving the generalizability and origins of these sex differences unknown. Here, we report on sex differences in risk preferences among the Hadza, one of the only remaining populations of hunter-gatherers who rely primarily on wild foods for subsistence. Given that the Hadza live in a social and physical environment that more closely approximates that of human origins than industrialized environments, their risk preferences may provide insight into the origins of sex differences (Apicella & Dreber, 2015; Apicella, Feinberg, & Marlowe, 2007; Cashdan, Marlowe, Crittenden, Porter, & Wood, 2012). If nothing else, the Hadza offer a valuable example of how men and women living in a subsistence economy – without farming or livestock – make decisions under conditions of risk.

Anthropologists, economists, and psychologists have used the term risk to mean different things. In the current study, we formalize risk preferences in the tradition of economics to represent the tradeoff between the variance and the expected value for a given resource. Our measures, therefore, involve asking participants to make choices between options that are less rewarding but more certain, and options that are less certain, but potentially more rewarding. This study focuses on risk in the domain of gains.

Nearly all species have evolved in environments with a substantial element of unpredictability. Consequently, decisions involving uncertain outcomes in diverse behaviors such as mating, foraging, or parenting are ubiquitously observed across taxa, and the outcomes of such behaviors can have measurable fitness consequences. In hunter-gatherers, for instance, decisions are made daily about which foods to target for consumption. Foods such as meat are risky since variance in hunting returns is high, while other foods, such as foraged plant items, are more

reliably procured but may be less energy dense (Cordain, Watkins, & Mann, 2001; Smith, 1988). Outside of the traditional realms of ethological study one can find analogies in the decision making of humans in industrialized societies, from career decisions to medical treatment options. In all of these instances, the degree to which choices have consequences to fitness, evolution can be expected to have an underlying role.

To the extent that men and women confronted different challenges in the past and that the same choices made under conditions of uncertainty would have yielded different returns based on sex, it is possible that natural selection shaped sex differences in risk preferences. The standard narrative for many observed sex differences from ornamentation (e.g., Darwin, 1871) to mate choice (e.g., Buss, 1989) is that they are evolutionary downstream consequences of sex differences in the patterning of reproduction, in which the costs of reproducing are higher for females (Trivers, 1972). This difference leads to higher potential rates of reproduction and reproductive skew for men (Bateman, 1948; Trivers, 1972); the corollary of this is that men are designed to compete for mates since this is the limiting factor for their reproductive success. Apicella et al. (2008), suggest that financial risk-taking may be a modern form of male-male competition for resources, which can then be used to attract mates. More generally, Wang et al. (2009) argue that increased acceptance of risk-taking in males facilitates male-male competition. Formalized evolutionary models for sex differences in risk preferences have been provided. Dekel and Scotchmer (1999) argue that sex differences in risk-taking will be selected in winner-take-all environments, where top males mate with the majority of females. Rubin and Paul (1979) show that in environments where only those males who are above a certain income threshold are attractive to females, sex difference in risk preferences will evolve. Robson (1996) expands on this model by including repeated thresholds that correspond to increasingly larger number of mates and shows that if males choose lotteries over wealth, they will choose very risky lotteries, if any. In hunter-gatherers, hunting for big game may be akin to choosing risky lotteries.

For nearly all forager populations for which detailed ethnographic data exist, we see a marked sexual division of labor wherein men primarily target high-risk resources such as game animals and women primarily target plant resources, the staple of the diet (Kelly, 2013).² The fact that better hunters experience greater reproductive success in a number of these societies, including the Hadza (Apicella, 2014; Hawkes, 2001; Marlowe, 1999), the Ache (Hill & Hurtado, 1996; Kaplan & Hill, 1985) and !Kung (Wiessner, 2002) supports the notion that hunting ability, which requires a protracted period of learning (Gurven, Kaplan, & Gutierrez, 2006; Blurton Jones & Marlowe, 2002), was evolutionarily selected. While women do value hunting ability in their mates (Marlowe, 2003a, 2003b, 2004a; Apicella & Crittenden, 2016), there is lively debate over how hunting increases men's reproductive success. It has long been viewed that hunting evolved to provision a man's pair-bonded family unit (e.g., Washburn & Lancaster, 1968). Indeed, evidence suggests that a hunter's family benefits directly by receiving choice cuts of meat – even in settings of communal sharing (Wood & Marlowe, 2013) – and by obtaining nutrients and protein not found in foraged foods (Domínguez-Rodrigo et al., 2013), but alternative explanations have been proposed. Specifically, it had been argued that hunting may instead serve as a costly signal for advertising mate quality (Hawkes & Bliege Bird, 2002; Smith, 2004) and/or building a reputation for generosity useful for fostering cooperative friendships (Gurven, Allen-Arave, Hill, & Hurtado, 2000). Since game meat is less reliable and shared widely in hunter-gatherer groups, these are plausible explanations. How this debate is settled may have implications for how we understand the evolution of sex differences in risk preferences in

¹ Filippin and Crosetto (2016) largely analyze papers employing the Holt-Laury task where participants are presented with a menu of paired lotteries and are asked to decide between a safer option and riskier option and where one decision in the list is randomly chosen for payment. These choices together, are then used to estimate risk attitudes. They find that this produces a gender gap in risk-aversion, but one so small that studies will need samples in excess of, and likely double, several hundred participants. The authors compare this to simpler methods such as the Investment Game constructed by Gneezy and Potters (1997) and an ordered lottery selection task used by Eckel and Grossman (2002). From this, they isolate two key characteristics that jointly correlate with the likelihood of observing a sex difference. The first is whether there is a safe option available within the choice set and the second is whether the lotteries use 50/50 fixed probabilities.

² Notable exceptions do exist; in some ecological settings, such as with the Agta of the Philippines, women routinely hunt (Goodman, Griffin, Estioko-Griffin, & Grove, 1985).

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