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Original Article

Foundations of the Crazy Bastard Hypothesis: Nonviolent physical risk-taking enhances conceptualized formidability☆,☆☆

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ABSTRACT

Wilson and Daly's Young Male Syndrome thesis seeks to explain why young men are disproportionally involved in both violence and non-violent activities entailing a risk of injury or death. One interpretation of this thesis, which we term the Crazy Bastard Hypothesis, holds that the correlation between violence and other forms of physical risk-taking occurs because the latter behaviors inherently index the general propensity to take risks with one's life. In violent conflicts, individuals who are indifferent to the prospect of injury or death constitute dangerous adversaries, and valuable allies. Voluntary physical risk-taking may thus serve a signaling function such that risk-prone individuals are perceived as more formidable than risk-averse individuals. Prior work has demonstrated that relative formidability is represented using the dimensions of conceptualized size and strength, providing an avenue for testing the Crazy Bastard Hypothesis. In multiple studies conducted in two disparate societies, we demonstrate that physically risk-prone men are envisioned to be larger, stronger, and more violent than risk-averse men. A separate study reveals that such conceptualizations are unlikely to reflect actual correlations between size/strength and physical risk-proneness, and are instead plausibly interpreted as revealing the contribution of observed physical risk-proneness to assessments of relative formidability.

1. Introduction

Wilson and Daly's explanation of the predominance of young men as both perpetrators and victims of homicide is a landmark theory in evolutionary psychology. As articulated in their seminal 1985 paper and subsequently expanded (Daly & Wilson, 1988, 1990, 2001; Wilson & Daly, 1993; Wilson, Daly, & Pound, 2002), Wilson and Daly's Young Male Syndrome thesis holds that our species' combination of sex-biased parental investment (creating an effectively polygynous mating system) and protracted social and reproductive careers has selected for risk-proneness in young males, primarily defined as preferring exposure to relatively large or likely hazards in exchange for relatively large or likely benefits (Wilson & Daly, 1985). Much violence among men, Wilson and Daly assert, constitutes competition over status or resources that would have translated into mating opportunities in ancestral environments (see also Archer, 2009; Sell, Hone, & Pound, 2012). Because humans have long lifespans, the stakes in such competition are particularly high for young men, as they are entering the competitive arena for the first time, and those who succeed in obtaining high rank will reap substantial fitness returns over the long term.

From its initial formulation, Wilson and Daly's thesis has included the observation that the epidemiology of homicide matches that of other forms of risk-taking. Although nowhere do Wilson and Daly expound extensively upon all facets of this argument, we interpret their position as suggesting five mutually compatible explanations for this pattern. First, some forms of young male risk-taking may be byproducts of the greater risk-proneness that is a prerequisite for the propensity to enter into potentially lethal male–male confrontations. Second, many nonviolent forms of risk-taking, such as those occurring in contexts of resource acquisition, may reflect the same logic as that underlying male–male violence, namely that the higher fitness payoffs of success make gambling more worthwhile for men, particularly when young. Third, nonviolent risk-taking can honestly signal attributes – including both underlying genetic quality and manifestations such as strength and coordination – that are valued by potential mates, affines, and allies. Fourth, some acts offer inductive potential beyond the specific act itself, as they index the tendency to engage in a larger class of actions of which the observed act is an instance. Because the potential costs entailed by voluntary physical risk-taking will deter most individuals from so acting, it is rational for observers to assume that instances of physical risk-taking reveal an underlying behavioral tendency in the actor observed — independent

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of bodily properties signaled by risky behavior, physical risk-taking indexes the actor's propensity to take risks with life and limb. Attributes such as strength and coordination have utility in many domains, hence signals of such qualities inform observers about many potential contexts of interaction. In contrast, indices of physical risk-proneness have particular relevance to the domain of violent confrontation. Ceteris paribus, a physically risk-prone individual is a more formidable adversary than a risk-averse individual, as, being less deterred by the possibility of harm, the former will initiate, persist in, and escalate agonistic interactions to a greater degree. Because knowledge of a potential adversary's physical risk-proneness can thus lead those less willing or able to suffer costs to defer or retreat, honestly advertising risk-proneness by risking one's physical safety is of particular value to individuals inclined to pursue fitness advantages through violent conflict, i.e., young men (see also Fessler, 2010). Moreover, given the importance of coalitions in conflicts, potential adversaries are not the only audience for such signals, as potential allies should also be interested in acquiring information regarding an individual's formidability. Fifth, because any behavior that communicates valued attributes can become an arena for prestige competition, and because prestige yields additional fitness benefits, the same logic predicts that young men are most likely to seek prestige through physical risk-taking. However, in contrast to attributes such as strength and coordination that are valued by a broad audience, physical risk-proneness will be valued principally by that narrower category of individuals likely to form agonistic coalitions, and hence it will be considered prestigious primarily among young men.

Consonant with the role of reputation in deterrence, the presence of an audience is known to enhance the likelihood that altercations among young men will escalate to violence; correspondingly, from their earliest work on the Young Male Syndrome, Wilson and Daly (1985) similarly noted that audiences have an exacerbating effect on nonviolent risk-taking in young men, a pattern subsequently probed experimentally (Daly & Wilson, 2001; see also Ermer, Cosmides, & Tooby, 2008; Fischer & Hills, 2012; Griskevicius et al., 2009). Such findings suggest that young men's propensity for nonviolent risk-taking may indeed serve a communicative function.

Substantial research examines the notion that young men engage in risky activities to signal broadly-valued attributes and compete for associated prestige (e.g., Baker & Maner, 2009; Bliege Bird & Smith, 2005; Farthing, 2005; Frankenhuis, Dotsch, Karremans, & Wigboldus, 2010; Hawkes & Bliege Bird, 2002; Kelly & Dunbar, 2001; Ronay & von Hippel, 2010; Stenstrom, Saad, Nepomuceno, & Mendenhall, 2011; Sylwester & Pawłowski, 2011; Wilke, Hutchinson, Todd, & Kruger, 2006). Despite this, the question of whether physically risky behavior is valuable in part because it communicates risk-proneness remains unexplored. Drawing on evocative, if vulgar, slang, we label this the Crazy Bastard Hypothesis (CBH). In American vernacular English, this term is applied to individuals, generally young men, who intimidate rivals and impress friends through voluntary physical risk-taking — the uninformed are warned not to transgress against a "crazy bastard." More formally, the CBH's account of voluntary physical risk-taking as a strategy to deter adversaries and attract allies in a world of agonistic competition rests on the claim that information regarding an individual's degree of physical risk-proneness inherently contributes to an assessment of his formidability. Here, we explore this claim.

In previous research, we have demonstrated that relative formidability is conceptualized in terms of size and strength. Size and strength are phylogenetically ancient determinants of formidability, a relationship reinforced by developmental experience. However, these are not the only factors influencing formidability, as features such as health, sex, age, coalition size, and, in humans, access to weapons all play key roles. We theorized that, in light of the phylogenetic and ontogenetic centrality of size and strength in this domain, to facilitate decision making, multiple determinants of relative formidability are summarized in a representation wherein each relevant factor influences the conceptualized bodily size of the target — the more formidable the target relative to the perceiver, the larger and more muscular the target is conceptualized as being. It is important to note here that these dimensions of size and muscularity refer to a minds-eye image of the target — our theory concerns representations, not perceptions, of the target.

Addressing aspects of the target, we demonstrated in the U.S. that knowing that a man possesses a weapon increases estimations of his size and muscularity (Fessler, Holbrook, & Snyder, 2012). Consonant with the importance of coalitions in agonistic interactions, among U.S. participants, cognizance of terrorist leaders' military defeats lowers estimations of the size and muscularity of a representative terrorist, while awareness of their successes has the opposite effect (Holbrook & Fessler, 2013). Addressing aspects of the perceiver, among U.S. men, the presence of allies reduces the envisioned size and muscularity of an enemy (Fessler & Holbrook, 2013a). Similarly, in both the U.S. and rural Fiji, male participants' own physical strength is inversely related to their estimations of a potential antagonist's size and muscularity (Fessler et al., n.d.). Conversely, being physically incapacitated increases U.S. men's judgments in this regard, and decreases assessments of their own size (Fessler & Holbrook, 2013b).

Convergent evidence consonant with the above representational thesis is supplied by other investigators, working outside of an evolutionary framework, employing different measures. Yap, Mason, and Ames (2013) found that manipulating participants' sense of power shaped their estimates of a target individual's size and weight, such that participants made to feel powerful underestimated these dimensions, while participants made to feel powerless overestimated them. Similarly, Duguid and Goncalo (2012) demonstrated that participants made to feel powerful overestimated their own height and, secondarily, underestimated the height of a target individual.

In sum, existing evidence indicates that relative formidability is represented using conceptualized size and strength. Here, we employ this insight to test the foundations of the CBH: if knowledge of a target individual's degree of physical risk-proneness influences assessments of that individual's formidability, and if formidability is summarized in terms of conceptualized size, then physically risk-prone targets should be conceptualized as larger than risk-averse targets.

Our methods presume that information regarding an individual's physical risk-proneness will influence participants' estimates of his physical size because those estimates reflect participants' representations of his formidability. However, if we are to employ such methods, we must address the possibility that, in actuality, size may be correlated with risk-proneness. If it were the case that taller people took more physical risks than shorter people, then, should the predicted pattern of results occur, a parsimonious explanation would be that participants are good observers. Theory offers arguments both for and against such a possibility. On the one hand, as noted, physical risk-taking can serve as an honest signal of genetic quality, as the relative costs of the behavior are lower for those of higher quality. Ceteris paribus, height should also reflect genetic quality, as higher-quality individuals can afford to allocate fewer resources to immune defenses and somatic repair, and more resources to growth, predicting a positive correlation between height and risk-taking. On the other hand, risk-proneness should reflect life history variables (Hill, Thomson Ross, & Low, 1997; Wang, Kruger, & Wilke, 2009) orthogonal to quality. A key component of Wilson and Daly's thesis is that poor, low-status men have the most to gain by gambling with their lives (1985, 1993; Daly & Wilson, 1988, 1990, 2001; Wilson et al., 2002). Consonant with a faster life history trajectory, such men can also be expected to mature early, resulting in reduced stature, and thus a negative correlation between height and risk-taking. Because it is difficult to know in advance how each of these factors contributes to epidemiological patterns that could be observed by participants, we turn to empirical evidence.

In large surveys of Europeans and Americans, Korniotis and Kumar (in press) found that height correlated positively with financial risk-taking (measured as investment in risker assets and owning a business) and with health risk-taking (e.g., smoking). Ball, Eckel, and Heracleous (2010) measured height, strength, and financial risk-taking in a real-stakes task, finding that, particularly for men, strength, but not height, correlated with risk-proneness. In a large German survey and a smaller field study that included a financial risk-taking task, Dohmen et al. (2011) found that height correlated with risk-taking as measured by self-assessed overall risk-proneness and reported behavior concerning finances, driving, sports and leisure, career, and health.

In evaluating the above findings with regard to the proposed test of the CBH, the relevant consideration is the relationship between body size and risk-proneness in readily-observed behaviors carrying obvious risks of injury or death, as the CBH hinges on the notion that formidability can be signaled by revealing indifference to bodily harm. Although some of the above studies report a correlation between height and financial risk-taking, doubt is cast on the relevance of such results for the present project by investigations, employing more detailed measures, that reveal no correlation between financial risk-taking and dangerous physical activities (Blais & Weber, 2006; see also Ball et al., 2010; Kruger, Wang, & Wilke, 2007). Dohmen et al. (who find domain-general risk-proneness) do report that height is positively correlated with risk-proneness in the potentially relevant categories of "sports and leisure" and "driving behavior". However, Dohmen et al. employed only a single vague question addressing self-assessed risk-proneness in each domain. In light of ambiguity in the existing literature as to whether height is correlated with participation in overtly dangerous observable activities, we therefore began by conducting our own investigation of this question.

2. Study 1

2.1. Methods

2.1.1. Participants

1172 adults were recruited from across the U.S. via Craigslist.org to participate in an online study of "Personality, Feelings and Preferences". Participants were screened prior to analysis for repeat participation, incomplete or overly brief sessions, implausible answers to the height question, or admission that the study was not taken seriously. This left a sample of 853 (619 female) with a mean age of 34.83 years ($SD = 13.05$). The ethnicity of the sample was 81.1% White, 8.4% Hispanic, 4.8% Black, 3.3% Asian, and 2.3% mixed or other ethnicities.

2.1.2. Materials and measures

Participants completed the adult version of the *Domain-Specific Risk-Taking Scale* (DOSPERT; Blais & Weber, 2006). Participants were instructed to "indicate the likelihood that you would engage in the described activity or behavior if you were to find yourself in that situation" on a 7-point scale (1 = *Extremely Unlikely*; 7 = *Extremely Likely*). The DOSPERT assesses risk-taking propensities in five domains: Health/Safety (e.g., "Sunbathing without sunscreen"), Recreational (e.g., "Bungee jumping off a tall bridge"), Financial (e.g., "Betting a day's income at a high-stake poker game"), Social (e.g., "Disagreeing with an authority figure on a major issue"), and Ethical (e.g., "Passing off somebody else's work as your own"). The five subscales were internally reliable (Health/Safety $\alpha = .65$; Recreational $\alpha = .81$; Financial $\alpha = .72$; Social $\alpha = .61$; Ethical $\alpha = .67$), as was the overall scale ($\alpha = .82$).

Participants' financial risk preferences were also measured behaviorally using a real-stakes game, adapted from Apicella et al. (2008). Participants selected an amount between $0 and $250 to allocate to a double-or-nothing coin toss to be conducted in the event they won a raffle, with any unallocated amount constituting a guaranteed payoff. Participation in this optional raffle required providing an email address; 824 participants elected to participate.

In a within-subjects design, participants answered the DOSPERT, then filler measures unrelated to the present paper, followed by the behavioral financial risk measure, then demographic questions.

2.2. Results and discussion

A preliminary ANOVA confirmed that, as expected, men reported greater risk-taking overall than women (see Table 1, ESM, available on the journal's website at www.ehbonline.org). A one-way MANOVA tested for effects of sex on the five subscales, revealing a significant main effect, $F(1,847) = 14.63$, $p < .001$, $\eta^2 = .08$. Men reported greater risk-taking propensity in all domains except social risk (see Table 1, ESM, available on the journal's website at www.ehbonline.org). Men also bet significantly more money ($M = 133.29$, $SD = 98.41$) than women ($M = 100.27$, $SD = 79.01$) in the double-or-nothing wager, $F(1,822) = 25.00$, $p < .001$, $\eta^2 = .03$.

To assess whether participant height influenced risk-taking independent of sex, we conducted a series of regressions including height and sex as predictors, with the five subscale scores, the composite risk score, and the coin-toss wager as the outcome variables. Controlling for sex, height significantly predicted greater risk-taking only in the domain of health/safety (see Table 2, ESM, available on the journal's website at www.ehbonline.org). We next tested whether sex moderated the influence of height by simultaneously including height (centered), sex, and the interaction between height and sex in a series of regressions, with the five risk domain scores, composite risk, and the coin-toss wager as the outcome variables. These tests revealed significant moderation of the effect of height by sex for health/safety ($\beta = -.35$, $SE = .03$, $p < .02$), composite risk ($\beta = -.38$, $SE = .02$, $p < .02$), and the wager ($\beta = -.30$, $SE = 2.22$, $p < .05$). There were no other indications of moderating effects of sex on the influence of height ($ps > .14$). Follow-up tests indicated that all three moderation effects were driven by women. In women, height positively correlated with health/safety risk, $r(619) = .12$, $p < .01$, composite risk, $r(619) = .09$, $p < .03$, and wager amount, $r(596) = .09$, $p < .03$. In men, there were no significant correlations between height and the wager amount or any of the other self-reported domains of risk, $rs = -.02$–$.10$, $ps > .13$.

In sum, we found that height did not independently predict risk-taking propensities across domains, including recreational risk-taking, the domain that best fits our criteria of observable behaviors carrying self-evident risks of injury or death. Moderation tests revealed that, in women, height did predict composite risk-taking, risk-taking in the domain of health and safety, and financial risk-taking in the wager; however, women are not the principal focus of the CBH. These results provide grounds for interpreting any positive effects of information regarding a man's physical risk-proneness on conceptualizations of his size as reflecting representations of his formidability, not past observations of correlations in the world. We therefore conducted a series of studies testing the prediction that physically risk-prone individuals would be conceptualized as larger than risk-averse individuals. Throughout, our core experimental design consisted of a short vignette describing either a physically risk-prone or a risk-averse man, followed by estimations of his bodily size. Although, with regard to the role of signaler, the CBH applies primarily (albeit not exclusively) to men, the same is less true of the role of recipient: because both men and women benefit from acquiring information about the formidability of men, we can expect selection to have endowed both sexes with the capacity to translate information about a target individual's risk-proneness into a representation of that individual's relative formidability. Accordingly, both men and women were recruited in most of the studies that follow.

3. Studies 2 and 3

3.1. Methods

3.1.1. Participants

In Study 2, 905 adults were recruited from across the U.S. via Craigslist.org to participate in an unpaid online study concerning social intuitions. Data were pre-screened as in Study 1, leaving a sample of 773 adults (568 female) with a mean age of 35.1 years ($SD = 12.92$), 70.2% White, 11.1% Hispanic, 5.3% Black, 7.1% Asian, and 6.3% mixed or Other.

In Study 3, 627 unpaid adult volunteers were recruited as in Study 2. Identical prescreening produced a sample of 538 adults (417 female) with a mean age of 32.7 years ($SD = 12.36$), 77.9% White, 6.5% Hispanic, 3.5% Black, 6.1% Asian, and 6.0% mixed or Other.

3.1.2. Materials and measures

In Studies 2 and 3, participants read one of two vignettes (risk-prone or risk-averse condition), followed by a numerical height estimation question (in feet and inches) and a visual array from which participants selected the image that most closely resembled how they envisioned the man described in the vignette. The risk-prone vignette described a "daredevil" who regularly engages in extreme sports and plays Russian roulette; the risk-averse vignette described a "cautious guy" who avoids risks (see ESM). The array was composed of 5 copies of a computer-generated image of a man of average proportions and ambiguous ethnicity, the copies differing only in size (see Figure 1, ESM, available on the journal's website at www.ehbonline.org).

Concerned that the arrays employed in Study 2 might entail demand characteristics because the constituent images differed only in size, in Study 3 we replicated Study 2, substituting arrays of diverse male silhouettes. Multiple versions of each array were created by randomly varying both the relative size and the left-to-right sequence of the silhouettes; participants were randomly assigned to view one of the four resulting arrays (see Figure 1, ESM, available on the journal's website at www.ehbonline.org).

3.2. Results and discussion

In Study 2, a one-way MANOVA assessing the estimations of height (in inches) and size (via the array) revealed a significant main effect of condition, $F(2, 770) = 13.01$, $p < .001$, $\eta^2_p = .03$. As predicted, participants envisioned the risk-prone man as taller in inches ($M = 69.61$; $SD = 3.20$) than the risk-averse man ($M = 68.69$; $SD = 2.99$), $F(1,771) = 16.88$, $p < .001$, $\eta^2_p = .02$. The risk-prone man was also envisioned as larger using the 5-point array ($M = 3.28$; $SD = .98$) than the risk-averse man ($M = 2.94$; $SD = .89$), $F(1,771) = 24.29$, $p < .001$, $\eta^2_p = .03$. Follow-up tests exploring the possible effects of sex on envisioned physical formidability revealed that women estimated the target to be larger using the image array ($M = 3.18$; $SD = .94$) compared to men ($M = 2.96$; $SD = .98$), $F(1,771) = 8.11$, $p < .01$, $\eta^2_p = .01$. There was no effect of sex on estimated height, $p > .1$, and no interaction between sex and risk condition, $p > .8$.

Study 3 replicated the effects of Study 2 using alternate arrays. Preliminary analyses revealed an unintended significant effect of the version of the silhouette array on size estimation, $p < .01$; hence, the array used was controlled for in subsequent analyses. A one-way MANCOVA assessing the estimations of height (in feet and inches) and size (via the array) revealed a significant main effect of condition, $F(2, 534) = 4.80$, $p < .01$, $\eta^2_p = .02$. As predicted, participants envisioned the risk-prone man as taller in inches ($M = 69.61$; $SD = 3.01$) than the risk-averse man ($M = 68.77$; $SD = 2.77$), $F(1,535) = 9.11$, $p < .01$, $\eta^2_p = .02$. The risk-prone man was also envisioned as larger using the 4-point silhouette array ($M = 2.46$; $SD = .97$) than the risk-averse man ($M = 2.26$; $SD = .92$), $F(1,535) = 4.68$, $p < .04$, $\eta^2_p = .01$. Unlike in Study 2, follow-up tests exploring the effects of participant sex revealed no significant differences in height or size estimation, $ps > .1$. As in Study 2, there was no interaction between sex and risk condition, $p > .8$.

Studies 2 and 3 support our prediction that physically risk-prone men will be perceived as more formidable, and therefore physically larger, than risk-averse men. However, mention of Russian roulette in the risk-prone vignette implied that this individual has access to firearms, a confound given that individuals who possess guns are conceptualized as larger than those who do not (Fessler et al., 2012). To address this, we conducted an additional study using vignettes exclusively addressing participation in dangerous sports.

4. Study 4

4.1. Methods

4.1.1. Participants

Recruitment and data cleaning were identical to Studies 2 and 3, leaving a final sample of 437 adults (347 female) with a mean age of 33.8 years ($SD = 13.35$), 75.4% White, 8.7% Hispanic, 3.2% Black, 8.3% Asian, 4.4% mixed or Other.

4.1.1. Materials and measures. Paralleling Studies 2 and 3, vignettes described a male "daredevil" and a "cautious guy," where the former enthusiastically engages in three obviously dangerous sports (extreme mountaineering, freestyle motorcycling, and big-wave surfing), while the latter refuses to join his friends in these activities, finding that merely watching makes him nervous (see ESM). Dependent measures consisted of a numerical height estimation question and a randomly-assigned version of arrays composed of four silhouettes, varying only in size, selected so as to provide minimal cues regarding social class or ethnicity (see Figure 2, ESM, available on the journal's website at www.ehbonline.org).

4.2. Results and discussion

Preliminary analyses revealed a significant effect of the version of the silhouette array on size estimation, $p < .01$; hence, the array used was controlled for in subsequent analyses. Consistent with predictions, a one-way MANCOVA assessing the estimations of height (in feet and inches) and size revealed a significant main effect of condition, $F(2, 433) = 22.71$, $p < .001$, $\eta^2_p = .10$. As predicted, participants envisioned the risk-prone man as taller in inches ($M = 70.18$; $SD = 2.30$) than the risk-averse man ($M = 68.57$; $SD = 2.76$), $F(1,434) = 40.46$, $p < .001$, $\eta^2_p = .09$, and as larger when judged using the array ([$M = 2.76$; $SD = .62$] versus [$M = 2.40$; $SD = .78$]), $F(1,434) = 28.69$, $p < .001$, $\eta^2_p = .06$. As in Study 3, follow-up tests revealed no effects of participant sex, or interactions between sex and condition, on envisioned physical formidability, $ps > .1$.

These results replicate those obtained in Studies 2 and 3, revealing a robust pattern wherein U.S. participants conceptualize physically risk-prone men as larger than risk-averse men. While Study 4 was free of the gun confound accompanying Studies 2 and 3, all three studies nonetheless suffer limitations. First, all focus on risky sports in a society in which some of the male stars of such behaviors (e.g., Travis Pastrana, Laird Hamilton) are both taller than average and celebrated in ubiquitous mass media. It is therefore possible that these findings reflect a culturally parochial schema concerning recreational physical risk-taking. Second, the core feature of the CBH at issue is the link between physical risk-taking and the danger that the target individual poses to adversaries. Although our previous research documents that conceptualized physical size is used to represent formidability, and although it follows logically that the propensity to aggress is linked to formidability, nevertheless, the interpretation of Studies 2–4 as

supporting the foundation of the CBH rests on the presumption that perceiving physical risk-takers as formidable equates to viewing them as more dangerous. We therefore conducted a fifth study. To address the possibility of a schema parochial to U.S. Internet users, data were collected in rural Fiji, a culturally and technologically disparate context. To address the question of whether our earlier results reflect special features of celebrated recreational activities, we employed vignettes describing physically risky activities encountered during everyday male tasks common in that locale. To address the question of whether perceived size equates to likelihood of violence, we added items concerning violent responses to transgressions. We also included exploratory questions relating anger and violence, given prior work linking anger to the propensity to employ violence (e.g., Hess, Helfrecht, Hagen, Sell, & Hewlett, 2010; Sell, Tooby, & Cosmides, 2009). Lastly, as noted in the Introduction, size is one of two dimensions that we have previously shown are used to represent relative formidability, strength being the other. Accordingly, in addition to a 6-silhouette version of one of the male image arrays employed in Study 4 (see Figure 3, ESM, available on the journal's website at www.ehbonline.org), we employed an array depicting six male bodies of identical height that differ in muscularity (see Figure 3, ESM, available on the journal's website at www.ehbonline.org).

5. Study 5

5.1. Methods

5.1.1. Participants

As part of a larger study of life on Yasawa Island, Fiji, 34 adult men with a mean age of 44.3 years ($SD = 16.52$) were recruited from two villages (for relevant ethnography, see Gervais, 2013; Henrich & Henrich, in press).

5.1.1. Materials and measures. Using ethnographic observations to identify physical risks encountered by men during subsistence activities (e.g., climbing tall coconut trees and sailing rough seas without a life vest), two vignettes were composed, one describing a risk-prone man and one describing a risk-averse man (see ESM). In a within-subjects, counterbalanced design, participants were randomly assigned to respond first to either the risk-prone or risk-averse vignette; following a delay of 7 to 8 days, each participant then responded to the alternate vignette. Due to variance in literacy, tasks were administered orally in Standard Fijian by a Fijian research assistant, under M.G.'s supervision.

Following the vignettes, participants viewed the silhouette and muscularity arrays, in counterbalanced order across participants, with the order reversed within participants at the time of the second interview; participants pointed to the image matching how they envisioned the male protagonist. As other evidence indicated that participants had difficulty employing quantitative measurements of height, numerical estimations were not used.

Next, participants employed visual scales, with verbally described markers, to answer the following questions, in fixed order: As a manipulation check, participants were first asked, "How likely do you think this man is to leave the water if several large/aggressive sharks swim near him?" (1 = *Not at all likely*; 4 = *Very likely*). Next, to probe perceived aggressiveness, participants were asked, "How likely do you think this man is to react violently if someone does something harsh to him?" (1 = *Not at all likely*; 4 = *Very likely*). To probe perceived anger-proneness, participants were then asked, "How angry do you think this man would be if his wife was seen talking to another man in the forest?" (1 = *Very little*; 5 = *Very much*). Finally, to probe the target's envisioned propensity for violence stemming from anger, participants were asked, "How likely do you think he would be to hit her?" (1 = *Not at all likely*; 4 = *Very likely*).

5.2. Results and discussion

Confirming the success of the manipulation, a repeated-measures ANOVA revealed that participants rated the risk-prone target as less likely to leave the water upon the approach of sharks ($M = 1.74$, $SD = 1.14$) than the risk-averse target ($M = 2.97$, $SD = 1.03$), $F(1, 33) = 18.19$, $p < .001$, $\eta^2_p = .36$.

Preliminary analyses revealed no effects of order for either condition or the sequence of size array versus muscularity array, $ps > .6$; hence, order was not controlled for in subsequent analyses. As predicted, a repeated-measures ANOVA revealed that the risk-prone man was envisioned as taller/larger ($M = 4.47$, $SD = 1.66$) than the risk-averse man ($M = 3.38$, $SD = 1.84$), $F(1, 33) = 7.19$, $p < .02$, $\eta^2_p = .18$. The risk-prone man was also envisioned as more muscular ($M = 4.50$, $SD = 1.62$) than the risk-averse man ($M = 2.59$, $SD = 1.67$), $F(1, 33) = 23.20$, $p < .001$, $\eta^2_p = .41$.

Also consistent with predictions, a repeated-measures ANOVA revealed that the risk-prone man was envisioned as more likely to react violently if provoked ($M = 2.50$, $SD = 1.05$) than the risk-averse man ($M = 1.94$, $SD = 1.07$), $F(1, 33) = 6.00$, $p = .02$, $\eta^2_p = .15$. However, against predictions, the risk-prone man was not envisioned as prone to experience greater anger upon witnessing his wife talking with another man in the forest ($M = 4.12$, $SD = 1.01$) than the risk-averse man ($M = 3.85$, $SD = 1.40$), $p > .3$. Finally, consistent with predictions, the risk-prone man was envisioned as more likely to hit his wife ($M = 2.94$, $SD = 1.01$) than the risk-averse man ($M = 2.21$, $SD = .95$), $F(1, 33) = 9.39$, $p < .01$, $\eta^2_p = .22$.

Using a culturally disparate sample and domains of activity unrelated to those employed previously, Study 5 replicated the patterns found in Studies 2–4, as a man who voluntarily undertakes activities entailing a risk of injury or death was conceptualized as larger than a man who avoids such risks. Extending our prior results, Study 5 also documented that the physically risk-prone man is conceptualized as more muscular than the risk-averse man. Consonant with the position that formidability, represented using the dimensions of size and muscularity, is linked to the propensity to aggress, the physically risk-prone man was seen as more likely to engage in violence than the risk-averse man. These results suggest that, in keeping with the premise of the CBH, physical risk-taking informs observers about the danger that an actor poses as a potential adversary.

Although Study 5 addressed many of the limitations of Studies 2, 3, and 4, nonetheless, it shares with them a possible alternative explanation. Prior work indicates that information regarding a target individual's social status influences perceptions of the target's size (reviewed in Higham & Carment, 1992; see also Duguid & Goncalo, 2012; Marsh, Yu, Schechter, & Blair, 2009; Masters, Poolton, & van der Kamp, 2010; Sorokowski, 2009; Wilson, 1968). While this pattern likely indicates the cooptation of an ancestral system, evolved to represent formidability, for the uniquely human function of representing prestige (Fessler & Holbrook, 2013b; Fessler et al., 2012; Holbrook, Piazza, & Fessler, in press), it may also reflect an observational phenomenon, as height is correlated with actual social position and corresponding social influence — taller people achieve greater professional success, are paid more, are more likely to be elected, etc. (reviewed in Marsh et al., 2009; Sorokowski, 2009; see also Murray & Schmitz, 2011; Stulp, Buunk, Verhulst, & Pollet, 2012). Regardless of the causes of the conceptual association between height and status, if participants considered the risk-prone target in Studies 2–4 more prestigious than the risk-averse target, they may have conceptualized the former as both larger and of higher standing. Whether this also applies to Study 5 is questionable. First, the risky activities employed are mundane in Yasawa, reducing their prestige value. Second, Yasawan status is largely inherited, and is negatively correlated with physical strength (M.G., unpublished data), probably due to a positive correlation with age. Third, status is contingent on

evincing "chiefliness," (*vakaturaga*) a trait antithetical to violence. Nevertheless, because we did not measure perceived status in Study 5, we cannot eliminate this explanation. We therefore conducted a study in the U.S. employing physically risky activities unlikely to be prestigious, and measured perceived prestige.

6. Study 6

6.1. Methods

6.1.1. Participants

Recruitment and data cleaning were identical to Studies 2–4, leaving a final sample of 522 U.S. adults (399 female) with a mean age of 32.8 years ($SD = 12.11$), 77.8% White, 6.3% Hispanic, 3.8% Black, 3.8% Asian, 8.3% mixed or Other.

6.1.2. Materials and measures

Participants were randomly assigned to one of three vignette conditions (risk-prone, risk-averse, or neutral). In the risk-prone vignette, the target man was described as not wearing a seatbelt, eating, and texting while driving; speeding; and driving through a red light; the risk-averse man was described as explicitly taking steps to engage in the opposite behaviors. The neutral vignette described a man whose behavior was neither highly risky nor highly cautious (see ESM). All three vignettes ended with the target being insulted by a stranger in a bar. In fixed order, participants were asked how likely the target was to get into a fistfight with the stranger (1 = *Not at all likely*; 9 = *Very likely)*, the target's height in feet and inches; and whether the target is shorter or taller than average (1 = *Very short*; 6 = *Very tall*). Participants next rated the target's muscularity and overall height/size using 4-image versions of the arrays employed in Study 5. Participants then rated how respected they imagined the target to be in his community (1 = *Not at all respected [almost no one admires Bob]*; 9 = *Highly respected [almost everyone admires Bob]*). Lastly, participants rated how likely the target was to engage in each of 25 activities (1 = *Not at all likely*; 9 = *Very likely*). Six of the activities involved voluntary risk-taking, including extreme sports and other physically risky behaviors, and were averaged to create a risk score; two questions were drawn from the vignette as attention checks; and the balance were distracters.

6.2. Results and discussion

Analyses of the attention check questions revealed that participants understood and attended to the relevant features of the vignettes (see ESM). A one-way ANOVA confirmed that the risk-prone man was rated more likely to engage in other risky behaviors ($M = 4.54$, $SD = 1.56$) than the neutral man ($M = 3.75$, $SD = 1.46$) or the risk-averse man ($M = 2.97$, $SD = 1.38$), $F(2, 519) = 47.02$, $p < .001$, $\eta^2_p = .15$. Planned contrasts showed that the differences between conditions in estimated participation in risky activities were all mutually significant, $ps > .001$, confirming that the target's propensity to take risks was manipulated as intended.

A one-way MANOVA revealed significant main effects of risk condition on the two judgments of height and on the judgment of muscularity, $Fs(4, 516) > 3.3$, $ps < .05$, $\eta^2_p = .01$ - .02. As predicted, the risk-prone man was envisioned as taller (in feet and inches), taller relative to average, larger (according to the size array), and more muscular than the neutral or risk-averse targets (see Table 3, ESM for descriptives, available on the journal's website at www.ehbonline.org). However, the main effect of condition for ratings of size using the 4-point silhouette array did not reach significance in this study, $p > .8$, and the difference in muscularity ratings between the risk-prone and neutral targets was nonsignificant, $p > .2$; nevertheless, in both cases, what differences did occur were in the predicted direction. In addition, whereas the risk-prone target was rated as significantly taller (in feet and inches) than the risk-averse target, the difference between the risk-prone and neutral targets only reached a nonsignificant trend, $p < .09$. Similarly, the difference in relative height ratings between the risk-prone and risk-averse targets only reached a nonsignificant trend, $p < .08$. Consistent with predictions, separate one-way ANOVAs revealed significant main effects of condition on ratings of prestige, $F(2, 519) = 15.11$, $p < .001$, $\eta^2_p = .06$, and on ratings of the target's likelihood of fighting the man in the bar, $F(2, 519) = 77.39$, $p < .001$, $\eta^2_p = .23$. The risk-prone man was envisioned as significantly less prestigious, yet significantly more likely to fight the man in the bar, than the man described in either the neutral or risk-averse conditions (see Table 3, ESM, available on the journal's website at www.ehbonline.org). Follow-up tests revealed no effects of participant sex, or interactions between sex and condition, on envisioned height, size, muscularity, or prestige, $ps > .1$. There was an effect of sex on likelihood of fighting, $F(1, 521) = 7.28$, $p < .01$, $\eta^2_p = .01$; female participants rated the target as less likely to fight ($M = 3.14$; $SD = 1.98$) relative to male participants ($M = 3.70$; $SD = 2.15$). However, there was no interaction between sex and risk condition on estimated likelihood of fighting, $p > .3$.

6.2.1. Mediation analysis

We assessed conceptualized formidability via distinct dimensions of height, overall size, and muscularity. To assess whether the between-condition differences in the target man's envisioned propensity to aggress were mediated by his conceptualized formidability, the four items probing imagined bodily height, size, and muscularity were standardized and averaged to create a composite formidability score ($\alpha = .67$).

To test whether conceptualized formidability mediated the effect of condition on the target's estimated likelihood of fighting, we ran a bootstrapping procedure (5000 samples) using the INDIRECT macro for SPSS (Preacher & Hayes, 2008). We entered composite conceptualized formidability scores as the mediating variable, risk condition (risk-prone versus non-risk-prone, combining the neutral and risk-averse conditions) as the independent variable, and likelihood of fighting as the dependent variable. Consistent with predictions, the direct effect of condition on estimated likelihood of fighting ($\beta = .46$, $SE = .17$, $p < .001$) was slightly weaker with conceptualized formidability included in the model ($\beta = .45$, $SE = .11$, $p < .001$), whereas the indirect effect of conceptualized formidability on aggression remained significant ($\beta = .11$, $SE = .11$, $p < .01$), and the bias-corrected and accelerated confidence intervals did not overlap with zero (95% CI = [−.081, −.004]). In sum, conceptualized formidability partially mediated the effects of the risk condition on envisioned aggression, although the manipulation clearly also influenced this evaluation via additional mechanisms.

Study 6 reveals that information regarding a man's propensity to take physical risks enhances conceptualizations of his size and strength in a manner that cannot be attributed to the esteem in which he is held, as the risk-prone target was simultaneously envisioned to be tall, muscular, and of low prestige. Likewise, confirming the premise of the CBH, participants viewed the risk-prone target as more likely to respond violently to transgression; given the low prestige assigned this man, such aggressiveness is not explicable in terms of entitlements attending high status.

7. Conclusion

Taken together, converging findings from five studies document that knowing that a man voluntarily engages in dangerous nonviolent activities leads others to conceptualize him as larger and stronger. Such conceptualizations are unlikely to stem from prior observations of any link between size and risk-proneness, as we find no correlation between male height and self-reported participation in physical risk-taking. Rather, this pattern of conceptualization is consistent with

previous work showing that diverse determinants of relative formidability are summarized using a representation employing the dimensions of size and muscularity. In keeping with the risks inherent in violent conflict, our results thus reveal a strong link between knowledge of another's physical risk-proneness and assessment of the other's formidability as a potential adversary or ally, a connection underlined by our cross-culturally replicated finding that physically risk-prone men are indeed perceived to be more violent. These findings thus provide preliminary support for the Crazy Bastard Hypothesis, which holds that physical risk-taking has signal value in part because it honestly reveals physical risk-proneness, a determinant of formidability. More broadly, this linkage adds to existing explanations of epidemiological associations between involvement in nonviolent physical risk-taking and violence.

To date, evolutionary research on the epidemiology of risk-taking has largely focused on risk-taking's capacity to signal phenotypic/genotypic quality, features of interest to a variety of signal recipients. Although we concur that such signaling likely contributes to many forms of risk-taking, nonetheless, we believe that investigators may have overestimated its importance, particularly as regards connections with violence. While individuals of higher phenotypic quality may indeed both suffer fewer costs in dangerous nonviolent pursuits and be more inclined to engage in violence, this pattern stands independent of the attribute of risk-proneness per se, the determinants of which, as noted earlier, include life history variables unrelated to issues of relative quality. Indeed, at the individual level, accidental injury rate is correlated with both participation in violence (Junger & Tremblay, 1999; Suchman, 1970) and dispositional aggression (Hansen, 1988), a pattern consistent with the notion that involvement in both nonviolent and violent dangerous activities is in part driven by risk-proneness independent of phenotypic quality.

Wilson and Daly's Young Male Syndrome thesis addresses that demographic category that is both most likely to be involved in violence and most likely to engage in other risky activities. In seeking to shed light on the relationship between violent and nonviolent risk-taking, the CBH thus prototypically applies to young men. Accordingly, in our studies of the effects of nonviolent risk-taking on conceptualizations of size and strength qua representations of relative formidability, we have exclusively employed male targets. However, the logic that links nonviolent risk-taking and assessed formidability is not unique to such targets, as relative indifference to the prospect of injury or death enhances formidability regardless of the actor's sex. Studies employing female targets should therefore produce results similar to thaose reported here.

The effects of risk-proneness on perceived relative formidability that we have documented do not in themselves prove that the association between the propensity for violence and the tendency to engage in nonviolent physical risk-taking has been driven over evolutionary time by the signaling affordances of the latter. As noted in the Introduction, nonviolent risk-proneness may be a byproduct of the reduction in sensitivity to risk necessary to promote agonistic competitiveness. If so, then observers could be expected to be aware of the correlation between these two behavioral patterns, leading them to infer that risk-takers are violent, and thus should be represented as formidable. However, while not eliminating this possibility, our findings nevertheless suggest that a pure byproduct account is implausible. Given that observers appear to infer increased formidability from nonviolent risk-taking, even if elevated nonviolent risk-proneness was originally a byproduct, it is unlikely to have remained such over evolutionary time. Individuals who capitalized on the signaling potential of this behavior would, by virtue of the deference thereby achieved, have had higher fitness than those who did not. As a consequence, selection can be expected to have favored mechanisms that calibrate nonviolent risk-taking in ways that would have been adaptive in the environments of our ancestors, i.e., even if this trait began as a byproduct, it would have been crafted into an adaptation.

The CBH generates novel predictions not produced by existing signaling accounts of risk-taking. Because the CBH stresses that the signal at issue is primarily relevant to issues of relative formidability, such signaling behavior should be affected by the value placed on formidability. For example, the CBH uniquely predicts that the presence of a male audience should generally have a larger effect on physical risk-taking than the presence of a female audience, since formidability is typically a greater concern for the former. This is consonant with findings that, among Western university students, nonheroic physical risk-taking reduces men's attractiveness to women as long-term mates, but increases their attractiveness to men as friends (Farthing, 2005; also Sylwester & Pawłowski, 2011; but see also Bassett & Moss, 2004). Likewise, the CBH predicts that women's valuation of nonviolent physical risk-taking in prospective long-term mates should hinge on the extent to which they are willing to pay the costs of a potentially coercive partner in exchange for the benefits of greater male protection (Snyder et al., 2011). Similarly, in electing leaders and otherwise assigning power and prestige, the value that constituents place on nonviolent physical risk-taking should be contingent on the perceived likelihood of violent conflict with other groups. Lastly, existing evidence indicates that attention to cues of dominance (and thus, for our purposes, of formidability) is contingent on both the perceiver's own physical formidability (Watkins et al., 2010) and the extent to which formidability is relevant to the current social context (Watkins & Jones, 2012; Watkins, Debruine, Feinberg, & Jones, 2013). The CBH predicts that the same individual and situational variables should predict attention to nonviolent physical risk-taking. Given the many testable predictions of the CBH, we look forward to the next chapter in the study of risk-taking and its connection to violence.

Supplementary materials

Supplementary to this article can be found online at http://dx.doi.org/10.1016/j.evolhumbehav.2013.09.003.

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