

Original Article

Stranger danger: Parenthood increases the envisioned bodily formidability of menacing men[☆]

Daniel M.T. Fessler^{a,b,*}, Colin Holbrook^{a,b}, Jeremy S. Pollack^b, Jennifer Hahn-Holbrook^{b,c}

^a Department of Anthropology, University of California, Los Angeles, Los Angeles, CA 90095, USA

^b Center for Behavior, Evolution, and Culture, University of California, Los Angeles, Los Angeles, CA 90095, USA

^c Department of Psychology, University of California, Los Angeles, Los Angeles, CA 90095, USA

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ABSTRACT

Due to altriciality and the importance of embodied capital, children's fitness is contingent on parental investment. Injury suffered by a parent therefore degrades the parent's fitness both by constraining reproduction and by diminishing the fitness of existing offspring. Due to the latter added cost, compared to non-parents, parents should be more cautious in hazardous situations, including potentially agonistic interactions. Prior research indicates that relative formidability is conceptualized in terms of size and strength. As erroneous under-estimation of a foe's formidability heightens the risk of injury, parents should therefore conceptualize a potential antagonist as larger, stronger, and of more sinister intent than should non-parents; secondarily, the presence of one's vulnerable children should exacerbate this pattern. We tested these predictions in the U.S. using reactions to an evocative vignette, administered via the Internet (Study 1), and in-person assessments of the facial photograph of a purported criminal, collected on the streets of Southern California (Study 2). As predicted, parents envisioned a potential antagonist to be more formidable than did non-parents. Significant differences between parents with children and non-parents without children in the threat that the foe was thought to pose (Study 1) were fully mediated by increases in estimated physical formidability.

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1. Introduction

Humans are unique among primates in both the altriciality of our offspring and the degree to which learning and other forms of embodied capital can affect offspring fitness (Kaplan, Lancaster, & Robson, 2003). This combination creates the potential for a high rate of return on parental investment. We can therefore expect natural selection to have favored the evolution of multiple psychological adaptations regulating a variety of behaviors related to parenting. To date, considerable work has explored factors bearing directly on parental investment, including, for example, mechanisms active in attraction to infants (Glocker et al., 2009; Parsons, Young, Kumari, Stein, & Kringelbach, 2011), parent–infant bonding (Bowlby, 1982; Carter, 2005; Feldman, Gordon, Schneiderman, Weisman, & Zagoory-Sharon, 2010), and discriminative parental solicitude (Daly & Wilson, 1995). More recently, investigators have begun to explore the consequences of parenthood for social relations with third parties, a notable example being the effects of lactation on maternal

aggression toward transgressing adults (Hahn-Holbrook, Holbrook, & Haselton, 2011; Hahn-Holbrook, Holt-Lunstad, Holbrook, Coyne, & Lawson, 2011). Such work dovetails with studies in animal behavioral ecology that explore responses to the risk of infanticide (van Schaik & Janson, 2000). Importantly, logic suggests that the consequences of parenthood for relations with potentially dangerous third parties extend beyond the period when offspring are infants, and, indeed, beyond situations in which offspring are in harm's way. Specifically, the potential for substantially enhancing the success of one's children through continued investment over a period of many years means that parental injury degrades a parent's fitness not merely by limiting or truncating the parent's reproduction, but also by reducing the fitness of existing offspring (Hurtado & Hill, 1992; Scelza, 2010). Correspondingly, for individuals pursuing a reproductive strategy involving substantial parental investment, parenthood should notably influence social cognition with regard to potentially agonistic situations.

The impact of parenthood on social cognition in potentially agonistic contexts can be decomposed into at least three separable but interrelated components. First, given the consequences of parental injury for offspring fitness, we can expect parenthood to be accompanied by a decrease in the propensity to take risks with one's health and welfare: when the probabilities of both positive and negative outcomes are known, relative to non-parents, parents should display a reduced preference for options that, though potentially

[☆] The complete datasets for all studies reported in this paper are included in the Electronic Supplementary Material, available at www.ehbonline.org.

* Corresponding author at: Department of Anthropology, 341 Haines Hall, University of California, Los Angeles, Los Angeles, CA 90095-1553, USA. Tel.: +1 310 794 9252; fax: +1 310 206 7833.

E-mail address: dfessler@anthro.ucla.edu (D.M.T. Fessler).

yielding large rewards, are also accompanied by a risk of injury (Campbell, 1999; Wang, Kruger, & Wilke, 2009; Hahn-Holbrook, Holbrook, et al., 2011; Hahn-Holbrook, Holt-Lunstad, et al., 2011). As a consequence, in general, when facing an antagonist, parents should be less inclined to engage in combat than non-parents. One important exception to this generalization concerns situations in which the antagonist threatens the parent's child, in which case, by virtue of their vested interest in the child's welfare, parents can be expected to be more inclined than non-parents to engage in combat (Maestriperi, 1992). Second, when others' intentions are unclear, parents should display more conservative error management strategies (Galperin & Haselton, 2012) in estimating said intentions. The threshold for presuming that another harbors hostile intent should thus be lower in parents than in non-parents, as this will reduce the likelihood that the perceiver will fail to identify an assailant—in short, parents should assess potential assailants as more malevolent in ambiguous situations, since failing to identify an attack is more costly than is falsely suspecting attack in a benign context. With the exception of the reversal of parents' aversion to combat in parental defensive aggression when attack is imminent (Hahn-Holbrook, Holbrook, et al., 2011; Hahn-Holbrook, Holt-Lunstad, et al., 2011), the presence of one's child should intensify parental misgivings about others' intentions in ambiguous situations, as the child's vulnerability increases the value of a pessimistic estimation in this regard. Third, when faced with an apparently agonistic context, in deciding whether to fight, attempt to negotiate, or flee, parents should be more pessimistic than non-parents in estimating the fighting capacity, or formidability, of an antagonist relative to themselves, as this will reduce the likelihood that the parent will suffer injury due to inaccurate predictions of possible outcomes. In this case, too, the presence of one's child should intensify the pattern of pessimism. Here, after reviewing existing evidence in support of parental combat avoidance, risk-aversion, and distrust, we present results from two studies concerning the influence of parenthood on the estimation of relative formidability, a hitherto unexplored topic.

Parental avoidance of combat is a subsidiary category of a predicted general propensity for high-investing parents to be more averse than non-parents to situations involving a risk of injury (i.e., physical risk). One indirect index consonant with the predicted pattern is the finding that, across anthropoid primates, sex differences in survival rates reflect the degree and direction of sex differences in parental care (Allman, Rosin, Kumar, & Hasenstaub, 1998). However, survival rates are admittedly determined by many factors; to date, surprisingly little research addresses the question of whether parents are less likely to engage in physical risk-taking in general, and violence in particular, than non-parents. Beginning with the animal literature, studies of mice (Parmigiani, Palanza, Rodgers, & Ferrari, 1999) and howler monkeys (Cancelliere, 2012) reveal increases in precautionary behavior – presumably corresponding with increased aversion to physical risk – in females with dependent offspring. In humans, given the links between testosterone and aggression and related forms of risk-taking (reviewed in Yildirim & Derksen, 2012), it is suggestive that paternal testosterone declines following the birth of a child (Gray & Campbell, 2009; Gettler, McDade, Feranil, & Kuzawa, 2011); cross-sectional evidence suggests that similar patterns occur in women as well (Kuzawa, Gettler, Huang, & McDade, 2010). However, the applicability of these observations is limited in that the principal proximate determinant of aggressiveness may be the plasticity of testosterone levels rather than baseline testosterone levels (Carré, McCormick, & Hariri, 2011). Baseline testosterone is associated with financial risk-taking (Stanton, Liening, & Schultheiss, 2011), and, for both sexes, parents have a lower tolerance for financial risk than non-parents (Chaulk, Johnson, & Bulcroft, 2003). Relatedly, among non-parents, women, but not men, show greater risk-aversion in a gambling task when a baby will share the proceeds compared to when the recipient is an adult (Fischer & Hills, 2012). However, the

relevance of these findings is unclear given that financial risk-taking may be a poor predictor of participation in activities entailing a risk of injury (Blais & Weber, 2006).

Criminal offending frequently entails the possibility of violence and injury. For both men and women, high-investing parenthood is associated with reduced offending (Ganem & Agnew, 2007), particularly for individuals of higher socioeconomic status (Giordano, Seffrin, Manning, & Longmore, 2011). In regard to social conflict in more everyday settings, compared to non-parents, parents report lesser likelihood of engaging in risky behaviors in two domains, within-group competition and between-group competition, both of which entail the possibility of violence (Wang et al., 2009). A small interview study finds reduced self-reported male physical risk-taking following the birth of a child (Garfield, Isacco, & Bartlo, 2010), although the qualitative nature of the results limits their robustness. More broadly, a large economic survey documents that parents are more willing than non-parents to pay for programs that reduce the risk that they will suffer serious health problems (Cameron, DeShazo, & Johnson, 2010).

In a series of papers, Eibach and colleagues explore the relationship between parenthood, perceptions of danger, and related considerations such as distrust. Correlating reported perceptions of increases in danger in society with the year in which participants' children were born, Eibach, Libby, and Gilovich (2003) find that parenthood appears to make the world seem more dangerous (similarly, Drottz-Sjöberg & Sjöberg, 1990 find that parents perceive nuclear energy to be more dangerous than do non-parents). Subsequent studies indicate that reminding individuals of their status as parents (by placing a demographic question concerning parenthood prior to dependent measures) enhances parents' perceptions of the dangerousness of a variety of features of the world, including the dangerousness of extreme sports, and the risk of criminal victimization (Eibach & Mock, 2011; Eibach, Libby, & Ehrlinger, 2012). Somewhat surprisingly, one of these studies found no difference in perceptions of danger between parents and non-parents when parents were not reminded of their parenthood (Eibach & Mock, 2011). Consonant with the above patterns, Eibach and Mock (2011) also found that, when (and only when) their status as parents was primed, parents reported greater distrust of strangers than non-parents, and made less trusting (and less risky) decisions in hypothetical economic games.

Lastly, turning to parents' concerns for the welfare of their children rather than themselves, obsessive and intrusive postpartum ideation concerning potential hazards to infants occurs in both mothers and fathers, albeit more so in the former (Abramowitz, Schwartz, & Moore, 2003). More broadly, when compared with parental concerns regarding other hazards present in the contemporary environment, fear that one's children will be harmed by strangers looms disproportionately large in light of the actual risks that such individuals pose, a distortion explicable in terms of the operation of psychological mechanisms that evolved in a world in which conspecifics were a prominent threat (Hahn-Holbrook, Holbrook, & Bering, 2010).

To summarize the above, although the literature is surprisingly sparse given both the theoretical and the practical importance of the topic, nevertheless, there is some evidence that, compared to non-parents, parents are more likely to avoid risk-taking in general, physical risk-taking in particular, and violence as a specific case. The small subset of studies among these that tap issues of parental distrust of other's intentions is similarly consonant with theoretical expectations that parents should be more pessimistic in this regard than non-parents. Against this backdrop, we turn to the background for our novel prediction, that parents will be more pessimistic than non-parents in estimating the formidability of a potential assailant.

Formidability is always relative to a given agonistic context, as the outcome of a violent conflict hinges not on one's absolute fighting

capacity, but on one's fighting capacity relative to that of one's foe. A wide variety of factors contributes to relative formidability, including strength, body size, sex, health, the possession of weapons, combat expertise, and the size and cohesiveness of coalitions. Such variety poses a challenge. In situations of potential violent conflict, individuals must rapidly decide whether to fight, flee, appease, or negotiate—the actor faces the problem of needing to consider multiple diverse attributes of the foe and of the self and quickly arrive at a decision as to how to act. When manifold factors contribute to a decision, it is often useful to compile the relevant information into a single representation. An emerging corpus of work indicates that, consonant with the phylogenetic antiquity and ontogenetic ubiquity of size and strength as important variables in this regard, the diverse determinants of relative formidability are summarized in a representation that employs the dimensions of size and strength: in essence, the greater the foe's formidability relative to one's own, the larger and stronger the foe is conceptualized as being. It is important to emphasize here that the aforementioned thesis refers to issues of representation, not to issues of perception. Size and strength are features of a mind's-eye image that summarizes a wide variety of tactical assets and liabilities possessed by the prospective combatants—the mind represents potential foes as large and muscular when the foe possesses notable tactical advantages over oneself, and as small and non-muscular when the opposite obtains. There is thus no suggestion that actual perceptual processes (or, at the least, 'perception-for-action' processes [Milner & Goodale, 2008]) will be influenced by tactical attributes of either party—indeed, it would likely be maladaptive were this to occur, as, at a minimum, it would lead to a reduction in the effectiveness of offensive or defensive tactics (e.g., missed blows stemming from inaccurate perceptions of the opponent's height, etc.).

Consistent with the above hypothesis, knowing that a man possesses a gun or a knife increases estimations of his size and muscularity (Fessler, Holbrook, & Snyder, 2012); conversely, the presence of allies who could assist in a fight diminishes such estimations (Fessler & Holbrook, 2013a). Likewise, learning that the leader of a terrorist group has suffered military defeats, or, alternately, experienced successes, leads participants to respectively decrease or increase their estimations of the size and strength of a representative terrorist (Holbrook & Fessler, 2013). Being temporarily physically incapacitated leads men to perceive an antagonist as larger and stronger, and themselves as smaller (Fessler & Holbrook, 2013b), while a man's own strength is inversely correlated with his estimations of an antagonist's physical formidability (Fessler et al., in press [a]). Knowing that an individual is relatively indifferent to the possibility of injury or death – and thus is unlikely to back down in a conflict – increases estimations of his size and strength (Fessler et al., in press [b]). Racist stereotypes portraying outgroup members as dangerous are accompanied – and mediated – by conceptualizations of increased size and muscularity (Holbrook et al., n.d.). More broadly, being made to feel powerful leads participants to underestimate a target individual's size (Duguid & Goncalo, 2012; Yap, Mason, & Ames, 2013) and overestimate their own (Duguid & Goncalo, 2012).

The above findings concerning the representation of relative formidability provide an avenue for exploring parental pessimism in formidability assessment, as asking parents and non-parents to provide estimates of another individual's size and muscularity constitutes an unobtrusive means of measuring predicted differences in the degree to which they are pessimistic in evaluating the formidability of a potential assailant. We therefore conducted two studies in the U.S., the first online and the second in person, in which we asked participants to estimate the height, body size, and muscularity of a target individual presented as a likely foe. If parental pessimism occurs, then parents should envision the stranger as larger and more muscular than should non-parents.

In Study 1, we asked participants to read an evocative vignette (adapted from Petralia & Gallup, 2002; see ESM, available on the journal's website at www.ehbonline.org) wherein the reader imagines him- or herself alone in a dark parking lot, having been followed – and ultimately approached – by an unfamiliar man; participants are then asked to estimate the antagonist's bodily characteristics. This design also affords an auxiliary exploration of parental distrust, as we can ask participants to judge the man's intentions and the corresponding danger that he poses, then explore the relationship between these judgments and perceptions of the man's relative formidability.

To investigate the predicted exacerbating effect of the presence of one's child on both parental pessimism in formidability assessment and parental distrust, in a separate condition, we modify the vignette, asking parents to envision themselves accompanied by their child (see ESM, available on the journal's website at www.ehbonline.org). However, should we observe that these parents respond differently than the parents who envisioned themselves alone, this observation by itself would not allow us to determine whether this effect is unique to the parent–child dyad. It is likely that, in the contemporary United States, most people believe that adults have a responsibility to protect children. As a consequence, while kin selection considerations predict an enhanced effect of the presence of one's own child compared to the effect of the presence of an unrelated child, nevertheless, the presence of any child may lead to increased caution in detecting potentially hostile agents and assessing their relative formidability. To tease apart these respective contributions, we add a condition in which parents are asked to envision themselves accompanied by an unrelated child (see ESM, available on the journal's website at www.ehbonline.org). Lastly, because the same broad moral considerations apply to non-parents, we add a condition in which non-parents are asked to envision themselves accompanied by an unrelated child (see ESM, available on the journal's website at www.ehbonline.org).

2. Study 1 methods

2.1. Participants

Via the nationwide market research firm uSamp (Encino, CA), 650 adult residents of the U.S. were recruited to participate in an online study described as a "survey of social intuitions" in exchange for \$1. To be eligible, prospective participants had to be married (thus ensuring comparability between parents and non-parents with regard to relationship status), between the ages of 26 and 35 (a common age range for parents of young children), and, for those who were parents, have at least one child under the age of 5 (thus ensuring that the envisioned child would be vulnerable to aggression).

Data were pre-screened to ensure that participants met the eligibility criteria and provided complete responses. The final sample consisted of 609 adults (53.2% female), with a mean age of 31.5 years ($SD = 2.26$). Although we had contracted for equal numbers of parents and non-parents, some individuals identified by uSamp as non-parents reported having children: 74.7% of the sample were parents (52.1% mothers), with a mean of 2.25 children ($SD = .96$). Among parents, the mean age of their youngest child was 2.83 years ($SD = 1.63$). The ethnicity of the sample was 83.4% White, 7.1% Asian, 4.9% Hispanic, and 4.6% Black.

2.2. Materials and procedures

After providing informed consent, participants were assigned to read one of three different vignettes in which the reader is the protagonist (see ESM, available on the journal's website at www.ehbonline.org). In the *alone* condition, non-parents read a vignette in which the protagonist is alone and is approached by a potentially threatening unfamiliar man. In the *with child* condition, the non-parent sample read a similar vignette in which the protagonist is

accompanied by the 4-year-old child of a neighbor with whom the protagonist has a passing acquaintance (this detail was added to ensure plausibility regarding the presence of the child while minimizing ancillary strategic considerations, such as how treatment of the child might affect the protagonist's relationship with the child's parents, etc.) (see ESM, available on the journal's website at www.ehbonline.org). Parents also read vignettes in which the protagonist is alone or with the neighbor's child. Finally, parents in the *own child* condition read a version in which the reader is accompanied by his or her own young child (see ESM, available on the journal's website at www.ehbonline.org). Thus, there were five conditions: non-parents alone ($N = 69$), parents alone ($N = 166$), non-parents with a neighbor's child ($N = 85$), parents with a neighbor's child ($N = 159$), and parents with their own child ($N = 130$).

After reading the assigned vignette, participants were asked to estimate the physical attributes of the unfamiliar man; the vignettes contained no cues as to his bodily characteristics. In fixed order, participants estimated the stranger's height, overall body size, and muscularity. Height was estimated in feet and inches; two arrays of six images each were used to estimate overall size and muscularity, respectively (see ESM, available on the journal's website at www.ehbonline.org Fig. 1). For each of these three ratings, standardized z-scores were calculated by subtracting the mean rating in the entire sample from the individual rating, then dividing this difference by the standard deviation for the sample. To simplify between-condition contrasts, the target's estimated physical formidability was then composited using the standardized values of the three ratings ($\alpha = .51$) (although a score of at least .7 is generally considered necessary to establish statistical reliability, lower scores are acceptable in exploratory studies such as this, particularly if the measure is comprised of few or notably non-redundant items [Nunnally, 1978; Robinson, Shaver, & Wrightsman, 1991]). Composite scores greater than zero are thus above average for the entire sample, and composite scores less than zero are below average for the entire sample.

Following the estimations of the stranger's bodily traits, participants rated the threat they imagined him to pose by answering two questions: "How dangerous do you think the man is?" (1 = *Not at all dangerous*, 9 = *Extremely dangerous*), and "What sort of intentions do you think the man has?" (1 = *Innocent / non-violent intentions*, 9 = *Extremely violent intentions*). These two scores were composited to create an overall threat score ($\alpha = .89$).

Participants next answered demographic questions. Our predictions concerned the effects of parenthood on mental representations of a potential foe, distinct from the influence of individual differences likely to correspond with parenthood. In order to take

such differences into account, we included items measuring political orientation (1 = *Very liberal*, 7 = *Very conservative*), annual household income, and education level.

Finally, participants were probed for suspicion about the hypotheses, thanked, and debriefed. Consistent with both the contents of the vignettes and the nature of the threat questions, several participants speculated that the study involved perceptions of threat. However, importantly, none connected this issue to parenthood or child presence.

3. Study 1 results

3.1. Preliminary analyses

Preliminary ANOVAs were conducted to test for demographic differences between parents and non-parents in income, politics, education, and age. Parents and non-parents significantly differed in political orientation (parents: $M = 4.20$; $SD = 1.76$; non-parents: $M = 3.88$; $SD = 1.77$; $p = .05$), and age in years (parents: $M = 31.7$; $SD = 2.26$; non-parents: $M = 31.0$; $SD = 2.16$; $p < .001$). Parents and non-parents also differed in education level; on average, parents had partially completed the requirements for an Associate's degree, whereas non-parents had partially completed the requirements for a Bachelor's degree ($p = .02$). The difference in annual household income was not significant (parents: $M = \$62,000$; $SD = \$28,256$; non-parents: $M = \$64,221$; $SD = \$27,267$; $p = .40$). Individual differences in politics, education, and age were therefore controlled for in all subsequent tests comparing parents and non-parents. (Controlling for these differences does not alter the overall pattern of results.)

3.2. Envisioned relative formidability of stranger by parenthood status

To conduct a first-pass test for differences between parents and non-parents, we pooled results across the conditions within each parenthood category. Consistent with predictions, a one-way ANCOVA revealed that parents estimated the stranger to be more physically formidable ($M = .07$; $SD = .72$) than non-parents ($M = -.18$; $SD = .64$), $F(1, 604) = 13.60$, $p < .001$, $\eta^2_p = .02$ (see Fig. 1). A follow-up MANCOVA assessing the individual estimations of height, size, and muscularity revealed a significant multivariate main effect of condition, $F(3, 602) = 6.27$, $p < .001$, $\eta^2_p = .03$. Parents envisioned the stranger as taller, larger, and more muscular, although only relative height and muscularity differed significantly between conditions (see Table 1 for descriptives). There was no effect of participant sex on estimates of the stranger's height or size; however, men estimated the target male to be slightly more muscular ($M = 2.97$; $SD = 1.27$) than did women ($M = 2.76$; $SD = 1.19$), $F(1, 607) = 4.52$, $p < .05$, $\eta^2_p = .01$. There were no interactions between parenthood status and participant sex, $ps > .14$.

3.3. Threat assessment of stranger by parenthood status

Parents did not evaluate the stranger as more threatening than non-parents ($p = .18$), perhaps due to a ceiling effect, as both groups

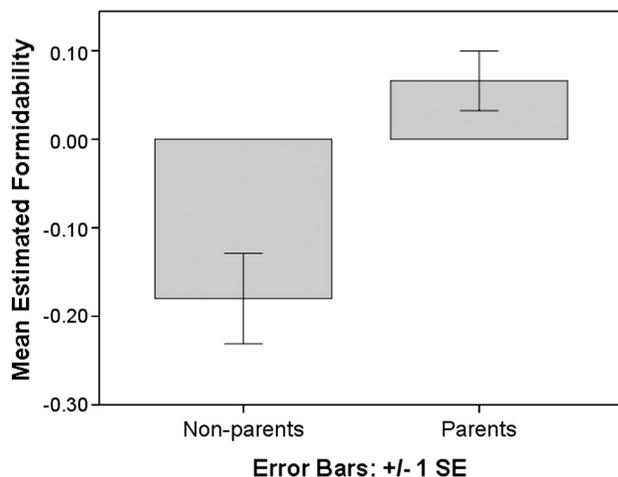


Fig. 1. Judgments of the stranger's composite physical formidability (standardized scores) by parenthood status.

Table 1
Mean estimated height, size, muscularity, and threat by parenthood status.

	Non-parents ($N = 154$)		Parents ($N = 455$)		F	p
	M	SD	M	SD		
Height	72.88	3.31	73.80	4.02	6.03	.014
Size	4.68	.84	4.81	.82	2.16	.143
Muscularity	2.53	1.02	2.97	1.28	15.20	.001
Threat	4.84	1.20	4.93	1.31	1.84	.176

Note. Estimated heights are in inches.

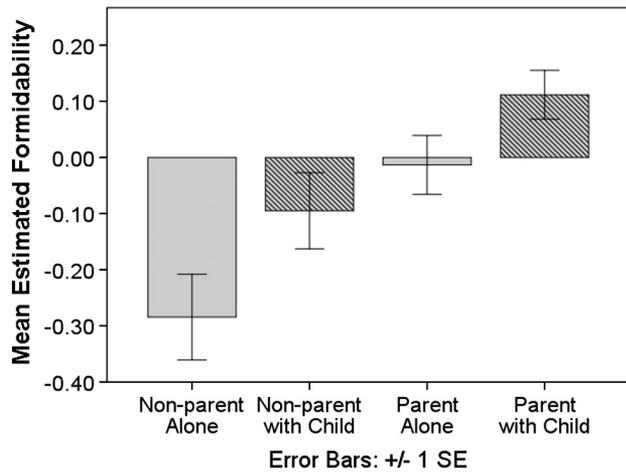


Fig. 2. Judgments of the stranger's composite physical formidability (standardized scores) by parenthood status and child-presence condition.

rated the man as highly menacing (see Table 1). Women evaluated the stranger as more threatening ($M = 5.06$; $SD = 1.22$) than did men ($M = 4.73$; $SD = 1.33$), $F(1, 607) = 10.32$, $p = .001$, $\eta^2_p = .02$. Follow-up tests revealed no interaction between parenthood and participant sex on threat assessment, $p > .8$.

3.4. Envisioned relative formidability of stranger by child-presence condition

We next assessed differences in assessments of physical formidability and threat between child-presence conditions. Contrary to predictions, a preliminary test comparing parents' ratings in the *own child* versus *unrelated child* conditions revealed no significant differences in either composite physical formidability scores or individual ratings of height, size, or muscularity, $ps > .1$. To simplify analyses, in subsequent tests the *own child* and *unrelated child* conditions were therefore pooled into a single *parent with child* condition.

A one-way ANCOVA detected a significant effect of condition on estimated composite formidability, $F(3, 602) = 6.24$, $p < .001$, $\eta^2_p = .03$ (see Fig. 2; see Table 2 for descriptives). Planned contrasts revealed that, as predicted, parents in the *alone* condition estimated the stranger to be more physically formidable than non-parents in the *alone* condition, $p < .01$. Parents in the *alone* condition did not estimate the stranger to be more physically formidable than non-parents in the *with child* condition, $p > .3$. Consistent with predictions, parents in the *with child* condition rated the stranger as more physically formidable than both non-parents in the *with child* condition, $p = .017$ and non-parents in the *alone* condition, $p < .001$. However, although the means were in the predicted direction, parents in the *with child* condition did not rate the stranger

as significantly more formidable than parents in the *alone* condition, $p = .10$. Likewise, non-parents in the *with child* condition did not envision the stranger as more physically formidable than non-parents in the *alone* condition, $p > .10$, although the means were again in the predicted direction.

3.5. Threat assessments by child-presence condition

A one-way ANCOVA detected a significant main effect of condition, $F(1, 602) = 2.79$, $p = .04$, $\eta^2_p = .01$ (see Table 2 for descriptives). Planned contrasts showed that, consistent with predictions, parents in the *with child* condition rated the stranger as more threatening than non-parents in the *alone* condition ($p < .01$). Further, non-parents in the *with child* condition envisioned the stranger as more threatening than non-parents in the *alone* condition ($p < .05$). Parents in the *alone* condition did not estimate the stranger to be significantly more threatening than non-parents in the *alone* condition, $p = .14$, although the means were in the predicted direction. Likewise, parents in the *alone* condition did not estimate the stranger to be significantly less threatening than parents in the *with child* condition, $p = .11$. Finally, there was no significant difference between parents and non-parents in the *with child* condition ($p > .70$).

3.6. Mediation analysis

As predicted, the starkest differences in both envisioned formidability and threat were between non-parents in the *alone* condition and parents in the *with child* condition. To test whether envisioned physical formidability mediated the difference between these two conditions in threat scores, we ran a bootstrapping procedure (5000 samples), using the INDIRECT macro for SPSS (Preacher & Hayes, 2008). First, we created a new composite formidability variable using standardized height, size, and muscularity estimates from the sample of non-parents in the *alone* condition and parents in the *with child* condition ($\alpha = .55$). We then entered this composite physical formidability score as the mediating variable, non-parent *alone* versus parent *with child* condition as the independent variable, and threat rating as the dependent variable, controlling for differences in age, politics and education. Consistent with predictions, the direct effect of condition on threat rating ($b = .48$, $SE = .17$, $p < .01$) was no longer significant with composite physical formidability included in the model ($b = .26$, $SE = .17$, $p > .12$), whereas the indirect effect of composite physical formidability on threat remained significant ($b = .55$, $SE = .09$, $p < .001$), and the bias-corrected and accelerated confidence intervals did not overlap with zero (95% CI = [.115, .342]). In sum, perceptions of relatively greater physical formidability fully mediated the effects of the non-parent *alone* versus parent *with child* condition on envisioned threat.

4. Study 1 discussion

The results of Study 1 reveal that, as predicted, parents conceptualize a hypothetical potential antagonist as larger and more muscular than do non-parents, a pattern consistent with greater pessimism among the former regarding the relative formidability of the foe. In contrast to the stark effects of parenthood status, the effects of child presence do not reach statistical significance. Nevertheless, there are hints that, consistent with the tactical liability posed by the presence of a child for whom one is responsible, among parents and non-parents alike, imagining a child to be present may lead participants to envision the antagonist as more formidable. Interestingly, contrary to kin selection considerations, the latter effect does not vary as a function of relatedness to the child, a pattern that may reflect either a) the tactical liability that any child poses to someone responsible for them; b) the increased need to avoid danger that such responsibility entails; or c) both (a) and (b). Lastly, underscoring the

Table 2
Mean estimated height, size, muscularity, and threat by child-presence condition.

	Non-parent alone (N = 69)		Non-parent with child (N = 85)		Parent alone (N = 166)		Parent with child (N = 289)	
	M	SD	M	SD	M	SD	M	SD
Height	71.68 ^a	3.87	73.86 ^{b, c}	2.39	73.17 ^b	4.12	74.16 ^c	3.92
Size	4.73 ^a	.86	4.65 ^a	.83	4.80 ^a	.83	4.81 ^a	.82
Muscularity	2.46 ^a	.98	2.59 ^a	1.06	2.89 ^b	1.24	3.01 ^b	1.31
Threat	4.64 ^a	1.31	5.00 ^b	1.09	4.81 ^{a, b}	1.33	5.00 ^b	1.29

Note. Means with different superscripts are significantly different with alpha at .05. Estimated heights are in inches.

predicted pattern of parental pessimism, when the categories predicted by theory to be most divergent (parents with children versus non-parents alone) are compared, those expected to be most pessimistic indeed viewed the antagonist as more threatening than did those expected to be least pessimistic, a pattern mediated by differences in the conceptualized size and strength of the foe.

While the results from Study 1 provide initial support for the predicted effects of parenthood – and hint at possible effects of child-presence – on assessments of relative formidability, this study is subject to important limitations. First, even the most evocative vignette constitutes a relatively weak stimulus compared to the inputs employed in real life by mechanisms that calculate relative formidability. Second, Study 1 did not measure differences in own formidability between parents and non-parents. If, for example, owing to more time for recreation, non-parents are more physically fit, or have more time for martial arts training, than parents, this alone could potentially explain the differences between participants in these two categories in the envisioned formidability of the antagonist. We therefore conducted a second study designed to address these limitations. Pursuing enhanced ecological validity, we recruited participants on the streets of Southern California either accompanied by children or not, and asked them to judge the bodily characteristics of a criminal depicted in a facial photograph, while also completing measures of their ability to defend themselves from physical assault.

As is often true, in the design of Study 2, ecological validity comes at the expense of experimental control, as i) ethical considerations precluded varying participants' proximity to young children accompanying them on the street, and ii) due to the highly gendered nature of childcare in the U.S., women are far more likely than men to be accompanied by young children in public, hence only women were recruited. To ensure that participants would classify the target individual as a potential antagonist, we displayed a photo of an angry young man's face, describing him as a criminal (see Fig. 2, ESM, available on the journal's website at www.ehbonline.org); to minimize the likelihood that participants would use the researcher as a reference point in estimating the bodily attributes of the target, all data were collected by female research assistants. The unambiguously threatening nature of the target precluded meaningful assessment of differences in perceived threat, hence we did not collect such data. Lastly, to address the possibility of differences in own formidability between parents and non-parents, we deployed two additional measures. First, we asked participants to report their self-assessed ability to defend themselves from violence. Second, following Muñoz Reyes, Gil Burmann, Fink, and Turiegano (2012), we employed handgrip strength as a proxy for upper-body strength, a key factor in fighting ability.

5. Study 2 methods

5.1. Participants

117 adult women who were either alone or in the presence of one or more children were recruited on public streets in exchange for \$3 compensation. Six participants who did not complete the study were dropped, leaving a final sample of 111 women, with a mean age of 32.3 years ($SD = 7.87$). This sample consisted of 61 mothers (14 of whom were alone, and 47 of whom were accompanied by children) and 50 non-mothers (43 of whom were alone, and 7 of whom were with children). In the subsample of women accompanied by children, the mean child age was 2.74 years ($SD = 1.83$), and the mean number of children present was 1.33 ($SD = .51$). The ethnicity of the sample was 48.6% White (Mothers: 53.7%; Non-mothers: 43.9%), 16.2% Hispanic (Mothers: 20.4%; Non-mothers: 12.3%), 14.4% Asian (Mothers: 11.1%; Non-mothers: 17.5%), 10.8% Black (Mothers: 7.4%; Non-mothers: 14.0%), and 9.9% mixed or Other (Mothers: 7.4%; Non-mothers: 12.3%).

5.2. Materials and procedures

The study was framed as involving various forms of “visual perception and intuition”. Following several filler/distracter measures involving visual judgment, participants were shown a facial photograph of a target male face, displaying anger, depicted in grayscale, and cropped to mask his bodily characteristics (see Fig. 2, ESM, available on the journal's website at www.ehbonline.org); the image was described as “a convicted criminal's mugshot”. Participants estimated the target man's height in feet and inches, and used the same 6-item pictorial arrays employed in Study 1 to estimate his overall body size and muscularity. Demographic items followed, including self-reported relationship status, annual income, education, political orientation, and parity. Relationship status was reported using a 4-point scale (1 = *No current relationships*; 2 = *Dating (Non-exclusively)*; 3 = *Dating (Exclusively)*; 4 = *Married or Engaged*). An item assessing self-perceived defensive fighting ability was embedded within the demographic items: “Relative to other people of your gender, how good at physical fighting would you be, if attacked?” (1 = *No good at all / defenseless*; 7 = *Extremely capable / Lethal if necessary*). Finally, handgrip strength was measured using a hydraulic dynamometer (manufacturer: Baseline). Participants were encouraged to squeeze as hard as possible with their dominant hand. Participants repeated this grip strength measure three times ($\alpha = .97$); these values were averaged to create a grip strength score.

Upon completion, participants were debriefed, thanked, and questioned for suspicion about the purpose of the study. None evinced suspicion that the study addressed parenthood.

6. Study 2 results

6.1. Preliminary analyses

Preliminary ANOVAs were conducted to test for demographic differences between mothers and non-mothers in income, politics, education, age, and relationship status. There were no significant differences in politics ($p = .10$) or education ($p = .83$). On average, mothers were older ($M = 34.9$; $SD = 7.94$) than non-mothers ($M = 29.1$; $SD = 6.56$), $F(1, 109) = 16.98$, $p < .001$, $\eta^2 = .14$. Mothers also reported being in significantly more committed relationships ($M = 3.62$; $SD = .87$; median = “married or engaged”) than non-mothers ($M = 2.62$; $SD = 1.18$; median = “dating exclusively”), $F(1, 109) = 26.40$, $p < .001$, $\eta^2 = .20$. Finally, mothers reported greater household income ($M = \$78,644$; $SD = \$77,725$) than non-mothers ($M = \$50,900$; $SD = \$61,858$), $F(1, 109) = 4.19$, $p < .05$, $\eta^2 = .04$. Individual differences in age, relationship status, and household income were therefore controlled for in all subsequent tests comparing mothers and non-mothers. In tests comparing mothers and non-mothers, we also controlled for the presence of children. Because only 14 of the women recruited while alone identified as mothers, and only 7 women recruited while accompanied by children identified as non-mothers, we were not able to test for a main effect of child presence independent of the effect of motherhood.

A one-way ANCOVA (controlling for child presence, age, relationship status, and household income) revealed no significant difference between mothers and non-mothers in self-assessed fighting ability, $p = .32$. Likewise, a one-way ANCOVA (controlling for child presence, age, relationship status, and household income) revealed no significant difference between mothers and non-mothers in handgrip strength, $p = .23$.

6.2. Effects of motherhood on envisioned physical formidability

Composite physical formidability scores were created by averaging the standardized estimates of height, overall size, and muscularity ($\alpha = .70$). As predicted, the estimates of the composite formidability

Table 3
Linear regression of motherhood and covariates on estimated physical formidability.

	<i>B</i>	<i>SE</i>	<i>Beta</i>	<i>p</i>
Motherhood	.565	.204	.357	.007
Child Presence	.114	.182	.072	.533
Age	−.016	.010	−.156	.114
Relationship Status	.058	.069	.083	.408
Household Income	.000	.000	−.025	.786

N = 111.

of the target man provided by mothers ($M = .27$, $SD = .82$) were greater than the estimates provided by non-mothers ($M = -.33$, $SD = .61$). We assessed the unique influence of motherhood on formidability estimation by entering motherhood status, child presence, age, relationship status, and household income into a simultaneous linear regression. As predicted, motherhood significantly predicted estimated formidability in the model that emerged (see Table 3). None of the covariates significantly predicted estimated formidability in the model. We next assessed the influence of motherhood on individual estimations of height, size, and muscularity with a one-way MANCOVA (controlling for child presence, age, relationship status, and household income). There were significant effects of motherhood on all three dimensions of formidability, although the difference in estimated size was only marginally significant (see Table 4).

We next conducted exploratory tests, within the child-present condition, to assess whether being the mother of one of the children present influenced formidability estimates. Echoing the results of Study 1, in which imagining the presence of one's own child exerted equivalent effects to imagining the presence of an unrelated child, there were no significant differences in estimated height, size, or muscularity related to being the mother of a present child, $ps > .60$. We also assessed whether the number of children present predicted estimated formidability within the child-present condition, finding no such relationship, $p > .99$. However, within mothers in the child-present condition, a marginally significant negative correlation was observed between the average age of the children present and the estimated composite formidability of the target male, $r(47) = -.27$, $p = .07$. Although this correlation did not reach statistical significance, it is consistent with the proposition that mothers are particularly sensitive to the danger that hostile males pose to younger, more vulnerable children.

7. Study 2 discussion

Study 2 replicated the core finding of Study 1: parenthood again exercised an independent influence on the envisioned formidability of a prospective antagonist, as mothers envisioned the angry male target as larger and more muscular than did non-mothers. The absence of differences in either self-assessed fighting ability or handgrip strength between mothers and non-mothers suggests that the aforementioned pattern is unlikely to be due to differences in actual formidability

Table 4
Mean estimated height, size, and muscularity, by motherhood condition (Study 2).

	Non-mother (<i>N</i> = 50)		Mother (<i>N</i> = 61)		<i>F</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Height	68.91	2.07	70.48	3.06	4.80	.031
Size	3.43	.92	4.08	1.12	3.92	.050
Muscularity	2.32	.89	3.07	1.28	5.04	.027

Note. Estimated heights are in inches. Significance tests controlled for individual differences between mothers and non-mothers in child presence, age, relationship status, and household income.

between the two classes of participants. In Study 2, most of the women recruited in the presence of children were mothers. As a consequence, we were not able to provide a test of the mixed results from Study 1 that had suggested that the presence of a young child – whether one's own child or someone else's – might also enhance assessments of the foe's formidability. Future research on the unique effects of child presence on threat assessment should obtain larger samples of non-mothers in the presence of children.

8. General discussion

Across two studies, we find support for our core prediction that being a parent is associated with more pessimistic assessments of the relative formidability of a prospective foe—parents consistently estimated the potential assailant to be more physically formidable than did non-parents, a pattern that, when operationalized in actual agonistic contexts, would reduce the likelihood that a parent would suffer injury due to underestimation of a foe's fighting capacity. Importantly, this appears to reflect a trait-level difference between parents and non-parents, as we find this pattern in Study 1 despite not having primed participants' status vis-à-vis parenthood (recall that recruitment procedures made no mention of parenthood, and demographic questions were presented after all dependent measures had been completed), and we find this pattern in Study 2 regardless of whether a mother's child is present at the time of participation. This stands in contrast to Eibach and associates' (Eibach & Mock, 2011; also Eibach et al., 2012) prior work on parental risk-aversion and parental distrust that finds only state-level effects of parenthood (but see also Eibach et al., 2003). Given that both the phenomena being investigated and the methods employed differ somewhat across the respective studies, it is difficult to determine what is responsible for these differences. However, theory does suggest that we should expect trait-level effects to occur. In ancestral hunter-gatherer societies, fathers, and mothers of weaned toddlers and young children, would have frequently been separated from their offspring during subsistence activities, hence it would be inefficient indeed if parents failed to adaptively alter their behavior absent reminders of their status as parents. That said, it is plausible that, via proximate pathways such as empathy, reminders of parental status may well exaggerate the differences between parents and non-parents. Indeed, the trends evident in Study 1 suggesting that the presence of a child might increase perceptions of the formidability of a foe are consistent with the possibility that both trait and state processes could be working in tandem to facilitate parental precaution. More research is needed to tease apart the unique contributions of parenthood status and child presence.

Although the means were in the predicted directions, our two-question measure of threat assessment in Study 1 revealed neither a stark pattern of parental distrust nor an unambiguous exacerbating effect of child presence on distrust: statistically significant differences are evident only between the two conditions predicted to be poles on this spectrum, namely non-parents alone versus parents with a child. The muted character of these patterns may reflect limitations of our methods. First, the menacing nature of the interaction depicted in the vignettes may have reduced variation in the perceived threat posed by the stranger. Second, given the dramatic content of the vignettes, asking participants to provide propositional assessments of the threat posed by the stranger inevitably entailed demand characteristics, thereby potentially reducing endogenously-produced differences in reactions. In contrast, judgments about the bodily attributes of the stranger likely tapped intuitions rather than explicit propositional reasoning, making them less subject to demand issues, and thus more reflective of endogenous differences. Indeed, building on prior work examining implicit representations of relative formidability, the current investigation was structured on this supposition; our probes regarding

perceived threat were an auxiliary component to the project. Against this backdrop, we find it compelling that the significant differences in perceived threat are nonetheless fully mediated by differences in estimated bodily attributes, suggesting that representations of relative formidability inherently capture threat assessments that include issues of another's malevolent intentions.

At the broadest level, the pattern of parental pessimism in assessments of relative formidability documented here reveals a potentially important facet to the system generating representations of relative formidability. Such parental pessimism can be understood as reflecting differences between parents and non-parents in the fitness costs of injury. This is an instance of a larger class of considerations, namely the size of the stakes at issue in a conflict. In principle, stake size could be addressed by an entirely different system than that responsible for assessing relative formidability. However, the postulated function of representations of relative formidability is the facilitation of rapid decision-making in situations of agonistic conflict. Incorporating considerations of relative stake size into such representations is efficient, as only a single representation need be consulted in deciding how to address the threat at hand. Parental pessimism may therefore well be the tip of the iceberg in regard to how formidability assessment is moderated by factors that increase the costs of defeat or injury.

Our findings should be considered preliminary, as our investigations are subject to a number of limitations. First, there is the possibility that our participants are not representative of parents and non-parents more broadly in the U.S. That said, it is important to note that our findings suggest that parents, and, possibly, non-parents accompanied by small children, will be particularly concerned when approached by a stranger in public, with the most cautious among them declining the invitation to participate in research. Accordingly, it is likely that the results of Study 2 understate, rather than overstate, the core phenomena at issue, as those who most strongly evinced the predicted patterns would have elected not to participate. Second, our exclusive use of U.S. samples means that caution is in order in inferring the presence of species-typical psychological mechanisms. Third, our measures of own fighting capacity – absent in Study 1, but employed in Study 2 – are imperfect: participants' self-reported ability to defend themselves could be subject to impression management and/or inaccurate due to lack of experience in the population sampled, while handgrip strength may be a poor proxy for somatic contributors to fighting capacity (see Fessler et al., in press [a]). Fourth, because we employed cross-sectional designs, we cannot rule out the possibility that self-selection is responsible for the documented differences between parents and non-parents, as individuals who elect to become parents likely differ in many ways from those who do not. Although we controlled for differences in gross demographic variables and, in Study 2, found no differences in own formidability, these measures may not have captured underlying features relevant to evaluating potentially agonistic situations. The added decrement in fitness which injury poses for parents relative to non-parents should scale with i) the degree of dependency of the child, expected to be largely a function of the child's age, ii) the number of existing children, and iii) the level of parental investment. Our recruitment procedures do not allow us to cleanly examine (i) and (ii); in the interests of minimizing the invasiveness of our study (thereby maximizing participant compliance), we did not investigate (iii). Nevertheless, all three factors are potentially amenable to investigation.

An expanding body of research explores the psychological changes that occur following the birth of a child. The methods employed in the two studies reported here are readily administered; could be used in longitudinal investigations; could be employed in small-scale societies; could be modified to vary the physical presence of children at the time of participation; and could be enhanced through the use of both larger samples (capturing greater variation in number and age of children) and measures probing level of parental investment. In light

of these possibilities, we look forward to further investigations of the concepts presented here.

Supplementary Materials

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.evolhumbehav.2013.11.004>.

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Electronic Supplementary Materials

To Accompany

*Stranger Danger: Parenthood and Child Presence Increase the Envisioned Bodily Formidability
of Menacing Men*

Stimuli employed in Study 1

Participants were asked to read a single vignette (modified from Petralia & Gallup, 2002) that varied in the details across condition. Versions were as follows:

Imagine that you and your child have just spent the evening visiting a friend who is in the hospital with a broken leg. As the two of you leave the building, you realize that it is much later than you thought and that the area is now deserted. You zip up your jacket in the cold, and make sure that your child is bundled up as well. It is a long walk out to your car on the far end of a parking lot, which is on the other side of a small wooded area. On this dark night, not even the dim glow of the outside lights seems to illuminate the dark parking lot. You look up to the sky to see where the moon is, but you realize the sky is clouded over and no moon can be seen. “No wonder it’s so dark tonight,” you think as you and your child begin the trek to your car.

It’s late and you’re tired, so without thinking you lead your child on a shortcut through the pine trees that stand between you and the parking lot. In the shadow of the trees, you must help your child to avoid tripping on the large tangled roots along the woodland ground. Suddenly, you hear a noise, perhaps another footstep, but in the darkness you can’t discern what it is. A chilling gust of wind strikes and causes you to tighten your coat and quicken your step. You hear something else. What was that? Was it a noise or just the wind?

The two of you make it through the trees. You don’t like walking alone with your child this late at night and you’re glad to have the darkness of the pine trees behind you. Now the parking lot is just ahead. As the wind picks up, you hear another noise and look back. You see the silhouette of a man emerging from the pine trees and the sight of him startles you. Again, you quicken your pace, pulling your child by the hand.

At the edge of the vacant parking lot, you pause and look for your car. You see the car a short distance away, parked between two of the few remaining vehicles—a beat-up old pick-up truck and one of those family vans. Happy with the sight of your car, you reach into your pants pocket for your keys and find that they are not there. As you begin to feel around for them in your back pockets, you notice that strange man again, now walking behind you. This time he appears to be headed directly towards you and your child. Walking quickly, you reach your car. You now feel the approaching man’s eyes upon you and frantically search for your keys in your jacket pocket. Finally, your fingers make contact with your

keys and you pull them out of your jacket. As you fumble to unlock the car, you feel the man's cold hand on your shoulder . . .

The references to a child were omitted in the "alone" conditions. In the "unrelated child" conditions, the following explanatory passage was added to the beginning:

Imagine that a new neighbor from down the street, whom you've only spoken to a few times, has broken her leg and is currently in the hospital. She hasn't met too many people in the area yet, so as a favor she asked you to bring her 4-year-old child by the hospital to visit her for a few minutes, then drop the child off with one of your neighbor's relatives.

Dependent measure arrays employed in Studies 1 and 2

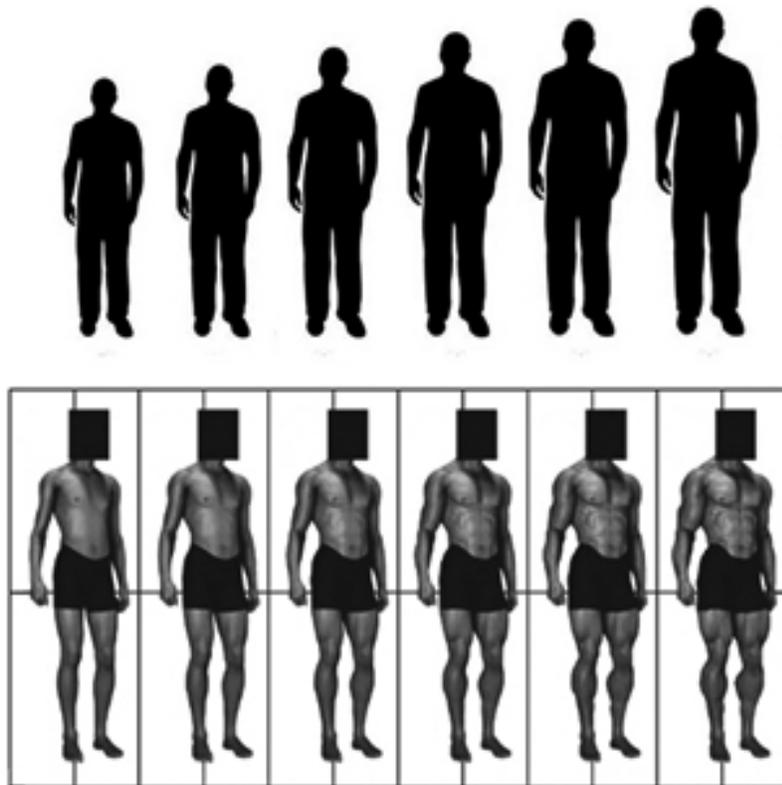


Fig. 1 Image arrays were used to estimate size (top) and muscularity (bottom). The muscularity array was modified from Frederick and Peplau (2007).

Procedural Note

In Study 1, for logistical reasons, data collection for the “parents with own child” and “non-parents alone” conditions opened one week prior to data collection for the other conditions.

Stimulus employed in Study 2



Fig. 2 Participants in Study 2 estimated the physical characteristics of this individual. The cropped face photo was framed as a “convicted criminal’s mugshot”; in reality, the image was modified from the Radboud Faces Database (Langner et al. 2010).

References

Frederick, D. A., & Peplau, L. A. (2007). *The UCLA Body Matrices II: Computer-generated images of men and women varying in body fat and muscularity/breast size to assess body satisfaction and preferences*. Proceedings from 8TH Annual Meeting of the Society for Personality and Social Psychology, Memphis, TN.

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Petralia, S. M., & Gallup, G. G., Jr. (2002). Effects of a sexual assault scenario on handgrip strength across the menstrual cycle. *Evolution & Human Behavior*, 23(1), 3-10.