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Original Article

Height among Women is Curvilinearly Related to Life History Strategy

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Abstract: It was hypothesized that women of medium height would show a more secure, long-term mating pattern characterized by less jealousy, less intrasexual competition and a "slower" life history strategy. In three samples of female undergraduate students clear support was found for these hypotheses. In Study 1, among 120 participants, height was curvilinearly related to well-established measures of possessive and reactive jealousy, with women of medium height being less jealous than tall as well as short women. In Study 2, among 40 participants, height was curvilinearly related to intrasexual competition, with women of medium height being less competitive towards other women than tall as well as short women. In Study 3, among 299 participants, height was curvilinearly related to the Mini-K, a well-validated measure of "slower" life history strategy, with women of medium height having a slower life history strategy than tall as well as short women. The results suggest that women of medium height tend to follow a different mating strategy than either tall or short women. Various explanations and implications of these results are discussed.

Keywords: height, jealousy, intrasexual competition, life history

Introduction

Tallness among human males is not only related to a variety of indices of status, including academic rank (Hensley, 1993) and income level (e.g., Judge and Cable, 2004), but also to reproductive success (Mueller and Mazur, 2001; Pawlowski et al., 2000). In addition, male height is an indicator of various fitness related qualities such as physical health and morphological symmetry (Manning, 1995; Silventoinen, Lahelma, Rahkonen, 1999),

and cognitive abilities (Case and Paxon, 2006). Not surprisingly therefore, females have a preference for taller males (Kurzban and Weeden, 2005; Pawlowski, 2003; Shepperd and Strathman, 1989). Indeed, taller men receive more replies to dating announcements (Pawlowski and Koziel, 2002), and have more physically attractive girlfriends (Feingold 1982). Buunk, Park, Zurriaga, Klavin and Massar (2008) argued that as taller males have apparently higher mate value, and may more successfully deter rivals, they will have less need for mate-guarding and jealousy. Indeed, in two studies they found clear evidence for this.

However, according to Buunk et al. (2008), for women, the relationship between height and jealousy is quite different, because there is some evidence that in Western societies women of medium height are the healthiest and the most attractive to men. Very short and very tall women are more prone to illnesses than women of average height (Silventoinen et al., 1999). In addition, there is evidence that women of approximately average height have relatively more reproductive success (Nettle, 2002) in Western societies (Deady and Smith, 2006), as well as in underdeveloped countries such as Guatemala (Pollet and Nettle, 2008; see also Sear, 2006). Very tall women are also more likely to develop depressive symptoms (Bruinsma et al., 2006). Men consistently tend to prefer women who are shorter than they are, although not too short (Pawlowski, 2003; Pawlowski and Koziel, 2002), and tend to perceive tall women as having less considerate and nurturing characters (Chu and Geary, 2005). In addition, shorter women tend to be more symmetrical (Manning, 1995). The apparent curvilinear relationship between female height and attractiveness to males would suggest that women of medium height would have the highest mate value, and would therefore be the least jealous. Indeed, Buunk et al. (2008) found that women of around average height were the least jealous and that women were more jealous as they were increasingly taller or shorter than average. In addition, approximately average-height women tended to be less jealous of physically attractive, i.e., more "feminine", rivals, but more jealous of rivals with "masculine" characteristics of physical dominance and social status.

In the present research, that was conducted in three independent samples of women, we assumed that the lower jealousy of women of medium height reflects a more secure, long-term mating pattern not only characterized by less jealousy, but also by less intrasexual competition and a "slower" life history strategy. First, in Study 1, we examined again the relationship between height and jealousy among women using well-established scales for reactive, anxious and possessive jealousy (Buunk, 1997; Barelds and Dijkstra, 2007). In addition to establishing more unequivocally the relationship between height and jealousy in Study 1, in Study 2 we examined the relationship between height and individual differences in intrasexual competition, a broader and more encompassing concept than jealousy. Finally, and most importantly, in Study 3 we examined the relationship between height and a "slower" life history strategy.

Intrasexual competition

Intrasexual competition refers to rivalry with same-sex others over access to mates. In most species, males invest little in their offspring and engage in often fierce competition with other males over the access to females, whereas females show few signs of intrasexual competition. However, because in humans both sexes invest resources and parental care in their offspring, both sexes will be discriminating in the choice of mates. Thus, both sexes will engage in competition with same sex conspecifics (e.g., Trivers, 1972). Indeed, in the past decades it has been become increasingly clear that women may be intrasexually quite

competitive and even aggressive (e.g., Bettencourt and Miller, 1996; Frodi, Macaulay, and Thome, 1977). For example, in a cross-cultural examination, Burbank (1987) found that in polygynous societies, co-wives may compete with other women for food and money, paternal care for their offspring, and for their offspring's inheritance. In 61% of the 137 cultures she analysed, women engaged in physical aggression, typically fighting other women over men. While throughout human history, men have competed primarily in the domains of status, resources, and dominance, women tend to compete primarily in the domains of physical attractiveness (e.g., Cashdan, 1998; Dijkstra and Buunk, 2002). For example, when confronted with highly attractive rivals, women tend to "dislike" such a rival, particular when she makes intrasexual competition salient, such as when she conversing with a male (Baenninger, Baenninger, and Houle, 1993). It seems probable that being strongly intrasexually competitive may be adaptive under certain conditions, yet maladaptive under other conditions. Such other conditions might include a low life expectancy, a low perceived chance of attaining a high status in the long run, and a low mate value – for example as a consequence of being relatively small or tall. Thus, relatively short and relatively tall women can be predicted to be more intrasexually competitive. This implies that they will view the confrontation with other women, especially in the context of contact with the opposite-sex, in competitive terms (Buunk and Fisher, 2009). This competitiveness may be expressed, among others, in the desire to beat other women rather than to perform well (cf. Van Yperen, 2003); the desire to view oneself as better than other women (cf. self-enhancement, Zuckerman and O'Loughlin, 2006); envy and frustration when other women are better off (cf. Smith and Kim, 2007); malicious pleasure when high achieving women ("tall poppies") lose face (cf., Feather, 1994), and rejecting attractive and competent women as candidates for a position in their department (Luxen and Van de Vijver, 2005).

Life history strategy: The "slow" vs. "fast" continuum

We assumed that the lower jealousy and intrasexual competition of women of medium height reflect differences in life-history strategy. There is evidence that taller women have their first menstruation later, marry later, and get their first child later (e.g., Sear, 2006). In general, because of limited resources, individuals, in order to successfully reproduce, are forced to make trade-offs between mating effort, i.e. locating a mate and courting him or her, and parenting efforts, i.e. gestation, childbirth, and postnatal care of children (e.g., Chisholm, 1993; Figueredo, Vasquez, Brumbach, Schneider, Sefeek, et al., 2006). These trade-offs can be arranged on a continuum that was originally often described in terms of the r-K model of reproductive strategies (e.g., Charles and Egan, 2005, Ellis, 1988), but is now more commonly referred to as the fast-slow continuum of life history strategy. Individuals at the faster end of the continuum seek to produce many offspring without great investment in their welfare (i.e. low parental and high mating effort), whereas individuals at the slower end of the continuum produce fewer offspring and provide greater nurturing (i.e. high parental and low mating effort). Although both strategies are equally favored by natural selection, they differ in the type of reproductive success they maximize. Whereas the fast strategy particularly maximizes short-term reproductive success, the slow life history strategy maximizes long-term reproductive success (e.g., Figueredo et al., 2006; Kaplan and Gangestad, 2005). That is, having fewer, high quality, offspring may result,

ultimately, in more descendants in distant future generations than having numerous lesser quality offspring, whose reproductive success depends more on luck.

In general, as a species, humans tend to follow a "slow" life history strategy (Bjorklund and Shackelford, 1999; Chisholm, 1993). However – as in many other species – in order to adapt to changing environmental conditions, individuals in each new generation also show flexibility regarding their individual position on the "slow" vs. "fast" life history continuum (Figueredo, Vásquez, Brumbach and Schneider, 2007). Therefore, some individuals are "slower" in their life history strategy than others (Chisholm, 1993). Overall, faster life history strategy is the optimal reproductive strategy when the environment is adverse or unstable (e.g., Chisholm, 1993), and when populations are still growing (e.g., Rushton, 2004). In contrast, when population size stabilizes, and mortality rates are low, slower life history strategy individuals come to predominate because under steady state conditions, they are more competitively successful at raising young and organizing the more complex societies that sustain them (e.g., Figueredo et al., 2005). There is considerable evidence that stressful experiences in and around their families of origin – such as marital discord, father absence, or traumatic separation from one's parents - leads individuals to invest disproportionately in mating and in early reproduction. In contrast, children who grow up in harmonious homes and homes were the father is present, mature later, postpone sexual activity and display greater investment in the fewer children they produce (e.g., Belsky, Steinberg and Draper, 1991; Bjorklund and Shackelford, 1999; Ellis, 2004; Pesonen, Räikkönen, Heinonen, Kajantie, Forsén, and Eriksson, 2008; Tither and Ellis, 2008). Nevertheless, there seems to be a strong genetic influence (h^2= .65) on life history strategy (Figueredo, Vásquez, Brumbach, and Schneider, 2004).

On the basis of the preceding discussion, we expected that women who have – due to their height – fewer chances of attracting an investing long-term mate, will be more likely to engage in a faster life history strategy, whereas women who are desired by men and have higher fitness – i.e., women of medium height – will more likely adopt a slower life history strategy. In a series of psychometric studies, Figueredo and his colleagues (e.g., Figueredo et al., 2005; 2006), have shown that a slow life history strategy can be conceptualized as a higher order construct characterized by a number of reproductive, parental and sexual behaviors, including good executive functions, positive relationships with one's parents, positive attachment to an adult partner, low mating effort, low Machiavellianism, low levels of risk taking, more foresight and planning, and persistence and self-directedness.

To summarize, in three samples of female undergraduate students, the present research expands previous research from a life history perspective. It was hypothesized that women of medium height would show a more secure, long-term mating pattern characterized by less jealousy, less intrasexual competition and a slower life history strategy than women who either at the tall or the short end of the spectrum.

Materials and Methods

Study 1: Height and Jealousy

A total of 120 female first year psychology students (age M = 19.9 years, SD = 2.9) participated in the study as partial fulfillment of course requirements. The mean height was

M = 172 (*SD* = 5.74). Three participants were identified as outliers and were excluded from the analysis due to the low variability of their responses, which suggests that they did not complete the task seriously.

Measures

Participants were asked to indicate their height, and completed questionnaires on computers in separate cubicles. The different types – reactive, preventive and anxious jealousy were assessed with scales measuring jealousy as a chronic trait (Buunk, 1997; Barelds and Dijkstra, 2007). The original version of the scale included 15 items. For the reactive jealousy scale participants had to rate on the scale from 1 (not at all irritating) to 5 (very irritating) how upsetting they would find their partners behavior, e.g. "Discussing personal things with someone else", and "Flirting with someone else". One item assessing reactive jealousy i.e., reactions to sexual contact with someone else of opposite sex, was removed as it produced a ceiling effect – 90% of participants provided the highest answer (5). The 4-item scale of reactive jealousy had a medium reliability (α = .58). Anxious jealousy was assessed with items on which participants indicated how often they experienced certain thoughts or feelings, e.g. "I am concerned about my partner finding someone else more attractive than me", and "I worry about the idea that my partner could have a sexual relationship with someone else" on a scale from 1 (never) to 5 (always). The 5-item scale had a reliability of α = .87. Possessive jealousy was assessed with items asking participants to indicate on the scale from 1 (not at all) to 5 (very much) to what extent the statements applied to them, e.g. "I don't want my partner to meet too many people of the opposite sex" and "I it is not acceptable to me if my partner sees people of the opposite sex on a friendly basis". The 5-item scale was highly reliable (α = .80).

Study 2: Height and Intrasexual Competition

A total of 40 female first year psychology students (age *M* = 20.4 years, *SD* = 4.3) from the University of Groningen in the Netherlands participated in the study. The mean height was, *M* = 170 (*SD* = 6.91). The participants completed questionnaires on computers in separate cubicles as part of a larger study, and their participation was part of the fulfillment of course requirements.

Measures

Participants indicated their height and completed several questionnaires. Intrasexual competition was measured with a 12-item scale (Buunk and Fisher, 2009). The items assess the negative responses of individuals to intrasexual competition, i.e., rivalry with same sex others over access to mates, e.g., "I can't stand it when I meet another man/woman who is more attractive than I am", "I tend to look for negative characteristics in attractive women", "I just don't like very ambitious women". The reliability of the scale was high with αs of .85 and. 87 in a Dutch and a Canadian sample, respectively (Buunk and Fisher, 2009). Also in this study the scale reached high reliability (α = .82).

Study 3: Height and Life History Strategy

A total of 299 female first year psychology students (age *M* = 19.8 years, *SD* = 3.1) from the University of Groningen in the Netherlands participated in the study. The mean

height was M = 172.45 (SD = 6.27). The participants completed a questionnaire online as part of the fulfillment of their course requirements.

Measures

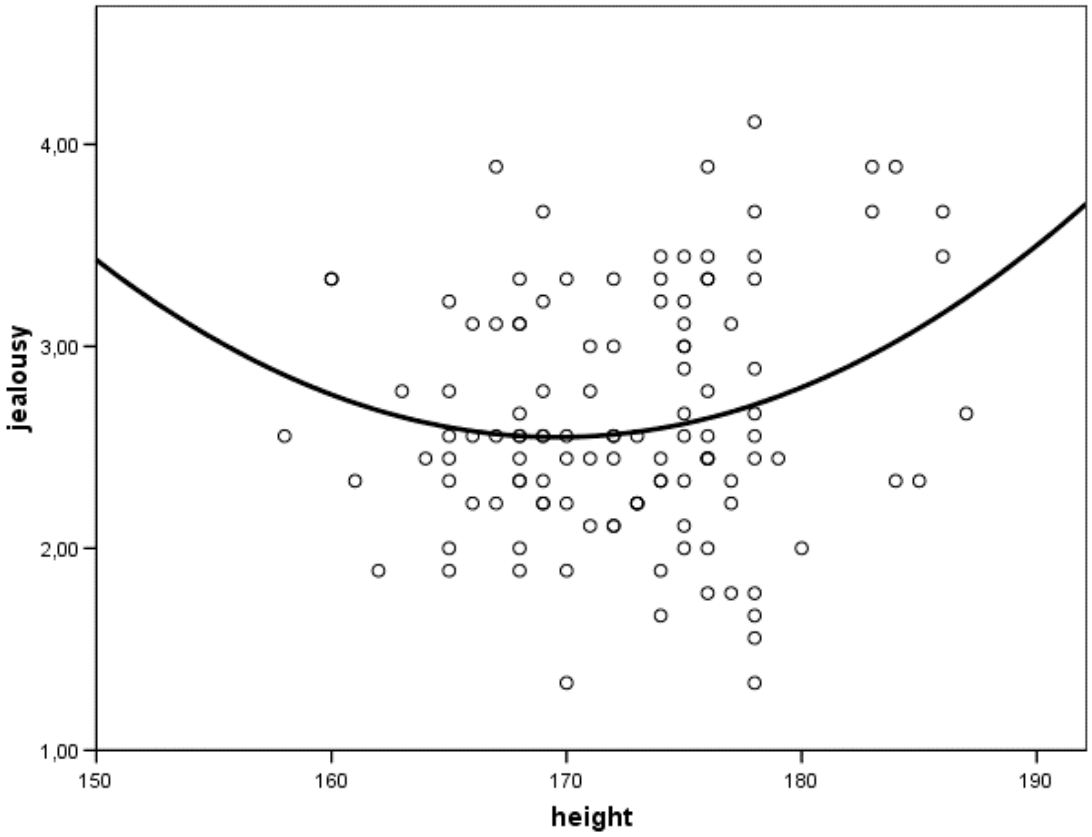
Participants indicated their height and completed several questionnaires. Slow life history strategy was measured with the *Mini-K Life History Strategy Short Form* (Figueredo et al., 2006), a 20-item short form of the Arizona Life History Battery (*ALHB;* Figueredo, 2007), which is a battery of cognitive and behavioral indicators of life history strategy compiled and adapted from various original sources. These self-report psychometric indicators measure graded individual differences along various complementary facets of a coherent and coordinated life history strategy, as specified by life history theory, and converge upon a single multivariate latent construct, the "slow" factor. The component scales are scored directionally to indicate a "slow" life history strategy on the "fast-slow" continuum. The Mini-K correlates 0.85 with the full *ALHB* (Gladden, Sisco, and Figueredo, 2008), and uses a 7-point Likert scale, which ranges from -3 (*Disagree Strongly*) to +3 (*Agree Strongly*). Reliability in the present sample was .73.

Results

Study 1: Height and Jealousy

To investigate the relationship between height and intrasexual competition, we performed a regression analysis to detect both linear and curvilinear relationships. The results showed that height had a significant curvilinear effect on reactive jealousy, F (2,114) = 2.97, p =.05, and a non-significant linear effect, F (1,114) = .21, p = .65. Height also had a significant curvilinear effect on possessive jealousy, F (2,114) = 3.62, p = .03 as well as a significant linear effect, F (1,115) = 4.53, p = .04. However, neither the linear, F (1,115) = 2.01, p = .28, nor the curvilinear relationship, F (2,114) = 1.31, p = .28), between height and anxious jealousy were significant. Next, for reasons of presentational clarity, we combined the reactive and possessive jealousy scales into a single overall jealousy scale (α = .80). Height had a significant curvilinear effect, F (2,114) = 3.10, p = .05, r = .22, and a non-significant linear effect, F (1,115) = 2.28, p = .13, on the combined jealousy scale (see Figure 1). As predicted, jealousy was the lowest among women of medium height and higher among relatively small and relatively tall women.

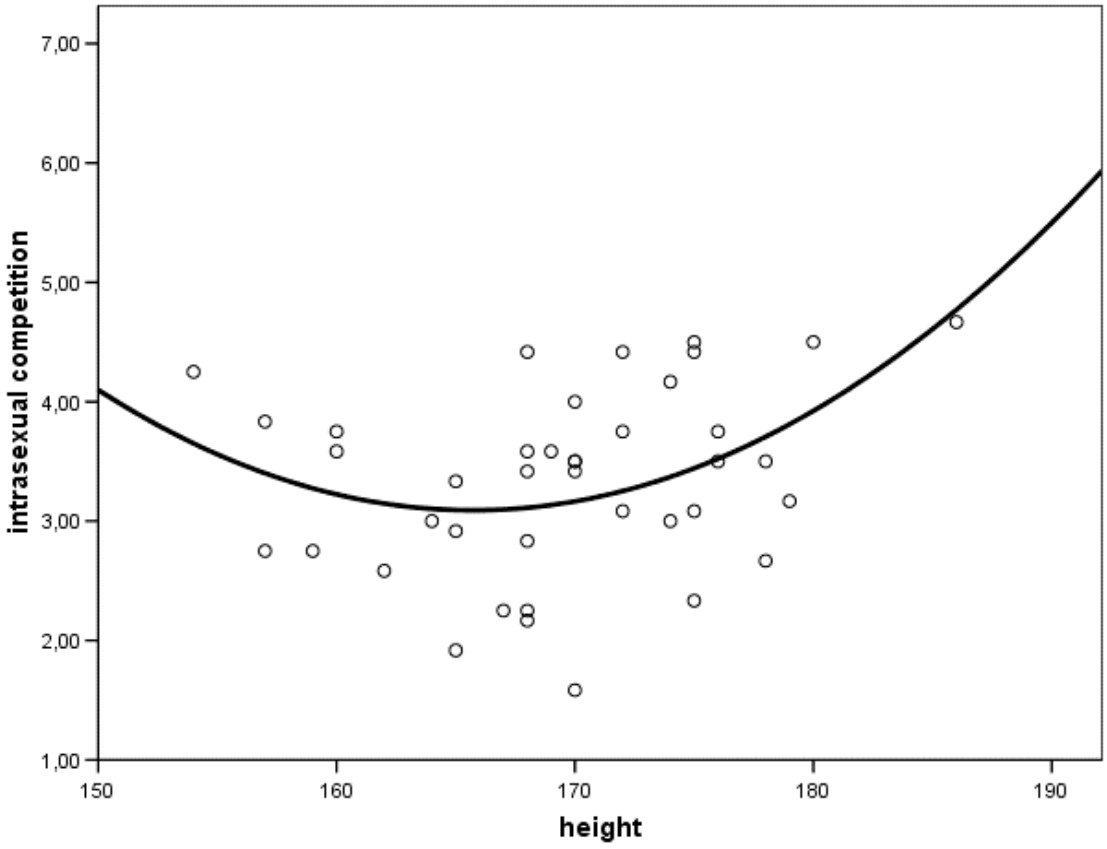
Figure 1. The curvilinear relationship between height and the combined scales of reactive and possessive jealousy.



Study 2: Height and Intrasexual Competition

To investigate the relationship between height and intrasexual competition, we performed a regression analysis to detect both linear and curvilinear relationships. The results showed that height had a curvilinear effect on intrasexual competition, F (2, 37) = 3.82, $p < .05$, $r = .41$. As predicted, and as shown in Figure 2, height and intrasexual competition had a U-shape relationship, which means relatively shorter and taller women were higher in intrasexual competition than women of medium height. The linear relationship between intrasexual competition and height did not reach significance, F (1, 38) = 2.25, $p = .14$.

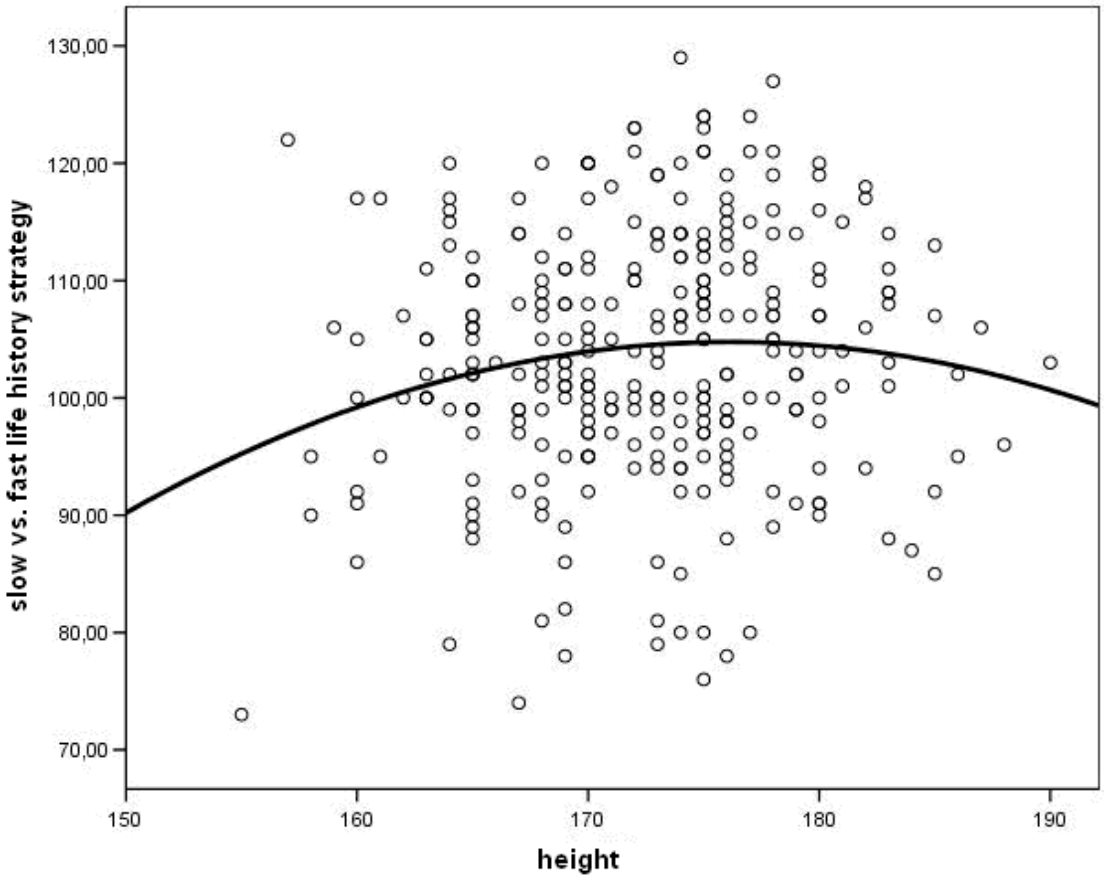
Figure 2. The curvilinear relationship between height and intrasexual competition.



Study 3: Height and Life History Strategy

To investigate the relationship between height and life history strategy, we performed a regression analysis to detect both linear and curvilinear relationships. The results showed that height had a curvilinear effect on life history strategy, F (2, 290) = 3.05, $p < .05$, $r = .14$). As predicted, and as shown in Figure 3, height and life history strategy had a U-shape relationship, which means that women of medium height were more oriented towards a slower life history strategy than relatively shorter and taller women is higher. The linear relationship between life history strategy and height was in the predicted direction but not significant, F (1, 291) = 2.76, p = .10.

Figure 3. The curvilinear relationship between height and a "slow" life history strategy.



Discussion

The present research intended to expand previous research from a life history perspective. It was hypothesized that, compared to both tall and short women, women of medium height would show a more secure, long-term mating pattern that would be characterized by less jealousy, less intrasexual competition and a slower life history strategy. Clear support was found for these predictions: all three studies showed curvilinear relationships between height and the dependent variables. Women of medium height showed overall relatively lower levels of reactive and possessive jealousy, and were less intrasexually competitive, i.e., responded less negatively to other women who were more successful and who received more attention from the opposite sex. These less competitive responses among women of medium height seemed to reflect a more long-term mating pattern as apparent from their higher levels of characteristics typical of a slower life history strategy, such as good executive functions, positive relationships with one's parents, low mating effort, low levels of risk taking, more foresight and planning, and persistence and self-directedness. Vice versa, relatively tall and relatively short women seemed to be characterized more by a faster life history strategy accompanied by more jealousy towards rivals interfering in one's relationship, and, overall, by more competitive responses to other women and higher levels of characteristics typical of a faster life history strategy, such as an emphasis on mating effort, more risk taking, and less positive relationships with one's

parents. The present research suggests that the findings of Buunk et al. (2008) that women of medium height were the least jealous, is not a coincidental result, but seems to reflect a rather robust phenomenon. Overall, the present results are consistent with previous research suggesting that height may have a curvilinear relationship with attractiveness, health and reproductive success among women (e.g., Nettle, 2002; Silventoinen et al., 1999). These findings are also consistent with previous research linking higher self-reported jealousy to faster life history strategies through the construct of high mating effort in response to both emotional and sexual infidelity (Jones, Figueredo, Dickey, and Jacobs, 2007). It must be noted that the effect sizes were not very high, and varied from small to moderate; however, this is generally to be expected for correlations between physical and psychological characteristics. Nevertheless, it is obvious that life history strategy is not only dependent upon height, but may be independently thereof be affected by various other variables, including physical attractiveness, ecological conditions and life expectancy (e.g., Ellis, 2004; Kaplan and Gangestad, 2005).

Although the present findings are in line with previous research, it is as yet not completely clear what processes underlie the effects. First, there may be a direct genetic link: women of medium height may be genetically more healthy and fertile (cf. Hartge, 2009), which may be accompanied by a better mental health, as expressed in lower levels of jealousy and competitiveness, and in traits such as persistence, good relationships with one's parents, and a long-term orientation. It seems likely that such traits are also associated with differences in mate value, which might in part explain the effects. Second, one can argue that the effects are caused by uncertain environmental conditions that make individuals move to either the fast or slow end of the life history continuum. As noted by Belsky et al. (1991), stressful experiences related to one's family background– such as marital discord or father absence – may lead individuals to invest disproportionately in mating as opposed to parenting. As environmental stress tends to affect growth negatively, it might be that shortness as well as an emphasis on mating as opposed to parenting effort are both the result of the same stressful family background. However, this cannot explain why relatively tall women seem to show the same type of mating strategy as relatively short women. A third explanation lies in the positive feedback women of medium height receive from men, due to which they feel more secure about their reproductive opportunities, and may feel less competitive and jealous. Vice versa, relatively tall and relatively short women may feel not especially valued by males, and, consequently feel more inclined to engage directly in mating effort and risk taking.

Such phenomena may therefore represent conditional adaptive strategies involving elements of reactive heritability (Figueredo and Jacobs, 2000). Although behavioral ecologists have specified the functional requirements of conditional strategies, the proximate mediation of such an adaptation is not well specified. One common metaphor is the "developmental switch", an ethological mechanism analogous to imprinting, in which a specific environmental contingency directly triggers an innate releasing mechanism for the conditional strategy. Cognitive learning theories (e.g., Brunswik, 1952, 1955; Tolman, 1925), on the other hand, suggest that an organism learns the relative efficacy of various responses, representing alternative *means* to a desired end. Through interactions with the environment, an organism establishes a hierarchy of alternative ("vicarious and intersubstitutable") responses based on experience with the relative *ecological validities* of alternative means for producing a given distal achievement (Petrinovich, 1979), which

assess the relative efficacies of various biologically prepared adaptive strategies. Learning need not be totally *de novo*, but is instead based on evolved behavioral programs of some sophistication and complexity (see Pinker, 1994; Garcia and Ervin, 1968; Garcia, Hankins, Rusiniak, 1974; Mayr, 1974; Seligman, 1970; Seligman and Hager, 1972; Waddington, 1957).

Because interaction with the environment determines which behavioral strategy works best *for each individual*, other individual differences also matter. An individual not only assesses its external environment, but also assesses *itself* within that environment. Gibson (1979) refers to similar transactional contingencies as *affordances*. Psychosexual development involves a self-assessment of sociosexual capabilities and opportunities, calibrating optimal utilization of physical assets such as size, strength, health, and attractiveness, as well as psychosocial assets such as intelligence, self-efficacy, social skills, personality, and socioeconomic status or prospects (e.g., Hunter and Figueredo, 2000). Individual differences in self-assessment also play a major role in which of the available strategies is implemented.

Figueredo and colleagues (2000) applied this framework to address the ultimate causes of adolescent sex offending behavior by proposing a Brunswikian Evolutionary Developmental (*BED*) Theory, wherein an inability to use mainstream sexual strategies lead an individual to develop deviant sexual strategies (for a more general statement of this principle, see also Figueredo, Hammond, and McKiernan, 2006). Because some adolescents suffer psychosocial problems and consequent competitive disadvantages in the sexual marketplace, sex offending behavior may represent the culmination of a tragic series of failing sexual and social strategies, leading from psychosocial deficiencies to sexual deviance, thence to antisocial deviance, and finally to sexual criminality. When indirect means of intrasexual competition fail, more direct means are selected (Thornhill and Thornhill, 1992).

To conclude, future research is necessary to tease apart the effects of genetic, environmental, and social factors potentially responsible for the effects we observed. Nevertheless, the present findings suggest again that height has important psychological consequences, and our findings contribute to the emerging literature documenting physical features and psychological mechanisms that influence intrasexual competition and mating versus parenting effort in humans.

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