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EVOLUTIONARY PSYCHOLOGY | REVIEW ARTICLE

Size did not matter: An evolutionary account of the variation in penis size and size anxiety

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Abstract: The human penis exhibits considerable variation in size, while a substantial proportion of the adult male population experiences size anxiety. This paper employs an evolutionary framework in order to understand this variation, as well as the concern men exhibit about the adequacy of the size of their penis. It is argued that female choice has been one important sexual selection force, responsible for shaping the size of the penis. However, this force has been relatively weak, because women do not consider the size of their partners' penis to be the most important determinant of their sexual satisfaction. Also, in ancestral human societies, sexual satisfaction was a secondary concern, while women had limited space to exercise mate choice. The mismatch between ancestral and modern conditions, with female choice being stronger in the present than in the past, causes anxiety in men about their ability to satisfy their partners, which is also manifested in their concerns about size.

Subjects: Behavioral Sciences; Bioscience; Social Sciences

Keywords: evolution of penis' size; female choice; parental choice; size anxiety; sexual selection

1. Introduction

The size of the penis is important for the sexual satisfaction of a man's partner (Lever, Frederick, & Peplau, 2006; Mautz, Wong, Peters, & Jennions, 2013); accordingly, it can be predicted that selection forces would eliminate much of the variation around an optimal size. However, the penis exhibits substantial variation in size, both in terms of length and girth (Khan, Somani, Lam, & Donat, 2012; Veale, Miles, Bramley, Muir, & Hodsoll, 2015). Part of this variation appears to be a source of concern for many men, who go to great lengths, including taking pills, purchasing weight systems, stretching devices, vacuum pumps, doing silicone injections, or resorting to penis enlargement in order to increase the size of their penis (Lever et al., 2006; Templer, 2002). Recently, an evolutionary framework



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PUBLIC INTEREST STATEMENT

The human penis exhibits considerable variation in size, while a substantial proportion of adult male population experiences size anxiety. This paper employs an evolutionary framework in order to understand this variation, as well as the concern men exhibit about the adequacy of their penis' size.

has been proposed to account for the variation in sexual functioning in men and women, and why part of this variation classifies as dysfunctional (Apostolou, 2015b,c). The present paper aims to apply this framework in addressing the questions: (1) why selection forces have allowed for such variation in penis size, and (2) why part of this variation is considered dysfunctional, causing men anxiety.

More specifically, the evolutionary framework of sexual functioning has four components. The first one incorporates evolutionary models which identify the possible sources of variation in a trait. The second component identifies the selection forces which have shaped this trait, and the third one attempts to reconstruct ancestral conditions in order to assess the relative strength of these selection forces in ancestral human societies. Finally, the fourth component combines insights from the other three in order to understand the observed variation a trait exhibits, and why part of this variation may not be optimal. This framework will be applied in understanding the variation in the size of penis and size anxiety.

2. Sources of variation

The first aim of the proposed framework was to address the question of variation: if there is an optimal level for a given trait, any allele that predisposes for deviations from it should be selected out from the gene pool, resulting in this trait exhibiting no variation. Even so, considerable variation in a trait can still exist. One reason is purely environmental: there is variation in traits which has nothing to do with genetic predispositions. For instance, people vary in the number of fingers they have, because due to accidents, some people have lost one or more of their fingers. Nevertheless, most traits exhibit variation which has a genetic basis (Plomin, DeFries, McClearn, & McGuffin, 2008). This is either because individuals have specific alleles, which predispose for specific variation in a trait irrespective of the environment, or they have alleles which respond to specific environmental factors to give rise to a specific trait variant. There are three evolutionary models which can potentially account for this variation.

The first one is the polygenic mutations model. Genetic replication is not infallible, which means that mutant genes or alleles are expected to arise in every generation. A mutant allele will affect the phenotype of a trait, pushing it away from the optimal level. Selection forces will then remove this allele from the gene pool in one or more generations. At any given time, variation is expected to be present as there are several mutations that selection forces did not have time to remove from the gene pool (Keller & Miller, 2006).

How fast selection forces remove mutations from the gene pool is positively related to the fitness cost of these mutations (i.e. how much they impair survival and reproduction), which in turn, is determined by the environmental conditions where these mutations arise (Fisher, 1958). If a mutation greatly impairs fitness (e.g. leads to early death), it will be selected out in a single generation; nevertheless, if it has low fitness costs or it is neutral to fitness, it may take many generations before it is selected out of the gene pool. In the ancestral neutrality model, environmental conditions in ancestral human societies have turned specific mutant genes to be fitness neutral or to have very limited fitness costs; these genes are still in the gene pool today because selection forces have not removed them yet (Keller & Miller, 2006). As a given trait is usually coded by many genes, several mutations that predispose for variations in this trait with no or limited adverse fitness effects are likely to accumulate in the gene pool. In this respect, a trait can exhibit considerable variation around an optimal level, a variation which had little fitness consequences in the context where it evolved.

In the balancing selection model, a species occupies a specific environmental niche, but this niche consists of other sub-niches, which require a different combination of traits to be successfully occupied. Accordingly, selection forces would favor not one morph (i.e. an individual with the trait set at a specific level) but polymorphism (i.e. individuals with this trait set at different levels). The relative frequency of a given morph depends on the size of the sub-niche it has evolved to occupy, which in turn, depends on environmental conditions (Figueredo et al., 2010; MacDonald, 1995).

These models can possibly account for the variation a trait exhibits, but they can also explain why part of the observed variation is considered dysfunctional. Starting from the polygenic model, a mutation can result in a variant of a trait that is not optimal for the current environment individuals occupy, leading to fitness penalties for those who carry this mutation. In the ancestral neutrality model, environmental conditions may change and turn fitness neutral variations into fitness impairing ones. This will accelerate the removal of the alleles responsible for these predispositions from the gene pool, but in the meantime, those who carry them will experience fitness losses. In the balancing selection model, if environmental conditions change, a sub-niche can either disappear, become smaller, or change. Accordingly, morphs who have evolved to fill it may suffer fitness costs, either because this niche is no longer there to be occupied, or it is smaller so there are morphs in surplus, or because it has changed and these morphs are not well adapted to occupy it.

Overall, these evolutionary models can enable us to understand the possible sources of variation the size of the penis exhibits, and whether a portion of this variation is likely to be considered problematic under modern conditions. In order to understand this variation, the selection force(s) that drive this trait need to be identified first.

3. Penis size and female choice

One function of the penis is to provide sexual satisfaction to women (Mautz et al., 2013). Masters and Johnson (1966, 1970) argued that the size of the penis plays little role in doing so. They reached this conclusion on the basis of their physiological studies that show that the vagina adapts to fit the size of the penis. Thus, they argued that any size penis will fit and provide adequate sexual stimulation to a woman. Nevertheless, subsequent studies indicated that size is important for the sexual satisfaction of women.

More specifically, in one study women were asked about the importance of two aspects of penis size: length and girth (Francken et al., 2002). About 21% rated length as important and about 33% rated girth as important. Another study asked 556 women aged 19–49 years about the importance of penis length and girth (Štulhofer, 2006). With respect to length, 57.4% considered it somewhat important, 18% very important, and 24.6% unimportant. With respect to girth, 53% considered it somewhat important, 21.5% very important, and 25.4% as unimportant. In addition, more experienced women judged penis size as more important, both in terms of length and girth. Similarly, one study in the Middle East found that women reported size to be important (67.2%), where 40% believed girth is most important and 40% valued both length and girth (Shaeer, Shaeer, & Shaeer, 2012). It was also found that dissatisfaction with a partner's penis size was associated with greater risk of female sexual dysfunction.

In a different line of research, women from the USA, New Zealand, Cameroon, and China rated stylized male figures with somewhat longer than average penises as more attractive (Dixson, Dixson, Bishop, & Parish, 2010; Dixson, Dixson, Li, & Anderson, 2007; Dixson, Dixson, Morgan, & Anderson, 2007). Similarly, an Australian study of female assessment of digitally projected life-size, computer-generated images, found that women rated men with large penises as more attractive (Mautz et al., 2013). In a representative Czech sample, 34% of the women with history of orgasm from penile–vaginal intercourse and enough coital partners to be able to make a comparison, reported being more likely to have an orgasm from penile–vaginal intercourse with a man who has a longer than average penis length (Brody & Weiss, 2010). These results were also replicated in a Scottish sample (Costa, Miller, & Brody, 2012). An Internet study of 26,437 heterosexual female participants found that 94% of women who reported that their current partner's penis was “large” were “very satisfied” sexually, but only 32% of women whose partner's penis was “small” were very satisfied sexually, and 68% of those women wished that their partner's penis was larger (Lever et al., 2006).

Evidence that female choice had been an important selection force operating on penis size has also been provided by a recent study (Apostolou, 2015a). This study tested the hypothesis that, if in ancestral human societies female choice had been exercised on penis size, and given that women

exhibit a stronger preference for girth than length (Eisenman, 2001; Francken et al., 2002), the observed penis size would be less variable in terms of girth than in terms of length. The reason is that female choice would have been stronger on girth than on length. Analysis of the variation in a large data-set found evidence which is consistent with this hypothesis.

Overall, as women are concerned about the size of their partners' penis, men who have alleles that predispose for sizes desirable to women will gain a selective advantage over men who have alleles which do not. In effect, understanding the variation that the size of the penis exhibits today, requires assessing the strength of female choice in ancestral human societies.

4. Female choice in ancestral human societies

4.1. Parental control over mating

The genus *Homo* appeared on earth approximately two million years ago, and for most of this period our ancestors were living in small bands which based their subsistence on hunting and gathering (Lee & Devore, 1968). Approximately 10,000 years ago, the agropastoral revolution took place, which resulted into the eventual transition of most human societies to a sedentary life and subsistence based on agriculture and animal husbandry (Bellwood, 2004). Accordingly, most of human evolution took place in a pre-industrial context where subsistence was based on hunting and gathering and on agropastoralism (Lee & Devore, 1968; Tooby & Cosmides, 1990).

In order to assess the strength of female choice in these societies, knowledge about their mating patterns is required. Ancestral foragers did not leave behind any written records, but the anthropological record on modern hunting and gathering societies can be a useful source of information. The way of life of modern foragers approximates the way of life of ancestral ones, meaning that the typical patterns of mating in the former are likely to reflect the typical patterns of mating in the latter (Apostolou, 2014; Ember, 1978). In the same vein, the anthropological record of modern agropastoral societies can be used to reconstruct the way of life in ancestral agropastoral societies.

Anthropological and historical evidence indicates that in a pre-industrial context mate choice is regulated, with arranged marriage being the typical mode of long-term mating (Broude & Greene, 1983; Stephens, 1963). In more detail, one study collected evidence on mating patterns from a sample of 190 contemporary foraging societies (Apostolou, 2007). It was found that the most frequent mode of long-term mating, in approximately 70% of cases, was arranged marriage, where parents choose spouses for their children. A subsequent study revealed similar patterns in contemporary pre-industrial societies, which base their subsistence on agriculture and animal husbandry (Apostolou, 2010). Similarly, one study coded for the mating patterns of 16 historical agropastoral societies (Apostolou, 2012) and it found that in all societies but one, the primary mode of long-term mating was arranged marriage, where fathers and other male relatives dominated marriage arrangements, and daughters were controlled more than sons.

In a pre-industrial context, there is considerable space for women to exercise choice. To begin with, they can engage in sexual relationships before their parents arrange a marriage for them (Apostolou, 2014). Women can also exercise mate choice through engaging in extramarital relationships, which are found in almost all pre-industrial societies (Broude, 1980). Last but not least, women can exercise choice in later marriages, when they are less dependent on their parents or their parents are absent due to death or are physically too weak to impose their will (Apostolou, 2014).

The evidence from the anthropological and historical records indicates that during most of the period of human evolution, female choice had been relatively weak as women's mate choices were predominantly controlled by their parents (see also Walker, Hill, Flinn, & Ellsworth, 2011). However, because women had space to exercise mate choice, female choice has been a significant selection force.

4.2. Ancestral preferences

Mate and in-law preferences are not rigid but adjust to local conditions (Apostolou, 2014; Buss, Shackelford, Kirkpatrick, & Larsen, 2001). In this respect, the mate and in-law preferences we observe today in post-industrial societies are also likely to have been present in the ancestral ones, but it is also likely that they had different weights ascribed to them.

More specifically, the low technological development in ancestral human societies made food resources scarce and unpredictable. Furthermore, in ancestral human societies there were no social protection systems, such as the police and a well-developed welfare state. Consequently, individuals had to rely heavily on each other for their survival. Accordingly, in the ancestral context, parents as well as their children were likely to have valued traits that predict resource provision, such as industriousness and good family background, more than traits that predict intimacy and sexual satisfaction.

In post-industrial societies, technological developments and the resulting increase in wealth, along with the existence of the welfare state have changed marriage and intimate relationships in general: they are no longer seen as a means to promote an individual's survival but instead as a means to receive intimacy and satisfaction (Coontz, 2005). In more detail, individuals in post-industrial societies are likely to have a job that affords them adequate resources for their subsistence, and they can rely on the welfare state if something goes wrong. Thus, when they look for mates, they look for ones who can provide them with more intimacy and sexual satisfaction than resources required for subsistence. For example, Finkel, Hui, Carswell, and Larson (2014) argued that preferences for marital partners have drastically changed in the last decades in the USA, so that more value is being placed on traits associated with intimacy. Therefore, the value people ascribe to sexual satisfaction today is probably an overestimate of the value placed in ancestral human societies.

Overall, there are reasons to believe that both mate and in-law seekers are likely to have placed less emphasis on traits related to sexual satisfaction and more on traits related to survival. This hypothesis, combined with evidence that in ancestral human societies mate choice was regulated by parents, predominantly fathers, who value such traits less in an in-law than their children in a spouse, would suggest that negative selection pressures on these traits would be relatively weak, allowing for a higher prevalence rate. This dimension i.e. the difference between modern and ancestral preferences, has not been considered in previous formulations (Apostolou, 2015a,b).

4.3. Long-term and short-term mating strategies

It has been argued that men can follow two primary mating strategies, namely a short-term one which involves high mating effort, multiple casual mates, and low parental investment, and a long-term one which involves low mating effort, few long-term mates, and high parental investment (Buss, 2003; Buss & Schmitt, 1993). The former strategy emphasizes more on providing sexual satisfaction, while the latter emphasizes more on providing resources that are required for raising a family (Apostolou, 2015b). If ancestral conditions favored a short-term strategy, then selection pressures on the size of penis would be stronger than if they favored a long-term strategy.

Evidence from anthropological and historical resources indicates that although both strategies are present, the long-term is the dominant one: individuals tend to establish long-term committed intimate relationships with the purpose of having and raising children (Apostolou, 2014; Coontz, 2005). The higher prevalence of the long-term mating strategy is also corroborated by comparative analysis of penis morphology in primates, demonstrating that in size and complexity the human penis is more similar to monogamous and polygynous primates than to those with promiscuous mating systems (Dixson, 2009). Overall, a long-term mating strategy is likely to have been prevalent during human evolution, which suggests weak selection pressures on penis size.

5. The causes of size variation and anxiety

5.1. Variation

The proposed theoretical framework, and particularly the ancestral neutrality model discussed above, can be applied in understanding the observed variation in penis size. More specifically, female choice has been identified as one main selection force responsible for shaping the human penis. Evidence indicates that this selection force operating on penis size in ancestral human societies had been weak so, alleles that predispose for a larger or smaller than an assumed optimal size would experience weak negative selection pressure and would remain in the gene pool. This predicts that the size of the human penis would exhibit considerable variation.

Consistent with this prediction, several studies find that the penis exhibits substantial variation (Khan et al., 2012; Ponchiatti et al., 2001; Veale et al., 2015). It has to be said at this point that height, and body size in general, exhibits considerable variation; so, the penis, being a part of the body, will also exhibit such variation. Accordingly, there is positive correlation between height and penis size, but this correlation is weak (Lever, Frederick, & Peplau, 2006), which means that the variation in body size explains only a small proportion of the variation in penis size.

Predispositions for deviations from the optimal size would experience weak selection pressures; however, as these deviations become more extreme, the negative selection pressures would increase considerably. For instance, alleles that predispose for very small penises would be eliminated by selection forces relatively quickly, as men who carry them would face difficulties not only in sexually satisfying but also in impregnating their partners. Similarly, men with very large penises would not provide satisfaction to their partners and would also be likely to injure them. On this basis, it is predicted that there would be very few instances of men who have very small and very large penises. These instances would be predominantly the result of mutations that selection forces did not have time to remove from the gene pool. Accordingly, approximately 2.3% of the male population is estimated to have an abnormally small penis (Wessells, Lue, & McAninch, 1996; see also Kumanov, Robeva, & Tomova, 2007). To the knowledge of the authors there are no estimates of the prevalence rates of abnormally large penises.

This framework predicts also cross-cultural variation in size. In particular, parental choice is stronger and female choice weaker in pre-industrial societies which base their subsistence on agriculture and animal husbandry than in societies which base their subsistence on hunting and gathering (Apostolou, 2010, 2012). On this basis, it can be predicted that penis size would exhibit more variation and a smaller mean size in the former than in the latter type of society. This prediction should be tested by future research.

On this basis, it can be argued further that the transition from a mode of life based on hunting and gathering to a mode of life based on agropastoralism, that took place approximately 10,000 years ago, would have weakened female choice (Apostolou, 2014). As a consequence, the penis would tend to exhibit more variation; this trend would have been reversed by the transition to post-industrialism and the strengthening of female choice, which places emphasis on intimacy and on receiving sexual pleasure. In evolutionary terms, the transition from pre-industrialism to post-industrialism has only taken place recently. This means that the allele frequencies for specific traits involved in mating are not optimal for modern conditions, as selection forces did not have adequate time to remove from the gene pool the ones that predispose for non-optimal variation. Therefore, the frequencies will be changing: since women prefer larger to smaller penises, the mean size of the penis is predicted to increase. In addition, since female choice is stronger now than it had been in the past, it is further predicted that the variation in size will decrease. Future studies need to examine whether such effects are present.

5.2. Size anxiety

As opposed to ancestral human pre-industrial societies, women in modern post-industrial societies are freer to exercise mate choice, and they would prefer mates who give them sufficient sexual satisfaction. Consequently, one's capacity to provide sexual satisfaction is valued more in the mating market.

Thus, this difference between ancestral and modern conditions indicates that part of the variation in penis size allowed by selection forces in the past, may not be optimal for the present: men who carry alleles predisposing them for sizes that compromise their capacity to provide sexual satisfaction to women, in ancestral human societies, where this capacity was less important and women had limited space to exercise choice, would not face any or would face few intimate relationship problems. On the other hand, in post-industrial societies, where this capacity is more important and where women can exercise mate choice, this variation is likely to have more adverse effects on men's mating success. In turn, reduced mating success has adverse consequences on reproductive success, which would result into the activation of mechanisms, such as feelings of anxiety that will prompt corrective action (Frank, 1988).

Accordingly, it is predicted that in modern post-industrial societies, a considerable part of the adult male population exhibits concerns about penis size. Consistent with this prediction, men frequently complain about the size of their penis (Lever, Frederick, & Peplau, 2006). In one study in the Middle East, when men were asked "Are you satisfied with the size of your penis?" 30% answered "no" (Shaeer et al., 2012). Similarly, men worry that their romantic partner may not be satisfied with the size of their penis (Alter, 1995; Van Driel, Weijmar Schultz, Van DE Wiel, & Mensink, 1998).

Women indicate a preference for larger penis size (Lever et al., 2006; Shaeer et al., 2012), suggesting that most of the variation which is not optimal refers predominantly to smaller than larger sizes. This observation leads to the prediction that men's concern would be directional toward larger size: they would predominantly worry that their penis is not large enough rather than it is too large. Consistent with this prediction, one Internet survey of 52,031 heterosexual individuals of both sexes found that 55% of men were satisfied with their penis size, 45% wanted to be larger, and 0.2% wanted to be smaller (Lever et al., 2006).

This reasoning also predicts that a considerable proportion of women would not be satisfied with the size of their partner's penis. This is because there is variation in the population which is not satisfactory to women, but it has remained present due to weak selection pressures in ancestral societies. The second prediction is that the lack of satisfaction would be directional, with women preferring their partner to have larger rather than smaller penis. Consistent with these predictions, the large Internet study found that 16% of women in the sample were not satisfied with the penis size of their partner, 14% wanted their partner to be larger, and 2% wanted their partner to be smaller (Lever et al., 2006).

The direction of the difference mirrors men's difference in concern where they want bigger and not smaller penises. The proportion of unsatisfied women does not mirror, however, the proportion of unsatisfied men. In particular, 14% of female participants wanted their partners to have large penises, but 45% of male participants wanted to have larger penises. One possible reason for this discrepancy could be that women underreport their lack of satisfaction. Another possibility is that men may not properly assess what size women prefer and how they fair with respect to other men. For instance, one study found that the majority of men who seek penile lengthening procedures have average length penises (Mondaini et al., 2002). This bias could be due to cultural factors, such as the consumption of porn, which may make men underestimate the size of their penis as they have biased reference points. It has also to be considered that this study was posted on MSNBC.com, and participants were self-selected. Future research needs to examine these differences more thoroughly.

The proposed framework predicts further that there will be cross-cultural variation in the concern men exhibit about size. In particular, in societies where mate choice is more regulated and women have a lower capacity to exercise choice, men would exhibit less concern about their size than in societies where mate choice is less regulated. Cross-cultural research needs to test this prediction.

6. Conclusion

The present paper employed an evolutionary framework in order to understand the observed variation in penis size, as well as the concern that men exhibit about the size of their penis. It was argued that female choice has been one important sexual selection force responsible for shaping the size of the penis. However, this force has been relatively weak, because women do not consider the size of their partner's penis to be the most important determinant of their sexual satisfaction because in ancestral human societies, sexual satisfaction had been a secondary concern, and because women had limited space to exercise mate choice. The recent evolutionary transition to post-industrialism and the associated strengthening of female choice, along with the importance individuals place on sexual satisfaction, has resulted in evolutionarily novel pressure on men to provide sexual satisfaction to their partners. This creates concerns and anxiety about size, which may be augmented by cultural biases that tend to overestimate the average penis size.

One insight gained from this framework is that considerably smaller or larger than the average size penises need to be viewed as normal variations rather than as a developmental or genetic problem. Even so, part of this variation may have an adverse effect for men: those with considerably small or large penises are likely to face difficulties in providing sexual satisfaction to their partners. With respect to size anxiety, this framework indicates that, in the majority of cases, this anxiety is not pathological in the sense of the mechanism regulating anxiety dysfunctions. Instead it has been suggested that this is due to the mismatch between ancestral and modern environments: the stronger emphasis placed on sexual satisfaction in the present compared to in the past causes men anxiety about their size adequacy. Part of this anxiety is justified and part of it is not.

The evolutionary framework developed here can enable a better understanding of the variation the size of the human penis exhibits, which is independent from the variation in body size. It can also explain why part of this variation can potentially be problematic. Future research needs to advance this framework further and test hypotheses derived from it.

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