

Review

Beyond masculinity: Testosterone, gender/sex, and human social behavior in a comparative context

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ABSTRACT

Largely based on pre-theory that ties high testosterone (T) to masculinity, and low T to femininity, high T is mainly studied in relation to aggression, mating, sexuality, and challenge, and low T with parenting. Evidence, however, fails to support this, and the social variability in T is better accounted for by a competition–nurturance trade-off as per the Steroid/Peptide Theory of Social Bonds (van Anders et al., 2011). Four key domains are discussed: adult–infant interactions, sexual desire, sexual behavior, and partnering. Empirical engagements with gender/sex are shown to lead to important insights over assumptions about masculinity–femininity. Humans are discussed within a comparative framework that attends to cross-species principles informed by human insights alongside human-specific particularities like social constructions, which are critical to evolutionary understandings of the social role of T. This paper thus integrates seemingly orthogonal perspectives to allow for transformative approaches to an empirically-supported social phenomenology of T.

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1. Introduction

What does high vs. low testosterone do, socially speaking? Behavioral endocrinology maintains that hormones do not cause behavior, but instead influence its likelihood of occurring. So, though testosterone (T) is commonly understood to cause masculinity, this is a scientific misunderstanding. Perhaps, then, it would be more precise to suggest that T influences the likelihood of masculine behaviors occurring, that masculine behaviors increase T, or that high T¹ co-occurs with masculinity. This presumed tie between T and masculinity, regardless of directionality, is one thread that runs through lay, biomedical/health, and scientific communities. For example, reputable online health sites like Medline and Mayo Clinic define T as a “male hormone” despite noting its presence in women as well. Searching for “testosterone” in Google Image is a compelling visual demonstration of the lay cultural conjunction between T and masculinity. The articles that are ranked most highly from a search for T in journals like *Hormones and Behavior* or *Frontiers in Neuroendocrinology* focus on males or masculine phenomena. Mainstream hormone textbooks define T either as a male hormone

or mostly focus on males (for an exception, see Adkins-Regan, 2005). These examples are not surprising given how widespread and robust the presumptive tie between T and masculinity is across cultural, scientific, and health communities.

Males do have higher T than females across most species (Nelson, 2011), so why question the link between T and masculinity? Defining T as the essence that makes men male or masculine raises a host of definitional problems, e.g.: what does its natural occurrence do in *females*, then? As an analogous example, men are taller than women, on average, but height is not defined as a male characteristic just because men have “more” of it. Moreover, maleness and masculinity are not the same, and their difference in large part relies on somatic vs. sociobehavioral phenomena. Along with other androgens, T is a major influence on male-typical physical development (though this understanding also becomes problematic when the physio role of T is considered in females), including the brain. Since the brain – along with the environment – influences behavior, the dividing line between maleness and masculinity is nothing less than the dividing line between sex and gender. This is obviously contested ground upon which entire fields of scholarship are built. For the purposes of this paper, however, I operationalize masculinity to mean social and behavioral phenomena that are *thought* to be archetypally male (regardless of whether they *actually* characterize males). For example, *masculinity* entails unwavering sexual interest, but many *actual* men experience low sexual desire (Brotto, 2010). Of course, many scientists do not see masculinity and high T as proxies for each other, but this presumption is widespread.

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¹ An individual might have “high” testosterone relative to a number of reference points, including the same individual at another timepoint reflecting endogenous biorhythms (e.g., morning vs. night) or life phase (e.g., youth vs. older age), after exogenous administration of testosterone (or other androgens or gonadotropins), or other individuals who are seen to be members of valid comparison groups (e.g., winners vs. losers).

The general framework for studying T is that it is positively correlated with aggression, mating, sexuality, and challenge (via masculinity), and negatively to parenting (via femininity) (see Fig. 1, bottom panel). A predominant framing of the social role of T is as a driver of male reproductive tactics or life history patterns (e.g., Ellison and Gray, 2009; Székely et al., 2010). Of course, not all see it this way or see it this way without qualifications (including these authors), but this conjunction still abounds. In this paper, I will show how the social role of high vs. low T is *not* located in a masculinity–femininity dichotomy, and how this adjustment opens up new horizons in terms of research and theory. To do so, I will describe four key areas of current research that provide a compelling rationale for retheorizing the social role of T.

T is critical to behavioral theories because it is so closely tied to life history trade-offs (Ketterson and Nolan, 1992; McGlothlin et al., 2010; Oliveira, 2009; Wingfield et al., 1990a). Social behaviors relevant to T have implications for individual or offspring survival, social and sexual affiliation, aggression, and reproduction among other evolutionarily-significant parameters. In this way, T is one hormonal linchpin among others. An empirically accurate framing of T is a foundation for generating novel and valuable insights about evolved social behaviors.

1.1. How 'pre-theory' about gender drives research on testosterone

High T is understood to be linked to challenge, mating, sexuality, and aggression – with masculinity as the intermediary (see Fig. 1, bottom panel), though usually presumptive rather than laid out explicitly. This might be called 'pre-theory', which refers to largely unstated and implicit assumptions that nevertheless guide research, in this case with assumptions about masculinity guiding research on T (Fausto-Sterling, 2000; Fine, 2010; Jordan-Young, 2010; Karkazis et al., 2012). A major problem with pre-theory is that it cannot be actually tested, revised, or falsified – and is therefore not scientific (see (Lloyd, 1993) for an interesting discussion in relation to female orgasm). In fact, there are surprisingly few *formal* theories about the social role of T. One important exception is the well-known Challenge Hypothesis (Wingfield et al., 1990a). It explicitly depicts a trade-off between high T and challenge with low T and parenting, and has broad support across a wide variety of species and taxa including mammals, fish, birds, and insects (e.g., Adkins-Regan, 2009; Gleason et al., 2009; Hirschenhauser and Oliveira, 2006; Ketterson and Nolan, 1992; McGlothlin et al., 2007; van Anders and Watson, 2006b; Wingfield et al., 1990a).

Basing research about T on pre-theory has important implications. For example, T and aggression are rarely studied in women, likely because pre-theory about masculinity precludes this possibility. Pre-theory may drive the continuing quest for correlations between aggression and T in men despite broad null findings (Archer et al., 2005; Carre et al., 2011; Halpern et al., 1993; O'Connor et al., 2004). Pre-theory can thus affect what gets studied and what does not (see, e.g., Tuana, 2004) on gendered epistemologies of ignorance). Social phenomena thought to lie outside the purview of masculinity may never receive empirical attention. This lack of research can lead to a conceptual transformation of *no* findings into *null* findings.

A body of literature *does* show compelling associations between T and social behavioral contexts in women and females (e.g., Goldey and van Anders, 2011; Hamilton et al., 2009; Ketterson et al., 2005; Kuzawa et al., 2010; van Anders et al., 2007a; van Anders and Dunn, 2009; van Anders and Goldey, 2010; van Anders, 2012). Notably, work from Ellen Ketterson's lab has shown the important role of T in female birds (e.g., Cain and Ketterson, 2012; Clotfelter et al., 2004; Ketterson et al., 2005; O'Neal et al., 2008). Despite this, the vast majority of research on hormones and behavior in females focuses on female-specific reproductive

biology (e.g., menstruation, pregnancy, menopause, lactation) as if only those phenomena that are female-specific can be studied in women and non-human females (Oudshoorn, 1994) even though behaviors that females and males engage in are studied frequently in males. Even this body of research on hormones and female-specific reproductive biology excludes T as if T cannot be relevant to female-specific phenomena. Femininity is thus *inversely* linked to T, such that low T is tied to phenomena like parenting that are thought of as feminine. But, even low T is studied mostly in males.

Sources of T include the gonads, fat cells, and the adrenal gland. However, adrenal contributions to circulating androgens are relatively larger in women than men (Abraham et al., 1975; Wajchenberg et al., 1986). It is unclear how this might affect associations between T and social phenomena, especially because there is clear evidence that circulating T in women is not merely a reflection of adrenal activation (Abraham, 1974). In fact, social modulation of T and cortisol are not necessarily correlated (Oliveira et al., 2009), and T responds to social stimuli in both women and men (van Anders and Watson, 2006a,b).

Even if high T might sometimes be linked with concepts that map onto masculinity in this time and place, a reliance on pre-theory linking high T with masculinity misses the scientific boat (Adkins-Regan, 2005). It obscures interesting, complex, and important ways T is related to social behaviors, and resulting broader insights. A goal of this paper, then, is to highlight how countering pre-theory might lead to more accurate understandings of the social role of T.

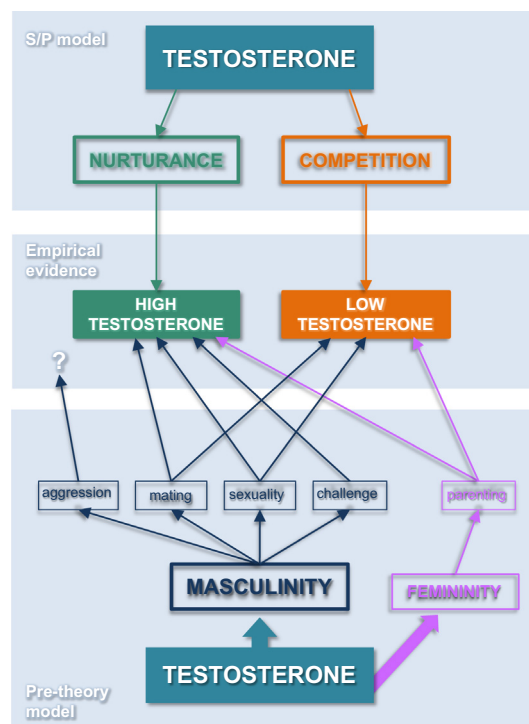


Fig. 1. Contrasting models of the social role of testosterone (T) derived from pre-theory and the Steroid/Peptide Theory of Social Bonds (S/P Theory; van Anders et al., 2011). This figure demonstrates how the S/P Theory accounts more parsimoniously for the empirical evidence linking T with social behaviors than pre-theory about masculinity and femininity. The top panel demonstrates how the S/P Theory divides social behaviors into nurturant and competitive. The middle panel demonstrates how these are parsimoniously associated with low and high T, respectively. The bottom panel demonstrates how pre-theory positions masculinity as the essence of T that is associated with aggression, sexuality, mating, and challenge. It also shows how parenting is associated with T, via femininity. The middle panel, however, shows how empirical evidence actually links these phenomena with *both* high and low T.

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