



Preliminary evidence that testosterone's association with aggression depends on self-construal[☆]



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ABSTRACT

A contribution to a special issue on Hormones and Human Competition.

Previous research and theory suggest testosterone is an important hormone for modulating aggression and self-regulation. We propose that self-construal, a culturally-relevant difference in how individuals define the self in relation to others, may be an important moderator of the relationship between testosterone and behaviors linked to aggression. Within two studies (Study 1 $N = 80$; Study 2 $N = 237$) and an integrated data analysis, we find evidence suggesting that acute testosterone changes in men are positively associated with aggressive behavior for those with more independent self-construals, whereas basal testosterone is negatively associated with aggression when individuals have more interdependent self-construals. Although preliminary, these findings suggest that self-construal moderates the association between testosterone and aggression, thereby paving the way toward future work examining the potential cultural moderation of the behavioral effects of testosterone.

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1. Introduction

Violence and aggression are highly detrimental to society, resulting in over 1.3 million deaths each year worldwide (World Health Organization, 2014). Yet, although aggression often leads to undesirable outcomes, it likely exists to serve important evolutionary functions such as defending territory, self-defense, and acquiring resources necessary for survival (Hawley, 1999). Many causes and risk factors contribute to the emergence of aggression. These include hormones, genetics, negative affect, observational learning, violent media, psychopathy, deficits in brain regions associated with aggression, poor self-control, alcohol, the presence of weapons and aggressive cues, narcissism, serotonin deficits, poor socialization, bullying, and culture, among others (see Bushman and Huesmann, 2010; Carré et al., 2011;

Ferguson and Beaver, 2009; Ferguson and Dyck, 2012; Ferguson and Kilburn, 2009; Huesmann, 2007; Mehta et al., 2013; for reviews). To advance the etiology of aggression, it is critical to adopt an integrative account of aggressive behavior that incorporates biological, psychological, and socio-cultural factors.

One hormone relevant to poor self-regulation and aggression is testosterone (e.g., Archer et al., 2005; Mazur and Booth, 2014). Previous research suggests testosterone is linked to increased aggression and impulsivity. Indeed, exogenously administered testosterone in humans can augment sensitivity to reward (van Honk et al., 2004), reactivity to threats in regions of the brain associated with aggression (Goetz et al., 2014), and aggressive behavior (e.g., Pope et al., 2000). At present, there is a heightened recognition of the need to differentiate between basal testosterone (stable level of endogenous testosterone) and acute testosterone changes (see Carré et al., 2011; Mazur and Booth, 1998; for reviews).

Basal testosterone is implicated in aggressive/antisocial behaviors, but the effect size is relatively weak in humans (see Archer et al., 2005). Complicating this matter, basal testosterone may promote prosocial behavior in women (e.g., Boksem et al., 2013; Eisenegger et al., 2010) and cooperation with ingroup members during intergroup competition (Diekhof et al., 2014; Reimers and Diekhof, 2015).

In contrast, acute testosterone fluctuations may be more relevant for aggression. Numerous studies examine various contexts that alter

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testosterone concentrations, including competitive interactions (e.g., Carré et al., 2013; Zilioli et al., 2014), social rejection (Geniole et al., 2011), aggressive provocation (Carré et al., 2014), and interactions with aggressive stimuli (Klinesmith et al., 2006). These studies show a reliable link between momentary increases of testosterone and aggression/antisocial behavior (See Carré and Olmstead, 2015 for a review).

Testosterone concentrations generally fluctuate in response to competitive interactions, often with concentrations elevated in winners relative to losers (see Geniole et al., 2017, this issue, for meta-analysis). As predicted by the Biosocial Model of Status (Mazur, 1985), a rise in testosterone may serve to facilitate dominant behaviors designed to gain or protect social status. On the other hand, a decrease in testosterone serves to facilitate submissive behaviors aimed at avoiding further threats to status (Mazur, 1985). Indeed, rises in testosterone during competitive interactions often predict future elevated aggression and effect size estimates of testosterone changes have been of moderate to large size (Carré et al., 2009; Carré et al., 2013; Carré et al., 2014; Geniole et al., 2011; Klinesmith et al., 2006; see Carré and Olmstead, 2015 for a review). One potential caveat is that in one study post-competition testosterone changes predict female athletes' motivation to reconcile with opponents after a competition (Casto and Edwards, 2016). Hence, more work is needed to identify potential moderators of the link between both basal testosterone and testosterone dynamics and aggression/antisocial behavior.

1.1. Individual differences as contexts for understanding testosterone and aggression

Previous work suggests some personality and socio-cultural factors as potentially important moderators of the link between testosterone and aggression and other social behaviors. For example, trait dominance appears to influence the extent to which testosterone is associated with dominant mating behaviors (Slatcher et al., 2011). Further, trait dominance is associated with the degree to which exogenously administered testosterone affects victory-dependent competitive decision making in women (Mehta et al., 2015a) and aggressive behavior in men (Carré et al., in press). Additionally, being in a committed relationship is associated with decreased testosterone for women, but this effect is evident only for those who are low in both extraversion and sensation seeking (Costa et al., 2015). Testosterone responses to competition are associated with aggressive behavior primarily in low anxiety men (Norman et al., 2014), whereas men with higher grandiose narcissism show greater testosterone responses while engaging in aggression (Lobbestael et al., 2014). Overall, this work suggests that the link between testosterone and aggression is stronger for those who are inclined toward competition (i.e., those who are high in dominance, extraversion, and sensation seeking).

1.2. The role of self-construal

One important individual difference that might predispose how people respond to competition concerns “self-construal,” or how people mentally represent the self as independent from others or interdependent with them (Cross et al., 2011; Markus and Kitayama, 1991). Self-construal was initially coined to describe differences in self-definition and self-representation between people in individualistic (e.g., United States of America) and collectivistic cultures (e.g., Japan) (Markus and Kitayama, 1991). Within any given culture, these two construals are often orthogonal and thus can co-exist within the same person (Singelis, 1994). Nevertheless, researchers have also suggested that the two construals could be combined such that self-construal is defined by the relative balance between independent versus interdependent self-construals (Kitayama et al., 2009).

Those with more independent self-construals (hereby called independents) view the self as being unique and independent of others,

defining the self by internal attributes, such as attitudes, abilities, and personality traits. Previous work implicates a more independent self-construal in individual competitive behaviors that maximize gains for the self, rather than for others. This work often employs social dilemma games, which test competitive vs. cooperative behaviors when individual and collective interests conflict (Dawes, 1980). For example, cooperation in a social dilemma game decreases as a function of independent self-construal (Utz, 2004). People from an independent culture (Americans) also tend to cooperate less in social dilemma games than those from an interdependent culture (Vietnamese) (Parks and Vu, 1994). In contrast, those with interdependent self-construals (hereby called interdependents) view themselves as connected to and motivationally-oriented toward others, defining the self by external, situational factors (e.g., groups, relationships, communities) (Cross et al., 2011; Markus and Kitayama, 1991).

Altogether, we hypothesize that individual competition should be more important and more likely as a function of greater independence, whereas it may be less of a concern and less likely with greater interdependence. To the extent that the link between testosterone and aggression is more robust among those motivated during individual competitions (Carré and McCormick, 2008; Eisenegger et al., 2011; Mehta and Josephs, 2006), we anticipate that this link is more robust and reliable as a function of independence dominance and, conversely, less robust and weaker as a function of interdependence dominance.

The link between testosterone and aggression could be conceived at multiple levels. The first goal of the current work was to determine whether self-construal would moderate the link between testosterone and aggression and, moreover, this moderation effect might differ for basal testosterone level versus acute testosterone changes (Aims 1 and 2). We also tested whether competition induced testosterone dynamics would differ as a function of self-construal (Aim 3).

1.2.1. Aim 1: Does self-construal moderate the association between basal testosterone and aggression?

Cross and Madson (1997) theorized that interdependents avoid aggression as it could jeopardize social connections or demonstrate poor self-regulation. Interdependence is associated with decreased engagement in cyber-bullying and victimizing in adolescents (Cetin et al., 2012). Cross-cultural comparisons have revealed that individualistic, independent groups are more likely to initiate competitive conflicts and use more competitive, dominant conflict resolution tactics compared to more interdependent groups, who adapt obliging, harmonizing tactics (Oetzel, 1998a, 1998b). Differences in self-construal also explain conflict management strategies better than ethnicity or sex (Ting-Toomey et al., 2001). Overall, this suggests that interdependence may de-couple the association between testosterone and aggression. The basal testosterone-aggression association may be small in humans because interdependents suppress aggressive behaviors or motivations to aggress when testosterone levels are elevated. Rather than investigating bivariate associations between basal testosterone and aggression, or self-construal and aggression, Aim 1 is focused to test an interactive model. Thus, in Aim 1, we investigated whether the association between basal testosterone and aggression differs between independents and interdependents.

1.2.2. Aim 2: Does self-construal moderate the association between testosterone changes and aggression?

Researchers have reasoned that acute changes in testosterone more robustly accounts for reactive aggression than basal testosterone (e.g., Carré et al., 2011). Because more interdependent individuals (as previously mentioned) with high testosterone may avoid acting aggressively when testosterone is elevated, self-construal might also moderate associations between testosterone dynamics and aggression.

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