universität wien

MASTERARBEIT / MASTER'S THESIS

Titel der Masterarbeit / Title of the Master's Thesis

„Perception of Masculinity and the Effects of Testosterone on Aggression in Men"

verfasst von / submitted by

Lara Diaz Rodriguez BSc

angestrebter akademischer Grad / in partial fulfilment of the requirements for the degree of

Master of Science (MSc)

Wien, 2019 / Vienna 2019

Studienkennzahl lt. Studienblatt / degree programme code as it appears on the student record sheet:	A 066 840
Studienrichtung lt. Studienblatt / degree programme as it appears on the student record sheet:	Masterstudium Psychologie UG2002
Betreut von / Supervisor:	Univ.-Prof. Dr. Claus Lamm

Acknowledgements

During this time and process of writing my thesis I have received support from many people which I would like to thank. First, I would like to thank my co-supervisor, Hana Kutlikova, for being so open-minded about the thesis topic that I wanted to write about and help me find a way to integrate it into the big study that was going to start at the NBU, and for guiding me throughout the whole process and giving me advice whenever I had doubts about the theoretical approach or the methods used in my thesis.

I would also like to thank my colleagues for their contribution to the big study conducted at the NBU, specially to Felix Dörflinger for sharing the results of the task he programmed with me. Without that great teamwork none of this would have been possible. Also, I am very grateful that Mark Talatzko accepted correcting my thesis and did so in such short notice.

And last but not least, I would like to thank my husband, Philipp, for emotionally supporting me throughout my Master's studies, with the ups and downs, for being so patient and always saying the right thing at the right time in order help me find my motivation again and for making me believe in myself.

Table of Contents

1. Abstract

Introduction Some studies argue that testosterone is related to aggression only if an aggressive behavior is seen as a means to achieve or maintain a high status. In patriarchal cultures men have automatically a higher social status than women. However, to profit from it, they must be acknowledged by others as men. Some men maintain or regain their gender status by behaving aggressively, which is considered a typical masculine behavior. The aim of this study is to throw some light into the aggression-testosterone relationship from a gender perspective. The endorsement of a traditional masculinity ideology and a precarious manhood are expected to increase the number of aggressive responses in men to whom testosterone was administered. **Methods** Participants (N = 183) were randomly assigned either to a placebo or to a testosterone group. Approximately 4 hours after the administration, they answered the Man Box questionnaire, a measure for the endorsement of a traditional masculinity ideology, and the precarious manhood questionnaire, a measure for the perceived elusion of manhood, and completed an adapted version of the PSAP task. **Results** 2x2 ANOVAs show a main effect of the endorsement of a traditional masculinity ideology on aggression but no effect of either precarious manhood, testosterone or an interaction of any of these variables. **Discussion** These results support various studies relating a traditional masculinity ideology with aggression and open the door to use masculinity questionnaires as a control variable in the future for studies researching traits directly related to a traditional masculinity.

2. Introduction

In the last 15 years the American Psychological Association (APA) has published guidelines to advice psychologists on how they should treat specific populations and inform them about the distinct psychological, social and life characteristics of the various populations and how these characteristics could affect not only the treatment but also the diagnosis of some disorders. One of the initial sets of guidelines pertaining to practicing with specific populations was for girls and women, 12 years ago, (APA, 2007). Later the APA published guidelines for the practice with homosexual and bisexual clients (APA, 2012), older adults (APA, 2014) and gender nonconforming people (APA, 2015), among others. However, it came as a surprise when in August 2018 they published a similar set of guidelines for the practicing with men and boys (APA, 2018). Men have been historically seen in psychology, as well as in other disciplines, as the norm representing the whole population and not as a specific group with specific characteristics and needs. Nevertheless, since the 1990s the topic

of boys and men being an overrepresented group when talking about problems with physical and mental health has been getting more attention and acknowledgement (APA, 2018). For example, men tend to avoid visits to the doctor, ignore symptoms they might have, take more risks and they engage more often, and are victims of, violent encounters, which leads to higher rates of heart disease and strokes as well as higher rates of accidents and death (Courtenay, 2011; Evans, Frank, Oliffe, & Gregory, 2011; Galdas, Cheater, & Marshall, 2005; Yousaf, Grunfeld, & Hunter, 2015). They also do not seek psychological help as often as women do, and when they do seek psychological help, they can be misdiagnosed (e.g. mistaking substance abuse for depression), which could be an explanation for the much higher suicide rates among men compared to women (Seidler, Dawes, Rice, Oliffe, & Dhillon, 2016; Wong, Ho, Wang, & Miller, 2017; Yousaf, Grunfeld, & Hunter, 2015). Men are also highly overrepresented in prisons; 93% of inmates are male in comparison to the 7% of female inmates in American prisons (Federal Bureau of Investigation, 2019), whereas in Europe we find that 95,35% of all inmates are male while 4,65% are female (European Commission, 2018).

One must notice the emphasis of the APA (2018) in how social and gender norms, beliefs surrounding the concept of masculinity, and contextual norms influence the above-mentioned behaviors in boys and men and how this might indicate a paradigm shift—from biological to social—in psychology, especially when referring to psychological gender differences. As much as this change can be appreciated, human behavior is extremely complex and usually the most fitting theories and explanations are the ones that integrate both the biological and the social approaches. Bearing this in mind, my intention with this study is to incorporate a gender perspective into the already-existing biological research linking testosterone with aggression. As testosterone plays a role in social behaviors, taking into account that men are also gendered beings who try to fulfill societal expectations related with their role in society as men could help to understand more thoroughly the way testosterone influences some behaviors. For this reason, one of the purposes of this study and what could be considered a contribution to future research is to introduce the concept of what could be defined as a "masculinity control variable" for research on topics such as aggression, social status, dominance, risk behavior, homophobia and threat perception, among others.

2.1.Testosterone

Testosterone is a sex steroid produced primarily by the Leydig cells in the testes in men and the ovaries and the placenta in women, as well as the adrenal cortex both in men and in women (Eisenegger, Haushofer, & Fehr, 2011; Mazur & Booth, 1998). Testosterone concentrations in blood are much higher in men (10 ng/ml) than in women (approximately one seventh of normal male values) and vary throughout life, as well as differing between

time of day and season (Book, Starzyk, & Quinsey, 2001; Mazur & Booth, 1998). They are at their highest in the morning—due to the high production of gonadotropin-releasing hormone (GnRH) during the night, which controls the synthesis of testosterone— and fall over the course of the day (Celec, Ostatníková, & Hodosy, 2015; Mazur & Booth, 1998).

In men, testosterone is first produced by the testes during the perinatal phase—i.e. gestation and shortly after birth—and it has organizational effects; it causes the development of some body parts such as the penis and the scrotum, organizes hormone receptors in the brain and creates brain structures. Organizational effects of testosterone are long-term, opposed to activational effects, which are short-term and activate the structures and neural networks previously formed. Both organizational and activational effects are thought to affect behavior (Book et al., 2001; Mazur & Booth, 1998). In a number of animal species, testosterone during this phase contributes to sexual differentiation of some areas of the brain—e.g. the size of the nuclei of the medial amygdala is bigger in male than female rats due to the effects of testosterone (Lovejoy, 2005). In humans, it is still not clear which brain dimorphisms are caused by testosterone, as the production, interaction and function of the hormone are highly complex (Archer, 1991; Mazur & Booth, 1998; Nguyen, Ducharme, & Karama, 2017). However, some studies claim that perinatal testosterone production influences behavior in later life stages. Higher testosterone levels during the perinatal phase are associated with a dominant behavior and rough-and-tumble play (Archer, 1991) and assertive and aggressive behavior (Book et al., 2001).

From six months of age to pre-adolescence, testosterone levels in men stay low, and early in puberty the testes start producing testosterone in large volumes until adult testosterone levels are reached. During this stage, adolescents experience, among other changes, penis and muscle mass growth as well as body and facial hair presence and some behavioral changes such as an awakened interest in sex (Mazur & Booth, 1998). Testosterone levels in men peak in their late adolescence and early 20s and from that point on they decline progressively with age. Because sexual activity and aggressiveness follow a similar timeline, peaking around the early 20s and declining with age, it was believed that testosterone was the cause of such behaviors. However, when looking at libido and sexual activity, it cannot be clearly established that testosterone fluctuations are reflected in sexual behavior as long as there is a minimum amount of the steroid circulating (Mazur & Booth, 1998). The relationship between testosterone and aggression is thoroughly discussed below.

2.1.1. Testosterone and aggressive behavior. Although the relationship between testosterone and aggressive behavior in humans is not clear, some studies with non-human animals show that testosterone causes aggressiveness in some species, especially in rodents

and birds (Archer, 1991; Book et al., 2001). However, even in those cases, it has been reported that previous fight experience can annul the effect of testosterone (Archer, 1991).

In young boys, studies show contradictory results. For example, Olweus, Mattsson, Schalling, and Loew (1988) show correlations only with aggressive behavior as a response to perceived provocation, while some studies show no correlation at all (Constantino, Grosz, Saenger, Chandler, Nandi, & Earls, 1993; Inoff-Germain, Arnold, Nottelmann, Susman, Cutler, & Chrousos, 1988; Susman, Inoff-Germain, Nottelmann, Loriaux, Cutler, & Chrousos, 1987; Udry, 1990), and other studies do show correlations between testosterone and aggressive behavior in young men (Archer, 1991; Book et al., 2001; Mazur & Booth, 1998).

In adults, we find the same range of results varying form study to study, which is why in respect to this topic it is useful to look at meta-analysis. Archer, Birring, and Wu (1998) analyzed 18 studies and calculated their effect sizes with Cohen's *d* values in order to be able to compare them. They also considered the different methods of assessing aggressive behavior—questionnaires for verbal and physical aggression, records of aggressive or criminal behavior and peer ratings. Archer and his colleagues found and overall effect of $d = 0.28$ after removing three outliers (the effect of all 18 studies was $d = 0.40$). Book and her colleagues (2001) included 45 studies in their meta-analysis, 61studies were excluded, among other reasons due to missing information regarding the method used to measure testosterone or aggression, or regarding effect sizes—this included some studies reporting no significant results which additionally did not include any specific information about the statistics used. The effect sizes of the studies, calculated with Rosenthal's *r*, range from -.28 to .88 and they were positive in 83% of the studies; the unweighted mean correlation was $r = .23$, non-significant. When the correlation was weighted by the sample size of the studies it became significant but smaller: $r = .14$. Archer, Graham-Kevan, and Davies (2005) reanalyzed the meta-analysis of Book and colleagues (2001) on grounds of methodological errors and found a corrected overall effect of $r = .08$.

In summary, it can be stated that the mean effects found in the meta-analysis are small, or small to medium. This includes some studies showing negative effects and some studies excluded from the meta-analysis with no significant results (*file-drawer problem*; Rosenthal, 1979). The wide range of results found in the individual studies indicates a high degree of inconsistency in the literature pertaining to the relationship between testosterone and aggression. When looking at more recent studies, the results are also contradictory (Carré, Geniole, Ortiz, Bird, Videto, & Bonin, 2017; Turanovic, Pratt, & Piquero, 2017).

Possible moderator variables. To explain the discrepancy in results when it comes to establishing the link between the sex steroid and aggressiveness, different moderator variables have been proposed by various researchers.

Circadian rhythm and life cycle of testosterone. As mention in section 2.1., testosterone has daily, seasonal and life cycles, which could partly explain the range of different results in literature. Book and her colleagues (2001) report a highly significant moderating effect of the time the testosterone was collected, and of the subjects' age—only in men—in the studies used in their meta-analysis.

Sex. It has been shown that women have much lower levels of testosterone in general and it is speculated that testosterone could work differently in men and in women. For example, Mazur and Booth (1998) state that testosterone levels in women do not rise before a competition, but they do in men.

Aggression measures. Archer (1991) argues that one reason for the variety in results is the broad definition of aggression in humans in comparison to aggression in animals. In humans, aggressive behavior has to have the intention to harm another human. It has to have a manifestation of this intention and it has to be accompanied by a negative emotion ranging from irritation to rage. Carré, McCormick, and Hariri (2011) do not consider the presence of a negative emotion to be necessary to engage in an aggressive act and they differentiate between proactive aggression, which takes place in the absence of a provocation and is accompanied by low physical arousal, and reactive aggression, which is perpetrated as a reaction to a perceived provocation or threat and is accompanied by high physical arousal. Because of this broad and complex definition and some ethical concerns about measuring direct, overt aggression in humans, aggressive behavior is usually measured as a personality trait or predisposition using questionnaires and often overlaps or can be confused with other constructs such as dominance—thoroughly explained below in section 2.1.2. These measures do not always correlate with actual aggressive behavior and studies using more accurate measures for aggressive behavior, such as ratings done by peers or reported past behavior, are more reliable (Archer, 1991; Book et al., 2001; Mazur & Booth, 1998). Thanks to technological developments it is nowadays possible to measure aggressiveness in a more direct way and in a laboratory setting using tasks specifically developed for that purpose such as the Taylor Aggression Paradigm (TAP), the Ultimatum Game (UG) or the Point Subtraction Aggression Paradigm (PSAP) (Carré at al., 2011).

Testosterone measures. The different ways to measure testosterone can also influence the results of a study. One of the most used methods due to its simplicity and its non-invasiveness is to measure salivary testosterone levels; this method allows researchers to collect saliva repeatedly within hours without any special training. However, there are some aspects that can influence the results of the analysis of salivary testosterone. Chewing gum before collecting the saliva or using cotton-based products to collect it can affect the sample. Blood in the mouth can contaminate the sample. Furthermore, the relationship between

salivary and serum testosterone is different between men and women which leads to an underestimation of the correlation testosterone-behavior by 65.13% in women and 10.13% in men. Moreover, the temperature at which saliva samples are stored and the length of storage time influences the detection of testosterone levels in the saliva (Granger, Shirtcliff, Booth, Kivlighan, & Schwartz, 2004). The method of assessment of testosterone plays a role as well in the accuracy of the measurement. Immunoassays are thought to be an unreliable way of measuring various proteins as well as testosterone in people with low testosterone levels such as children and women and instead it is recommended to use other methods such as the liquid chromatography-mass spectrometry (LC-MS/MS) combined method (Becker & Hoofnagle, 2012; Moal, Mathieu, Reynier, Malthièry, & Gallois, 2007).

The second to fourth finger ratio (2D:4D) is a sex dimorphism found in humans—women tend to have higher ratios than men have—thought to be a biomarker for prenatal testosterone exposure (Lutchmaya, Baron-Cohen, Raggatt, Knickmeyer, & Manning, 2004; Manning, Scutt, Wilson, & Lewis-Jones, 1998). For this reason, some studies use this measure to research the organizational effects of testosterone in behavior. However, the difficulty to clearly replicate these results, partly due to the complications of directly measuring testosterone levels in the placenta as well as the existence of studies contradicting such relationship (Warrington et al., 2018; Wong & Hines, 2016), makes us question whether this measure is indeed reliable.

Basal vs reciprocal model. Most studies try to find correlations or even a causal explanation assuming that testosterone variations within one subject are small oscillations of their basal levels of testosterone, which remain stable and consistent from early adulthood. That means that men who at one point have high testosterone levels also have high levels a couple of days, months and years later, and the same understanding applies to men with low testosterone levels (*basal model*; Mazur & Booth, 1998). According to this model, the time point of the testosterone measurement is irrelevant. Conversely, the *reciprocal model* states that testosterone levels and behavior influence one another; that testosterone is cause and consequence for some behaviors. For example, testosterone levels rise in men before a competition and increase in the event of a winning outcome or decrease in the event of a loss. It is argued that this increase after a win could play a role in searching for other competitions to maintain the acquired status, while in losers it could play a role in retiring from future competitions and experiencing another loss (Carré et al., 2011; Mazur & Booth, 1998). This last model is usually not taken into account in the literature about testosterone and aggression where testosterone levels are measured only once. Carré and McCormick (2008) show the importance of the reciprocal model in a study in which they measured the testosterone of participants before and after a PSAP task. The results present no correlation between the first

measure of testosterone and reactive aggression during the PSAP task, but they do show a relationship between testosterone levels measured at the second point in time and reactive aggression.

2.1.2. Testosterone, dominance and social status. The difference between aggression and dominance is that the intention of the first is to inflict harm in others, while the intention of the second is to demonstrate dominance, power or a higher social status over others. In animals, dominance is often only achieved by showing an aggressive behavior. However, the palette of behaviors with which humans can show dominance is much broader. Sports, elections, any kind of competition, staring duration or body postures are some examples of social settings and situations in which a high social status can be established without aggression (Eisenegger et al., 2011; Mazur & Booth, 1998). For this reason, it is claimed that testosterone is only linked to aggression in those cases when dominance or a high social status is asserted by an aggressive behavior and various studies confirm that claim (Campbell, Muncer, & Odber, 1997). For example, Dabbs and Morris (1990) report that antisocial, risky and aggressive behavior are related to extreme testosterone levels only in subjects with a low socio-economic status (SES) and hypothesize that people with a high SES can find "excitement" in playing sports instead of assaulting or arguing instead of fighting. This assumption fits the claim that testosterone is only linked to aggression in those cases when dominance or a high social status is asserted by an aggressive behavior (Mazur & Booth, 1998). A study of Carré and his colleagues (2017) demonstrate that exogenous testosterone only increases aggressive behavior in men with high scores in trait dominance or low scores in trait self-control. Eisenegger and his colleagues (2011) mention various studies showing correlations between basal testosterone levels and measures of dominance and power motivation, as well as studies suggesting that testosterone plays a key role in a set of behaviors that have the goal of maintaining or gaining a high social status, such as reducing fear, reducing facial mimicry, reducing the ability to infer feelings and intentions from others by looking to their eyes, reducing trust and increasing stress resilience.

2.1.3. Testosterone and status threat. In order to maintain a high social status, one must be vigilant for possible threats to status. As testosterone plays an important role in status-seeking behaviors, it is only logical to think that it could also play a role in threat perception and threat vigilance. One way to measure this selective attention to threat is with subjects' reactions to angry faces, as it is thought to be a threat signal to one's social status in face-to-face encounters (Eisenegger et al., 2011). Van Honk and his colleagues (1999) found a positive relationship between testosterone levels and selective attention to angry faces.

Once a stimulus or a situation is perceived as a threat, the reaction to that threat is enhanced by testosterone; men who received exogenous testosterone reacted by taking more

money from their opponents after having played a modified TAP task if they lost and perceived their opponents as being socially provocative—i.e. taking substantial amounts of money from the subjects if they had lost the game (Wagels, Votinov, Kellermann, Eisert, Beyer, & Habel, 2018); exogenous testosterone in women increased the activation of brain areas related to reactive aggression (amygdala, hypothalamus) and impulse control (orbitofrontal cortex, OFC) after seeing images of angry faces (Hermans, Ramsey, & van Honk, 2008); after a GnRH antagonist reduced testosterone levels of male participants to a common baseline and exogenous testosterone was administered, there was an increased activation of the amygdala and the hypothalamus in reaction to seeing angry faces (Goetz, Tang, Thomason, Diamond, Hariri, & Carré, 2014).

2.2. Men and masculinities

When talking about social status, it is important to take into account the implicit and close relationship that it has with men in patriarchal cultures, but before looking deeper at this link, a number of key concepts should be defined to allow a complete understanding of their use later. *Sex* is the classification of a person into man or woman due to biological characteristics, which have been socially established (Gildemeister, 2010). Some state these biological characteristics should be the appearance of genitalia, others argue it should be based on genetics—Y chromosomes indicate maleness: XX or XXX would be classified as female and XY or XXY as male—and a third group claims the classification should be based on levels of sex hormones (Sullivan, 2011). *Gender* refers to the subjective classification based on what society and culture attribute to being masculine or feminine and the social expectations stemming from them regarding behavior, interests, and personality (Delphy, 1993; Gildemeister, 2010). Even though these two concepts are independent and may or may not overlap each other, most researchers outside the field of Gender Studies often confuse the terms or use them as synonyms. The belief, held by some researchers and lay people still to this day, that a masculine or feminine behavior has exclusively a biological nature implies that it is not possible to change it, and this view is often used as an argument to maintain discriminatory practices (Conger, 2017; Taylor, 2017). However, a behavior with a social nature makes it more malleable (Connell & Messerschmidt, 2005).

The term *masculinity* is quite new from a historical point of view and it is opposed to femininity (Connell, 2005). The Oxford English Dictionary defines masculinity as “qualities or attributes regarded as characteristic of men”. However, depending on the field of usage of the term, it has different connotations and has been defined using different approaches. Connell (2005) mentions 4 of these approaches; the *essentialist* approach bases the definition of masculinity on a chore characteristic of the masculine: active, risk-taking, aggressive, etc. —depending on who is defining. The *positivist* approach is used in social sciences and

psychology and defines masculinity by measuring personality traits of men and women and attributing as masculine the traits in which men received statistically higher scores than did women. The *normative* approach assigns men characteristics they must have and a set of social rules they must follow in order to be considered masculine. However, men only meet these standards of masculinity to a degree. The *semiotic* approach considers masculinity as a neutral, unmarked term in contrast to femininity, which is defined as the lack of what masculine is.

In this Master's thesis, the term masculinity is used in the sense of Connell (2005) which describes it as a social construct that changes through time differs from culture to culture, from social class to social class, even from person to person. There is no single "real" masculinity, but multiple, diverse masculinities influenced by different gender ideologies and social, historical and cultural contexts (Levant & Richmond, 2008). There are white, black, gay, worker and traditional masculinities, only to name a few, and within these categories there are also different masculinities: the masculinity of Japanese salarymen, the masculinity of black-American sportsmen, the masculinity of white-elite university students, etc.

2.2.1. Social status. Most gender ideologies in the world serve the purpose of maintaining power structures based on gender, and so the various masculinities are hierarchized; *hegemonic masculinity* stands at the top of the social-status hierarchy and femininity—as a "natural" opponent to masculinity—stands at the bottom. All other masculinities are situated in between and their hierarchical position changes depending on the society and culture of a specific geographical region and time in history. Hegemonic masculinity can be defined as "the configuration of gender practice which embodies the currently accepted answer to the problem of the legitimacy of patriarchy, which guarantees (or is taken to guarantee) the dominant position of men and the subordination of women" (Connell, 2005, p. 77). In other words, hegemonic masculinity is the pattern of actions and roles attributed to men that perpetuate their dominance over women. It is a changing ideal of what and how a man should be, depending on the current state of society, in order to maintain a patriarchal hierarchy and cultural dominance in that society. A specific hegemonic masculinity will only be established in the society if it is supported by an institutional power, e.g. the military or the government (Connell, 2005). The ideal man can be a soldier in times of war, a working-class provider during the industrial revolution, or a muscular football player in the sports world, just to mention a few examples. It should be noted that the term *hegemony* should be understood as dominance—it does not necessarily involve violence, even though it can—and is ingrained in the government, the media, the economy and the religion. This dominance is not a total dominance, where others are eliminated, but a constant play of power to keep them subordinated (Connell, 1987).

As mentioned above, the hierarchies among different masculinities change with time. One good example is the social status of homosexual men, which has increased in the last few decades in certain countries and in certain circles. A couple of decades ago it would have been unthinkable to have an openly gay Prime Minister anywhere in the world. However, in in Europe in recent years there have been two homosexual male Primer Ministers—Xavier Bettel, in Luxembourg, and Elio di Rupo in Belgium. Despite some advances, rates of violence and discrimination against homosexual men are still higher than those against heterosexual men (Marzullo & Libman, 2009).

Despite the hegemonic man not being the statistical norm—very few men embody all its characteristics—it is normative, and because men as a collective profit from its function of keeping power away from women, most of them, consciously or unconsciously, agree and support this normative hegemonic masculinity and create hierarchies among themselves depending on how much or how little other males embody this ideal (Bird, 1996; Connell, 2005; Connell & Messerschmidt, 2005).

According to Connell's various theories about masculinities, gender and power (Connell, 1987; Connell, 2005; Connell & Messerschmidt, 2005), men in patriarchal societies automatically have a higher social status than women since they are born without having to do anything for it, in contrast to women, who are automatically at the bottom of this hierarchy. This could be an explanation for the phenomenon observed by Donelly and Twenge (2017) when comparing the responses of men and women in the Bem Sex-Role Inventory (BSRI; Bem, 1974) from 1974 to 2012. The BSRI includes a masculinity (M) scale, a femininity (F) scale and a social desirability scale, each with 20 personality traits—the M and F scales have items thought to be desirable in in the opposite gender in 1974, e.g. aggressive, athletic, independent, competitive and self-sufficient are traits on the M scale, and affectionate, childlike, gentle, shy and understanding are traits on the F scale. Donelly and Twenge's (2017) results show a shift through time in women's responses in the M and F scales. From 1974 to 1993 women's scores on the M scale increased significantly with stable scores on the F scale, whereas from 1993 to 2012 scores on the M scale from 1993 remained stable and scores on the F scale decreased significantly. However, men's responses both on the M and the F scales remained stable through time. These results would support Connell's theory: Men embracing what are considered typical feminine personality traits would descend in the social status hierarchy, whereas women adopting typical masculine traits would ascend in the hierarchy. There are some examples through history that also support this theory, where we observe women embracing typical masculine behaviors or characteristics but cases in which men welcome typical feminine characteristics are marginal: women wearing pants, women not wearing make-up, women joining the workforce instead of staying home, etc.

2.2.2. "Real" men. To benefit from this high social status, one must be first socially acknowledged as a man. Even though the characteristics and ideas that are associated with being a man evolve over time and with culture, there is still a particular and widespread idea of what a "real" man is or should be. The specific set of traits that are considered to be standard for men are the ones associated with the traditional male role, with the traditional masculinity ideology and with the hegemonic man before the sexual revolution of the 70s (Levant & Richmond, 2008; Pleck, Sonenstein, & Ku, 1993). In his book review of David and Brannon's *The forty-nine percent majority: The male sex role*, Pleck (1977) mentions the four pillars established by David and Brannon for men to follow in order to behave like men; "no sissy stuff" refers to the avoidance of anything remotely considered as feminine, "the big wheel" of success and status, "the sturdy oak" is a metaphor for how strong, tough and confidence men should be, and "give 'em hell" refers to violent, adventurous and risky behaviors. Later, in 1984 Brannon published a masculinity scale based on these four pillars and suggested that it was necessary for men to score high in some of these dimensions, but not necessarily all, in order to be considered masculine. Also, as mentioned in section 1.2.1, the BSRI describes traits such as aggression, violence, competitiveness and dominance as being masculine traits and show how in 2012 men still self-identified with such traits. In the late 80s Levant and Fisher (1998) developed the Male Role Norms Inventory (MRNI), a questionnaire to measure men's attitudes towards the roles of men and masculinity norms, which consisted of 57 normative statements to which subjects had to indicate their agreement. Since then, various versions of the MRNI have been published and in 2007 Levant, Smalley, Aupont, House, Richmond, and Noronha, validated in their study the revised version of the MRNI (MRNI-R), which assesses only traditional male role norms and has updated language. The MRNI-R has seven subscales: Avoidance of Femininity, Fear and Hatred of Homosexuals, Extreme Self-Reliance, Aggression, Dominance, Non-relational Attitudes toward Sexuality, and Restrictive Emotionality. The results of Levant and his colleagues (2007) show a high endorsement by men of traditional male roles and a traditional *masculinity ideology*. Masculinity ideology can be defined as the endorsement of masculinity and the roles of men by men. It provides boys and men with a set of culturally-based, internalized beliefs regarding which behaviors they should adopt and which behaviors they should avoid (Levant & Richmond, 2008; Pleck, Sonenstein, & Ku, 1993). The Conformity to Masculine Norms Inventory (CMNI; Mahalik et al., 2003) is another example that shows which traits and behaviors are associated with men. They identified 12 subscales: Winning, Emotional Control, Risk-Taking, Violence, Dominance, Playboy, Self-Reliance, Primacy of Work, Power Over Women, Disdain for Homosexuals, Physical Toughness, and Pursuit of Status. These examples reveal how up-to-date the traditional masculinity ideology is and the

characteristics which are common in all questionnaires: aggression, avoidance of femininity, status and toughness.

Various correlational studies show a direct relationship between a traditional masculinity ideology and aggressive behavior (Heilman, Barker, & Harrison, 2017; Steinfeldt, Vaughan, LaFollette, & Steinfeldt, 2012) as well as a moderating effect of the traditional roles of men on aggression (Cohn, Seibert, & Zeichner, 2009; Thomas & Levent, 2012).

2.2.3. Precarious manhood. Many men feel that manhood is gained with difficulty and can be easily lost (Vandello, Bosson, Cohen, Burnaford, & Weaver, 2008). While womanhood is thought to be biologically determined—the process of becoming a woman is usually attributed to biological changes—, manhood is thought to be socially constructed. For this reason, Vandello et al. (2008) argue that there are numerous rituals to make the process of changing from boy to man explicit, and in the cultures where these rituals do not exist, the status as a man is ambiguous and uncertain. Thus, manhood is seen as elusive and so it requires some effort to maintain or reestablish it. This concept is known as *precarious manhood*. For this reason, when men feel that their manhood is being threatened—which at the same time is a social status threat for all the reasons mentioned above—they react by behaving as manly as they can.

Bosson, Vandello, Burnaford, Weaver, and Arzu Wasti (2009) show how men who had to complete the task of hair-braiding—which men consider stereotypically feminine and emasculating, and thus was perceived as a gender threat—choose more often to punch a punching pad instead of solving a riddle in comparison to men who had to complete the task of rope-braiding, considered gender-neutral. However, when men had to choose between two tasks considered equally manly, punching a punching pad or shooting a basketball, no differences were found between the gender-threat group and the neutral group but the gender-threat group punched the pad significantly harder. Cohen, Nisbett, Bowdle, and Schwarz (1996) present another example of reactive aggression to a perceived status threat related to masculinity: Men living in what they referred to as a *culture of honor* (a culture where already small confrontations are perceived as a threat to one's reputation and social status) understood pride as pride of manhood, and linked it to courage and physical strength. These men were much more likely to react with violence and threat to an insult than men with a different cultural background. They also noticed that the testosterone levels and cortisol levels of southern men rose by 12% and 79% respectively after the perceived threat in comparison to the control. Cheryan, Cameron, Katagiri, and Monin (2015) mention various studies that show the wide range of behaviors with which men react to a masculinity threat: displaying aggression, harassing women, discrediting non-masculine men, among others. Their results show how men who feel that their masculinity is being threatened react by displaying less

interest in typical feminine products and describing themselves with more typical masculine traits.

3. Research questions and hypothesis

There is no clear direct, causal relationship between testosterone and aggressive behavior (Archer, 1991; Book et al., 2001) and there are some variables that moderate the existing relationship between the hormone and aggression (Archer, 1991; Book et al., 2001; Carré & McCormick, 2008; Mazur & Booth (1998). Moreover, there is evidence that testosterone is involved in behaviors to gain or maintain social status (Carré et al., 2017; Dabbs & Morris, 1990; Eisenegger et al., 2011; Mazur & Booth, 1998).

Various studies show the close relationship between men and social status (Connell, 1987; Connell, 2005; Connell & Messerschmidt, 2005) and how in people's imaginary, especially in men's imaginary, the hegemonic masculinity—i.e. the one on top of the social status hierarchy—is still rooted in traditional masculine traits such as aggression and dominance (Donelly & Twenge 2017; Levant & Richmond, 2008; Mahalik et al., 2003; Pleck et al., 1993) and how endorsing this traditional masculinity ideology is linked to higher levels of aggression (Cohn et al., 2009; Heilman et al., 2017; Steinfeldt et al., 2012; Thomas & Levent, 2012). Also, men feel the need to restore their manhood whenever they perceive a gender threat, which is usually considered a status threat, and they do so with a variety of what they consider typical masculine behaviors, for example with aggression (Bosson et al., 2009; Cohen et al., 1996).

3.1. Research question 1

The first research question based on the literature mentioned above is: "How does the endorsement of a traditional masculinity ideology affect the relationship between testosterone and aggression in men?".

Hypothesis 1 (H1). I expect to find the highest number of aggressive responses in men who are in the testosterone group and men who see aggressive behavior as a way to achieve a higher status, i.e. men who endorse a traditional masculinity ideology.

H_0: Men who endorse a traditional masculinity ideology and are in the testosterone group will show no significant differences in the number of aggressive responses in comparison to any other group.

H_1: Men who endorse a traditional masculinity ideology and are in the testosterone group will show the significantly highest number of aggressive responses in comparison to any other group.

Hypothesis 2 (H2). I expect to find the lowest number of aggressive responses in men who are in the testosterone group and men who do not see aggressive behavior as a way to achieve a higher status, i.e. men who do not endorse a traditional masculinity ideology.

H_0: Men who do not endorse a traditional masculinity ideology and are in the testosterone group will show no significant differences in the number of aggressive responses in comparison to any other group.

H_1: Men who do not endorse a traditional masculinity ideology and are in the testosterone group will show the significantly lowest number of aggressive responses in comparison to any other group.

Hypothesis 3 (H3). I expect to find no differences between subjects in the placebo and the testosterone groups who do not see aggressive behavior as a way to achieve a higher status, i.e. men who do not endorse a traditional masculinity ideology.

H_0: Men in the testosterone and the placebo groups who do not endorse a traditional masculinity ideology will show no significant differences in the number of aggressive responses.

H_1: Men in the testosterone and the placebo groups who do not endorse a traditional masculinity ideology will show significant differences in the number of aggressive responses.

3.2. Research question 2

The second research question inferred from the above-mentioned literature is: “How does precarious manhood in men affect the relationship between testosterone and aggression in men?”.

Hypothesis 4 (H4). I expect to find the highest number of aggressive responses in men who are in the testosterone group and men who see manhood as precarious.

H_0: Men who see manhood as precarious and are in the testosterone group will show no differences in the number of aggressive responses in comparison to any other group.

H_1: Men who see manhood as precarious and are in the testosterone group will show the significantly highest number of aggressive responses in comparison to any other group.

Hypothesis 5 (H5). I expect to find the lowest number of aggressive responses in men who are in the testosterone group and men who do not see manhood as precarious.

H_0: Men who do not see manhood as precarious and are in the testosterone group will show no differences in the number of aggressive responses in comparison to any other group.

H_1: Men who do not see manhood as precarious and are in the testosterone group will show the significantly lowest number of aggressive responses in comparison to any other group.

Hypothesis 6 (H6). I expect to find no differences between subjects in the placebo and the testosterone groups who do not see manhood as precarious.

H_0: Men in the testosterone and the placebo groups who do not see manhood as precarious will show no differences in the number of aggressive responses.

H_1: Men in the testosterone and the placebo groups who do not see manhood as precarious will show differences in the number of aggressive responses.

3.3. Research question 3

I expect to find a significant correlation between the traditional masculinity measure and the precarious manhood measure. From this assumption I come to the third research question: “Does a composite measure of traditional masculinity ideology and precarious manhood explain more variance in aggressive behavior than the two measures separately?”.

Hypothesis 7 (H7). I expect to find a stronger effect of the composite measure on aggressive behavior than the effect of the endorsement of a traditional masculinity ideology or the effect of the precarious manhood phenomenon.

H_0: The effect size of the composite measure will not be significantly higher than the effect size of the traditional masculinity measure or the precarious manhood measure.

H_1: The effect size of the composite measure will be significantly higher than the effect size of the traditional masculinity measure or the precarious manhood measure.

4. Method

4.1. Participants

Participants were recruited via online advertisements and recruiting posters and were promised a monetary compensation for their participation in the study, which included a fixed amount of 35€ and a performance-related amount of a maximum of 30€. Potential participants were screened for any possible psychological disorders or chronic diseases, as well as self-reported regular drug use or intake of other substances such as anabolic steroids. All procedures were approved by the local research ethics board and conducted in accordance with the Declaration of Helsinki.

Participants who did not pass the screening test were excluded from the sample leaving a sample of 221 male subjects who took part in a double-blind, placebo-controlled study. From this sample, participants were excluded due to incomplete data (14), not having

understood the task (4) they had to complete or not giving or taking any points from their opponents (24) leaving a sample of 183 participants (see sections 4.2.3 and 5).

4.2. Materials

The study was part of a larger study that included various questionnaires and tasks and had a duration of approximately five to six hours. Participants had to fill in, among other questionnaires, the Behavioral Inhibition, Behavioral Activation Scale (BIS/BAS; Strobel, Beauducel, Debener, & Brocke, 2001), the Liebowitz-Soziale-Angst-Skala (LSAS; Stangier, U. & Heidenreich, T. (2015).), the Portraits Value Questionnaire (PVQ; Schmidt, Bamberg, Davidov, Herrmann, & Schwartz, 2007), and the short version of the Barratt Impulsiveness Scale (BIS-15; Meule, Vögele, & Kübler, 2011). Participants also had to complete a prosocial learning task, an inter-generational goods game task, a two-step task and a BART paradigm risk task. The questionnaires and task related to this specific study that participants had to complete are thoroughly described below.

4.2.1. Man Box questionnaire. The Man Box questionnaire (Heilman et al., 2017) was used to assess the degree of endorsement of a traditional masculinity ideology. The questionnaire consists of 15 statements about how "real" men should behave. Participants had to indicate their agreement to these statements with a 4-point scale (1 = *don't agree at all* and 4 = *completely agree*). The 15 sentences are divided into seven subscales:

- Self-Sufficiency: Men should be independent and do not need help even if it is related to their physical and emotional health.
- Acting Tough: Men should fight back and show toughness.
- Physical Attractiveness: Men should look good but without putting too much effort in it.
- Rigid Masculine Gender Roles: division of household choirs.
- Heterosexuality and Homophobia: Men should be heterosexual.
- Hypersexuality: Men should have as much sex as possible with as many partners as possible.
- Aggression and Control: Men should use violence, if necessary, to control their partners.

The 15 statements were chosen based on the Gender Equitable Men scale (GEM; Pulerwitz & Barker, 2008), which has a high internal consistency ($\alpha = .81$). The Man Box questionnaire was chosen over other questionnaires regarding gender norms for three main reasons: It is short in comparison to other questionnaires, which in this specific case was important due to the length of the whole study (approximately five hours); it includes the way men should behave in a social context, e.g. in a domestic environment instead of focusing only on agreeing with a belief or a trait without context as other questionnaires do; and it links

participants' responses to aggressive behavior (bullying) that took place during the month prior to taking the Man Box questionnaire—51% of participants who highly endorsed a traditional masculinity ideology reported perpetuating some kind of bullying (verbal, online or physical), whereas only the 16% of participants who did not endorse a traditional masculinity ideology reported it.

4.2.2. Precarious manhood questionnaire. The idea of precarious manhood, which is built on two concepts—that the status as a man is hard to obtain and that it is easy to lose—, was the second moderator variable. To see whether participants agreed with the elusion of manhood the questionnaire in Vandello et al. (2008) was used and adapted to German. It consists of 24 common proverbs and 6 proverb-like sentences regarding manhood: "Manhood is hard won and easily lost.", "As a gem cannot be polished without friction, a boy cannot become a man without struggles.", "All boys do not grow up to become real men.", A boy must earn his right to be called a man.", "It is a rocky road from boy to man.", and "A man must continually prove his honor." Participants had to indicate their agreement with these proverbs on a 6-point scale (1 = *don't agree at all* and 6 = *completely agree*). The correlation between the responses for these six items was highly correlated (r = .85) in the original study of Vandello et al. (2008), which shows a high internal consistency. To assess whether participants perceived manhood as something permanent, they were presented with the following sentence: "My life isn't what I expected it would be. I used to be a man. Now I'm not a man anymore." (Vandello et al., 2008), and they had to write interpretations of what the meaning of the sentence could be. More biological interpretations, such as a sex change or the inability to have offspring, indicated a more permanent state of manhood, while social interpretations, such as losing a job, indicated the idea that manhood is not permanent, and thus it is easily lost. Answers where one biological reason and one social reason were provided were coded as neutral.

4.2.3. PSAP. To measure the aggressive behavior of participants (dependent variable), a modified version of the PSAP (Dörflinger, unpublished; Geniole, MacDonell, & McCormick, 2017) was used. The original task shows a re-test reliability of r = .74 and correlates with other aggression measures such as Brown History of Violence (Brown, Goodwin, Ballenger, Goyer, & Major, 1979; r = .72), the direct aggression scale of the Buss-Durkee Hostility Inventory (BHI; Buss, & Durkee, 1957; r = .78) and the Overt Aggression Scale (Yudofsky, Silver, Jackson, Endicott, & Williams, 1986; r = .73), among other questionnaires showing lower correlations. In the original task participants played against a bogus opponent and their objective was to score as many points as possible which were later converted into money. They had to press a specific key X consecutive times in order to score one point, usually 100 times. The bogus opponent could take points from the participants and

they could either continue pressing the same key to earn points, press a second key for a specific number of consecutive times to protect their points for a limited amount of time or press a third key for a specific number of consecutive times to take points from their opponent—they could however, not keep the stolen points.

In our modified PSAP version, participants played also against a bogus opponent and the objective of the game was also to score as many points as possible. In addition to taking points from the participants or the opponents, the modified version included as well the possibility of giving points. The game proceeded as follows: Participants saw a black screen (1920x1080) with small white points moving around and after a 1000 ms, plus a variable interval with a duration between 0 and 4000 ms, three additional colored moving points appeared for 1600 ms, during which participants had to react. If exactly two of the three colored points were of the same color, participants had to press the Space bar to score a point, otherwise they did not have to press the Space bar to score a point. Additionally, at the beginning of each trial (during the first 600 to 1000 ms), participants could take points away from their opponents by pressing the Control key or give points to their opponents by pressing the Shift key. Participants had 17 trials to practice at the beginning of the game. Participants who scored a total of less than six points during this practice phase were required to play the 17 trials again. Once they scored more than six points, they were able to start with the game.

This version of the PSAP had three conditions: One neutral condition, which was played always first, in which the bogus opponent took two points from the participant and gave him two other points; one aggressive condition, in which the bogus opponent only took points from the participant; and one prosocial condition, in which the bogus opponent only gave points to the participant. The opponent's probability of taking or giving points in the aggressive and the prosocial conditions varied between 15 to 25% in every block. Each condition consisted of 4 blocks, each block consisted of 17 trials. The sequence of the aggressive and the prosocial condition was counterbalanced between subjects so that half of them played sequence 1 (neutral – aggressive – prosocial) and the other half sequence 2 (neutral – prosocial – aggressive). The aggression measure used was the number of times that participants took points away from their opponents over the entirety of the game divided by the number of total actions (the number of times that participants took points away from their opponents plus the number of times that participants gave points to their opponents).

As it has been shown that precarious manhood is related to reactive aggression as a response to a perceived gender or status threat (Bosson et al., 2009; Cohen et al., 1996; Cheryan et al., 2015), it is of special interest to compare the groups with the different sequences to see if it has an influence in the interaction between precarious manhood and testosterone on aggression (see section 5.2).

4.3. Procedure

Participants arrived at approximately 1 pm and were received by a male Psychology student, who was presented as the test supervisor and explained to them briefly how the testing session would proceed and gave them the informed consent to read and sign. Once signed, the supervisor scanned both hands of each participant in order to later measure their 2D:4D digit ratio, which was not used for this study.

4.3.1. Saliva and buccal swab samples. After the hand scans, a saliva sample from each participant was collected in an individual plastic tube. Participants were asked not to eat or drink anything 20 minutes prior to the saliva collection. They had to fill up to 2 ml of saliva using a straw or directly discharge the saliva in the tube with their mouth. Various saliva samples were collected through the whole study at different points of time. The saliva samples were stored at -30Cº until their analysis. Using the LC-MS/MS method, the Dresden LabService GmbH measured the testosterone and cortisol levels of the participants. Such measures are reported elsewhere.

Buccal swab samples were collected from all participants in order to analyze their androgen receptor gene, CAG repeat, which is thought to modulate the androgen receptor sensitivity (Vermeersch, T'sjoen, Kaufman, Vincke, & Van Houtte, 2010). This information was not used in this study.

4.3.2. Testosterone administration. After the first saliva sample and the buccal swab sample were collected, participants were asked to topically apply 150 mg of a gel to their shoulders and upper arms. The time of the application was the same for all participants and during a phase of the daily testosterone cycle when levels are thought to be more stable (Book at al., 2001). Both the testosterone gel (Testogel® 50mg) and the placebo gel were put in identical syringes so that neither the test supervisor nor the participants would be able to notice any difference between them. The placebo gel contained the same ingredients as the testosterone gel except testosterone, which made it look and smell identical to the testosterone gel. Once the gel was correctly applied, participants had a waiting period of approximately two hours (Eisenegger, von Eckardstein, Fehr, & von Eckardstein, 2013) during which they had to answer a number of questionnaires, including the questionnaire to asses precarious manhood (see section 4.2) and once they had finished, they could watch a documentary or read.

Approximately two hours after the gel administration, participants started performing the assigned tasks, including the PSAP task, which they started to complete about four hours after the gel administration. Participants concluded the study by answering the Man Box questionnaire and an additional opinion questionnaire. The reason why the Man Box

questionnaire was answered after all tasks were completed was to avoid any possible effects on the performance of the tasks. Before leaving, participants were advised to take a shower when they got home and were given the opportunity to ask any questions they might have regarding the study.

5. Results

From the original sample of 221 male subjects, 38 participants were excluded for neither giving nor taking any points from their opponents in the PSAP task or for not having understood the task, leaving a sample of 183 male participants between the ages of 19 and 39 (M_{age} = 25.39, SD_{age} = 3.93). Most participants were students (85.2%) while the rest were working (12.0%) or were unemployed (2.7%). The demographic characteristics of the final sample are displayed in Table 1. A chi-square test was performed to establish the relationship between de degree of education and the occupation throughout the variables (administration group, endorsement of traditional masculinity and precarious manhood). The chi-square test shows that the variables degree of education and endorsement of traditional masculinity (Man Box) are not independent ($X^2(2, 183) = 7.55$, $p = .023$). As Table 1 shows, the proportion of men with only a school degree is higher in men who endorse a traditional masculinity ideology (Man Box in) than those who do not endorse a traditional masculinity ideology (Man Box out). Chi-square tests for all other variables were not significant.

Table 1

Sociodemographic Characteristics of the Sample (Percentages in Parentheses)

	T *n* = 100 (54.6)	P *n* = 83 (45.4)	MB in *n* = 97 (53.0)	MB out *n* = 86 (47.0)	PM high *n* = 93 (50.8)	PM low *n* = 90 (49.2)
Education						
School degree	10 (10.0)	5 (6.0)	13 (13.4)	2 (2.3)	12 (12.9)	3 (3.3)
Highschool degree	69 (69.0)	51 (61.4)	59 (60.8)	61 (70.9)	58 (62.4)	62 (68.9)
University degree	21 (21.0)	27 (32.5)	25 (25.8)	23 (26.7)	23 (24.7)	25 (27.8)
Ocupation						
Studying	85 (85.0)	71 (85.5)	82 (84.5)	74 (86.0)	76 (81.7)	80 (88.9)
Working	14 (14.0)	8 (9.6)	11 (11.3)	11 (12.8)	13 (14.0)	9 (10.0)
Unemployed	1 (1.0)	4 (4.8)	4 (4.1)	1 (1.2)	4 (4.3)	1 (1.1)

Note. T = testosterone; P = placebo; MB = Man Box; PM = Precarious Manhood.

5.1. Research question 1

To find out how the endorsement of a traditional masculinity ideology influences the relationship between testosterone and aggression three variables were analyzed: the administration group, the results of the Man Box questionnaire and the number of aggressive actions during the PSAP task.

Cronbach's alpha of the 15 items of the Man Box questionnaire was .83. The results were non-normally distributed, with skewness of 0.96 (*SE* = 0.18). For this reason, participants were divided into two groups split by the median: Man Box in and Man Box out. Participants in the Man Box in group endorsed a traditional masculinity ideology more than participants in the Man Box out group. As the aggression measure used—the number of times participants took points from their opponent divided by total number of actions— was not normal distributed, a logarithmic transformation (log10) was performed.

To see if the endorsement of a traditional masculinity ideology interacted with the relationship between testosterone and aggression a 2 x 2, Administration Group (testosterone/placebo) x Endorsement of Traditional Masculinity (Man Box in/out), factorial ANOVA was performed. Only the main effect of the Man Box was highly significant ($F(1, 183) = 14.44$, $p < .001$, $\eta_p^2 = .075$). Men who endorse a traditional masculinity ideology took more points from their opponents ($M = 0.28$, $SD = 0.15$) than men who do not endorse a traditional masculinity ideology ($M = 0.16$, $SD = 0.16$). There was no main effect of the administration group ($F(1, 183) = 0.29$, $p = .593$, $\eta_p^2 = .002$) and no significant interaction between group and masculinity ($F(1, 183) = 1.33$, $p = .250$, $\eta_p^2 = .007$).

Table 2.

Results of the 2 x 2, Administration Group x Man Box, ANOVA

Variables	*n*	*M*	*SD*	*df*	*F*	*p*	η_p^2
Group				1	0.29	.593	.002
Testosterone	100	0.22	0.17				
Placebo	83	0.21	0.17				
Masculinity				1	14.44	.000	.075
Man Box in	97	0.26	0.16				
Man Box out	86	0.16	0.16				
Group * Masculinity				1	1.33	.250	.007
Testosterone * Man Box in	47	0.28	0.15				
Testosterone * Man Box out	53	0.16	0.16				
Placebo * Man Box in	50	0.24	0.16				
Placebo * Man Box out	33	0.17	0.17				

Note. *n* = subgroup size; *M* = mean; *SD* = standard deviation; *df* = degrees of freedom; *F* = *F* value; *p* = significance value; η_p^2 = partial eta squared.

When controlling for the sequence of the PSAP game that participants played (either neutral – aggressive – prosocial or neutral – prosocial – aggressive), no interaction between sequence, endorsement of a traditional masculinity and administration group was found ($F(1, 183) = 0.79$, $p = .377$, $\eta_p^2 = .004$), nor was an interaction of sequence with any other variable found (see Table 3). The only significant result remains the main effect of the endorsement of a traditional masculinity ideology.

Table 3.

Results of the 2 x 2 x 2, Administration Group x Man Box x Sequence, ANOVA

Variables	*df*	*F*	*p*	η_p^2
Group	1	0.54	.463	.003
Man Box	1	13.16	.000	.070
Sequence	1	0.80	.372	.005
Group * Man Box	1	0.79	.377	.004
Sequence * Group	1	0.01	.944	.000
Sequence * Man Box	1	3.31	.071	.019
Sequence * Group * Man Box	1	0.46	.498	.003

Note. *df* = degrees of freedom; *F* = *F* value; *p* = significance value; η_p^2 = partial eta squared.

As Carré and his colleagues (2017) found that the relationship between testosterone and aggression was moderated by trait dominance and self-control only in participants scoring high in dominance and low in self-control, a 2 x 2, Administration Group (testosterone/placebo) x Endorsement of Traditional Masculinity (Man Box in/out), factorial ANOVA was also performed in the participants whose aggression measures—number of times they had took points from their opponent divided by total number of actions they performed—were 1 standard deviation above ($n = 49$) or below ($n = 46$) the mean, to see if the interaction was only significant with extreme values. No interaction was found ($F(1, 95) = 0.02$, $p = .888$, $\eta_p^2 = .000$), nor was the main effect of administration group significant ($F(1, 95) = 0.27$, $p = .608$, $\eta_p^2 = .003$). However, the main effect of endorsement of traditional masculinity remained highly significant ($F(1, 95) = 14.59$, $p < .001$, $\eta_p^2 = .138$).

Contrary to what was expected, these results maintain the null hypothesis of H1 and H2, as there was no significant interaction between administration group and the endorsement of a traditional masculinity ideology. However, the results show a trend in said direction as the highest number of aggressive actions was found in the testosterone group of men who were inside the Man Box and the lowest number of aggressive actions was found in the testosterone group of men who were outside the Man Box (see Figure 1). As there was no

main effect of the administration group, results confirm H3 and maintain its null hypothesis: There are no significant differences between men in the groups testosterone and placebo who are outside the Man Box—neither there are significant differences between men who are inside the Man Box.

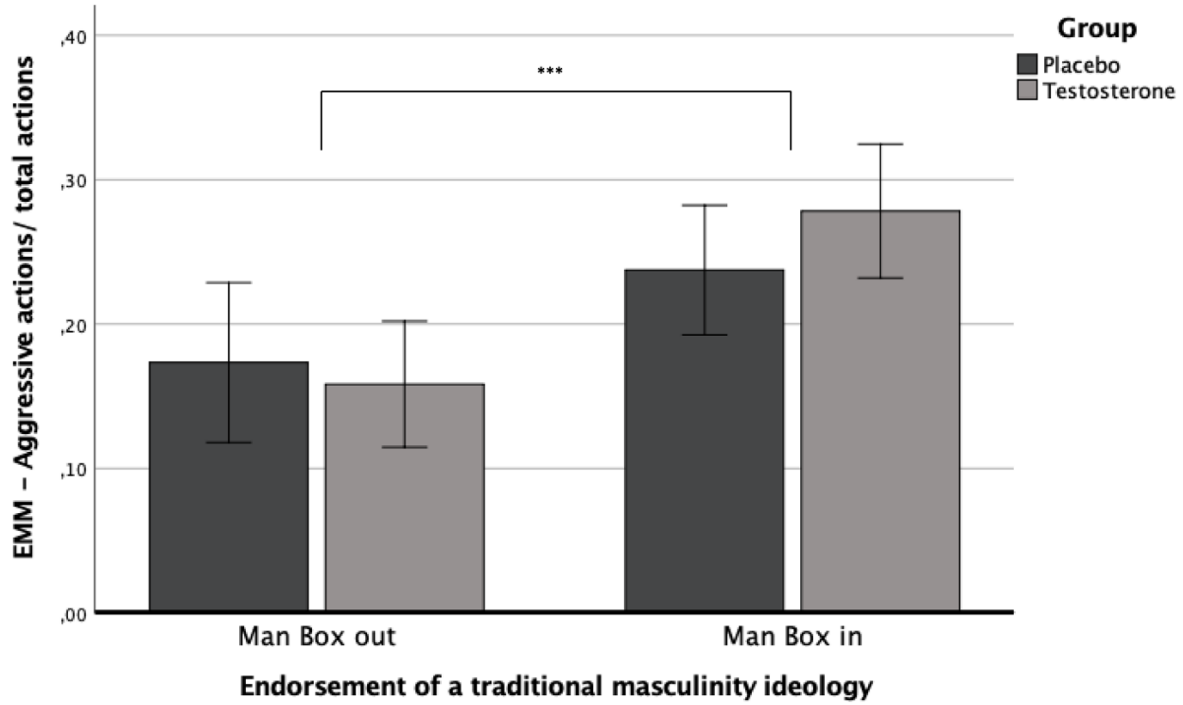

Figure 1. Effects of testosterone or placebo on the number of aggressive actions divided by the number of total actions in men who endorse more or less a traditional masculinity (Man Box in/out). Error bars represent 95% confidence intervals (CI). *** $p < .001$.

5.2. Research question 2

To find out how precarious manhood influences the relationship between testosterone and aggression three variables were analyzed: the administration group, the results of the precarious manhood questionnaire and the number of aggressive actions during the PSAP task.

As mentioned in section 4.2.2., the answers of participants interpreting what the author of the sentence "My life isn't what I expected it would be. I used to be a man. Now I'm not a man anymore" meant were coded into physical, social or neutral. Answers mentioning a sex change or referring to a biological function were coded as physical and thus perceived as stable (Vandello et al., 2008). Only 11.5% of participants perceived manhood as something physical (see Figure 2). Examples of such answers are, translated from the German, “Woman born in man’s body” or “The author of the sentence lost his potency. Maybe he got sterilized

or lost his potency under other circumstances and afterwards he could not procreate. That is why he did not feel manly anymore".

As expected, the majority of participants (62.8%) saw manhood as something social and thus unstable. Answers were coded as social if they referenced the author in relation to the society or other people, or a realization that life expectations were not met. Some examples of these answers are "His honor was hurt, maybe his wife left him", "He seems upset that things did not go as planned. The loss of power and control over his life makes him doubt his manhood". Most social answers made references to a loss of control or power, a change in what society expects of men, being the provider or being successful, loss of pride and honor or a break-up with a female partner.

If participants mentioned one physical and one social reason, their answers were coded as neutral, e.g. "Loss of his honor or his libido" or "Either the author underwent a sex change or he did something against his principles and feels now without honor". Participants mentioning neutral answers accounted for 15.8% of the total. The rest of participants (9.8%) did not answered this question.

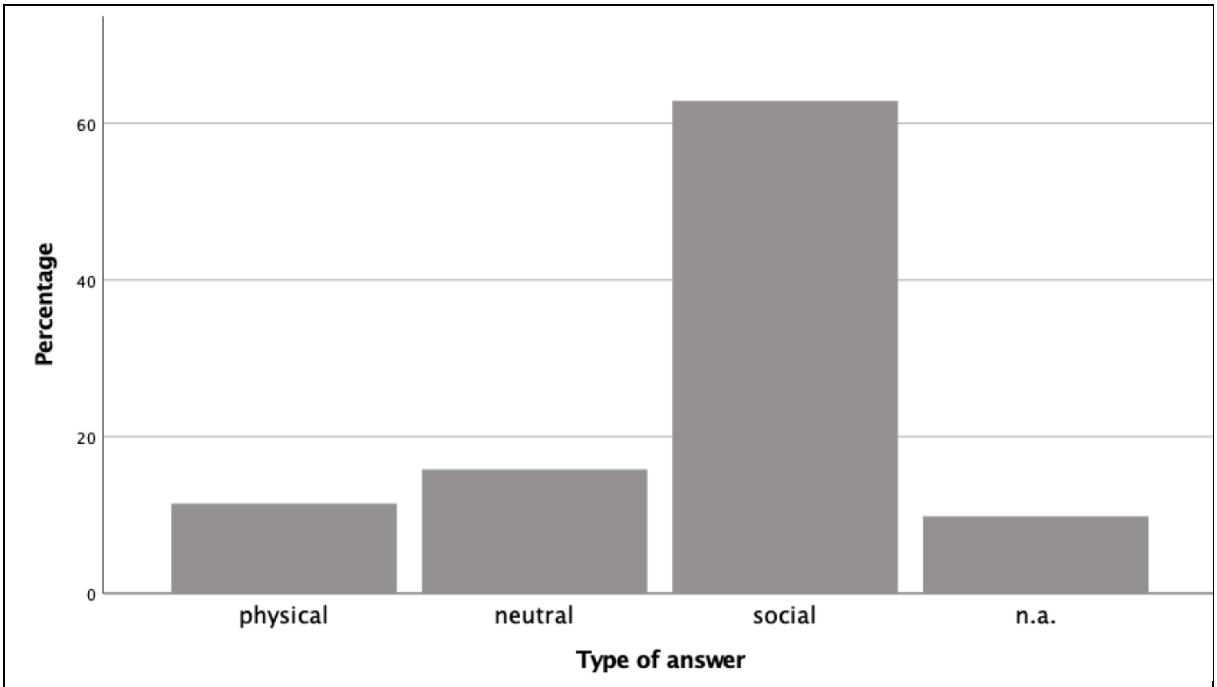

Figure 2. Frequencies in percentages of participants giving physical, neutral, social or no answers at all to the interpretation of the sentence "My life isn't what I expected it would be. I used to be a man. Now I'm not a man anymore".

Cronbach's alpha of the 6 items of the precarious manhood questionnaire was .87. As it happened with the Man Box questionnaire results, the precarious questionnaire results were non-normally distributed, with skewness of 0.43 (*SE* = 0.18). A median split was performed

and participants were divided into a high or low precarious manhood group. The aggression variable was logarithmically transformed (log10) for all analysis, including the analysis for the third research question, included in the next section.

To see if the idea of a precarious manhood interacted with the relationship between testosterone and aggression a 2 x 2, Administration Group (testosterone/placebo) x Precarious Manhood (high/low), factorial ANOVA was performed. There was no significant main effect for the precarious manhood variable ($F(1, 183) = 2.65$, $p = .105$, $\eta_p^2 = .015$), neither was the main effect of the administration group significant ($F(1, 183) = 0.002$, $p = .962$, $\eta_p^2 = .000$) nor was it the interaction between both variables ($F(1, 183) = 0.56$, $p = .454$, $\eta_p^2 = .003$).

The sequence played in the PSAP task was also controlled, in order to examine whether the experience of playing first the aggressive condition could be perceived as a status threat and thus as a masculinity threat and could trigger more aggressive behavior (Bosson et al., 2009). No significant main effects were found either for the sequence variable ($F(1, 183) = 0.47$, $p = .492$, $\eta_p^2 = .003$), the precarious manhood ($F(1, 183) = 2.34$, $p = .128$, $\eta_p^2 = .013$) or the administration group variables ($F(1, 183) = 0.03$, $p = .860$, $\eta_p^2 = .000$). There was also no significant interaction between all three variables ($F(1, 183) = 0.09$, $p = .764$, $\eta_p^2 = .001$), nor was there a significant interaction between sequence and administration group ($F(1, 183) = 0.09$, $p = .764$, $\eta_p^2 = .001$), sequence and precarious manhood ($F(1, 183) = 2.11$, $p = .148$, $\eta_p^2 = .012$) or group and precarious manhood ($F(1, 183) = 0.35$, $p = .553$, $\eta_p^2 = .002$). However, when performing a 2 x 2, Administration Group (testosterone/placebo) x Precarious Manhood (high/low), factorial ANOVA the main effect of precarious manhood gets significant only in participants with the sequence neutral – aggressive – prosocial (see Table 4).

Table 4

Comparison of a 2 x 2 ANOVA with the total sample and participants who played Sequence 1 (neutral – aggressive – prosocial)

Variables	*df*	*F*	*p*	η_p^2
Total sample[a]				
Administration group	1	0.002	.962	.000
Precarious manhood	1	2.65	.105	.015
Group * Precarious manhood	1	0.56	.454	.003
Sequence 1 sample[b]				
Administration group	1	0.02	.893	.000
Precarious manhood	1	4.69	.033	.049
Group * Precarious manhood	1	0.05	.832	.000

Note. [a]$N = 183$; [b]$n = 96$; *df* = degrees of freedom; *F* = *F* value; *p* = significance value; η_p^2 = partial eta squared.

As with the first research question, and contrary to what was expected, these results maintain the null hypothesis of H4 and H5, as there was no significant interaction between the administration group and the precarious manhood variable. However, the results also show a trend in said direction as the highest number of aggressive actions was found in the testosterone group of men who scored high in the precarious manhood variable ($M = 0.15$, $SD = 0.10$) and the lowest number of aggressive actions was found in the testosterone group of men who scored low in precarious manhood ($M = 0.11$, $SD = 0.10$), as shown in Figure 3. As there was no main effect of the administration group, results confirm H6 and maintain its null hypothesis: There are no significant differences between men in the groups testosterone and placebo who scored low in precarious manhood, but neither are there significant differences between men who scored high in precarious manhood and were in the placebo group.

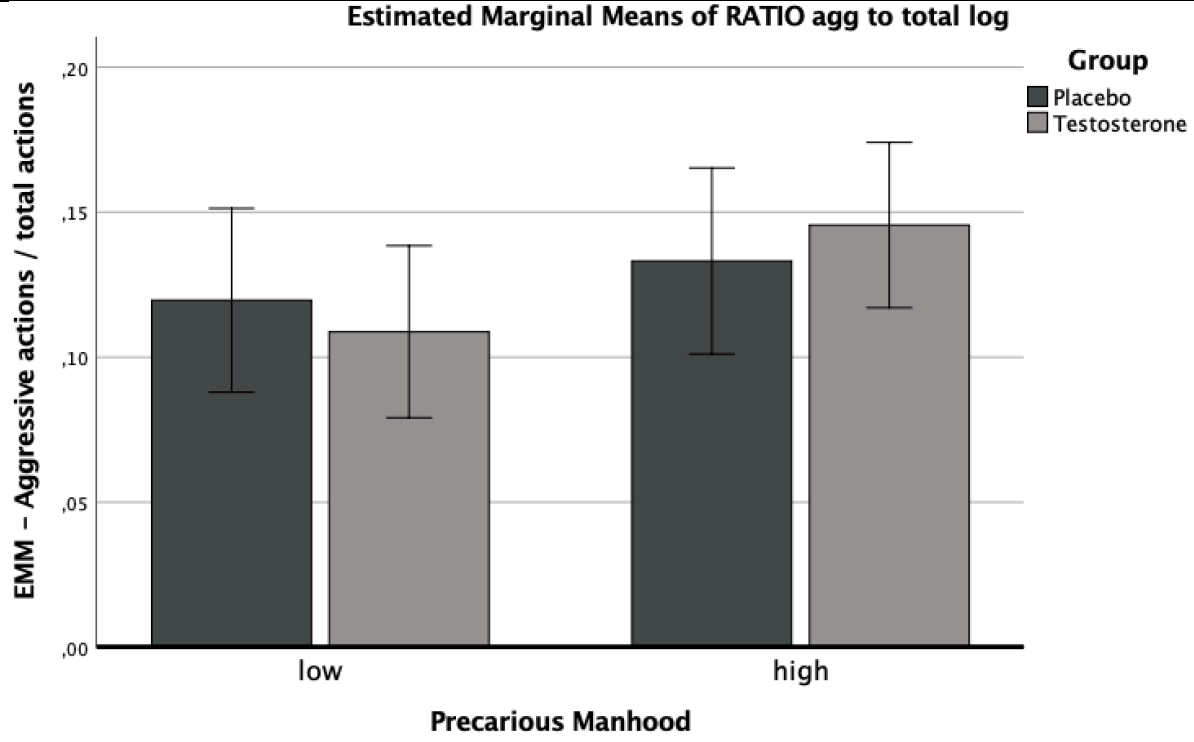

Figure 3. Effects of testosterone or placebo on the number of aggressive actions divided by the number of total actions in men who agree more or less with the concept of a precarious manhood (high/low). Error bars represent 95% confidence intervals (CI).

5.3. Research question 3

As expected, the variables endorsement of traditional masculinity and precarious manhood were highly correlated ($r = .69$, $p < .001$) and thus a composite measure was created to see if it explained more variance than the two measures separately. To create the composite

measure both scales were standardized (transformed to *z* scores). Contrary to what was expected, the composite measure did not explained more variance ($F(1, 183) = 13.22$, $p < .001$, $\eta_p^2 = .069$) than the endorsement of traditional masculinity alone ($F(1, 183) = 14.44$, $p < .001$, $\eta_p^2 = .075$). These results do not support H7 and maintain its null hypothesis. With respect to the other variables, results show the same pattern: there was no significant main effect of the administration group ($F(1, 183) = 0.01$, $p = .773$, $\eta_p^2 = .000$) nor was there a significant interaction between both variables ($F(1, 183) = 0.44$, $p = .510$, $\eta_p^2 = .002$). Also as shown in Table 5, when controlling for the sequence participants played, results remain similar to the ones found for the first and the second research questions.

Table 5

Results of the 2 x 2 x 2, Administration Group x Composite Measure x Sequence, ANOVA

Variables	*df*	*F*	*p*	Partial η2
Group	1	0.19	.661	.001
Composite measure	1	11.30	.001	.061
Sequence	1	0.41	.515	.002
Group * Composite	1	0.87	.353	.005
Sequence * Group	1	0.001	.969	.000
Sequence * Composite	1	2.66	.104	.015
Sequence * Group * Composite	1	0.000	.997	.000

Note. *df* = degrees of freedom; *F* = *F* value; *p* = significance value; η_p^2 = partial eta squared.

6. Discussion

The intention of this study was to shed some light, from a gender perspective, into the unclear relationship between testosterone and aggression (Archer et al., 1998; Book et al., 2001). As various studies point in the direction of a relationship between testosterone and dominance or high social status rather than aggression per se (Campbell et al., 1997; Carré et al., 2017; Eisenegger et al., 2011; Mazur & Booth, 1998), it was hypothesized that due to the close, implicit relationship men have with a high social status in western, patriarchal societies (Connell, 1987; Connell, 2005; Connell & Messerschmidt, 2005), and because a traditional masculinity is still strongly associated with aggression and violence in the social imaginary (Donelly & Twenge 2017; Levant & Richmond, 2008; Mahalik et al., 2003; Pleck et al., 1993), there would be an interaction between testosterone and the endorsement of a traditional masculinity ideology. Men in the testosterone group were expected to show the highest

number of aggressive actions only if they highly endorsed a traditional masculinity ideology, as they would see behaving aggressively, and therefore manly, as a way to maintain their high status in the gender social status pyramid. On the other hand, men to whom testosterone was administered but did not endorse a traditional masculinity ideology so much, and thus did not perceived behaving aggressively as manly or as a way to achieve a high social status, were expected to show the lowest number of aggressive actions. Even though results show such a pattern, the interaction between testosterone and the endorsement of a traditional masculinity ideology was not significant and neither was the main effect of testosterone. Even when only participants one standard deviation above or below the mean in the aggression measure values were included in the analysis, results did not show any significant interaction or a main effect of the administration group. However, the main effect of the endorsement of a traditional masculinity ideology was significantly strong for the whole sample. These results replicate the results of other studies, most of them correlation studies which used questionnaires for the aggression measure, showing a relationship between the endorsement of a traditional masculinity ideology and aggression (Campbell et al., 1997; Cohn et al., 2009; Heilman et al., 2017; Steinfeldt et al., 2012; Thomas & Levent, 2012).

Regarding the concept of precarious manhood, it was hypothesized that a situation of competitiveness and provocation could be interpreted by participants as a status threat and thus as a manhood threat and that participants would react in an aggressive way to that threat (Bosson et al., 2009; Cohen et al., 1996). It was further hypothesized that this phenomenon would interact with testosterone and that testosterone would enhance the perception of a threat in participants who perceived their masculinity as something unstable that can be easily lost and that they would show more aggressive reactions than other participants, as studies suggest a link between exogenous testosterone and an increased activation of the amygdala and the hypothalamus, which are areas related to reactive aggression (Goetz et al., 2014; Hermans et al., 2008; Wagels et al., 2018). The results do not support any of these hypothesis: No main effect of the precarious manhood variable or the administration group was found, and neither was an interaction between these two variables found. The lack of significant results in this case might be influenced by the fact that maybe participants did not perceive the PSAP task as a threat. For this reason, further analysis only with the participants who got the sequence neutral – aggressive – prosocial in the SPAP were performed. In this case results show a main effect of the precarious manhood variable, but still no main effect of testosterone or any interaction between the variables. The main effect of precarious manhood in this case could be interpreted as a reaction to regain the status lost after the bogus opponent only took points from them without having given them any points first. This sequence could have been

interpreted as a provocation from the opponent which would have been neutralized by more aggressive actions from the participants (Cohen et al., 1996).

A composite measure of the endorsement of a traditional masculinity ideology and precarious manhood was created to see if it explained more variance in aggressive behavior than the two variables separately, however this was not the case. No significant interactions were found between the composite measure and the administration group.

Summarizing, the only significant effect found was the main effect of the endorsement of traditional masculinity, no main effect of the administration group or the interaction between both variables was found. Further analysis mentioned above show always similar results independently of whether the sequence was introduced in the model or if the analysis were run only with participants whose values were one standard deviation above and below the mean of the moderating variable. Even though results were in some cases far from significant, all analysis point in the direction of a potential interaction between the administration group and the endorsement of a traditional masculinity or the concept of precarious manhood as participants in the testosterone group with high values in the above mentioned variables showed the highest number of aggressive actions in all analysis while participants in the testosterone group with low values in the Man Box and the precarious manhood questionnaires show the lowest number of aggressive actions. These results, even though not significant, would provide support for the theory that testosterone is not directly linked to aggression unless a subject sees aggression as a way to maintain or achieve a high social status (Dabbs & Morris, 1990; Eisenegger et al., 2011; Mazur & Booth, 1998).

One of the main, unpredicted problems was the low significant and partial eta squared numbers of the administration group variable, which range from $F(1, 183) = 0.002$, $p = .962$, $\eta_p^2 = .000$ in the worst case to $F(1, 183) = 0.54$, $p = .463$, $\eta_p^2 = .003$ in the best case, as well as the lack of interaction between the variables. Even though some studies have found no relationship between testosterone and an aggressive behavior (Campbell et al., 1997), meta-analysis show a small but positive overall effect (Archer et al., 1998; Book et al., 2001). One of the reasons why this relationship was not found in this study might have been the sample size, which in order to detect a small effect should have been at least of 500 participants. However, the authors of the meta-analysis named above mention studies with as little as 12 or 39 participants showing big effect sizes ($g = 2.25$ and Rosenthal's $r = 0.71$ respectively). As Campbell and her colleagues (1997) mention, it could be that the relationship between testosterone and aggression is influenced by the *file-drawer problem* and the real effect of testosterone is less than the one meta-analysis report or even non-existent. Another possible explanation is the pharmacokinetics of testosterone. Bos and his colleagues (2012) report social-emotional behavioral changes with a single testosterone administration and Eisenegger

and his colleagues (2013) show how a high single dose of exogenous testosterone (150 mg) causes testosterone levels to peak three hours after the administration and decline from that time point on but remain significantly higher than testosterone levels in the placebo group up until six hours after the administration had taken place. It could be that in the sample used for this study, testosterone levels would have fallen to levels previous to the administration before the six-hour period. Because the PSAP was the last task to be completed, at about 4 hours after the administration, it could be that testosterone effects were not strong enough to show behavioral differences between the testosterone and the placebo groups.

As traits related to a traditional masculinity are almost opposite to the ones related to femininity (Bem, 1974) and men, as well as women, are expected to behave in a certain way according to their gender, the degree of agreement with such masculine and feminine traits could explain why some studies researching traits associated with a traditional masculinity, such as aggression, risk taking and competitiveness among others, find gender differences (Book et al., 2001; Byrnes, Miller, & Schafer, 1999; Gneezy, Niederle, & Rustichini, 2003; Mazur & Booth, 1998). The fact that a highly significant middle to strong effect of the endorsement of a traditional masculinity ideology on aggression was found, might support this theory. However, studies researching typical feminine traits and the endorsement of a traditional femininity are needed to corroborate this theory. For this reason, future research would profit from a gender perspective by which men are not perceived as neutral individuals representing the whole population but as beings influenced by the perception of their gender's role and by society's expectations about their behavior. That is why a gender control variable for a traditional masculinity and femininity should be introduced in future studies.

Applying a gender perspective in the field has already shown how useful it can be. Various studies show favorable results after the application of violence prevention programs that promote gender equality. Gender equality opposes gender discrimination and thus opposes as well an hegemonic masculinity—which is maintained to keep women oppressed. By promoting gender equality, programs change the perception men have about their masculinity and adopt a more flexible approach to it, which has a direct impact in their behaviors (Barker, Ricardo, Nascimento, & World Health Organization, 2007; Kato-Wallace et al., 2019; Pulerwitz, Hui, Arney, & Scott, 2015). Understanding the role gender beliefs play in aggressive behavior and if and how it could interact with other variables such as testosterone, as well as identifying the neural structures that influence those beliefs and how they affect behavior could help to improve prevention programs directed to men. As there seems to be a relationship between strict masculinity norms and fear of emotions and shame and how men have learned that aggression can attenuate these feelings (Jakupcak, Tull, & Roemer, 2005; O'Neil & Harway, 1997), it can be speculated that men who endorse a

traditional masculinity ideology could have an attentional bias for social threats that lead to situations where they feel ashamed. If that were the case, we would expect brain regions involved in threat perception, social cognition, learning, as well as fear and shame to play a role in how the endorsement of a traditional masculinity ideology affects men's behavior. Therefore, we could expect an involvement of the amygdala, the prefrontal cortex, the insula, the temporal lobe, the cingulate cortex as well as structures of the thalamus, the hypothalamus and the hippocampus (Adolphs, 1999; Bastin, Harrison, Davey, Moll, & Whittle, 2016; Green & Phillips, 2004). However, this is mere speculation as there is still no research that links the endorsement of a traditional masculinity ideology with any neural correlates.

In conclusion, this is the first study to bring a gender perspective into the relationship between testosterone and aggression. Even though no main effect of testosterone or no interaction between testosterone and the endorsement of a traditional masculinity ideology was found, the fact that the main effect of the endorsement of a traditional masculinity was highly significant can shed some light into better explaining how aggression in men might work. The fact that this gender variable was the only one that significantly influenced an aggressive behavior shows the importance of applying a gender perspective in future research and use a masculinity/femininity control variable, specially in studies researching what are considered typical gendered traits, such as aggression, competitiveness, and social status.

7. References

Adolphs, R. (1999). Social cognition and the human brain. *Trends in Cognitive Sciences, 3*(12), 469-479.

American Psychological Association. (2007). Guidelines for psychological practice with girls and women. *American Psychologist, 62*(9), 949-979. doi: 10.1037/0003-066X.62.9.949

American Psychological Association. (2012). Guidelines for psychological practice with lesbian, gay, and bisexual clients. *The American Psychologist*, *67*(1), 10. doi: 10.1037/a0024659

American Psychological Association. (2014). Guidelines for psychological practice with older adults. *The American Psychologist*, *69*(1), 34. doi: 0.1037/a0035063

American Psychological Association. (2015). Guidelines for psychological practice with transgender and gender nonconforming people. *The American Psychologist*, *70*(9), 34, 832–864. doi: 10.1037/a0039906

American Psychological Association, Boys and Men Guidelines Group. (2018). *APA guidelines for psychological practice with boys and men*. Retrieved from http://www.apa.org/about/policy/psychological-practice-boys-men-guidelines.pdf

Archer, J. (1991). The influence of testosterone on human aggression. *British Journal of Psychology*, *82*(1), 1-28. doi: 10.1111/j.2044-8295.1991.tb02379.x

Archer, J., Birring, S. S., & Wu, F. C. (1998). The association between testosterone and aggression among young men: Empirical findings and a meta-analysis. *Aggressive Behavior: Official Journal of the International Society for Research on Aggression*, *24*(6), 411-420. doi: 10.1002/(SICI)1098-2337(1998)24:6<411::AID-AB2>3.0.CO;2-9

Archer, J., Graham-Kevan, N., & Davies, M. (2005). Testosterone and aggression: A reanalysis of Book, Starzyk, and Quinsey's (2001) study. *Aggression and Violent Behavior*, *10*(2), 241-261. doi: 10.1016/j.avb.2004.01.001

Barker, G., Ricardo, C., Nascimento, M., & World Health Organization. (2007). *Engaging Men and Boys in Changing Gender-based Inequity in Health: Evidence from Programme Interventions*. Retrieved from https://www.who.int/en/

Bastin, C., Harrison, B. J., Davey, C. G., Moll, J., & Whittle, S. (2016). Feelings of shame, embarrassment and guilt and their neural correlates: A systematic review. *Neuroscience & Biobehavioral Reviews, 71*, 455-471. doi: 10.1016/j.neubiorev.2016.09.019

Becker, J. O., & Hoofnagle, A. N. (2012). Replacing immunoassays with tryptic digestion-peptide immunoaffinity enrichment and LC–MS/MS. *Bioanalysis, 4*(3), 281-290. doi: 10.4155/bio.11.319

Bem, S. L. (1974). The measurement of psychological androgyny. *Journal of Consulting and Clinical Psychology*, *42*(2), 155. doi: 10.1037/h0036215

Bird, S. R. (1996). Welcome to the men's club: Homosociality and the maintenance of hegemonic masculinity. *Gender & Society*, *10*(2), 120-132. doi: 10.1177/089124396010002002

Book, A. S., Starzyk, K. B., & Quinsey, V. L. (2001). The relationship between testosterone and aggression: A meta-analysis. *Aggression and Violent Behavior*, *6*(6), 579-599. doi: 10.1016/S1359-1789(00)00032-X

Bos, P. A., Panksepp, J., Bluthé, R. M., & van Honk, J. (2012). Acute effects of steroid hormones and neuropeptides on human social–emotional behavior: a review of single administration studies. *Frontiers in Neuroendocrinology*, *33*(1), 17-35. doi: 10.1016/j.yfrne.2011.01.002

Bosson, J. K., Vandello, J. A., Burnaford, R. M., Weaver, J. R., & Arzu Wasti, S. (2009). Precarious manhood and displays of physical aggression. *Personality and Social Psychology Bulletin*, *35*(5), 623-634. doi: 10.1177/0146167208331161

Bremner, W. J., Vitiello, M. V., & Prinz, P. N. (1983). Loss of circadian rhythmicity in blood testosterone levels with aging in normal men. *The Journal of Clinical Endocrinology & Metabolism*, *56*(6), 1278-1281. doi: 10.1210/jcem-56-6-1278

Brown, G. L., Goodwin, F. K., Ballenger, J. C., Goyer, P. F., & Major, L. F. (1979). Aggression in humans correlates with cerebrospinal fluid amine metabolites. *Psychiatry Research, 1*(2), 131-139. doi: 10.1016/0165-1781(79)90053-2

Buss, A. H., & Durkee, A. (1957). An inventory for assessing different kinds of hostility. *Journal of Consulting Psychology*, *21*(4), 343. doi: 10.1037/h0046900

Byrnes, J. P., Miller, D. C., & Schafer, W. D. (1999). Gender differences in risk taking: A meta-analysis. Psychological bulletin, 125(3), 367. doi: 10.1037/0033-2909.125.3.367

Campbell, A., Muncer, S., & Odber, J. (1997). Aggression and testosterone: Testing a bio-social model. *Aggressive Behavior: Official Journal of the International Society for Research on Aggression, 23*(4), 229-238. doi: 10.1002/(SICI)1098-2337(1997)23:4<229::AID-AB1>3.0.CO;2-F

Carré, J. M., & McCormick, C. M. (2008). Aggressive behavior and change in salivary testosterone concentrations predict willingness to engage in a competitive task. *Hormones and behavior*, *54*(3), 403-409. doi: 10.1016/j.yhbeh.2008.04.008

Carré, J. M., McCormick, C. M., & Hariri, A. R. (2011). The social neuroendocrinology of human aggression. *Psychoneuroendocrinology*, *36*(7), 935-944. doi: 10.1016/j.psyneuen.2011.02.001

Carré, J. M., Geniole, S. N., Ortiz, T. L., Bird, B. M., Videto, A., & Bonin, P. L. (2017). Exogenous testosterone rapidly increases aggressive behavior in dominant and impulsive men. *Biological Psychiatry*, *82*(4), 249-256. doi: 10.1016/j.biopsych.2016.06.009

Caswell, T. A., Bosson, J. K., Vandello, J. A., & Sellers, J. G. (2014). Testosterone and men's stress responses to gender threats. *Psychology of Men & Masculinity*, *15*(1), 4. doi: 10.1037/a0031394

Celec, P., Ostatníková, D., & Hodosy, J. (2015). On the effects of testosterone on brain behavioral functions. *Frontiers in Neuroscience*, *9*, 12. doi: 10.3389/fnins.2015.00012

Cheryan, S., Cameron, J. S., Katagiri, Z., & Monin, B. (2015). Manning up: Threatened Men Compensate by Disavowing Feminine Preferences and Embracing Masculine Attributes. *Social Psychology, 46*(4), 218-227. doi: 10.1027/1864-9335/a000239

Cohn, A. M., Seibert, L. A., & Zeichner, A. (2009). The role of restrictive emotionality, trait anger, and masculinity threat in men's perpetration of physical aggression. *Psychology of Men & Masculinity*, *10*(3), 218. doi: 10.1037/a0015151

Cohen, D., Nisbett, R. E., Bowdle, B. F., & Schwarz, N. (1996). Insult, aggression, and the southern culture of honor: An" experimental ethnography". *Journal of Personality and Social Psychology*, *70*(5), 945. doi: 10.1037/0022-3514.70.5.945

Conger, K. (2017, May 8). *Exclusive: Here's the Full 10-Page Anti-Diversity Screed Circulating Internally at Google [Updated].* Retrieved from https://gizmodo.com

Connell, R. W. (1987). *Gender and power: Society, the person and sexual politics*. Cambridge: Polity Press.

Connell, R. W. (2005). *Masculinities* (2nd ed.). Cambridge: Polity Press.

Connell, R. W., & Messerschmidt, J. W. (2005). Hegemonic masculinity: Rethinking the concept. *Gender & society*, *19*(6), 829-859. doi: 10.1177/0891243205278639

Constantino, J. N., Grosz, D., Saenger, P., Chandler, D. W., Nandi, R., & Earls, F. J. (1993). Testosterone and aggression in children. *Journal of the American Academy of Child & Adolescent Psychiatry*, *32*(6), 1217-1222.

Courtenay, W. (2011). *Dying to be men: Psychosocial, environmental, and biobehavioral directions in promoting the health of men and boys*. Routledge.

Dabbs Jr, J. M., & Morris, R. (1990). Testosterone, social class, and antisocial behavior in a sample of 4,462 men. *Psychological Science*, *1*(3), 209-211. doi: 10.1111/j.1467-9280.1990.tb00200.x

Delphy, C. (1993). Rethinking sex and gender. *Women's Studies International Forum, 16*(1), 1-9. doi: 0.1016/0277-5395(93)90076-L

Donnelly, K., & Twenge, J. M. (2017). Masculine and feminine traits on the Bem Sex-Role inventory, 1993–2012: a cross-temporal meta-analysis. *Sex Roles*, *76*(9-10), 556-565. doi: 10.1007/ s11199-016-0625-y

Dörflinger, F. (2019). Investigating the influence of testosterone on aggressive and prosocial behavior. [unpublished master thesis]

Eisenegger, C., von Eckardstein, A., Fehr, E., & von Eckardstein, S. (2013). Pharmacokinetics of testosterone and estradiol gel preparations in healthy young men. *Psychoneuroendocrinology, 38*(2), 171-178. doi: 10.1016/j.psyneuen.2012.05.018

Eisenegger, C., Haushofer, J., & Fehr, E. (2011). The role of testosterone in social interaction. *Trends in Cognitive Sciences*, *15*(6), 263-271. doi: 10.1016/j.tics.2011.04.008

European Commission (2018). *Prisoners by age and sex - number and rate for the relevant sex and age groups*. Retrieved from https://ec.europa.eu/eurostat/web/crime/data/database

Evans, J., Frank, B., Oliffe, J. L., & Gregory, D. (2011). Health, illness, men and masculinities (HIMM): a theoretical framework for understanding men and their health. *Journal of Men's Health*, *8*(1), 7-15. doi: 10.1016/j.jomh.2010.09.227

Federal Bureau of Prisons (2019). *Inmate statistics*. Retrieved from https://www.bop.gov/about/statistics/statistics_inmate_gender.jsp

Galdas, P. M., Cheater, F., & Marshall, P. (2005). Men and health help-seeking behaviour: literature review. *Journal of advanced nursing*, *49*(6), 616-623. doi: 10.1111/j.1365-2648.2004.03331.x

Geniole, S. N., MacDonell, E. T., & McCormick, C. M. (2017). The Point Subtraction Aggression Paradigm as a laboratory tool for investigating the neuroendocrinology of aggression and competition. *Hormones and behavior, 92*, 103-116. doi: 10.1016/j.yhbeh. 2016.04.006

Gildemeister, R. (2010). Doing gender. In *Handbuch Frauen-und Geschlechterforschung* (pp. 137-145). VS Verlag für Sozialwissenschaften.

Gneezy, U., Niederle, M., & Rustichini, A. (2003). Performance in competitive environments: Gender differences. *The Quarterly Journal of Economics, 118*(3), 1049-1074. doi: 10.1162/00335530360698496

Goetz, S. M., Tang, L., Thomason, M. E., Diamond, M. P., Hariri, A. R., & Carré, J. M. (2014). Testosterone rapidly increases neural reactivity to threat in healthy men: a

novel two-step pharmacological challenge paradigm. *Biological Psychiatry*, *76*(4), 324-331. doi: 10.1016/j.biopsych. 2014.01.016

Granger D.A., Shirtcliff E.A., Booth A., Kivlighan K.T., & Schwartz E.B. (2004) The "trouble" with salivary testosterone. *Psychoneuroendocrin, 29*, 1229–1240. doi: 10.1016/j.psyneuen.2004.02.005

Green, M. J., & Phillips, M. L. (2004). Social threat perception and the evolution of paranoia. *Neuroscience & Biobehavioral Reviews, 28*(3), 333-342. doi: 10.1016/j.neubiorev. 2004.03.006

Hart, B. L. (1974). Gonadal androgen and sociosexual behavior of male mammals: a comparative analysis. *Psychological Bulletin*, *81*(7), 383. doi: 10.1037/h0056549

Heilman, B., Barker, G., & Harrison, A. (2017). *The Man Box: a study on being a young man in the US, UK, and Mexico: key findings.* Promundo US and Unilever: Washington DC and London.

Hermans, E. J., Ramsey, N. F., & van Honk, J. (2008). Exogenous testosterone enhances responsiveness to social threat in the neural circuitry of social aggression in humans. *Biological Psychiatry*, *63*(3), 263-270. doi: 10.1016/j.biopsych.2007.05.013

Inoff-Germain, G., Arnold, G. S., Nottelmann, E. D., Susman, E. J., Cutler Jr, G. B., & Chrousos, G. P. (1988). Relations between hormone levels and observational measures of aggressive behavior of young adolescents in family interactions. *Developmental Psychology*, *24*(1), 129. doi: 10.1037/0012-1649.24.1.129

Jakupcak, M., Tull, M. T., & Roemer, L. (2005). Masculinity, Shame, and Fear of Emotions as Predictors of Men's Expressions of Anger and Hostility. Psychology of Men & Masculinity, 6(4), 275. doi: 10.1037 /1524-9220.6.4.275

Kato-Wallace, J., Barker, G., Garg, A., Feliz, N., Levack, A., Ports, K., & Miller, E. (2019). Adapting a Global Gender-Transformative Violence Prevention Program for the US Community-Based Setting for Work with Young Men. *Global Social Welfare*, *6*(2), 121-130. doi: 10.1007/s40609-018-00135-y

Levant, R. F., & Fisher, J. (1998). The Male Role Norms Inventory. In C. M. Davis, W. H. Yarber, R. Bauserman, G. Schreer, & S. L. Davis (Eds.), *Sexuality-related measures: A compendium* (2nd. ed., pp. 469-472). Newbury Park, CA: Sage.

Levant, R. F., & Richmond, K. (2008). A review of research on masculinity ideologies using the Male Role Norms Inventory. *The Journal of Men's Studies*, *15*(2), 130-146. doi: 10.3149/ jms.1502.130

Levant, R. F., Smalley, K. B., Aupont, M., House, A. T., Richmond, K., & Noronha, D. (2007). Initial validation of the male role norms inventory-revised (MRNI-R). *The Journal of Men's Studies*, *15*(1), 83-100. doi: 10.3149/jms.1501.83

Lovejoy, D. A. (2005). *Neuroendocrinology: an integrated approach*. John Wiley & Sons. doi: 10.1002/0470027878

Lutchmaya, S., Baron-Cohen, S., Raggatt, P., Knickmeyer, R., & Manning, J. T. (2004). 2nd to 4th digit ratios, fetal testosterone and estradiol. *Early Human Development*, *77*(1-2), 23-28. doi: 10.1016/j.earlhumdev.2003.12.002

Mahalik, J. R., Locke, B. D., Ludlow, L. H., Diemer, M. A., Scott, R. P., Gottfried, M., & Freitas, G. (2003). Development of the conformity to masculine norms inventory. *Psychology of Men & Masculinity*, *4*(1), 3. doi: 10.1037/1524-9220.4.1.3

Marzullo, M. A. & Libman, A. J. (2009). *Research overview: Hate Crimes and Violence against Lesbian, Gay, Bisexual and Transgender People*. Retrieved from https://www.hrc.org

Mazur, A. (1985). A biosocial model of status in face-to-face primate groups. *Social Forces*, *64*(2), 377-402. doi: 10.1016/j.sbspro.2013.06.508

Mazur, A., & Booth, A. (1998). Testosterone and dominance in men. *Behavioral and Brain Sciences*, *21*(3), 353-363. doi: 10.1017/ S0140525X98001228

Manning, J. T., Scutt, D., Wilson, J., & Lewis-Jones, D. I. (1998). The ratio of 2nd to 4th digit length: a predictor of sperm numbers and concentrations of testosterone, luteinizing hormone and oestrogen. *Human Reproduction (Oxford, England)*, *13*(11), 3000-3004. doi: 10.1093/humrep/13.11.3000

Meule, A., Vögele, C., & Kübler, A. (2011). Psychometrische evaluation der deutschen Barratt impulsiveness scale–Kurzversion (BIS-15). *Diagnostica*, *57*(3), 126-133. doi: 10.1026/0012-1924/a000042

Moal, V., Mathieu, E., Reynier, P., Malthièry, Y., & Gallois, Y. (2007). Low serum testosterone assayed by liquid chromatography-tandem mass spectrometry. Comparison with five immunoassay techniques. *Clinica Chimica Acta, 386*(1-2), 12-19. doi: 10.1016/j.cca.2007.07.013

Nguyen, T. V., Ducharme, S., & Karama, S. (2017). Effects of sex steroids in the human brain. *Molecular Neurobiology*, 54(9), 7507-7519. doi: 10.1007/s12035-016-0198-3

Olweus, D., Mattsson, A., Schalling, D., & Loew, H. (1988). Circulating testosterone levels and aggression in adolescent males: a causal analysis. *Psychosomatic Medicine*, *50*(3), 261-272. doi: 10.1097/00006842-198805000-00004

O'Neil, J. M., & Harway, M. (1997). A multivariate model explaining men's violence toward women: Predisposing and triggering hypotheses. Violence against women, 3(2), 182-203. doi: 10.1177/1077801297003002005

Paulus, C. (2009). Der Saarbrücker Persönlichkeitsfragebogen SPF (IRI) zur Messung von Empathie: Psychometrische Evaluation der deutschen Version des Interpersonal Reactivity Index.

Pleck, Joseph. (1977, September). [Review of the book *The Forty-Nine Percent Majority: The Male Sex Role*, by D. S. David & R. Brannon] *Psychology of Women Quarterly, 2*, 79-80.

Pleck, J. H., Sonenstein, F. L., & Ku, L. C. (1993). Masculinity ideology and its correlates. *The Gender and Psychology Reader*, *49*(3), 308-326. doi: 10.1111/j.1540-4560.1993.tb01166.x

Pulerwitz, J., & Barker, G. (2008). Measuring attitudes toward gender norms among young men in Brazil: Development and psychometric evaluation of the GEM Scale. Men and Masculinities, 10(3), 322-338. doi: 10.1177/1097184X06298778

Pulerwitz, J., Hui, W., Arney, J., & Scott, L. M. (2015). Changing gender norms and reducing HIV and violence risk among workers and students in China. *Journal of health communication, 20*(8), 869-878. doi: 10.1080/10810730.2015.1018573

Rosenthal, R. (1979). The file drawer problem and tolerance for null results. *Psychological Bulletin*, *86*(3), 638. doi: 10.1037/0033-2909.86

Schechter, D., & Gandelman, R. (1981). Inter-male aggression in mice: Influence of gonadectomy and prior fighting experience. *Aggressive Behavior*, *7*(3), 187-193. doi: 10.1002/1098-2337(1981)7:3<187::AID-AB2480070302>3.0.CO;2-L

Schmidt, P., Bamberg, S., Davidov, E., Herrmann, J., & Schwartz, S. H. (2007). Die Messung von Werten mit dem "Portraits Value Questionnaire". *Zeitschrift für Sozialpsychologie*, *38*(4), 261-275. doi: 10.1024/0044-3514.38. 4.261

Seidler, Z. E., Dawes, A. J., Rice, S. M., Oliffe, J. L., & Dhillon, H. M. (2016). The role of masculinity in men's help-seeking for depression: a systematic review. *Clinical Psychology Review*, *49*, 106-118. doi: 10.1177/1557988318792157

Stangier, U. & Heidenreich, T. (2015). Liebowitz Social Anxiety Scale (LSAS). In *Collegium Skalen für Psychiatrie* (pp. 307 – 315). Göttingen: Hogrefe

Steinfeldt, J. A., Vaughan, E. L., LaFollette, J. R., & Steinfeldt, M. C. (2012). Bullying among adolescent football players: Role of masculinity and moral atmosphere. *Psychology of Men & Masculinity*, *13*(4), 340. doi: 10.1037/a0026645. 340

Strobel, A., Beauducel, A., Debener, S., & Brocke, B. (2001). Eine deutschsprachige Version des BIS/BAS-Fragebogens von Carver und White. *Zeitschrift für Differentielle und diagnostische Psychologie*. doi: 10.1024//0170-1789.22.3.216

Sullivan, C. F. (2011). Gender verification and gender policies in elite sport: Eligibility and "fair play". *Journal of Sport and Social Issues*, *35*(4), 400-419. doi: 10.1177/0193723511426293

Susman, E. J., Inoff-Germain, G., Nottelmann, E. D., Loriaux, D. L., Cutler Jr, G. B., & Chrousos, G. P. (1987). Hormones, emotional dispositions, and aggressive attributes in young adolescents. *Child Development*, 1114-1134. doi: 10.1016/0378-5122(82)90021-4

Taylor, A. (2017, March 3). *Polish politician says women should earn less because 'they are weaker, they are smaller, they are less intelligent'*. Retrieved from https://www.washingtonpost.com.

Thomas, K. D., & Levent, R. F. (2012). Does the endorsement of traditional masculinity ideology moderate the relationship between exposure to violent video games and aggression? *The Journal of Men's Studies*, *20*(1), 47-56.

Turanovic, J. J., Pratt, T. C., & Piquero, A. R. (2017). Exposure to fetal testosterone, aggression, and violent behavior: A meta-analysis of the 2D: 4D digit ratio. *Aggression and Violent Behavior*, *33*, 51-61. doi: 10.1016/0018506x(91)90049-n

Udry, J. R. (1990). Biosocial models of adolescent problem behaviors. *Social Biology*, *37*(1-2), 1-10. doi: 10.1007/978-1-4899-0203-0_3

Van Honk, J., Tuiten, A., Verbaten, R., van den Hout, M., Koppeschaar, H., Thijssen, J., & de Haan, E. (1999). Correlations among salivary testosterone, mood, and selective attention to threat in humans. *Hormones and Behavior*, *36*(1), 17-24.

Vandello, J. A., Bosson, J. K., Cohen, D., Burnaford, R. M., & Weaver, J. R. (2008). Precarious manhood. *Journal of Personality and Social Psychology, 95*(6), 1325. doi: 10.1037/a0012453

Vermeersch, H., T'sjoen, G., Kaufman, J. M., Vincke, J., & Van Houtte, M. (2010). Testosterone, androgen receptor gene CAG repeat length, mood and behaviour in adolescent males. *European Journal of Endocrinology*, *163*(2), 319-328. doi: 10.1530/EJE-10-0090

Wagels, L., Votinov, M., Kellermann, T., Eisert, A., Beyer, C., & Habel, U. (2018). Exogenous testosterone enhances the reactivity to social provocation in males. *Frontiers in Behavioral Neuroscience, 12*, 37. doi: 10.3389/fnbeh.2018.00037

Warrington, N. M., Shevroja, E., Hemani, G., Hysi, P. G., Jiang, Y., Auton, A., & McMahon, G. (2018). Genome-wide association study identifies nine novel loci for 2D: 4D finger ratio, a putative retrospective biomarker of testosterone exposure in utero. *Human Molecular Genetics*, *27*(11), 2025-2038. doi: 10.1093/hmg/ddy121

Wong, W. I., & Hines, M. (2016). Interpreting digit ratio (2D: 4D)–behavior correlations: 2D: 4D sex difference, stability, and behavioral correlates and their replicability in young children. *Hormones and Nehavior*, *78*, 86-94. doi: 10.1016/j.yhbeh.2015.10.022

Wong, Y. J., Ho, M. H. R., Wang, S. Y., & Miller, I. S. (2017). Meta-analyses of the relationship between conformity to masculine norms and mental health-related outcomes. *Journal of Counseling Psychology*, *64*(1), 80. doi: 10.1037/cou0000176

Yousaf, O., Grunfeld, E. A., & Hunter, M. S. (2015). A systematic review of the factors associated with delays in medical and psychological help-seeking among men. *Health psychology review*, *9*(2), 264-276. doi: 10.1080/17437199.2013.840954

Yudofsky, S. C., Silver, J. M., Jackson, W., Endicott, J., & Williams, D. (1986). The Overt Aggression Scale for the objective rating of verbal and physical aggression. *The American Journal of Psychiatry*.

8. Figures Index

9. Tables Index

10. Appendix

Zusammenfassung

Einleitung Bisherige Studien zeigen, dass Testosteron ein aggressives Verhalten nur beeinflusst, wenn dieses als Mittel wahrgenommen wird, um einen hohen sozialen Status zu erreichen oder diesen zu behalten. In patriarchalen Gesellschaften erhalten Männer automatisch einen höheren sozialen Status als Frauen. Jedoch müssen sie von anderen als Männer anerkannt werden, um von diesem hohen Status überhaupt erst profitieren zu können. Um das zu erreichen, verhalten sich manche Männer aggressiv, was als typisches männliches Verhalten identifiziert wird. Ziel dieser Studie ist es, die komplexe Beziehung zwischen Testosteron und Aggressivität aus einer Gender-Perspektive zu beleuchten. Es wird erwartet, dass die verschiedenen Wahrnehmungen des Konzepts Maskulinität die Beziehung zwischen exogenem Testosteron und aggressivem Verhalten moderieren. **Methode** Die Teilnehmer (N = 183) wurden willkürlich in eine Placebo- oder in eine Testosterongruppe zugeteilt. Vier Stunden nach der Verabreichung des Mittels mussten sie den Man-Box- und den Precarious-manhood-Fragebogen ausfüllen und die PSAP-Aufgabe erledigen. **Ergebnisse** Mehrere 2x2 ANOVAs weisen einen Haupteffekt in der Unterstützung einer traditionellen Männlichkeitsideologie auf, aber weder einen Haupteffekt von Precarious Manhood noch einen Haupteffekt von Testosteron oder eine Interaktion alle erwähnten Variablen. **Diskussion** Die Ergebnisse replizieren die Befunde anderer Studien, die eine traditionelle Maskulinitätsideologie mit einem aggressiven Verhalten in Bezug setzen und ebnen darüber hinaus den Weg, einen Maskulinitätsfragebogen als Kontrollvariable in zukünftigen Studien, die nach typischen männlichen Eigenschaften forschen, einzusetzen.

Abstract

Introduction Some studies argue that testosterone is related to aggression only if an aggressive behavior is seen as a means to achieve or maintain a high status. In patriarchal cultures men have automatically a higher social status than women. However, to profit from it, they must be acknowledged by others as men. Some men maintain or regain their gender status by behaving aggressively, which is considered a typical masculine behavior. The aim of this study is to throw some light into the aggression-testosterone relationship from a gender perspective. The endorsement of a traditional masculinity ideology and a precarious manhood are expected to increase the number of aggressive responses in men to whom testosterone was administered. **Methods** Participants (N = 183) were randomly assigned either to a placebo or to a testosterone group. Approximately 4 hours after the administration, they answered the

Man Box questionnaire, a measure for the endorsement of a traditional masculinity ideology, and the precarious manhood questionnaire, a measure for the perceived elusion of manhood, and completed an adapted version of the PSAP task. **Results** 2x2 ANOVAs show a main effect of the endorsement of a traditional masculinity ideology on aggression but no effect of either precarious manhood, testosterone or an interaction of any of these variables. **Discussion** These results support various studies relating a traditional masculinity ideology with aggression and open the door to use masculinity questionnaires as a control variable in the future for studies researching traits directly related to a traditional masculinity.