



# Androgen receptor gene and sociosexuality. Does fighting ability moderate the effect of genetics in reproductive strategies?

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Accepted: 7 December 2022

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## Abstract

Sociosexuality is a reliable proxy to evaluate the trade-off between short-term and long-term human mating strategies. The androgen receptor (*AR*) gene CAG-repeats polymorphism regulates the effect of testosterone and the expression of testosterone-related traits commonly associated with short-term mating strategies. According to the strategic pluralism hypothesis, a more effective receptor would prompt a short-term mating strategy to maximize the number of sexual partners, but studies are inconclusive and contradictory. The effect of a particular gene in behavior is frequently small and affected by the social environment and other variables, particularly psychological and personality traits. In the current study we propose the effect of the *AR* gene polymorphism in sociosexuality to be moderated by self-perceived fighting ability, a psychological attribute relevant in intrasexual competition. Our objective is to reveal if the CAG polymorphism is associated with a short-term strategy as expected from the strategic pluralism hypothesis, or conversely with long-term investments to maximize parental care. We fail to find any effect of the CAG polymorphism over mating strategies. However, self-perceived fighting ability is related to short-term mating orientation but not to the number of past sexual partners. In conclusion, we find no clear evidence about the potential role of CAG polymorphism of the *AR* gene over sociosexual attitudes and behavior. However, results from other studies suggest that there is evidence that genetic factors influence sociosexuality, but it is necessary to consider simultaneously more than a single genetic polymorphism and other psychological and physiological variables.

**Keywords** Sociosexuality · CAG polymorphism · Self-perceived fighting ability · Human reproductive strategy

## Introduction

Reproductive trade-offs are caused by the impossibility of simultaneously maximizing all the traits that benefit reproduction (Stearns, 1989). One of the most relevant reproductive trade-offs occurs between investing time and energy in mating or in parental care (Stearns, 1992). In this regard, humans show diverse strategies to deal with this trade-off that can be grouped into short-term mating strategies characterized by high investment in multiple mating and

uncommitted relationships and long-term mating strategies characterized by high investment in the establishment of a committed romantic relationship and parental care (Gangestad & Simpson, 2000). In this context, sociosexuality reflects the individual differences in the willingness to engage in sexual intercourse without a previous bond or commitment (Simpson & Gangestad, 1992). In a more recent conceptualization, it can be divided, at least, into three components, two attitudinal, which reflect the psychological predisposition toward investing in mating (short-term mating orientation) and parenting (long-term mating orientation), and the other behavioral, which refers to the number of past sexual partners (Jackson & Kirkpatrick, 2007). Sociosexuality has been associated with mating and parenting efforts (Valentova et al., 2020) and with traits denoting fast or slow life histories (Patch & Figueredo, 2017); therefore, it is considered a reliable proxy to assess reproductive strategies in humans.

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According to the strategic pluralism hypothesis, short and long-term mating strategies are considered conditional reproductive strategies contingent on the expression of specific morphological and physiological traits and the social environment (Gangestad & Simpson, 2000). In evolutionary terms, features signaling “good genes” and intrasexual competitive abilities would have benefited the pursuit of a short-term mating strategy, especially in men, whereas men with features indicating the ability to gain and maintain resources would have benefited from the pursuit of a long-term mating strategy (Gangestad & Simpson, 2000; Lukaswesky et al., 2014; Fajardo et al., 2022). This association between specific phenotypes and the balance of cost-benefits from pursuing one strategy or the other during human evolutionary history would explain some of the variation in sociosexual attitudes (short and long-term mating orientation) and behaviors displayed by men in the present. The hormone testosterone and features related to it, such as muscularity, facial masculinity, or strength, are relevant traits to determining the expression of mating strategies, especially in men (Archer, 2006; Gettler et al., 2019; Hughes & Gallup, 2003; Lukaszewski et al., 2014; Polo et al., 2019; Puts et al., 2015). These traits are related to higher intrasexual competition ability and status-seeking behaviors (Eisenegger et al., 2011; Gallup & Fink, 2018; Muñoz-Reyes et al., 2019) and, therefore, individuals showing these attributes may benefit from a short-term mating strategy (Gangestad & Simpson, 2000). In this regard, men with higher levels of circulating testosterone are more short-term oriented, more frequently involved in uncommitted relationships, and report a higher number of sexual partners (Burnham et al., 2003; Gettler et al., 2019; Gray et al., 2004; Peters et al., 2008; Pollet et al., 2011; Puts et al., 2015; Sakaguchi et al., 2006). Moreover, several studies reported that men with higher muscularity, strength and facial masculinity have more sexual partners and a short-term mating orientation (Frederick & Haselton, 2007; Hughes & Gallup, 2003; Lukaszewski et al., 2014; Polo et al., 2019). All these pieces of evidence suggest that testosterone and related traits are important in calibrating men’s short-term mating orientation.

In addition to physical and physiological traits, the individual expression of sociosexuality and the disposition toward short and long-term mating may be calibrated by social environment and specific reproductive contexts, such as the number of available potential partners or cues of parental care (Arnocky et al., 2016; Thomas & Stewart-Williams, 2018). However, evidence suggests that additive genetic factors influence sociosexuality more than environmental factors do (Bailey et al., 2000; Kupfer et al., 2021; Westerlund et al., 2010). In this regard, the androgen receptor (*AR*) gene exhibits a genetic polymorphism that affects sensitivity to testosterone and, in turn, the development of

testosterone-related traits (Edwards et al., 1992). As testosterone and testosterone-related traits are thought to be critical factors affecting sociosexuality and the number of sexual partners in men, this polymorphism could contribute to explaining the genetic basis of the reported variability in sociosexual attitudes and behavior.

The *AR* gene is hosted on the X chromosome. It shows a polymorphism in the population that results in different sensitivity to androgens and, therefore, affects transactivational ability (Rajender et al., 2008). This polymorphism is characterized by the presence of a variable number of CAG repeats (between 8 and 35 triplets) in the coding region of the DNA sequence of the *AR* gene (Edwards et al., 1992). Androgen receptors exert transcriptional control of androgen-dependent genes by binding to androgen response elements within DNA regulatory sequences in the cell’s nucleus (Eisenegger et al., 2017). Carriers of alleles with a lower number of CAG repeats exhibit androgen receptors with a higher sensitivity to their ligand (Beilin et al., 2000; Chamberlain et al., 1994; Tut et al., 1997). Therefore, individuals with lower CAG repeats will show a more significant response to a specific testosterone level than individuals with a higher number showing a continuous in the populations (Beilin et al., 2000; Chamberlain et al., 1994; Tut et al., 1997). Considering this, it can be expected that this polymorphism in the *AR* gene may have an effect on reproductive strategies and sociosexuality as it regulates the effects of the circulating testosterone in the individual. However, only a few studies investigate this relationship in men, offering mixed results (Gettler et al., 2017; Pearce et al., 2018; Simmons & Roney, 2011).

First, Simmons & Roney (2011) found that men with lower repetitions of the CAG sequences showed higher upper-body strength and higher self-reported measures of dominance and prestige. These traits are related to enhanced intrasexual competition ability, a key factor underlying short-term mating orientation (Gangestad & Simpson, 2000; Hughes & Gallup, 2003; Lukaszewski et al., 2014; Polo et al., 2019). However, counterintuitively, the number of CAG repeats was not related to unrestricted sociosexuality (i.e., short-term mating orientation) (Simmons & Roney, 2011). The authors argued that this polymorphism might be mainly associated with mating effort but oriented to seek a long-term relationship. Another significant result of this study is that the effect of the number of CAG repeats was not moderated by the levels of circulating testosterone, suggesting that the critical factor in the outcome is the receptor’s sensitivity (Simmons & Roney, 2011). A posterior study also failed to find a clear relationship between the number of sequences of CAG and the sociosexuality employing the 2D:4D digit ratio as a mediator variable (Pearce et al., 2018). However, Gettler and colleagues (2017) found positive evidence about

the role of the CAG polymorphism on mating strategies. These authors found that the number of CAG repeats was negatively related to short-term mating strategy (measured as the probability of separation within 4.5 years and low childcare) but only in men with high circulating testosterone levels (Gettler et al., 2017). Surprisingly, they also found that CAG repeats were positively related to short-term mating strategy but in this case in men with low levels of circulating testosterone. Apparently, both high and low levels of androgenicity had the same effect on short-term mating strategy and sociosexuality (e.g., Gettler et al., 2017; Polo et al., 2019). To summarize, studies investigating the link between *AR* gene polymorphism and sociosexuality are scarce, and results are inconclusive as results are mixed.

Simmons & Roney (2011) suggestion that the effect of a lower number of CAG repeats is related to long-term mating strategy is in opposition to the strategic pluralism hypothesis. In addition, these authors found that the number of CAG repeats was associated with other traits linked to intrasexual competition, such as upper-body strength, dominance, and prestige, but surprisingly, not to unrestricted sociosexuality. Given that, it seems feasible for the potential effect of the *AR* gene polymorphism over sociosexuality to be moderated by psychological traits denoting competitive abilities. In this regard, recent works have shown the importance of psychological and personality characteristics to moderate genetic and physiological effects on behavior (e.g., Carré et al., 2017; Geniole et al., 2019). The self-perception of fighting ability is a relevant psychological variable in an intrasexual competitive context because it may signal an individual's predisposition to fight over a valuable resource (Muñoz-Reyes et al., 2012; Sell et al., 2009). In fact, self-perception of fighting ability depends, at least partially, on physical traits such as muscularity and strength that are in turn related to competitive abilities (Gallup & Fink, 2018; Muñoz-Reyes et al., 2019), which makes it a potential trait that may be modulating the effect of the *AR* gene polymorphism on sociosexuality. Finally, sociosexuality has commonly been measured as a unidimensional construct with short and long-term mating strategies as opposite poles in the same dimension. However, a multidimensional approach that considers short and long-term strategies as different dimensions is more in accordance with the strategic pluralism hypothesis and could help to solve the controversy about the role of the number of repeats of CAG in short-term or long-term mating strategies.

This study aims to investigate the role of the CAG polymorphism in the *AR* gene over the expression of short and long-term mating strategies measured through a multidimensional sociosexuality construct, considering self-perception of fighting ability as a potential moderator. The goal is to test whether CAG polymorphism is associated with a

short-term mating strategy as expected from the strategic pluralism hypothesis or, conversely, is associated with a long-term mating strategy, as Simmons & Roney (2011) suggest. Following the strategic pluralism hypothesis, we expect to find a negative relationship between the number of CAG repeats and short-term mating orientation in men with high self-perceived fighting ability. In addition, we also expect the same relationships with the behavioral component of sociosexuality measured as the number of lifetime and last-year sexual partners. Conversely, if the number of CAG repeats plays a role in long-term mating strategy, we expect a negative relationship between CAG repeats and long-term mating orientation in those men with high self-perceived fighting ability; and a positive relationship with the behavioral component of sociosexuality measured as the number of lifetime and last-year sexual partners.

## Materials and methods

### Participants

Participants were recruited among undergraduate students using a verbal project explanation during classes at the Universidad Autónoma de Madrid (UAM). The total sample included 438 men of ages between 18 and 36 ( $M \pm SD = 22.15 \pm 3.03$ ). Sexual orientation was evaluated using a 5-point Likert scale (1: exclusively homosexual; 5: exclusively heterosexual) (exclusively homosexual = 1.6%, exclusively heterosexual = 0.2%, bisexual = 3.7%, mainly heterosexual = 10.3%, exclusively heterosexual = 84.2%;  $n = 438$ ) and relational status revealed a 48.5% involved in a relationship and a 51.5% not involved ( $n = 429$ ). The study was approved by the ethics committee of the UAM (CEI-83-1538). Participants signed an informed consent before they started their participation in the study and after receiving adequate instructions and information.

### Psychological and biological measurements

#### Multidimensional model of sociosexuality (MMS)

Participants fulfilled a Spanish-adapted MMS (Jackson & Kirkpatrick, 2007). The scale is divided into two parts. First, short-term and long-term mating orientation is evaluated (10 and 7 items, respectively). This initial part of the scale measures the attitudinal dimension (e.g., short-term mating orientation, "I can easily imagine being comfortable with and enjoying casual sex with different women"; long-term mating orientation, "I would like to have a romantic relationship that lasts forever") in the format of 7-point Likert scale responses (1: strongly disagree; 7: strongly agree). Second,

a behavioral dimension of the sociosexual orientation is measured with 5 open-ended questions focused on the number of sexual partners in the past (3 items) (e.g., “Over your entire life, how many women have you had complete sexual relations with?”), sexual fantasy (How often do you fantasize about having sexual relations with women other than your current partner?), and expected number of sexual partners in the future (How many women do you think you will have sexual relations within the next five years). We obtained a Cronbach- $\alpha$  of .901 for short-term mating orientation and a Cronbach- $\alpha$  of .902 for long-term mating orientation, indicating adequate instrument reliability.

### Self-perceived fighting ability questionnaire (SPFA)

Participants also completed a Spanish version of the SPFA questionnaire (Muñoz-Reyes et al., 2012), which consists of 4 items to be responded with a 7-point Likert scale (1: well below average; 7: well above average). The SPFA is designed to evaluate participants' self-perception of fighting skills (1. How good a fighter am I? 2. How do others perceive my abilities as a fighter? 3. How much fear can I provoke in someone who is about to fight me? 4. What are my odds of winning a fight if I have to fight someone?). We obtained a Cronbach- $\alpha$  of 0.864, indicating adequate reliability of the instrument.

### CAG repeats in the Androgen Receptor (AR) Gene

Saliva samples of all participants were taken in a propylene tube to a final volume of 1 mL. Before that, subjects were instructed not to drink, eat, or smoke for at least one hour and to rinse their mouth to avoid cross-contamination. DNA was isolated using the QIAmp DNA Mini kit (Qiagen), resuspended in a final concentration of 100 ng/ $\mu$ L in Milli-Q water (Merck), and stored at -20°C until use. The fragment of the *AR* gene containing the CAG repeats was amplified and isolated by PCR using the following primers (Forward 5'-FAM-TCCAGAGCGTGCGCGAAGTGAT-3', Reverse 5'-CGACTGCGGCTGTGAAGGTTG-3') (Butovskaya et al., 2013). In the PCR reaction protocol, 100 ng of DNA of each participant was amplified in the presence of 200  $\mu$ M dNTPs (Biotools), 10 pmol of each primer, 2 mM MgCl<sub>2</sub>, and 1,25 U of Taq Polymerase (Bioline). Amplification cycles included an initial denaturation at 94°C for 5 min, followed by 35 cycles at 94°C for 45 s, 62°C for 45 s, and 72°C for 45 s, and a final elongation at 72°C for 10 min. Results were run in a 1% agarose gel before their analysis by capillary electrophoresis in an ABI PRISM 3100 Genetic Analyzer (Applied Biosystems). The size of the amplicon was determined by employing Peak Scanner v1.0 (Applied Biosystems).

**Table 1** Descriptive statistics of studied and control variables

Variables	N	Mean $\pm$ SD
Lifetime sexual partners	422	6.84 $\pm$ 8.32
Last-year sexual partners	425	1.73 $\pm$ 1.96
STMO	435	45.72 $\pm$ 13.14
LTMO	433	36.69 $\pm$ 9.09
CAGn	413	24.04 $\pm$ 2.85
SPFA	432	16.65 $\pm$ 4.89
Age	438	22.15 $\pm$ 3.03
	<b>No (N)</b>	<b>Yes (N)</b>
In a relationship	221	208

Note: STMO=short-term mating orientation, LTMO=long-term mating orientation, CAGn=number of CAG repeats, SPFA=self-perceived fighting ability

### Statistical analysis

After calculating descriptive statistics, general linear models were fitted to test our predictions. To examine the first one, we fitted a model in which short-term mating orientation was the dependent variable, and the number of CAG repeats (CAGn) and the score in the Self-perceived fighting ability questionnaire were introduced as independent variables. We considered age and relationship status (single vs. paired) as control variables in the model. We standardized our variables to test for interaction effects and single effects simultaneously. We followed the same procedure to test our second prediction but with long-term mating orientation instead of short-term mating orientation. Finally, we fitted two additional models considering the number of lifetime and last-year sexual partners as dependent variables instead of short and long-term mating orientation. These models were employed to test the relationship between CAGn and sociosexual behavior that was expected to have opposite directions in each prediction. Analyses were performed using SPSS Statistics 25 software (IBM), setting the significance level at  $\alpha=0.05$ .

### Results

Table 1 shows the descriptive statistics of the studied and control variables.

Regarding our first prediction (Table 2), neither the single effect of CAGn in short-term mating orientation ( $\beta=0.015$ ;  $t=0.295$ ;  $p=.768$ ;  $\eta^2<0.001$ ) nor the interaction with self-perceived fighting ability ( $\beta=-0.002$ ;  $t=-0.044$ ;  $p=.965$ ;  $\eta^2<0.001$ ) were significant. However, self-perceived fighting ability was positively related to short-term mating orientation ( $\beta=0.115$ ;  $t=2.285$ ;  $p=.023$ ;  $\eta^2=0.013$ ). Both control variables were significant. Age was positively related to short-term mating orientation ( $\beta=0.120$ ;  $t=2.320$ ;  $p=.021$ ;  $\eta^2=0.014$ ), whereas single individuals reported higher

**Table 2** Short-term mating orientation model

	$\beta$	T test	p-value	$\eta^2$
<b>Intercept</b>	0.107	1.517	0.130	0.006
<b>RS = Single</b>	0.263	2.621	0.009	0.017
<b>Age</b>	0.120	2.320	0.021	0.014
<b>SPFA</b>	0.115	2.285	0.023	0.013
<b>CAGn</b>	0.015	0.295	0.768	<0.001
<b>SPFA*CAGn</b>	-0.002	-0.044	0.965	<0.001

Note: RS=relationship status, CAGn=number of CAG repeats, SPFA=self-perceived fighting ability

**Table 3** Number of lifetime sexual partners' model

	$\beta$	T test	p-value	$\eta^2$
<b>Intercept</b>	0.031	0.463	0.644	0.001
<b>RS = Single</b>	0.075	0.791	0.430	0.002
<b>Age</b>	0.329	6.454	<0.001	0.099
<b>SPFA</b>	0.032	0.661	0.509	0.001
<b>CAGn</b>	<0.001	-0.009	0.993	<0.001
<b>SPFA*CAGn</b>	0.074	1.596	0.111	0.007

Note: RS=relationship status, CAGn=number of CAG repeats, SPFA=self-perceived fighting ability

**Table 4** Number of last-year sexual partners' model

	$\beta$	T test	p-value	$\eta^2$
<b>Intercept</b>	0.040	0.621	0.535	0.001
<b>RS = Single</b>	0.146	1.581	0.115	0.006
<b>Age</b>	0.120	2.534	0.012	0.016
<b>SPFA</b>	0.001	0.013	0.989	<0.001
<b>CAGn</b>	-0.057	-1.181	0.238	0.004
<b>SPFA*CAGn</b>	0.067	1.489	0.137	0.006

Note: RS=relationship status, CAGn=number of CAG repeats, SPFA=self-perceived fighting ability

short-term mating orientation than paired ( $\beta_{\text{single}}=0.263$ ;  $t=2.621$ ;  $p=.009$ ;  $\eta^2=0.017$ ). Similarly, we did not find a relationship between CAGn with the number of lifetime sexual partners (Table 3) either as a single effect ( $\beta < 0.001$ ;  $t=-0.009$ ;  $p=.993$ ;  $\eta^2 < 0.001$ ) or in interaction with self-perceived fighting ability ( $\beta=0.074$ ;  $t=1.596$ ;  $p=.111$ ;  $\eta^2=0.007$ ). In this case, self-perceived fighting ability was not related to the number of lifetime sexual partners either ( $\beta=0.032$ ;  $t=0.661$ ;  $p=.509$ ;  $\eta^2=0.001$ ). Regarding our control variables, age was positively related to the number of lifetime sexual partners ( $\beta=0.329$ ;  $t=6.454$ ;  $p < .001$ ;  $\eta^2=0.099$ ). Finally, we did not find a relationship between CAGn with the number of last-year sexual partners (Table 4) neither as a single effect ( $\beta = -0.057$ ;  $t = -1.181$ ;  $p = .238$ ;  $\eta^2 = 0.004$ ) nor in interaction with self-perceived fighting ability ( $\beta=0.067$ ;  $t=1.489$ ;  $p=.137$ ;  $\eta^2=0.006$ ). In addition, self-perceived fighting ability was not related to the number of last-year sexual partners ( $\beta=0.001$ ;  $t=0.013$ ;  $p=.989$ ;  $\eta^2 < 0.001$ ). Regarding our control variables, age was positively related to the number of last-year sexual partners ( $\beta=0.120$ ;  $t=2.534$ ;  $p=.012$ ;  $\eta^2=0.016$ ).

**Table 5** Long-term mating orientation model

	$\beta$	T test	p-value	$\eta^2$
<b>Intercept</b>	-0.161	-2.340	0.020	0.014
<b>RS = Single</b>	-0.397	-4.039	<0.001	0.040
<b>Age</b>	0.058	1.155	0.249	0.003
<b>SPFA</b>	0.034	0.691	0.490	0.001
<b>CAGn</b>	0.055	1.088	0.277	0.003
<b>SPFA*CAGn</b>	-0.025	-0.515	0.607	0.001

Note: RS=relationship status, CAGn=number of CAG repeats, SPFA=self-perceived fighting ability

Regarding our second prediction (Table 5), neither the single effect of CAGn in long-term mating orientation ( $\beta=0.055$ ;  $t=1.088$ ;  $p=.277$ ;  $\eta^2=0.003$ ) nor the interaction with self-perceived fighting ability ( $\beta = -0.025$ ;  $t = -0.515$ ;  $p=.607$ ;  $\eta^2=0.001$ ) were significant. In addition, self-perceived fighting ability was not related to long-term mating orientation ( $\beta=0.034$ ;  $t=0.691$ ;  $p=.490$ ;  $\eta^2=0.001$ ). Regarding our control variables, single individuals reported less long-term mating orientation than paired individuals ( $\beta_{\text{single}}=-0.397$ ;  $t = -4.039$ ;  $p < .001$ ;  $\eta^2=0.040$ ). As we reported above, neither CAGn nor self-perceived fighting ability were related to the number of lifetime nor last-year sexual partners.

## Discussion

In this study, we tested the role of the CAG polymorphism in the *AR* gene over the expression of short and long-term mating strategies, considering self-perception of fighting ability as a potential moderator. Our purpose was to test if the differences in CAG repeats of this candidate gene were related to sociosexual attitudes and behaviors. We considered short and long-term mating orientation as the two dimensions of sociosexual attitudes and the number of lifetime and last-year sexual partners to measure sociosexual behavior. We mainly found null results, as the number of CAG repeats in the *AR* gene was not related to short-term or long-term mating orientation nor to the number of past sexual partners. We only found an effect of a psychological variable, the self-perceived fighting ability, over short-term mating orientation.

Considering our first hypothesis, we did not find any relationship between the number of CAG repeats with short-term mating orientation, lifetime sexual partners, or last-year sexual partners either as a main effect or in interaction with self-perceived fighting ability. These results indicate a lack of effect of the CAG polymorphism in both attitudinal and behavioral components related to a short-term mating strategy. Consequently, results do not support the general view from the strategic pluralism hypothesis, and from previous empirical evidence, about the role of testosterone and

low repetitions of CAG sequences in calibrating short-term mating strategies in men (Burnham et al., 2003; Frederick & Haselton, 2007; Gettler et al., 2019; Gray et al., 2004; Hughes & Gallup, 2003; Lukaszewski et al., 2014; Peters et al., 2008; Pollet et al., 2011; Polo et al., 2019; Puts et al., 2015; Sakaguchi et al., 2006). In addition, the inclusion of the interaction between self-perception of fighting ability and the number of CAG repeats did not alter the results. That may indicate that this self-perceived variable is not relevant to explain the null or mixed results found in this and previous studies (Gettler et al., 2017; Pearce et al., 2018; Simmons & Roney, 2011). However, self-perceived fighting ability was associated with short-term mating orientation, although it did not affect the number of last-year and lifetime sexual partners. These mixed results suggest that men who consider themselves better fighters are more oriented toward short-term mating but not necessarily more successful in getting multiple partners. That landscape is partially in agreement with previous studies that found that physical traits denoting fighting abilities like muscularity, facial masculinity, or strength are related to short-term mating orientation in men (Arnocky et al., 2018; Frederick & Haselton, 2007; Lukaszewski et al., 2014; Polo et al., 2019). However, these studies also report a positive link with the number of sexual partners. It is feasible that the self-perceived fighting ability uniquely captures the psychological dimension linked to same-sex competition for mates, conversely to those physical traits that indicate fighting ability related to both intrasexual competition and intersexual selection (Frederick & Haselton, 2007). Therefore, future studies should analyze characteristics that affect intersexual selection to obtain a more accurate and complex view of the relationship between short-term orientation and the number of sexual partners.

Our second prediction was not supported as the number of CAG repeats was not negatively related to long-term mating orientation nor positively related to lifetime sexual partners or last-year sexual partners, neither as a main effect nor in interaction with self-perceived fighting ability. These results contradict the suggestion made by Simmons & Roney (2011) that the number of CAG repeats plays a role in long-term mating strategy. In addition, self-perceived fighting ability was not related to long-term mating orientation either, reinforcing that traits related to fighting ability are exclusively relevant in short-term mating. This finding agrees with previous studies in which strength, a trait related to fighting ability, is positively associated with short-term mating orientation but not with long-term mating orientation in men (Fajardo et al., 2022; Lukaszewski et al., 2014).

Regarding our control variables, we found that single men are more oriented toward short-term mating orientation than paired men, and the opposite pattern was found

for long-term mating orientation. It is consistent with the employed construct of sociosexuality, as short-term oriented individuals are more likely to seek short-term or casual relationships, while long-term oriented individuals seek stable and committed relationships (Jackson & Kirkpatrick, 2007). This would make it more likely to find long-term oriented men involved in a relationship compared to short-term oriented men, and less likely to find single long-term oriented men compared to short-term oriented men. Age was positively related to short-term mating orientation, lifetime and last-year sexual partners suggesting a positive association between age and a short-term strategy. The relationship between age and last-year sexual partners can be understood if age is associated with higher sexual experience, increasing their mating success. However, the association with a short-term mating orientation is difficult to explain because younger individuals have, on average, higher levels of testosterone and higher fighting abilities than older ones (Zirkin & Tenover, 2012). Consequently, we should expect higher short-term mating orientation compared to older ones. Given that our sample is composed of young men, in our case, youth could reflect a lack of sexual experience which could be related to low short-term mating orientation.

Considering our findings, it is difficult to obtain precise conclusions about the role of CAG repeats in sociosexuality. Simmons & Roney (2011) did not find a relation between CAG repeats and sociosexuality and proposed that lower numbers of CAG repeats would be related to a long-term mating strategy. We did not find such an association despite employing a larger sample (438 compared to 149). Besides, the fact that a psychological trait, such as the self-perceived fighting ability, was positively associated with short-term mating orientation supports the strategic pluralism proposal that considers competitive-oriented behaviors characteristic of a short-term mating strategy (Gangestad & Simpson, 2000). Furthermore, Simmons & Roney (2011) found a lower number of CAG repeats to be linked to higher upper-body strength and higher self-reported measures of dominance and prestige. Our results are in accordance with these findings and suggest a potential relation of CAG repeats with traits related to intrasexual competitive abilities. However, the association of CAG repeats with short-term mating orientation has not been revealed to date. It might be necessary to explore other genetic variants in the *AR* gene and include the correct moderator variables and probably more participants if the gene effects are subtle.

Although research has provided some significant results regarding the roles of testosterone and the *AR* gene in behavior, some relevant and fundamental questions remain unanswered. For example, Gettler et al. (2017) revealed that a lower number of repeats (meaning a highly effective androgen receptor) together with high levels of circulating

testosterone were associated with a short-term mating strategy (measured as the probability of separation within 4.5 years and low childcare). Nevertheless, a similar result was obtained in individuals with low circulating testosterone levels and a less effective androgen receptor. Therefore, the additive effect of the number of CAG repeats with circulating testosterone levels is unclear, which is of paramount importance. That is the general case in the relationship between massively and independently codified and produced molecules in the organism, such as a circulating hormone and an abundant intracellular receptor affected by particular tissue regulations in the body (Geniole et al., 2019; Simmerly et al., 1990). Several results expose a complex physiological relationship between testosterone levels and the androgen receptor's presence (Hampson & Sankar, 2012; Manuck et al., 2010; Möhlig et al., 2011). However, the general idea is that the abundance of the receptor is more determinant in the final effects (Davey & Grossmann, 2016). The role of the androgen receptor in prostate cancer has been particularly explanatory in this sense. The CAG polymorphism is a determinant variable in prostate cancer development, but the genotype's relevance is affected by several other traits (Davey & Grossmann, 2016; Nelson, 2014). This situation points out the extraordinary complexity of the cascade of genetic and physiological events and the extreme importance of traits and psychological variables, moderating the effect of hormone receptors. Besides, regarding behavioral genetics, there is a general agreement in the field that candidate gene studies are limited and frequently fail to replicate (Charney, 2017). In the current study, we just focused on one gene, but most behaviors are explained by "many genetic variants, each of which accounts for a very small percentage of the behavioral variability" (Chabris et al., 2015). Therefore, besides including other physiological and psychological variables to analyze complex behaviors such as sociosexuality, we might also want to include more genes in the future. Otherwise, we might be missing relevant genetic contributions by focusing on just a polymorphism, even though it is a relevant one with several described effects (Davey & Grossmann, 2016).

In conclusion, despite the fact that there is evidence suggesting that genetic factors influence sociosexuality even more than environmental factors (Bailey et al., 2000; Kupfer et al., 2021; Westerlund et al., 2010), we did not find clear evidence about the potential role of CAG polymorphism of the *AR* gene over sociosexual attitudes and behavior. Future studies should include more than one polymorphism or even more than one candidate gene and the potential influence of current levels of circulating testosterone, together with physical and psychological variables, to shed light on the genetic factors underlying sociosexuality.

**Acknowledgements** This study was supported by a postdoctoral project from Universidad del Desarrollo for author Nohelia T. Valenzuela and funded by the project BIOUAM03-2019 of the Departamento de Biología of the Universidad Autónoma de Madrid.

**Data Availability** Data can be consulted in [https://osf.io/3bc8r/?view\\_only=06d54cb826f849d4892dcb8982edde18](https://osf.io/3bc8r/?view_only=06d54cb826f849d4892dcb8982edde18).

## Declarations

**Ethics approval:** All procedures performed involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the ethics committee of the UAM (CEI-83-1538).

**Informed consent:** Participants signed an informed consent before they started their participation in the study and after receiving adequate instructions and information.

**Conflict of interests:** The authors declare that they have no conflict of interests.

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