



Altruism predicts mating success in humans

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In order for non-kin altruism to evolve, altruists must receive fitness benefits for their actions that outweigh the costs. Several researchers have suggested that altruism is a costly signal of desirable qualities, such that it could have evolved by sexual selection. In two studies, we show that altruism is broadly linked with mating success. In Study 1, participants who scored higher on a self-report altruism measure reported they were more desirable to the opposite sex, as well as reported having more sex partners, more casual sex partners, and having sex more often within relationships. Sex moderated some of these relationships, such that altruism mattered more for men's number of lifetime and casual sex partners. In Study 2, participants who were willing to donate potential monetary winnings (in a modified dictator dilemma) reported having more lifetime sex partners, more casual sex partners, and more sex partners over the past year. Men who were willing to donate also reported having more lifetime dating partners. Furthermore, these patterns persisted, even when controlling for narcissism, Big Five personality traits, and socially desirable responding. These results suggest that altruists have higher mating success than non-altruists and support the hypothesis that altruism is a sexually selected costly signal of difficult-to-observe qualities.

Altruistic behaviours¹ have been observed across diverse vertebrate species of birds (Krams, Krama, Igaune, & Mänd, 2008), fish (Bshary, 2002), amphibians (Tóth, Hoy, & Hettyey, 2011), reptiles (Sinervo *et al.*, 2006), and mammals (Wilkinson, 1988), including modern humans (Trivers, 1971). Early research on altruistic behaviour among non-kin centred upon Trivers' (1971) theory of reciprocity – the notion that individuals may behave selflessly to receive some benefit in the future. However, researchers have recently suggested that reciprocity alone cannot sufficiently account for all altruistic behaviours among unrelated individuals (Fehr & Fischbacher, 2003; Sober & Wilson, 1998; reviewed by Barclay & Van Vugt, 2015). It has been further argued that reciprocity might only evolve under circumscribed environmental conditions (Roberts, 1998). This has prompted researchers to consider additional factors, which may have contributed to the evolution of altruistic behaviour.

One hypothesis, which has gained recent empirical support from studies on human behaviour, is the possibility that altruism functions as a costly signal of qualities that are

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¹ By 'altruism', we mean acts that decrease some fitness-proxy in the actor (at least temporarily) and function to confer benefits on a recipient, regardless of the underlying psychological motivations. Those who define 'altruism' differently should substitute their preferred term for such phenomena.

otherwise difficult to observe (Gintis, Smith, & Bowles, 2001; Zahavi, 1975). For example, hunting and sharing large game – especially without expectation of reciprocity – demonstrate one’s skills as a good hunter and thus one’s value as an ally or mate (Jaeggi & Gurven, 2013; Smith & Bliege Bird, 2000). In particular, it can be valuable to signal desirable qualities to potential mates. In support of this, evidence suggests that altruists may be viewed by others as more attractive mating partners relative to those who are less altruistic (Barclay, 2010; Farrelly, Lazarus, & Roberts, 2007; Moore *et al.*, 2013; Oda, Okuda, Takeda, & Hiraishi, 2014; Phillips, Barnard, Ferguson, & Reader, 2008). Yet such studies on preferences for altruistic mates fall short of determining whether altruism does indeed confer a mating advantage to the altruist. Given that mate preferences are not always good indicators of actual mate choice (Todd, Penke, Fasolo, & Lenton, 2007), the goal of this study was to explore whether self-reported altruistic behaviour predicted individuals’ mating behaviour in terms of their self-reported mating success, their lifetime number of sex partners, their lifetime number of casual sex partners, and the frequency with which they copulate with their current romantic partner and whether these relationships vary as a function of sex.

Costly signalling

A costly signal is any morphological or behavioural trait which advertises an organism’s quality at some expense (Zahavi, 1975; Zahavi & Zahavi, 2007). Provided that the signal is sufficiently costly for those who do not actually possess the quality (Getty, 2006; Számadó, 2011), bearing the burden of that feature can serve as an honest reflection of the signaller’s quality or cooperative intent (Barclay & Reeve, 2012; Gintis *et al.*, 2001). By attending to such signals, observers gain useful information about the qualities of the signaller(s).

Some researchers have conceptualized altruism within this framework as a courtship display which can advertise one’s mate-value characteristics including genetic endowment, health, resource control, or vigour (Miller, 2000, 2007; Smith & Bliege Bird, 2000; Tessman, 1995). To the extent that altruism is desired by potential mating partners, it is widely presumed that an associated increase in mating success would serve to recoup the initial cost of the altruistic acts or disposition (Hardy & Van Vugt, 2006). In support of the costly signalling hypothesis, McAndrew and Perilloux (2012) showed that individuals indeed view others’ altruistic behaviour as being costly, challenging, and important. The potential utility of altruism as a costly signal of phenotypic quality or cooperative intent may lead individuals to attempt to outcompete rivals within this domain – a phenomena termed ‘competitive altruism’ (Barclay, 2011, 2013; Roberts, 1998). Barclay and Willer (2007) found that when observers could choose whom to associate with, participants competed to be more generous than others. Given the particular importance of successful intrasexual competition towards augmenting male reproductive potential (Bateman, 1948), such competitive altruism may be more prevalent among men relative to women. Multiple studies have shown that men are more generous when observed by women, whereas the reverse is often not true (Böhm & Regner, 2013; Tognetti, Berticat, Raymond, & Faurie, 2012; Van Vugt & Iredale, 2013). McAndrew and Perilloux (2012) found that groups containing multiple males evidenced more competition to become an altruist relative to groups containing multiple females (Böhm & Regner, 2013; Hardy & Van Vugt, 2006; Iredale, Van Vugt, & Dunbar, 2008). Similarly, Raihani and Smith (2015) found that men make more online charitable donations to attractive women than to unattractive women and will compete with other men over donations to women.

Do we prefer altruistic mates?

Empirical tests of altruism as a strategy for accessing mating opportunities have hitherto focussed on individuals' penchants for altruistic mates. For example, Phillips *et al.* (2008) assessed men's and women's stated preferences for altruistic traits in a long-term mating partner (boyfriend, girlfriend, husband, or wife). Results showed that women exhibited a stronger preference for altruistic traits in a prospective romantic partner relative to men, controlling for relationship length and social desirability scores. Farrelly (2011) and Oda *et al.* (2014) have also demonstrated that women prefer altruistic behaviours in potential long-term mates; a preference that was not affected by women's ovulatory cycle. Barclay (2010) asked young men and women to read fictitious dating advertisements of opposite sex individuals for short- and long-term relationships, which varied in the expression of altruistic tendencies. Participants rated the ads on their interest in pursuing various relationships with that individual, as well as on the target's attractiveness and personality characteristics. Barclay (2010) found that both men and women rated individuals with altruistic traits as desirable for a long-term relationship, whereas women but not men rated altruistic opposite-sex individuals as desirable for single dates (this could be short-term mating, but it is important to note that desirability for one-night stands was unaffected). Taken together, the results of previous research suggest that altruism may benefit both men's and women's desirability, especially as a long-term mate. It is currently ambiguous whether altruism affects one's desirability as a short-term partner, with some studies saying no (Barclay, 2010; Oda *et al.*, 2014), and other studies suggesting that altruistic men are more desirable short-term partners than non-altruistic men (Farrelly, Clemson, & Guthrie, 2016; Moore *et al.*, 2013).

Interestingly, both altruistic personality and individuals' preferences for altruistic mates appear to be at least partly heritable, as evidenced by greater concordance of these factors among monozygotic twins compared to dizygotic twins, with genes accounting for much of the variance in the relationship (Phillips, Ferguson, & Rijdsdijk, 2010). Accordingly, Phillips *et al.* (2010) predicted that in ancestral populations, altruists would have mated frequently with individuals who exhibited a preference for having an altruistic partner. Studies of individuals' stated preferences for altruistic mates are nevertheless limited in the conclusions that can be drawn from them regarding the evolution of altruism as a mating strategy. Given that mate preferences are one among a host of factors, including the availability of mates and resources and the presence of competitors that determine *actual mating decisions and behaviours* (Arnocky, Ribout, Mirza, & Knack, 2014; Arnocky, Sunderani, & Vaillancourt, 2013; Todd *et al.*, 2007), it remains unclear whether or not altruistic behaviour is indeed correlated with enhanced mating success. This is an important distinction, given that it is actual mating outcomes which ultimately contribute to the evolution of particular phenotypes (Zohar & Guttman, 1989). Therefore, to the extent that mating with an altruist confers some reproductive advantage, or has done so over the course of human evolutionary history, we would expect altruists to exhibit increased mating success relative to their less altruistic counterparts.

Indirect evidence (typically from hunter-gatherer populations) lends circumstantial support to this hypothesis. It has been found that successful male hunters (who often share the meat they have obtained) receive greater reproductive access to females (Hawkes, 1991; Hawkes, O'Connell, Hill, & Charnov, 1985; Hill & Hurtado, 1996; Hill & Kaplan, 1988). This evidence seems consistent with sexual selection favouring altruists (Gintis *et al.*, 2001; Gurven & von Rueden, 2006). Tognetti, Berticat, Faurie, and Raymond (2014) found that rural Senegalese marry assortatively on cooperativeness, such that cooperative men tend to marry cooperative women. However, such assortment alone

could reflect either cooperators being highly desirable and choosing each other or cooperators being undesirable and marrying each other as a 'last resort' (e.g., cooperation as compensation for low mate value, Barclay, 2013, 2016). It is therefore essential to expand upon these initial findings by explicitly measuring altruism in relation to mating success, which can be done among young adults in a contemporary industrialized culture.

Across two studies, we tested the hypothesis of altruism as a costly signal by examining whether self-reported altruism (Study 1) and observable altruism in terms of monetary donation (Study 2) predicted various mating success indices in samples of undergraduate men and women. Rhodes, Simmons, and Peters (2005) suggest mating success in the way of sexual behaviour is a sufficient index of reproductive success in ancestral times; however, modern-day contraception attenuates this link between mating success translating into reproductive success.

STUDY 1

We hypothesized that self-reported altruism would predict greater self-reported desirability as a mate, having had more lifetime sex partners, more lifetime casual sex partners, and among those currently in a committed romantic relationship, more frequent copulation with one's partner within the past 30 days. Moreover, given that some research has suggested that altruism may be more important as a costly signal among men (especially for short-term matings, see Barclay, 2010; Böhm & Regner, 2013; Farrelly *et al.*, 2016; Moore *et al.*, 2013; Raihani & Smith, 2015; Van Vugt & Iredale, 2013), we explored interaction effects of sex as a potential moderator to these relationships. These hypotheses were tested in consideration of a potential confounding aspect of personality. Specifically, it is possible that any relationships between altruism and mating success may be an artefact of Big Five personality dimensions, which have been shown cross-culturally to correlate with altruism (Johnson *et al.*, 1989). For example, extraversion has been consistently linked to increased sexual behaviour across many (but not all) world regions (Schenk & Pfrang, 1986; Schmitt, 2004). Participant age was also controlled for given previous associations with number of sex partners in university samples (Arnocky *et al.*, 2013).

Method

Participants

Our sample consisted of 192 unmarried women and 105 unmarried men living in Northern Ontario, Canada, between the ages of 16 and 33 ($M_{\text{age}} = 21.21$, $SD = 3.48$). The ethnic composition of the sample was as follows: Caucasian (90%), Aboriginal (4%), Black (3%), Asian (2%), and South Asian (1%). Participants were recruited in common areas of a small university and college. As a part of a larger study on human mating behaviour, each participant completed a paper-and-pencil-based questionnaire containing self-report measures of altruistic behaviour, personality, mating success, and sexual history. Participants were compensated with an opportunity to win one of three \$100 draws.

Materials and procedure

Altruism

The 20-item Self-report Altruism Scale was used to measure dispositional altruism (Rushton, Chrisjohn, & Fekken, 1981). This is a widely used measure, which was

developed in the same Province of Canada in which the current research took place. The measure consists of items that assess the frequency of altruistic acts towards others, whereby direct reciprocity would be unlikely or unexpected. Example items include the following: 'I have given money to a charity', 'I have helped push a stranger's car out of the snow', 'I have given directions to a stranger', 'I have donated blood', 'I have offered to help a handicapped or elderly stranger across a street', and 'I have helped a classmate who I did not know that well with an assignment when my knowledge was greater than his or hers'. Response options ranging along a 5-point Likert-type scale (0 = *Never*, 4 = *Very Often*). The measure showed good internal consistency in both men ($\alpha = .86$) and women ($\alpha = .87$). An exploratory factor analysis was conducted to determine the fit of the items to one fixed factor: all items loaded well on a single factor, and there were no major differences in the relationship between altruism and mating success indices at the single-item level (see Supporting information).

Self-reported mating success

Self-reported desirability to the opposite sex was assessed using the self-perceived mating success scale (SPMS; Landolt, Lalumière, & Quinsey, 1995). The measure consists of 8 items with response options ranging along a 7-point Likert-type scale (1 = *disagree*, 7 = *agree*). The items are as follows: 'Members of the opposite sex that I like, tend to like me back', 'Members of the opposite sex notice me', 'I receive many compliments from members of the opposite sex', 'Members of the opposite sex are not very attracted to me' (reverse scored), 'I receive sexual invitations from members of the opposite sex', 'Members of the opposite sex are attracted to me', 'I can have as many sexual partners as I choose', and 'I do not receive many compliments from members of the opposite sex' (reverse scored). The measure showed good internal consistency ($\alpha = .85$).

Mating success indices (sexual history variables)

In assessing participants' past sexual behaviours, respondents self-reported on (1) their number of consensual lifetime sex partners and (2) their number of consensual casual sex partners where casual sex was defined as 'a sexual partner who [participants] were NOT in an exclusive, committed relationship with' (Arnocky et al., 2013). Finally, participants who self-reported as being currently in a romantic relationship (for at least 1 month) and who reported having had sex with their current partner at least once indicated the number of times they had engaged in consensual sexual intercourse over the past 30 days with that partner, as a measure of sexual access within the romantic dyad. Of the total sample, 111 participants (37.4%) met the criteria for currently being in a romantic relationship with a person whom they had previously copulated with (47 men, 64 women).

Personality dimensions

Big Five personality dimensions were measured using the Ten-Item Personality Inventory (TIPI; Gosling, Rentfrow, & Swann, 2003). Participants read the following set of instructions: 'Here are a number of personality traits that may or may not apply to you. Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other'. Participants then reported on the following ten items using a 7-point Likert-type scale (1 = *disagree*

strongly, 7 = *agree strongly*). Example items include the following: 'Extraverted, enthusiastic', and 'Reserved, quiet' (reverse scored) comprising the extraversion subscale. The TIPI has shown to converge with self, observer, and peer ratings of personality, as well as good construct validity and test-retest reliability (Gosling *et al.*, 2003; Jonason, Teicher, & Schmitt, 2011). In this study, the subscales all showed good intercorrelation, $r = .22, p < .001$ – $.52, p < .001$. All of the analyses of altruism produce qualitatively similar results whether age and personality are included or excluded in the regression models (Table 1).

Statistical analysis

Multiple ordinary least squares regression analyses were conducted using the PROCESS macro for SPSS (Hayes, 2013). Variables were mean centred (for continuous variables: altruism, age, extraversion, lifetime sex partners, lifetime casual sex partners, and mating success) and dummy coded (for dichotomous variable sex, M = -1, F = 1). Altruistic behaviour, sex (as the moderating variable) and their interaction were calculated with age and Big Five personality traits entered as covariates for each of the four mating success outcomes: self-reported mating success, lifetime number of sex partners, lifetime number of casual sex partners, and (for romantically involved participants) number of partner copulations in the past 30 days. Following the rationale outlined by Hayes (n.d.), we present unstandardized regression coefficients and standardized *t*-scores for each relationship (correlations between altruism and mating success indices are presented in the Supporting information). We present the effects of altruism both with and without covariates (age and personality factors).

Results and Discussion

We first examined the relationship between altruism, sex, and participants' self-reported mating success, controlling for age and TIPI scores (Table 1). Results showed that altruistic behaviour significantly predicted self-reported mating success, $b = 0.52, p = .0002$. Sex was not related to self-reported mating success, $b = -0.04, p = .61$. The altruism \times sex interaction was non-significant, suggesting that altruism predicts self-reported mating success regardless of sex, $b = 0.19, p = .16$. The model accounted for 19% ($R^2 = .19$) of explained variance in individuals' self-reported mating success.

We next examined the relationship between altruism, sex, and lifetime number of sex partners (Table 1). Results revealed that altruistic behaviour significantly predicted lifetime number of sex partners, $b = 2.60, p = .007$ (Figure 1). Sex also predicted lifetime number of sex partners, $b = -1.50, p = .02$, suggesting that men report having more lifetime sex partners than women. Moreover, the altruism \times sex interaction was also significant, $b = -3.01, p = .002$, suggesting that altruism matters more for men's access to sex partners relative to women. Simple slopes analysis indeed indicated that altruism predicted lifetime number of sex partners for men, $b = 6.34, \beta = .40, p = .0001$, but not for women, $b = 0.76, \beta = .02, p = .57$. The model accounted for 26% ($R^2 = .26$) of explained variance in individuals' total number of lifetime sex partners.

In examining individuals' lifetime number of casual sex partners, it was similarly found that altruistic behaviour significantly predicted total number of casual sex partners, $b = 2.16, p = .009$ (Table 1). Sex predicted number of casual sex partners, $b = -1.38, p = .009$, suggesting that men report more casual sex partners than did women. There

Table 1. Study 1: Unstandardized and standardized regression coefficients and standard errors for models testing altruism as a predictor of mating success indices, both with and without control variables (age and Big Five personality measures)

	Self-report mating success			Lifetime sex partners			Lifetime casual sex partners			In-pair copulation frequency		
	<i>b</i>	β	SE	<i>b</i>	β	SE	<i>b</i>	β	SE	<i>b</i>	β	SE
Model with control variables												
Altruism	0.52***	.25	0.13	2.60**	.16	0.97	2.16**	.16	0.83	3.83 [†]	.27	1.69
Sex (<i>M</i> = -1, <i>F</i> = 1)	-0.04	-.04	0.09	-1.50*	-.17	0.62	-1.38**	-.18	0.53	0.12	.02	0.92
Altruism × Sex	0.19	.09	0.14	-3.01**	-.19	0.98	-3.01***	-.22	0.84	3.05	.21	1.66
Age	0.09	.03	0.02	0.75***	.30	0.15	0.45***	.21	0.13	0.07	.03	0.23
Extraversion	0.28***	.34	0.05	1.30**	.21	0.38	1.04**	.21	0.33	0.41	.08	0.60
Conscientiousness	0.06	.05	0.07	-1.10*	-.13	0.51	-1.05*	-.15	0.44	-1.36 [†]	-.19	0.77
Emotional stability	0.03	.03	0.06	-0.57	-.09	0.43	-0.36	-.07	0.37	0.82	.15	0.65
Openness	-0.07	-.07	0.07	0.35	.04	0.53	0.09	.01	0.45	0.22	.03	0.85
Agreeableness	-0.05	-.05	0.07	-0.07	-.01	0.54	0.04	.01	0.46	-0.17	-.03	0.77
Model without control variables												
Altruism	0.55***	.26	0.13	3.27***	.21	0.95	2.66***	.20	0.76	4.26***	.30	1.37
Sex	-0.06	-.05	0.07	-1.61**	-.18	0.55	-1.46**	-.19	0.45	-0.18	-.02	0.74
Altruism × Sex	0.18	.08	0.13	-3.18**	-.20	0.98	-3.05***	.23	0.81	2.24	.15	0.12

Note. [†] *p* < .10; **p* < .05; ***p* < .01; ****p* < .005.

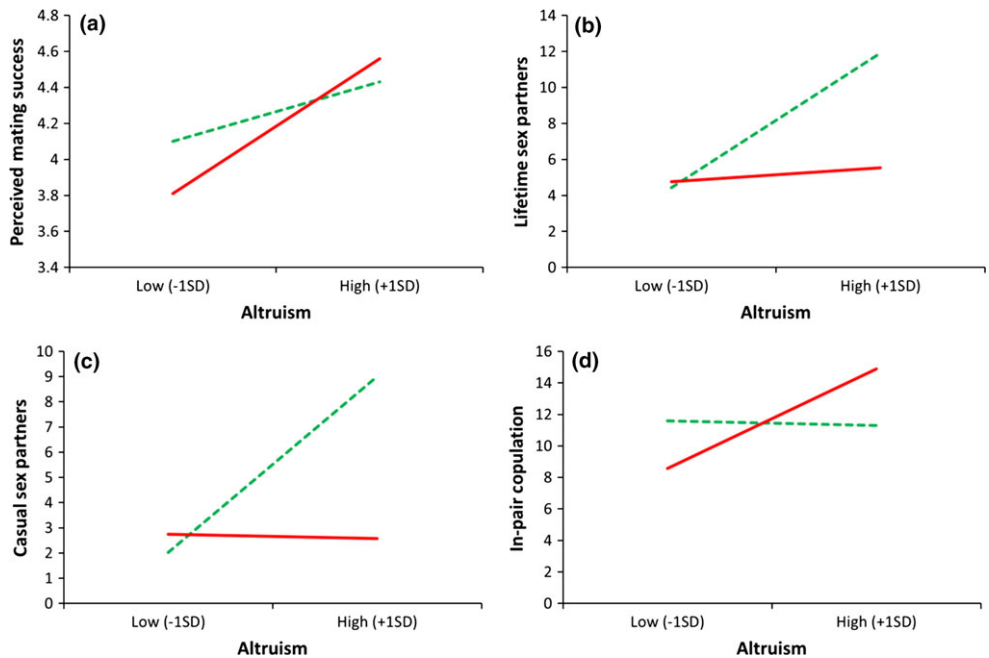


Figure 1. Self-reported altruism in Study 1 and reported mating success of males (dashed lines) and females (solid lines), as measured by (a) scores on a scale of self-reported mating success, (b) number of lifetime sex partners, (c) number of casual sex partners, and (d) number of in-pair copulations in the last month. Participant sex moderates the relationship between altruism and lifetime number of sex partners and number of past-year sex partners, but not self-reported mating success or lifetime casual sex. Note. For display purposes, low altruism = 1 SD below the mean and high altruism = 1 SD above the mean. [Colour figure can be viewed at wileyonlinelibrary.com]

was a significant altruism \times sex interaction, $b = -3.01$, $p = .0004$, suggesting that altruism related more strongly to number of casual sex partners among men relative to women (Figure 1). Simple slopes analysis indeed indicated that altruism predicted lifetime number of sex partners for men, $b = 5.88$, $\beta = .45$, $p = .0001$, but not for women, $b = -0.14$, $\beta = -.01$, $p = .89$. The model accounted for 23% ($R^2 = .23$) of explained variance in individuals' number of casual sex partners.

We next examined the relationship between altruism and number of times participants had sex with their partners within the past 30 days among a subset of our sample who had a dating partner at the time of data collection ($n = 111$ participants, Table 1). Results showed that altruistic behaviour was modestly related to number of copulations in the past month, $b = 3.83$, $p = .08$. Sex did not predict number of copulations, $b = 0.12$, $p = .90$. The altruism \times sex interaction was not significant, $b = 3.05$, $p = .13$. The model accounted for 13% ($R^2 = .13$) of explained variance in individuals' in-pair copulations. Without the control variables in the model, the effect of altruism increased in significance, $b = 4.26$, $p = .01$.

STUDY 2

Study 1 showed a link between altruism and mating success variables. However, it was limited in the use of a self-report measure of altruism. For Study 2, we utilized a modified

dictator dilemma as an observable measure of altruism, in which participants were entered into a draw for \$100 and were asked to indicate whether they wanted to keep their winnings, or to have the researchers donate a specific portion of their winnings on their behalf to a registered charity of their choosing.

Study 2 also extended upon Study 1 by considering the potential role of social desirability bias in responding to altruistic and sexual history items. Research on the reporting of sexual histories has shown that social desirability bias might influence sex differences in reporting number of sex partners, whereby men tend to over-report, and women to under-report, their number of past sexual partners (Fenton, Johnson, McManus, & Erens, 2001; Jonason, 2007). Research has also linked social desirability bias to charitable giving (Lee & Sargeant, 2011). Similarly, it is also possible that those high in narcissism (grandiose, inflated view of the self) might engage in some altruistic activities out of self-interest (Brunell, Tumblyn, & Buelow, 2014) and narcissism also relates to differences in mating behaviour, such as in more short-term mating (Jonason, Li, Webster, & Schmitt, 2009). If the results from Study 1 were driven by socially desirable responding or by narcissists over-reporting their altruism, then any altruism-mating link should disappear when controlling for narcissism and socially desirable responding.

Thus, our goal was to determine whether observable altruism in the form of monetary donation would predict the same mating success variables as in Study 1, along with two additional mating success variables: total number of lifetime dating partners and total number of sex partners within the past year, while controlling for Big Five personality factors (assessed using a more comprehensive measure), narcissism, and socially desirable responding.

Method

Participants

Our sample consisted of 335 undergraduate women and 189 undergraduate men from northern Ontario, Canada, between the ages of 18 and 47 ($M_{\text{age}} = 20.53$, $SD = 3.35$). The ethnic composition of the sample was largely Caucasian (94%). Participants were recruited from classrooms at a small university and college. Participant completed a paper-and-pencil-based questionnaire containing self-report measures of personality, social desirability responding, narcissism, mating success, and sexual history. Participants were compensated with an opportunity to win a \$100 draw and were given the opportunity to indicate whether they would like to be awarded the winnings or to have the researchers donate it (or a portion) to a registered charity of their choosing (our behavioural measure of altruism).

Altruism (monetary donation to charity)

Participants completed a self-report survey after which they were told they would be entered into a draw for a chance to win \$100 CAD. At the end of their questionnaire, participants read the following statement: 'For completing this survey, your name will be entered into a \$100 draw. If you happen to win the draw, you may (1) keep the money, (2) allow us to donate the money to a registered charity on your behalf, or (3) a combination of the two. If you would like to donate to a registered charity, please answer the following: I would like the researcher to donate \$_____ of my winnings to the following charity on my behalf (any money not donated will be given to you the participant and can be

picked up at the Evolution Lab A-222H upon notification of winning the draw)'. Participants opting to donate had the option of World Wildlife Foundation Canada, Canadian Cancer Society, ALS Society of Canada, Canadian Mental Health Association, or any other registered Canadian charity (as indicated by the participant in the space provided). Following previous research (Johannesson & Persson, 2000; Nettle *et al.*, 2013), we were interested in whether or not a participant made a donation (rather than the total amount of money donated), and we therefore operationalized donations as a dichotomous variable (0 = *no*, 1 = *yes*).² In the present sample, and similar to proportions of giving in some other laboratory-based dictator games (Nettle *et al.*, 2013; Rigdon, Ishii, Watabe, & Kitayama, 2009), 65.3% of participants, male = 57.7%, female = 69.6%, $\chi^2(1, N = 524) = 7.52, p = .006$, donated some of their potential winnings, suggesting that consistent with previous literature, women were more giving than men (Eckel & Grossman, 1998).

Self-reported mating success and mating success indices (sexual history variables)

Self-reported mating success was again measured using self-perceived mating success scale (SPMS; Landolt *et al.*, 1995). As in Study 1, respondents again self-reported on (1) their number of consensual lifetime sex partners, (2) their number of consensual casual sex partners, and for those in a romantic relationship (for at least one month) and who reported having had sex with their current partner at least once, and (3) the number of times they had engaged in consensual sexual intercourse over the past 30 days with that partner. Of the total sample, 250 participants (47.7%) met the criteria for currently being in a romantic relationship with a person whom they had previously copulated with (101 men, 149 women). In Study 2, participants additionally reported their total number of lifetime dating partners, as well as their total number of sex partners within the past year.

Personality dimensions

The 44-item Big Five Inventory (BFI; John & Srivastava, 1999) was used to measure extraversion versus introversion ($\alpha = .86$), agreeableness versus antagonism ($\alpha = .75$), conscientiousness versus lack of direction ($\alpha = .60$), neuroticism versus emotional stability ($\alpha = .83$), and openness versus closedness to experience ($\alpha = .73$). Participants respond to each item using a 5-point Likert-type scale (1 = *disagree strongly*, 5 = *agree strongly*).

Narcissism

The 16-item Narcissistic Personality Inventory (NPI) was used to measure trait narcissism (Ames, Rose, & Anderson, 2006). The NPI-16 has shown good face validity, discriminant, and predictive validity. Each item consists of two response items, and the respondent places an 'X' beside the statement that most closely describes their feelings and beliefs about themselves. An example item is as follows: 'I really like to be the center of attention OR It makes me uncomfortable to be the center of attention'. The measure showed good internal consistency ($\alpha = .72$).

² The variable 'amount of money donated' was also collected but was not normally distributed, Shapiro-Wilk $W(524) = .81, p = .0001$, and was thus excluded from further analyses.

Social desirability bias

Socially desirable responding (i.e., whether respondents are answering truthfully or are misrepresenting themselves as a function of impression management) was measured using the Balanced Inventory of Desirable Responding (BIDR, Paulhus, 1991). Participants respond to the 40-item measure using a 7-point Likert-type scale (1 = *not true*, 7 = *very true*). The measure provides two 20-item subscales: Self-Deceptive Enhancement, or the tendency to give honest but inflated self-descriptions, and Impression Management, or the tendency to give inflated self-descriptions to others. Items are recoded so that responses of 6 or 7 scored as a 1 and all other responses with a 0 (thus, scores for each subscale range between 0 and 20). Both the Self-Deceptive Enhancement subscale ($\alpha = .67$) and Impression Management subscale ($\alpha = .65$) showed acceptable internal consistency consistent with those reported by Paulhus (1991).

Results and Discussion

We examined the relationships between willingness to donate, sex, and participants' perceptions of their own self-reported mate value, while controlling for age, Big Five personality factors, and socially desirable responding, using the same regression analyses described in Study 1. Effects for models with and without control variables, as well as the relationships between the controls and dependent variables, are detailed in Table 2. Results showed that donating potential winnings to a charitable organization did not predict self-reported mating success, $b = -0.18$, $p = .11$ (Table 2). Sex predicted self-reported mating success, $b = 0.44$, $p = .0001$. The altruism \times sex interaction did not predict self-reported mating success, $b = -0.02$, $p = .92$. The model accounted for 9% ($R^2 = .09$) of explained variance in individuals' self-reported mating success.

We next examined lifetime number of dating partners. Results revealed no main effects for either donating $b = 0.25$, $p = .45$, or sex $b = -0.45$, $p = .14$, upon lifetime number of dating partners (Table 2). However, results did reveal a significant altruism \times sex interaction, $b = -1.50$, $p = .02$. Simple slopes analysis indeed indicated that altruism predicted lifetime number of dating partners for men, $b = 1.22$, $\beta = .15$, $p = .02$, but not for women, $b = -0.29$, $\beta = .03$, $p = .44$. The model accounted for 26% ($R^2 = .26$) of explained variance in individuals' total number of lifetime dating partners.

We next examined lifetime number of sex partners (Table 2). Results revealed that donating significantly predicted lifetime number of sex partners, $b = 1.57$, $p = .01$ (Figure 2). Sex also predicted lifetime number of sex partners, $b = -1.61$, $p = .02$, suggesting that men report having more lifetime sex partners than women. Moreover, the altruism \times sex interaction was also marginally significant, $b = -2.30$, $p = .07$, suggesting that donating money factors slightly more towards predicting men's access to sex partners relative to women. Simple slopes analysis indeed indicated that altruism predicted lifetime number of sex partners for men, $b = 3.05$, $\beta = .18$, $p = .002$, but not for women, $b = 0.75$, $\beta = .04$, $p = .34$. The model accounted for 28% ($R^2 = .28$) of explained variance in individuals' total number of lifetime sex partners.

We next examined lifetime number of casual sex partners. Results revealed that donating significantly predicted lifetime number of casual sex partners, $b = 1.26$, $p = .01$ (Figure 2). Sex also predicted lifetime number of casual sex partners, $b = -1.45$, $p = .01$, suggesting that men report having more lifetime casual sex partners than women. The altruism \times sex interaction was not significant, $b = -1.17$, $p = .27$, suggesting that altruism in the form of monetary donation was linked to having more casual sex partners

Table 2. Study 2: Unstandardized and standardized regression coefficients and standard errors for models testing altruism as a predictor of mating success indices, both with and without control variables (age and extraversion)

	Self-report mating success			Lifetime sex partners			Lifetime casual sex partners			Lifetime dating partners			Sex partners past year			In-pair copulation frequency		
	<i>b</i>	β	SE	<i>b</i>	β	SE	<i>b</i>	β	SE	<i>b</i>	β	SE	<i>b</i>	β	SE	<i>b</i>	β	SE
Model with control variables																		
Donate (yes/no)	-0.18	-.07	0.11	1.57**	.09	0.63	1.26**	.10	0.52	0.25	0.33	0.53**	.12	0.20	0.20	-0.10	-.01	1.19
Sex (M = -1, F = 1)	0.44***	.18	0.12	-1.61*	-.09	0.71	-1.45**	-.12	0.58	-0.45	-0.06	-0.53*	-.12	0.23	1.02	1.02	.06	1.38
Donate \times Sex	0.02	.01	0.22	-2.30 [†]	.06	1.29	-1.17	-.05	1.05	-1.50**	-.09	-0.41	-.05	0.41	-0.21	-0.21	-.01	2.37
Age	0.02	.06	0.02	0.97***	.40	0.09	0.59***	.35	0.07	0.56***	.48	0.05	-.01	0.03	0.15	0.15	.07	0.14
Extraversion	0.19*	.13	0.08	1.36**	.13	0.45	0.98**	.13	0.37	0.21	.04	0.24	0.35*	.13	0.14	0.25	.02	0.86
Conscientiousness	-0.03	-.01	0.13	-0.93	-.05	0.75	-0.82	-.06	0.61	-0.01	-0.01	0.39	-0.04	-.01	0.24	0.20	.01	1.48
Emotional stability	-0.01	-.01	0.08	0.10	.01	0.44	0.07	.01	0.36	0.24	.05	0.23	-0.06	-.02	0.14	-0.60	-.06	0.84
Openness	0.01	.01	0.10	0.16	.01	0.56	0.11	.01	0.46	-0.01	-0.01	0.29	0.20	.05	0.17	0.06	.01	1.03
Agreeableness	0.14	.06	0.11	0.09	.01	0.65	0.42	.04	0.53	-0.06	-0.01	0.34	0.06	.02	0.21	2.53*	.17	1.21
Narcissism	0.99**	.19	0.34	2.49	.06	1.98	1.54	.05	1.61	1.14	.05	1.03	-0.83	-.08	0.62	2.95	.07	3.68
Self-deception	0.01	.04	0.02	0.03	.01	0.11	-0.01	-.01	0.09	0.01	.01	0.06	0.02	.03	0.03	0.26	.11	0.19
Impression management	-0.03	.08	0.02	-0.13	-.05	0.12	-0.15	-.08	0.10	0.03	.03	0.06	-0.09*	-.13	0.04	-0.60**	-.20	0.22
Model without control variables																		
Donate (yes/no)	-0.14	-.06	0.11	2.31**	.13	0.74	1.57**	.13	0.52	0.50	.06	0.36	0.60**	.14	0.19	0.14	.01	1.11
Sex	0.27*	.11	0.11	-3.62***	-.21	0.73	-2.34***	-.19	0.52	-1.15**	-.14	0.36	-0.52**	-.12	0.19	-0.11	-.01	1.09
Donate \times Sex	-0.01	-.01	0.22	-3.33*	-.09	1.51	-1.52	-.06	1.07	-1.56*	-.09	0.73	-0.50	-.06	0.38	-0.15	-.01	2.25

Note. [†] $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .005$.

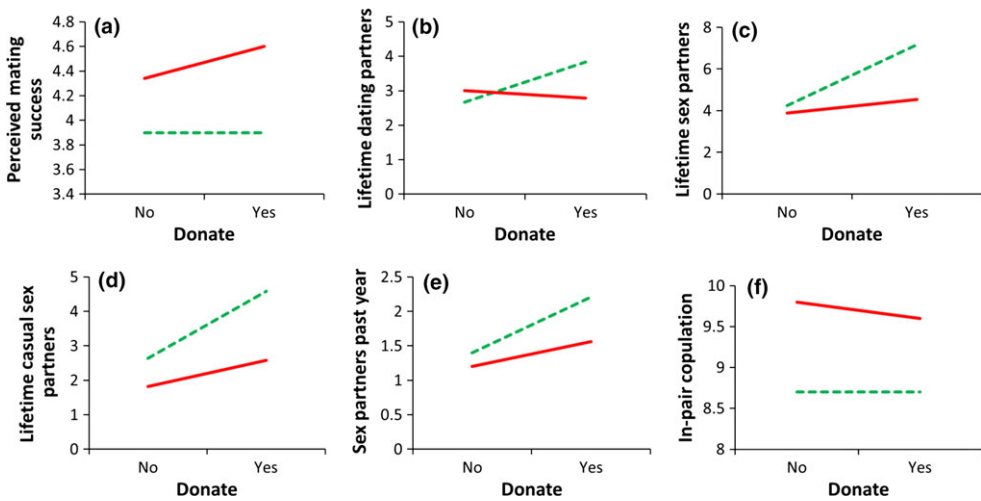


Figure 2. Altruism (willingness to make a monetary donation) in Study 2 and self-reported mating success of males (dashed lines) and females (solid lines), as measured by: (a) self-reported mating success, (b) lifetime number of dating partners, (c) lifetime number of sexual partners, (d) lifetime number of casual sex partners, (e) number of sexual partners in the last year, and (f) number of in-pair copulations in the last month. Altruism (donating) predicts lifetime number of dating partners (for men only), lifetime number of sex partners (for men only), lifetime number of casual sex partners, and sex partners over the past year. Altruism did not predict self-reported mating success or in-pair copulation frequency. [Colour figure can be viewed at wileyonlinelibrary.com]

among both men and women. The model accounted for 20% ($R^2 = .20$) of explained variance in individuals' total number of lifetime casual sex partners.

For number of sex partners in the past year, results revealed that donating significantly predicted number of sex partners in the past year, $b = 0.53$, $p = .008$ (Figure 2). Sex also predicted number of sex partners in the past year, $b = -0.53$, $p = .02$, suggesting that men report having had more sex partners in the past year. The altruism \times sex interaction was not significant, $b = -0.41$, $p = .32$, suggesting that altruism in the form of monetary donation was linked to having more past-year sex partners among both men and women. The model accounted for 7% ($R^2 = .07$) of explained variance in individuals' total number of sex partners within the past year.

Lastly, we examined the relationship between willingness to donate winnings and the number of times participants had sex with their partners within the past 30 days among a subset of our sample who had a dating partner at the time of data collection ($n = 250$ participants). Results showed that neither donating, $b = -0.10$, $p = .93$, sex, $b = 1.02$, $p = .46$, nor the altruism \times sex interaction was significant, $b = -0.21$, $p = .93$. The model accounted for 8% ($R^2 = .08$) of explained variance in individuals' in-pair copulations.

GENERAL DISCUSSION

Our results supported our overarching hypothesis that altruism would predict actual mating success, and not just ratings of attractiveness from audiences (as studied in previous research, e.g., Barclay, 2010). First, findings from Study 1 showed that even after controlling for age and personality, altruists reported themselves to be more desirable to

members of the opposite sex (Landolt *et al.*, 1995) than people who were less altruistic, and this was the case for both men and women. Moreover, when examining explicit reports of copulatory behaviour, it was found that altruists reported more lifetime sex partners, more casual sex partners, and for those who were currently in romantic relationships, more frequent sex with one's current partner (although the latter effect only met criteria for statistical significance without the control variables of age and personality included in the model). Upon examination of altruism's interaction with sex, it was found that altruism generally predicted number of sexual partners among men but not women.

Results for Study 2 were relatively consistent with those of Study 1 in showing that altruism in the form of donating potential winnings predicted lifetime number of dating partners (for men), and lifetime number of sex partners (for men), lifetime number of casual sex partners (for both men and women), and past-year total sex partners (for men and women). Results from Study 2 did, however, differ in a few notable ways, in that self-reported mating success and in-pair copulation frequency were not correlated with altruism (either with or without controls for socially desirable responding and narcissism). In contrast to the other sexual history variables which constitute counts of various sexual and dating partners, it may be that there was simply more subjectivity involved in perceiving and assessing the extent to which one believes they are attractive to the opposite sex. Thus, positive results from Study 1 linking altruism to such self-perceptions of desirability should be interpreted cautiously. Similarly, Study 2 failed to replicate the finding from Study 1 whereby altruism predicted in-pair copulation frequency, which even in Study 1, diminished upon inclusion of control variables. Future research might consider employing more diverse measures of relationship functioning such as overall relationship satisfaction to determine whether altruists' romantic dyads are meaningfully different in terms of benefits (resources provided by partners, sexual access) or in overall satisfaction, relative to non-altruists – perhaps while considering the altruistic tendencies of both relationship partners.

Taken together, these findings support previous research on various hunter-gatherer populations, which have focussed on food sharing by hunters among non-kin as a form of altruism, which show that men who hunt – and share – meat enjoy greater reproductive success (Hill & Kaplan, 1988; Smith, 2004). In modern industrialized cultures, research has previously shown that individuals report preferring altruistic mates (Barclay, 2010). The present findings converge with the aforementioned lines of inquiry to suggest that altruists in contemporary society benefit objectively in terms of enhanced mating success.

Previous research has suggested that altruism may matter more for men relative to women as a costly signal of their mate value (Barclay, 2010; Böhm & Regner, 2013; Raihani & Smith, 2015; Van Vugt & Iredale, 2013). Generally, men (as with males of other mammalian species) more than women, increase their reproductive fitness by attracting and copulating with multiple mates (Bateman, 1948; Trivers, 1972). Both Study 1 and Study 2 showed that altruism mattered more for men's than for women's lifetime number of dating partners and sex partners; Study 1 (but not Study 2) showed a similar effect for casual sex partners. Together, these findings support the hypothesis that men more than women may use altruistic behaviour as a costly signal to attract partners for short-term copulations.

Taken together, the present study provides the first empirical evidence that altruism may tangibly benefit mating in humans living in Western industrialized society and that sex differences might exist with respect to the utility of altruism for mating, whereby it is a more effective signal for men than for women.

In showing that altruists benefited not just in mating in general, but also in short-term mating ('casual sex partners'), previous studies are conflicting on whether altruists are desired for short-term relationships, with some studies saying no (Barclay, 2010; Farrelly, 2011; Oda *et al.*, 2014) and others saying yes (Farrelly *et al.*, 2016; Moore *et al.*, 2013). It is possible that the types of altruism in the present research differ from those in previous studies: there may be different kinds of altruism, some of which signal qualities like physical abilities or status, which are desirable for short-term relationships, and some of which signal qualities like cooperative intent, which are only desirable for long-term relationships (Barclay, 2013; Barclay & Reeve, 2012; Kafashan, 2012). In Study 1, all items on our measure of altruism measured on a single factor (see Supporting information), which speaks against this possibility, but other factor analyses have found different types of altruism (Kafashan, 2012), and these could have differential effects on desirability for long- and short-term relationships. For example, some types of altruism may signal difficult-to-observe qualities, whereas other types may be used to compensate for a lack of other desirable qualities (Barclay, 2013). This warrants further investigation. Another possibility is that when studying 'real' mating behaviour, individuals likely often hold discordant expectations of what might follow an initial copulation. It is possible, for instance, that some women who copulate with altruistic men may do so in hopes of forming a continued relationship (e.g., desiring them as a long-term partner), even though it may only result in a short-term mateship (hence increasing the man's number of short-term 'casual' sex partners). Future research would benefit from considering additional factors, which may address the apparent disconnect between mate preferences and actual mating outcomes pertaining to altruism and short-term mating.

Limitations and future directions

There are notable limitations and future directions to the present research. First, as with much of the extant literature on mating success and altruism, this research relied upon a correlational design, and thus, causal conclusions cannot be made. However, the present results complement previous laboratory studies that experimentally varied a target person's altruism and showed that altruism is a desirable quality in partners (Barclay, 2010; Farrelly, 2011; Moore *et al.*, 2013). Future research might consider conducting longitudinal assessment of baseline altruistic disposition at a young age, then following participants through late adolescence and early adulthood, and assessing subsequent mating activity. It would also be beneficial to examine whether these relationships hold cross-culturally, where differing values surround both the helping of others as well as sexual activity exist.

One might argue that the present results do not represent higher mating success of altruists, but are simply due to some participants tending to score themselves higher in general on everything, including both altruism and mating success. If this alternative hypothesis is correct, then the effect of altruism should disappear when controlling for other traits that participants could rate themselves highly on, such as personality, narcissism, and especially socially desirable responding. Instead, controlling for personality (Studies 1 and 2), narcissism, and socially desirable responding (Study 2) did not affect the relationship between altruism and mating success, which speaks against this alternate hypothesis.

It would be worth extending the study of altruism and mating success, both long term and short term, to include a wider array of variables. Mating success is a diverse construct that is often used as a proxy for ancestral reproductive success. Constructs such as

relationship length and power, partner quality (i.e., partner mate value), extrapair mating, and success at mate poaching are all potential indicators of mating success that would be worth examining in relation to altruism. Also, given that mate value is comprised of many components such as attractiveness, resources, intelligence, and a host of other factors, it would be worthwhile to explore how individuals 'trade-off' altruistic tendencies in potential partners against other desirable qualities under short- or long-term mating conditions. Given that altruism is likely to be a multi-dimensional construct with different types of altruism signalling different qualities (Kafashan, 2012), it would be worthwhile to examine how the different types of altruism impact short-term and long-term mating success.

Conclusion

Previous studies have investigated whether altruists are more attractive than non-altruists, all else being equal. The present study is the first to show that this may translate into real mating success, in that altruists had more mates than non-altruists. This supports the idea that altruism might be a costly signal of desirable qualities and could have evolved in part via sexual selection.

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Supporting Information

The following supporting information may be found in the online edition of the article:

Appendix S1. Exploratory factor analysis for the self-report altruism scale and item-specific correlations with mating success variables (Study 1).