Intra- versus Intersex Aggression:

Testing Theories of Sex Differences Using Aggression Networks

Ralf Wölfer and Miles Hewstone

University of Oxford

Author Note

Ralf Wölfer and Miles Hewstone, Department of Experimental Psychology, University of Oxford, United Kingdom.

This research was funded by the NORFACE research programme on Migration in Europe – Social, Economic, Cultural and Policy Dynamics.

Correspondence concerning this article should be addressed to Ralf Wölfer, Department of Experimental Psychology, University of Oxford, South Parks Road, Oxford OX1 3UD, United Kingdom. Email: ralf.woelfer@psy.ox.ac.uk

Abstract

Two theories seek to explain sex differences in aggressive behavior: Sexual selection theory and social role theory. While each theory has specific strengths and limitations depending on the opponent's sex, research hardly differentiates between intrasex and intersex aggression. In the present study, 11,307 students (M_{AGE} = 14.96 years; 50% girls) from 597 school classes provided multiple social network data (aggression, friendship) as well as physical (body mass index) and psychosocial (gender norms, masculinity norms) information. Aggression networks disentangled intra- and intersex aggression, whose class-aggregated sex differences were analyzed with contextual predictors derived from sexual selection and social role theories. As expected, results revealed that sexual selection theory predicted male-biased sex differences in intrasex aggression, while social role theory predicted male-biased sex differences in intersex aggression. Findings suggest the value of explaining sex differences separately for intra- and intersex aggression with a dual-theoretical framework covering both evolutionary and normative components.

Keywords: aggression, sex differences, social network analysis

Intra- versus Intersex Aggression:

Testing Theories of Sex Differences Using Aggression Networks

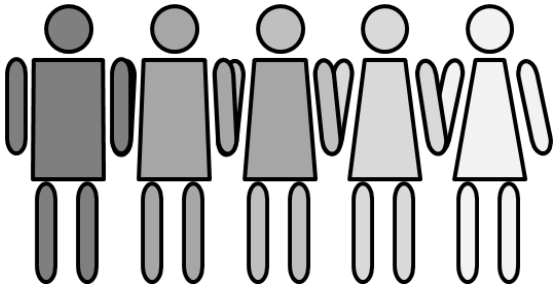
A robust finding in the field of human aggression is males' average tendency to be more aggressive than females. Especially for physical forms of aggressive behavior, several meta-analyses support this finding across different age groups, methods, and cultures (e.g., Archer, 2004; Bettencourt & Miller, 1996; Card, Stucky, Sawalani, & Little, 2008; Eagly & Steffen, 1986). Two co-existing theoretical approaches compete to explain this consistent sex difference in aggressive behavior, namely sexual selection theory (Darwin, 1871) and social role theory (Eagly, 1987), which are contrasted in Table 1.

Investigating the validity of these theoretical approaches is a continuous focus of scientific effort (cf., Archer, 2009a), which has produced cumulative evidence for both theories (e.g., Lindenfors & Tullberg, 2011; Nivette, Eisner, Malti, & Ribeaud, 2014). However, to date, this line of research has tended to confound aggressive acts by studying sex differences of aggressors without considering the sex of their victims. We believe that a differentiation between intrasex aggression and intersex aggression will help to further improve the precision of theories that aim to explain sex differences in aggression.

Dual-theoretical Explanation of Intra- and Intersex Aggression

The rationale for the differentiated examination of sex differences in intra- and intersex aggression is that existing theories differ in their suitability to explain these two phenomena. On the one hand, the main argument of sexual selection theory—intermale competition leads to sex differences in aggression—is specifically convincing for the explanation of sex differences in intrasex aggression. There have been attempts to widen the classic scope of sexual selection theory and propose evolutionary arguments for the occurrence of intersex aggression (Muller, Kahlenberg, Thompson, & Wrangham, 2007). However, male-female aggression is not a common reproductive strategy in humans, who

Table 1: Theories for Sex Differences in Aggressive Behavior

	Sexual Selection Theory	Social Role Theory
		
Similarities	■ Males are physically more aggressive than females ■ Differences occur in adolescence at the latest (either due to rising testosterone levels or cumulative socialization experiences)	
Meta-Theory	Theory of Evolution (Darwin, 1859)	Social Learning Theory (Bandura, 1977)
Main Idea	Sex differences are based on mammalians' method of reproduction: Females' higher parental investment decreases their reproductive rate making them a limited resource that males have to compete for.	Sex differences are based on the traditional division of labor: Socialization processes form gender-specific roles, which shape gender-specific identities, expectations, and behavior.
Predictors of higher male aggression	■ Variation of reproductive chances (social hierarchy in males) ■ Reproductive competition (operational sex ratio) ■ Body dimorphism (sex differences in body mass index)	■ Internalization of gender-typical roles (gender norms) ■ Traditional masculinity beliefs (masculinity norms)

typically engage in stable long-term relationships characterized by intensive biparental care (Fernandez-Duque, Valeggia, & Mendoza, 2009). Moreover, evolutionary arguments for intersex aggression only account for greater male-female, but not for greater female-male aggression, for which there is evidence in some human societies (cf., Alpern, 1998).

On the other hand, social role theory seems to be of particular value for explaining sex differences in intersex aggression, which were found to equalize in societies with less traditional and more liberal gender roles (Archer, 2006). While traditional gender roles in patriarchal societies encourage males' use of aggression, including the approval of male-female aggression, liberal gender roles in postfeminist western societies do not inhibit females' use of aggression including the approval of female-male aggression. The adequacy of social role theory has, however, also been challenged due to the non-cumulative growth of sex differences in aggression over the life course despite cumulative socialization experiences (cf., Archer, 2009a) or the constant sex ratio of crime prevalence rates in liberalized western societies over the last 50 years (Kenrick & Griskevicius, 2009).

Overall, literature indicates that neither of the two theories represents a universal framework for the explanation of sex differences in human aggression. Instead a dual-theoretical approach, with sexual selection theory explaining sex differences in intrasex aggression and social role theory explaining sex differences in intersex aggression, acknowledges the different mechanisms that underlie these two forms of sex differences.

Disentangling the Explanandum with Aggression Networks

There is only a small number of studies that differentiates intra- and intersex aggression (e.g., Hilton, Harris, & Rice, 2000; Pellegrini & Long, 2002), which is due, in part, to the methodological difficulties involved in assessing aggression within and between the sexes. We propose that a social network approach, which structures ties between network members (Borgatti, Mehra, Brass, & Labianca, 2009), helps to advance this line of research.

Depending on the nature of assessed ties, network information can capture different types of interdependencies. While most social network research focuses on positive ties such as friendship patterns, it is also possible to study negative ties such as aggressive behavior (cf., Huitsing et al., 2012). By considering the sex of all network members, an aggression network enables researchers to precisely disentangle intrasex aggression and intersex aggression. Moreover, relying on network data also helps to overcome some limitations of traditional methods, such as the unidirectional perspective of self-reports or the complex and time-consuming data assessment in observational studies.

Objective and Hypotheses

The present study sought to explain sex differences in aggressive behavior. Detailed network data allow us to disentangle intra- and intersex aggression within a given environment. A large-scale dataset that includes nearly 600 social networks enables us to determine the magnitude of these aggression scores in boys and girls across the different environments. This environment-dependent variability of sex differences in aggression will then be explained with the help of contextual predictors that derive from sexual selection theory and social role theory, as outlined in Table 1 (for more details see Archer, 2009a; Wood & Eagly, 2002).

To investigate this research objective, we focused on adolescence to ensure the necessary comparability between both theories, which suggest a similar development of sex differences in aggression until adolescence (see Table 1), but differ in their prediction thereafter (cf., Archer, 2009a). Moreover, we used an ethnically diverse dataset with a high number of immigrants from traditional societies to provide sufficient variability of traditional and western gender roles. Considering a diverse sample is important for studying sex differences in intersex aggression, which differ as a function of cultural norms (cf., Archer, 2004, 2006) and may, therefore, be moderated by its proxy ethnicity.

Based on the outlined literature, we tested the following hypotheses:

1. Males are more aggressive than females to same-sex opponents and, due to the ethnically diverse sample with more traditional norms, other-sex opponents.

2. Predictors derived from sexual selection theory explain sex differences in intrasex aggression, while predictors derived from social role theory explain sex differences in intersex aggression.

Method

Sample

Participants were drawn from the "Children of Immigrants Longitudinal Survey in Four European Countries" (CILS4EU; Kalter et al., 2013). All presented data in this study rely on the completed first wave of this ongoing international collaboration between England, Germany, the Netherlands, and Sweden. The target population of 14-year-old children was recruited within a school-based stratified sample selection standardized across countries. Given the main research goal of CILS4EU—comparing children of immigrant and non-immigrant parents—the present study systematically oversampled students from ethnic minority groups. Participation rate was high with an average school participation rate of 84%, average class participation within participating schools of 99%, and average student participation rate within participating classes of 85%.

From all four initial countries, England could not be considered in the present study due to a technical problem with the social network data. In the remaining three countries, school classes with fewer than 15 students were excluded (11%) in order to analyze considerably large networks. Moreover, given our main research question, the present study had to exclude single-sex classes (2%) as well as classes with a sex ratio of three standard deviations above and below the mean (1%) in order to conduct a meaningful comparison of aggressive behavior between girls and boys.

These inclusion criteria left a total of 597 classes including 12,640 students. Completed data on all study variables were available from 11,307 of these students (90%) with an average age of M = 14.96 years (SD = 0.62), an equally distributed sex ratio (50% girls), and the intended disproportionally high number of immigrants (38%; mainly from Turkey, Morocco, and Iraq). Drop out analyses revealed that students with missing data hardly differ regarding sex (52% girls; $z(12{,}631) = -1.19$, $p > .05$; $d = -.04$), age (14.97 years; $t(12{,}351) = -0.50$, $p > .05$; $d = -.02$), or ethnic minority status (44%; $z(12{,}599) = -3.56$, $p < .001$; $d = .12$), so that the attrition can be considered to be unsystematic.

Measures

Data were collected in the regular school setting by the middle of the school year 2010/2011. In a two-hour data assessment session, participants were asked to answer a standardized questionnaire with the help of trained test administrators. The complete questionnaire assessed core dimensions of integration, sociometric data, and school achievement, from which the present study analyzed the measures described below.

Criterion Variables. The criterion variables include intrasex aggression, intersex aggression, as well as the respective class-aggregated difference score between males and females. All of these outcomes rely on aggression network data. A peer nomination procedure asked participants to nominate aggressors in their class (i.e., “Who is sometimes mean to you?”). Subsequent network analysis elicited aggression networks in all classes by assessing participants’ first five nominations. Figure 1 illustrates a sample aggression network with black circles representing boys, white triangles representing girls, and lines representing aggression nominations with arrows indicating the nominated aggressor. The sample aggression network has a representative density (i.e., the ratio of existing to theoretically possible ties), which is on average substantially smaller than the density of friendship networks (cf., Huitsing et al., 2012).

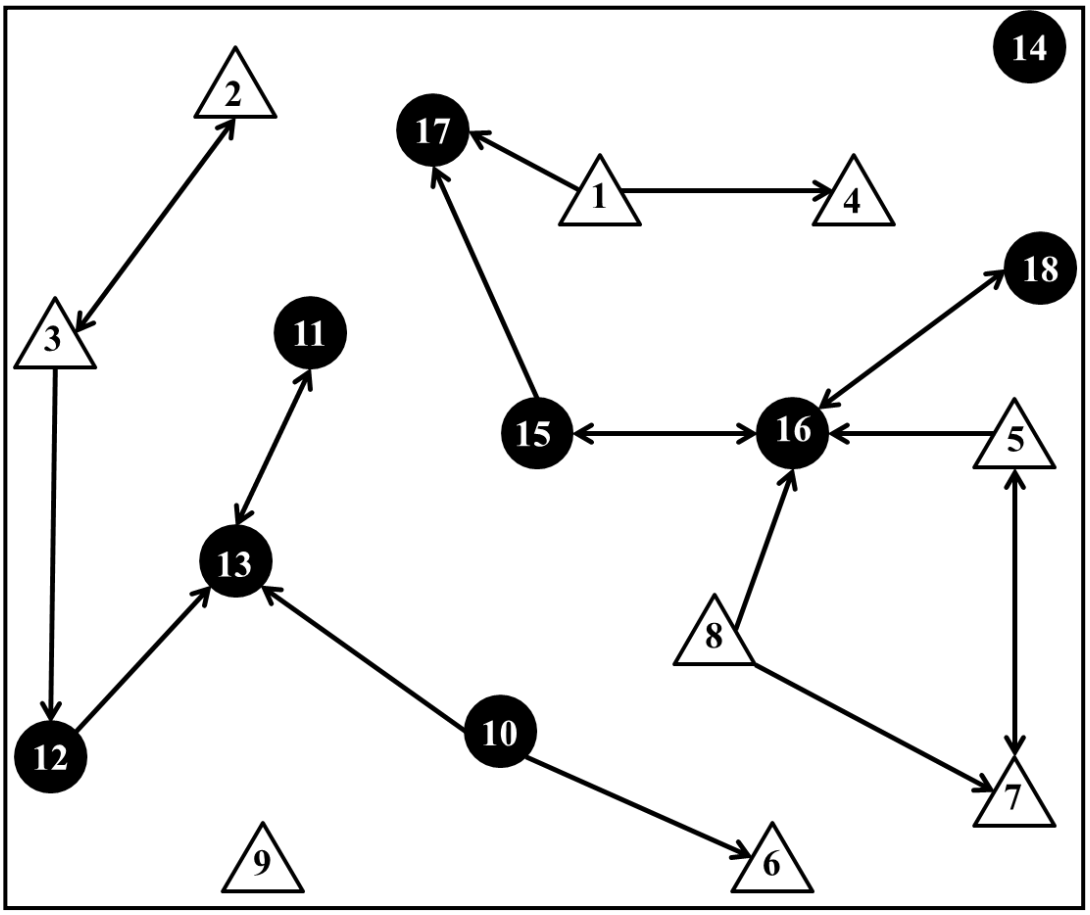


Figure 1. Sample aggression network of a school class

This information allowed us to determine the extent to which boys are nominated as aggressors by boys and girls are nominated as aggressors by girls (intrasex aggression), as well as the extent to which boys are nominated as aggressors by girls and girls are nominated as aggressors by boys (intersex aggression). In this way, we determined each individual's intra- and intersex aggression score by counting the number of received aggression nominations from network members of the same and the opposite sex, respectively.

For the main research question, we then averaged both aggression scores separately for boys and girls within each class and calculated their difference. The resulting two parameters represent the class-specific sex differences in intra- and intersex aggression with positive values indicating higher male aggression. That is, if boys receive on average 1.5 aggression nominations by their male classmates (male intrasex score = 1.5) and girls receive

on average 0.5 aggression nominations by their female classmates (female intrasex score = 0.5), then the resulting intrasex difference score within this particular class is 1.0 (1.5 – 0.5).

Sexual Selection Predictors.

Variation of reproductive chances (Social hierarchy in males). Reproductive chances are reflected in males' status (Hopcroft, 2006), and the extent to which this status varies across individuals can be expressed in the form of social hierarchy. Social hierarchy was determined with the help of friendship networks. Similar to the assessment of aggression network data, a sociometric peer nomination procedure asked participants to nominate up to five friends in their class (i.e., "Who are your best friends in class?"). The number of received peer nominations expresses the social status of a network member and the variation of this social status was calculated by using the contextual network parameter *centralization* (Freeman, 1979). While a low centralization score represents an equally-powered network, a high centralization score represents a hierarchical network with only few powerful individuals or even just one. Given that sexual selection theory emphasizes the relevance of social hierarchy in males, we calculated the class-specific variance of social status among boys only.

Reproductive competition (Operational sex ratio). Reproductive competition is measured best with the operational sex ratio (Kvarnemo & Ahnesjö, 1996), which is quantified as the proportion of males to females within a given environment. The operational sex ratio was calculated by dividing the number of boys by the number of girls in a class, so that higher scores represent a larger proportion of boys.

Body dimorphism (Sex differences in body mass index). Body dimorphism describes the phenotypic sex difference and can be quantified as the aggregated body mass difference between males and females within a given environment (cf., Larsen, 2003). The body mass index is determined by dividing the weight in kilogram by the squared height in meters. The respective aggregated sex difference was calculated by subtracting the mean body mass index

of boys from the mean body mass index of girls in a class, so that higher scores represent a body dimorphism in the male direction.

Social Role Predictors.

Gender-typical roles (Gender norms). The method of choice for assessing gender-typical roles is to measure the respective self-reported norms with the help of psychometric scales (McHugh & Frieze, 1997). In the present study, the mean score of four items assessed attitudes towards gender-specific activities (common stem: "In a family who should […]"; item-specific completion: "take care of the children?", "cook?", "earn money?", "clean the house?"). Individual gender norms were calculated by averaging participants' responses (*mostly the man*; *mostly the woman*; *both about the same*) across a recoded three-point scale (-1 *non-traditional gender norms*, 0 = *balanced gender norms*, 1 = *traditional gender norms*), so that higher scores represent the internalization of more traditional gender roles. The resulting scale had a reliability of Cronbach's $\alpha = .69$. Respective class-specific scores represent the internalization of gender norms within a given environment and were calculated as the mean gender norm score of all students in a class.

Masculinity beliefs (Masculinity norms). Masculinity beliefs are assessed adequately by means of self-reported norms (McHugh & Frieze, 1997). In the present study, the mean score of three items assessed the approval of male violence (common stem: "A man should be ready to use violence […]"; item-specific completion: "to defend his wife and children.", "against insults.", "if someone talks badly about his family."). Individual masculinity norms were calculated by averaging participants' responses across a five-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*), so that higher scores represent more traditional masculinity norms. The resulting scale had a reliability of Cronbach's $\alpha = .76$. Respective class-specific scores represent the degree of masculinity beliefs within a given environment and were calculated as the mean masculinity norm score of all students in a class.

Sociodemographics and Contextual Control Variables. Besides sex, we assessed the ethnic minority (immigrant) status accordingly to the second generation immigrant concept, which assigns participants to the minority group, if they report that their own, their mother's, or their father's country of birth differs from the respective survey country. On the contextual level, we controlled for the size of a class (i.e., number of students) and the diversity of a school (i.e., immigrant proportion).

Statistical Analyses

Data were analyzed using a two-step procedure: First, we tested the existence of sex differences in intra- and intersex aggression. For this purpose, we applied a multivariate analysis of variance (MANOVA) that compared the two aggression scores between males and females as well as between the minority and majority groups. Second, we predicted the class-aggregated sex differences in aggressive behavior with the help of contextual predictors. A multivariate multilevel model with outcome variables on level 1, school classes on level 2, and schools on level 3 simultaneously examined the effect of sexual selection predictors and social role predictors on both aggression outcome variables while adequately considering the nested data structure. Given the contextual focus of this study, with classes being the unit of analysis, we analyzed multilevel models across all countries in order to maximize statistical power. All continuous predictors were z-standardized in order to facilitate the interpretation of regression coefficients between variables with different scaling formats.

Results

General Descriptives

Aggression networks are based on a total number of 7,210 nominations, which corresponds to an average number of 12.08 (*SD* = 7.98) nominations per class and 0.64 (*SD* = 1.22) nominations per student, although the vast majority of students (66%) received no aggression nomination at all. In contrast, friendship networks are based on 41,033

nominations, which corresponds to an average number of 68.73 (*SD* = 21.58) nominations per class and 3.62 (*SD* = 1.97) nominations per student, while only a small minority of students (4%) received no friendship nominations at all. This expected pattern of students being more often nominated as a friend than as an aggressor, $t(11{,}306) = -138.71$, $p < .001$; $d = 1.83$, reflects the comparatively low density of aggression networks (*M* = .12, *SD* = .07) in contrast to the density of friendship networks (*M* = .70, *SD* = .11).

On average, there is no difference between students' degree of intrasex aggression (*M* = .32, *SD* = .73) and intersex aggression (*M* = .31, *SD* = .78), $t(11{,}306) = 1.63$, $p > .05$; $d = .01$. The similarly frequent occurrence of intra- and intersex aggression underscores the importance of studying both phenomena.

Table 2: Descriptives of Contextual Predictors

	1 Hierarchy of Males		2 Operational Sex Ratio		3 Body Dimorphism		4 Gender Norms[A]		5 Masculinity Norms[A]	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
	.17	.08	1.16	.69	.50	1.68	.34	.15	2.74	.32
2	.39***									
3	.02		.01							
4	.13**		.13**		-.05					
5	.19***		.27**		.01		.49***			

Note. N = 597 school classes; [A]class-aggregated scores; ** $p < .01$, *** $p < .001$

Table 2 presents the means, standard deviations, and intercorrelations of all contextual study predictors. Descriptives follow the expected pattern: On average, school classes have flat social hierarchies among males, equal sex ratios, male-biased body dimorphism, as well

as balanced gender and masculinity norms with a slight tendency for more traditional beliefs. All intercorrelations are small to moderate with an absolute value of .49 at most.

Sex Differences in Intra- and Intersex Aggression

The present study supports the well-documented sex difference in aggressive behavior. In the upper part of Table 3, descriptives of males' and females' levels of intra- and intersex aggression are reported in total and separately for the minority and majority group. Group comparisons were examined using a 2 (sex) x 2 (majority/minority status) MANOVA. The corresponding group differences for each aggression score are reported in the lower part of Table 3.

Table 3: Sex Differences in Aggressive Behavior

		Intrasex Aggression		Intersex Aggression	
		M	*SD*	*M*	*SD*
Boys	Total (*n* = 5,644)	.41	.82	.46	.97
	Minority (*n* = 2,130)	.43	.84	.52	1.02
	Majority (*n* = 3,514)	.40	.81	.42	.93
Girls	Total (*n* = 5,663)	.24	.62	.16	.47
	Minority (*n* = 2,213)	.24	.62	.19	.51
	Majority (*n* = 3,450)	.24	.62	.14	.44
Sex[1] *F*(1, 11,303)		155.37***		421.29***	
Status[2] *F*(1, 11,303)		1.35		27.24***	
Sex x Status *F*(1, 11,303)		1.09		2.96*	
ES (Cohen's *d*)		.23		.39	

Note. [1]Coded as '1' boys, '2' girls; [2]Coded as '0' majority group, '1' minority group; effect sizes contrast all boys and girls; * $p < .05$, *** $p < .001$

In accordance with the first hypothesis, males are more aggressive than females to same-sex opponents (intrasex aggression) as well as to other-sex opponents (intersex aggression), which is supported by meaningful effect sizes. As expected, the sex difference in intersex aggression is, in part, based on the proportionally high number of ethnic minority students given the significant Sex X Status interaction: While this sex difference is greater in the minority group compared to the majority group, both groups have a similar sex difference in intrasex aggression. Further analyses confirm the expectation that this interaction effect might be traced back to the more traditional norms of the ethnic minority, who, compared to the ethnic majority, score higher on both gender norms (M_{Min} = 2.39, SD = 0.36; M_{Maj} = 2.31, SD = 0.35; F(1, 11,305) = 131.46, p < .001; d = .23) and masculinity beliefs (M_{Min} = 2.83, SD = 1.04; M_{Maj} = 2.67, SD = .91; F(1, 11,305) = 71.80, p < .001; d = .17). It should be noted, however, that the sex difference in intersex aggression is still statistically significant in the subsample of majority students, t(6,962) = 15.83, p < .001; d = .38.

Explaining Sex Differences across Different Class Environments

Interestingly, class-aggregated sex differences in intra- and intersex aggression differ considerably across different class environments, as shown in Figure 2. These histograms illustrate the overall sex difference in aggressive behavior in the male direction, as reported above. However, at the same time, both normally distributed outcome variables also indicate a substantial amount of variance across the different class environments including a noticeable number of classes with girls being more aggressive to same-sex or opposite-sex classmates (i.e., classes with a negative score on the x-axis in Figure 2).

We examined this environment-dependent variability of sex differences in intra- and intersex aggression by simultaneously modeling predictors derived from sexual selection theory as well as social role theory, while controlling for the class size and ethnic composition of schools. Table 4 summarizes the results of the respective multivariate multilevel models.

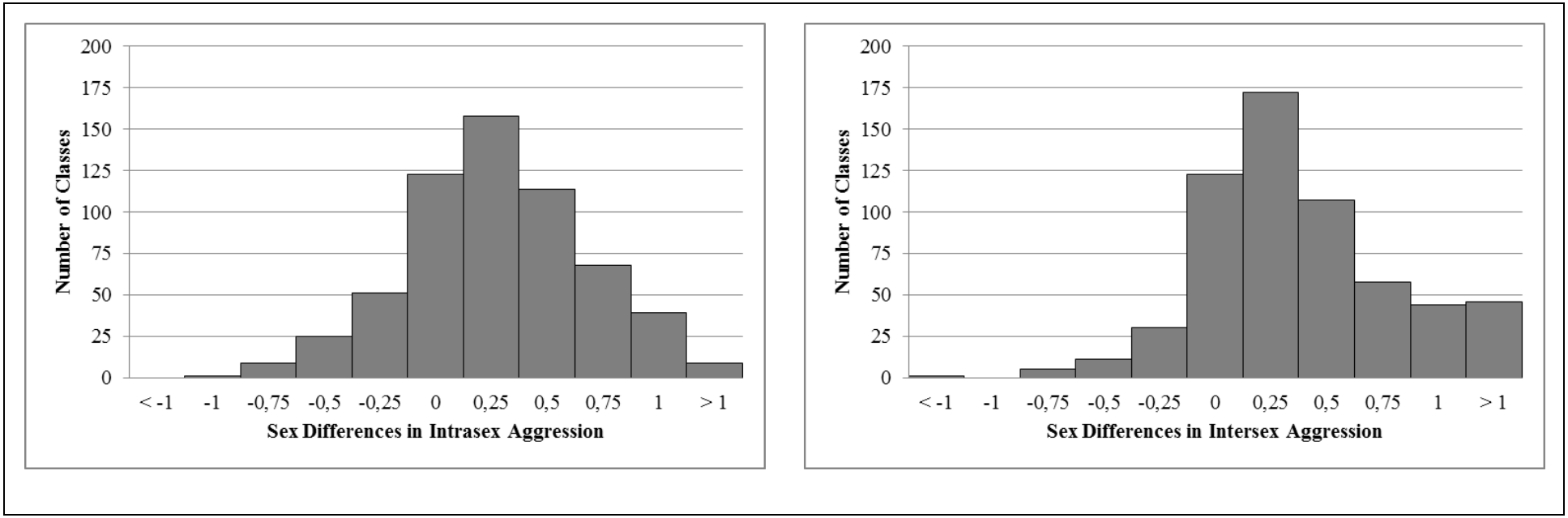


Figure 2. Class-aggregated sex differences in intra- and intersex aggression

Table 4: Multivariate Multilevel Prediction of Sex Differences in Aggressive Behavior

	LEVEL 1: OUTCOME VARIABLE							
	Sex Δ Intrasex Aggression				Sex Δ Intersex Aggression			
	B	*p*	*SE*	*(95% CI)*	*B*	*p*	*SE*	*(95% CI)*
LEVEL 2: SCHOOL CLASS								
Sexual Selection Predictors								
Social Hierarchy of Males	.037	*	.017	(.004, .070)	-.042		.022	(-.085, .001)
Operational Sex Ratio	.167	***	.027	(.114, .220)	-.186	***	.034	(-.253, -.119)
Body Dimorphism	.031	*	.016	(.000, .062)	.016		.020	(-.023, .055)
Social Role Predictors								
Gender Norms[A]	.026		.018	(-.009, .061)	.060	**	.024	(.013, .107)
Masculinity Norms[A]	.017		.019	(-.020, .054)	-.019		.024	(-.066, .028)
LEVEL 3: SCHOOL								
Ethnic composition	-.012		.017	(-.045, .021)	-.017		.022	(-.060, .026)
Null Model								
Variance on Level 2 (*R*)			.154				.236	

Variance on Level 3 (U_0)	.012	.025
Final Model		
Variance on Level 2 (R)	.144	.207
Variance on Level 3 (U_0)	.002	.030
Δ Deviance from Null Model	$\chi^2 = 79(7)$ ***	$\chi^2 = 57(7)$ ***

Note. N = 597 school classes nested in N = 323 schools; [A]class-aggregated scores; models are controlled for class size on level 2.

* $p < .05$, ** $p < .01$, *** $p < .001$

Findings suggest that the utility of sexual selection theory and social role theory for explaining the sex differences in aggressive behavior differs as a function of the opponent's sex. As hypothesized, while sexual selection predictors explain sex differences in intrasex aggression, social role predictors tend to explain sex differences in intersex aggression. That is, the male-biased sex difference in intrasex aggression increases in classes with a higher hierarchy among males, proportionally more males, and larger body dimorphism, while the male-biased sex difference in intersex aggression increases in classes with more traditional gender norms. The operational sex ratio needs to be interpreted with caution: For both outcome variables, this significant effect might be, in part, of structural nature given that classes with proportionally more males lack potential female targets and offer more potential male targets. Besides the level of statistical significance, revealed effects can be considered as meaningful. For example, the predictor social hierarchy in males indicates that sex differences in intrasex aggression change by .037, if this predictor increases by one standard deviation, which corresponds to a change of 12% in the outcome variable. It is, however, important to note that the relative importance of some predictors (i.e., body dimorphism, gender norms, masculinity norms) does not differ as a function of the different form of aggression sex difference, as indicated by the overlapping confidence intervals. That is, predictors largely fail to reach the level of statistical significance for explaining the non-theorized outcome variable, but this prediction is not significantly worse in comparison to the theorized outcome variable.

Comparing the fit of additional regression models that separately explain general aggression sex differences (adj R^2 = .014, 95% CI [-.005, .033], AIC = -208.18) versus intra- and intersex aggression sex differences (adj R^2 = .116, 95% CI [.068, .164], AIC = -485.36; adj R^2 = .076, 95% CI [.036, .116], AIC = -359.07) by using the same predictors revealed that it is valuable to differentiate and separately explain intra- and intersex aggression. Moreover, all results can be replicated in school classes with a low proportion of immigrants (n = 293).

Discussion

The present study precisely differentiated intrasex and intersex aggression with the help of aggression networks, determined their respective aggregated sex differences across ethnically diverse environments, and explained the environment-dependent variability of these sex differences by simultaneously considering biological and social factors. The main findings regard the male-biased sex difference in intrasex aggression as well as intersex aggression and its dual-theoretical explanation.

Sex Differences in Intra- and Intersex Aggression

Environments differ regarding the sex differences in aggressive behavior found therein, which includes the possibility that the usual male-biased difference reverses in some contexts (Clutton-Brock, 2007). However, in general, males were found to be more aggressive than females in terms of both intrasex and intersex aggression. While the sex difference in intrasex aggression seems to be a general effect that is consistent with findings across many meta-analyses (e.g., Card et al., 2008), the sex difference in intersex aggression replicates all studies that look beyond conventional western societies (e.g., Archer, 2006). In this way, the latter finding highlights the successful sampling procedure in this study that systematically oversampled students from ethnic minority groups with more traditional gender roles.

Having said that, the high proportion of ethnic minority students only contributed in part to the male-biased sex difference in intersex aggression, because this difference was also found, albeit to a slightly lesser extent, for the ethnic majority group. This finding challenges previous research, which suggests that this sex difference tends to equalize in samples from western societies (Archer, 2004). However, the few existing studies on intersex aggression mainly focused on aggression within romantic relationships and largely relied on self- or partner-reports. Utilizing objective network data of broader social settings, this study suggests an ethnically robust sex difference in both intrasex aggression as well as intersex aggression.

Dual-theoretical Explanation of Sex Differences in Aggression

In accordance with the existing literature, we found that sexual selection theory primarily predicts sex differences in intrasex aggression, whereas social role theory primarily predicts sex differences in intersex aggression. This specific pattern of associations is robust across settings ranging from low to high ethnic diversity.

Along these lines, a more helpful framework for explaining sex differences in human aggression seems to be a dual-theoretical approach with evolutionary as well as normative components. This theoretical refinement corresponds with recent integrative reformulations (Archer, 2009b; Wood & Eagly, 2002) as well as interactive approaches (Eagly & Wood, 2013; Geary, 1999; van den Berghe, 2009), which take into account both sides of the nature-nurture debate that underlies this theoretical debate. In fact, the complex interaction of biological predispositions as well as sociocultural influences will usually present a better explanation of human behavior than either perspective alone. Despite the revealed theory-specific predictive power, the finding that the relative importance of some predictors does not differ across the outcome variables suggests that social and biological factors are important in both aggression forms. It is, for example, plausible to assume that phenotypic sex differences are likely to predispose greater male-female aggression, while gender roles are likely to amplify male-biased differences in intrasex aggression. However, given the evidential strengths of sexual selection theory and social role theory as well as the increasing model fit when differentiating and separately explaining intra- and intersex aggression, it seems to be valuable for an integrative model of sex differences in aggression to specify the explanandum and emphasize a particular theory depending on the opponent's sex.

Limitations and Future Research Directions

Aggression network data used in this research did not specifically assess physical aggression, but measured this construct in a broad manner including physical and non-

physical forms of aggression. However, this makes the test of hypotheses more conservative, given females' higher or at least similar use of non-physical forms of aggression (Card et al., 2008; Crick & Grotpeter, 1995). Although we still found the expected sex differences, aggression networks in future studies should utilize more precise peer nomination items (e.g., "Who hits or pushes you sometimes?"). Another limitation is that we cannot draw causal conclusions from this study. Even though the present cross-sectional design is sufficient for testing the proposed dual-theoretical approach, experimental research allows a more powerful examination of its validity. More specifically, experimental designs allow researchers to test whether the manipulation of specific biological or social factors affects the sex difference in aggression (e.g., gender rearrangement in school classes). Moreover, even though the predictors used in this study cover a broad range of sociometric, psychosocial, and physical measures, we have to emphasize that any attempt to compare competing theories is limited by the operationalization of their key constructs and the debate should proceed with new studies using alternative operationalizations (e.g., testosterone dimorphism, parenting attitudes, perceived sex differences). Finally, besides much progress in understanding the male-biased sex differences in aggression, female-biased aggression is still poorly understood. In accordance with the literature, our study indicates that sex differences in aggression favor females in some contexts. This phenomenon deserves further research, because a better understanding of females' aggression will advance this field in general.

To conclude, the present study indicates that a differentiation between intrasex and intersex aggression has the potential to improve both theoretical adequacy and predictive power. A dual-theoretical approach with sexual selection theory explaining sex differences in intrasex aggression and social role theory explaining sex differences in intersex aggression seems to acknowledge the different mechanisms that underlie these two forms of sex differences in aggression.

References

Alpern, S. B. (1998). *Amazons of Black Sparta: The women warriors of Dahomey*. New York: New York University Press.

Archer, J. (2004). Sex differences in aggression in real-world settings: A meta-analytic review. *Review of General Psychology, 8*, 291-322. doi: 10.1037/1089-2680.8.4.291

Archer, J. (2006). Cross-cultural differences in physical aggression between partners: A social-role analysis. *Personality and Social Psychology Review, 10*, 133-153. doi: 10.1207/s15327957pspr1002_3

Archer, J. (2009a). Does sexual selection explain human sex differences in aggression? *Behavioral and Brain Sciences, 32*, 249-311. doi: 10.1017/S0140525X09990951

Archer, J. (2009b). Refining the sexual selection explanation within an ethological framework. *Behavioral and Brain Sciences, 32*, 292-300. doi: 10.1017/S0140525X09990963

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice Hall.

Bettencourt, B. A., & Miller, N. (1996). Gender differences in aggression as a function of provocation: A meta-analysis. *Psychological Bulletin, 119*, 422-447. doi: 10.1037/0033-2909.119.3.422

Borgatti, S. P., Mehra, A., Brass, D. J., & Labianca, G. (2009). Network analysis in the social science. *Science, 323*, 892-895. doi: 10.1126/science.1165821

Card, N. A., Stucky, B. D., Sawalani, G. M., & Little T. D. (2008). Direct and indirect aggression during childhood and adolescence: A meta-analytic review of gender differences, intercorrelations, and relations to maladjustment. *Child Development, 79*, 1185-1229. doi: 10.1111/j.1467-8624.2008.01184.x

Clutton-Brock, T. (2007). Sexual selection in males and females. *Science, 318*, 1882-1885. doi: 10.1126/science.1133311

Crick, N. R., & Grotpeter, J. K. (1995). Relational aggression, gender, and social-psychological adjustment. *Child Development, 66*, 710-722. doi: 10.1111/j.1467-8624.1995.tb00900.x

Darwin, C. (1859). *On the origin of species by means of natural selection*. London: Murray.

Darwin, C. (1871). *The descent of man, and selection in relation to sex*. London: Murray.

Eagly, A. H. (1987). *Sex differences in social behavior: A social role interpretation*. Hillsdale, NJ: Erlbaum.

Eagly, A. H., & Steffen, V. J. (1986). Gender and aggressive behavior: A meta-analytic review of the social psychological literature. *Psychological Bulletin, 100*, 309-330. doi: 10.1037/0033-2909.100.3.309

Eagly, A. H., & Wood, W. (2013). The nature-nurture debates: 25 years of challenges in understanding the psychology of gender. *Perspectives on Psychological Science, 8*, 340-357. doi: 10.1177/1745691613484767

Fernandez-Duque, E., Valeggia, C. R., & Mendoza, S. P. (2009). The biology of paternal care in human and nonhuman primates. *Annual Review of Anthropology, 38*, 115-130. doi: 10.1146/annurev-anthro-091908-164334

Freeman, L.C. (1979). Centrality in social networks I: Conceptual clarification. *Social Networks, 1*, 215-239. doi: 10.1016/0378-8733(78)90021-7

Geary, D. C. (1999). Evolution and developmental sex differences. *Current Directions in Psychological Science, 8*, 115-120. doi: 10.1111/1467-8721.00027

Hilton, N. Z., Harris, G. T., & Rice, M. E. (2000). The functions of aggression by male teenagers. *Journal of Personality and Social Psychology, 79*, 988-994. doi: 10.1037/0022-3514.79.6.988

Hopcroft, R. L. (2006). Sex, status, and reproductive success in the contemporary United States. *Evolution & Human Behavior, 27*, 104-120. doi: 10.1016/j.evolhumbehav.2005.07.004

Huitsing, G., van Duijna, M. A. J., Snijders, T. A. B., Wang, P., Sainiod, M., Salmivalli, C., Veenstra, R. (2012). Univariate and multivariate models of positive and negative networks: Liking, disliking, and bully-victim relationships. *Social Networks, 34*, 645-657. doi: 10.1016/j.socnet.2012.08.001

Kalter, F., Heath, A. F., Hewstone, M., Jonsson, J. O., Kalmijn, M., Kogan, I., & van Tubergen, F. (2013). *Children of immigrants longitudinal survey in four European countries (CILS4EU)*. GESIS Data Archive, Cologne. ZA5353 Data file Version 1.0.0.

Kenrick, D., & Griskevicious, V. (2009). More holes in social roles. *Behavioral and Brain Sciences, 32*, 283-285. doi: 10.1017/S0140525X09990331

Kvarnemo, C., & Ahnesjö, I. (1996). The dynamics of operational sex ratios and competition for mates. *Trends in Ecology & Evolution, 11*, 404-408. doi: 10.1016/0169-5347(96)10056-2

Larsen, C. S. (2003). Equality for the sexes in human evolution? Early hominid sexual dimorphism and implications for mating systems and social behavior. *Proceedings of the National Academy of Sciences, 100*, 9103-9104. doi: 10.1073/pnas.1633678100

Lindenfors, P., & Tullberg, B. S. (2011). Evolutionary aspects of aggression: The importance of sexual selection. In R. Huber, D. L. Bannasch, & P. Brennan (Eds.). *Aggression: Advances in genetics* (pp. 7-22). Burlington: Academic Press.

McHugh, M. C., & Frieze, I. H. (1997). The measurement of gender-role attitudes: A review and commentary. *Psychology of Women Quarterly, 21*, 1-16. doi: 10.1111/j.1471-6402.1997.tb00097.x

Muller, M. N., Kahlenberg, S. M., Thompson, M. E., & Wrangham, R. W. (2007). Male coercion and the costs of promiscuous mating for female chimpanzees. *Proceedings of the Royal Society of London B, 274*, 1009-1024. doi: 10.1098/rspb.2006.0206

Nivette, A. E., Eisner, M., Malti, T., & Ribeaud, D. (2014). Sex differences in aggression among children of low and high gender inequality backgrounds: A comparison of gender role and sexual selection theories. *Aggressive Behavior, 40*, 451-464. doi: 10.1002/ab.21530

Pellegrini, A. D., & Long, J. D. (2002). A longitudinal study of bullying, dominance, and victimization during the transition from primary school through secondary school. *British Journal of Developmental Psychology, 20*, 259–280. doi: 10.1348/026151002166442

van den Berghe, P. L. (2009). Sexual selection and social roles: Two models or one? *Behavioral and Brain Sciences, 32*, 291-292. doi: 10.1017/S0140525X09990355

Wood, W., & Eagly, A. H. (2002). A cross-cultural analysis of the behavior of women and men: Implications for the origins of sex differences. *Psychological Bulletin, 128*, 699-727. doi: 10.1037//0033-2909.128.5.699

Author Contributions

R. Wölfer developed the study concept, performed the data analysis, and drafted the manuscript. M. Hewstone was part of the team that designed the CILS study, managed the data collection, and provided critical revisions. Both authors approved the final version of the manuscript for submission.