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Sex Differences in the Relationships between School Bullying and Executive Functions in Adolescence

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ABSTRACT

The aim of the current study was to examine the associations between different types of executive functions (EFs) and bullying involvement in adolescent boys and girls. A self-report questionnaire was administered to 385 adolescents (mean age = 12.6 years) from nine junior high schools in France. Participants were divided into four bullying groups: pure victims, bully-victims, pure bullies, and noninvolved. Their parents completed the Behavior Rating Inventory of Executive Function. Results showed that adolescents with inhibition problems were more likely to be victims or bully-victims. Furthermore, working memory, organization of materials, and monitoring problems appeared to be associated with the risk of being a victim for girls. Bully-victims, especially girls, performed more poorly on cool and hot EF problems than controls. Pure bullies did not exhibit any EF impairments. The screening of EF abilities and the implementation of evidence-based EF promotion programs are discussed.



KEYWORDS

School bullying; executive functions; bullying roles; victimization; adolescence

School bullying during adolescence

School bullying is a concerning and pervasive problem for adolescents, and is recognized as a major international public health issue (e.g., Gini & Pozzoli, 2009). In 2014, a meta-analysis of 80 studies (Modecki et al., 2014) found that 35% of adolescents reported being involved in traditional bullying, and 15% in cyberbullying (Modecki et al., 2014). In other studies, the prevalence of traditional bullying has been estimated at 5–30% for perpetration, and 17–37% for victimization (e.g., Due et al., 2005; Solberg & Olweus, 2003). Regarding sex differences, victimization rates are higher for girls than for boys in most countries (Craig et al., 2009; Scheithauer et al., 2006), and the perpetrators of traditional bullying and bully-victims (who bully others but are themselves bullied) are often boys (e.g., Scheithauer et al., 2006).

Although definitions of bullying vary across studies and according to authors (Hymel & Swearer, 2015), there is a general consensus that *bullying* characterizes a specific type of aggression between peers with three behavioral characteristics: (i) harmful or hurtful action that is deliberately perpetrated, (ii) repetitive acts over time, and (iii) power imbalance between the bully and the bullied. Bullying is therefore an abuse of power that occurs repeatedly over time, against a less powerful victim (Olweus, 1994, 1995, 2006). Olweus (Olweus, 1995; Olweus & Limber, 2010) adds that victims feel vulnerably exposed to the perpetrator, as they cannot effectively defend themselves (see Lamb et al., 2009; Thomas et al., 2015). Bullying is characterized by two main behavioral

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patterns (Crick & Grotpeter, 1995): direct/overt (e.g., physical aggression, hitting, verbal threat) and indirect/covert (e.g., relational aggression, gossiping, social isolation). It is customary to differentiate between types of involvement in bullying. Early studies divided pupils involved in bullying into two groups: bullied (victims) and bullies (perpetrators or aggressors). Although numerous studies are still based on this dichotomy, current research indicates the existence of another major group, namely bully-victims (i.e., who are bullied but who also bully; Lereya et al., 2015), to which we must add *bystanders*.

A well-established body of research has extensively described the negative outcomes of bullying in terms of internalizing disorders such as anxiety and depressive symptoms (e.g., Schneider et al., 2012; Turner et al., 2013), or suicide (see Van Geel et al., 2014), especially for victims. Externalizing problems (Ttofi et al., 2014) such as aggression or anger (e.g., Camodeca & Goossens, 2004; Salmivalli & Nieminen, 2001) and conduct problems (Ragatz et al., 2011) are more characteristic of bullies. For bully-victims, a now robust dataset tends to describe these students as having both internalizing and externalizing problems, and at higher levels than either pure victims or pure bullies (e.g., Gini & Pozzoli, 2009; Veenstra et al., 2005).

Given the negative consequences of bullying, which have been well documented over the past decade, researchers have begun to examine how cognitive skills or abilities may impact involvement in bullying. The identification of intrinsic vulnerabilities or protective factors is central for developing prevention and counseling strategies. Many studies have explored the socioemotional processes of young people involved in bullying (e.g., Zych et al., 2019), but little is known about the cognitive characteristics of bullies and victims. In particular, the relationship between bullying and neuropsychological behavioral functions, and more especially executive functions (EFs), has been poorly investigated, even though these functions play an important role in social interaction and behavior control (Smith & Jones, 2012).

Executive functions and aggressive behaviors

EFs commonly refer to the self-regulation mechanisms involved in goal-directed and problem-solving behaviors (Diamond, 2013; Miyake & Friedman, 2012). They encompass several skills, such as planning, inhibition, organization, cognitive flexibility, emotional control, self-monitoring, initiation, and working memory. According to Diamond (2013), EFs can be divided into two sublevels: a primary level (inhibitory control, working memory, and cognitive flexibility), and a higher level (planning, reasoning, and problem-solving). Working memory, inhibitory control and cognitive flexibility, which emerges later in development, therefore constitute the three core EFs that form the basis for higher level EFs.

Adolescence is characterized by linear and nonlinear EFs development that may correspond to linear and nonlinear brain maturation (Poon, 2018; Taylor et al., 2015), with high-level cognitive abilities continue to develop into young adulthood (Best & Miller, 2010; Blakemore & Choudhury, 2006). Furthermore, some results suggest that cool EFs (i.e., cognitive skills such as strategic planning, problem solving, working memory, and cognitive flexibility) and hot EFs (i.e., empathy, emotion regulation, and affective decision-making) may develop relatively independently during the transition to adolescence (Prencipe et al., 2011; Zelazo & Carlson, 2012). Sex differences in EFs remain unclear, especially during adolescence (e.g., Lee et al., 2013). Some studies have found significant differences in favor of boys (Gur & Gur, 2016), and others in favor of girls (Ardila et al., 2005). These divergent results suggest that the effect of sex varies according to the tasks used and, more broadly, to cultural aspects.

A meta-analysis concluded that there is a negative relationship between EFs, especially inhibition, and externalizing behaviors (Ogilvie et al., 2011). EF deficits have been reported in individuals with an aggressive/impulsive behavioral style, especially boys (Morgan & Lilienfeld, 2000; Séguin et al., 1999, 1995; Van Nieuwenhuijzen et al., 2017), and those experiencing peer relationship problems (Holmes et al., 2016; Verlinden et al., 2014). Moreover, according to Zelazo et al. (1997)'s assumption, the

resolution of peer conflict involves four major executive skills: problem representation, planning, execution, and evaluation.

Although it is unclear whether all aggressive pupils are characterized by poor EFs, aggressive behavior has most often been related to lower EF performances (Morgan & Lilienfeld, 2000; O'Toole et al., 2017; Ogilvie et al., 2011), such as inhibition (Ellis et al., 2009; Raaijmakers et al., 2008), planning/organization (Ellis et al., 2009), and working memory (Coolidge et al., 2004; Séguin et al., 1999; Verlinden et al., 2014). These results are in line with the deficit model hypothesis, whereby aggression is the result of a lack of social skills (Crick & Dodge, 1996). However, other studies (Björkqvist et al., 2000; Sutton et al., 1999) have shown that some aggressive behaviors (e.g., indirect aggression) also require good inhibition, control and planning skills (Ellis et al., 2009). Based on these results, EFs can be regarded as central self-regulation processes in bullying and victimization (Séguin & Zelazo, 2005; Sutton et al., 2001).

While EFs are particularly important for regulating behavior in social situations (Diamond, 2013) and refraining from inappropriate aggressive responses (Beauchamp & Anderson, 2010), they have been poorly investigated in studies of school bullying, especially among adolescents. Moreover, there is a relative dearth of research on the associations between specific EF components and bullying, especially in adolescent samples. Pupils involved in bullying may have difficulty inhibiting responses that are not appropriate to the situation (e.g., to resist temptation and delay immediate reward), planning an adaptive solution, or considering other solutions (flexibility) in social interactions or peer conflicts. Poor EF skills may increase the risk of acting aggressively in order to dominate interpersonal relationships (Hughes et al., 2000). In addition, they may increase the risk of being the victim of bullying, as a result of poor conflict management during peer interactions.

Executive functions and school bullying

The majority of studies have examined relationships between bullying and EFs in preschool and school-aged children (Coolidge et al., 2004; Medeiros et al., 2006; Monks et al., 2005). By comparison, research on the relationship between EFs and bullying in adolescents is limited, although, as we have underlined, it is important to investigate this age range. Only two studies have specifically focused on adolescents (Holmes et al., 2016; Jenkins et al., 2017), while two other studies considered adolescents with either autism spectrum disorder (ASD) or dysexecutive syndrome (Kloosterman et al., 2014; Liu et al., 2016).

Poor performance on EF tasks (Medeiros et al., 2006; Monks et al., 2005) has been associated with bullying perpetration. In particular, impairment of inhibition, initiation, working memory, and decision making have been identified in bullies at elementary school (Medeiros et al., 2006; Monks et al., 2005; Verlinden et al., 2014). Among adolescents, bullying perpetration has been associated with deficits in initiation, metacognitive ability (Coolidge et al., 2004), or inhibition (Jenkins et al., 2018). However, a recent study found that male bullies with ASD had no EF deficits (Kloosterman et al., 2014).

Despite scarce data for bully-victims, one study found that they exhibit poorer inhibitory control than noninvolved students (Verlinden et al., 2014). Pure victims of school bullying, in turn, experience difficulties in EF tasks (Monks et al., 2005) or perform poorly on indirect measures of EFs (Kloosterman et al., 2014; Liu et al., 2016). It should be noted that higher victimization is associated with poorer EFs, including inhibition (Jenkins et al., 2018; Verlinden et al., 2014), flexibility (Jenkins et al., 2018; Medeiros et al., 2006), initiation, and self-monitoring (Jenkins et al., 2018).

Overall, the literature on bullying and EF deficits is inconclusive, and more research among adolescents is needed. Up to now, research on bullying has largely focused on the elementary and early secondary school period (Finkelhor et al., 2013, 2015). Nevertheless, evidence shows that school bullying persists across the secondary school years (e.g., Finkelhor et al., 2015; Ryoo et al., 2015). Unfortunately, most studies (empirical and meta-analyses) have included both preteens and adolescents (i.e., making no developmental distinction), and have therefore not considered the

different stages of neurocognitive development (Spear, 2013). Moreover, one potential pitfall is the failure to make a distinction between bully-victims and pure bullies, which may have contributed to confusing results in the past. Regarding bullying roles, few studies have differentiated between pure victims or pure bullies and bully-victims, when examining the link between EFs and peer harassment, particularly in adolescence. There is a lack of research investigating the associations between EFs and bullying roles, even though studies have highlighted more behavioral and emotional dysregulation among bully-victims than among either pure victims, pure bullies, or noninvolved individuals (e.g., Runions et al., 2018). Given the growing body of literature indicating that reactive and proactive forms of aggression are differentially associated with different components of EF (e.g., Hecht & Latzman, 2017), it appears especially important to consider specific EF components in relation to bullying roles. Finally, despite sex differences in bullying behaviors and EFs, particularly in adolescence, few studies have addressed potential sex differences in the association between EF and bullying.

Thus, the aim of the present study was to investigate the associations between EF components (inhibition, flexibility, emotional control, working memory, and planning/ organization) and being a bully, a victim, or a bully-victim in adolescence. These different executive processes, albeit partially independent, are strongly linked and are involved either alone or in association in the different bullying roles (e.g., Jenkins et al., 2018; Verlinden et al., 2014). Based on previous studies among children, we expected to find negative relations between poor EFs and bullying involvement, for both perpetration and victimization. We also expected pure bullies, pure victims and bully-victims to display higher levels of neuropsychological behavioral dysfunction than noninvolved participants. Again based on previous studies (e.g., Medeiros et al., 2006; Verlinden et al., 2014), we expected pure bullies and bully-victims to demonstrate more frequent inhibition and control problems than the others. Furthermore, previous studies did not include sex differences when exploring different forms of bullying involvement or EF skills (Holmes et al., 2016; Jenkins et al., 2017). To address this gap in the literature, the current study was designed to examine sex differences in the relationship between EF skills and bullying, in order to improve understanding of the individual factors that may elevate the risk of engaging in bullying perpetration or victimization. Owing to the inconsistency and scarcity of studies on EFs and bullying incorporating sex differences, we did not formulate any hypotheses regarding possible sex differences.

Method

Participants

After excluding incomplete responses (i.e., one or more missing values in the assessment, $n = 18$), invalid responses (i.e., all true or all false answers, $n = 5$, or Behavior Regulation Inventory of Executive Function (BRIEF) Inconsistency score equal to or above 7, $n = 12$), and incomplete protocols (i.e., absence of self- or parent-assessment, impossibility of pairing the adolescent's responses with the parent's responses, $n = 55$), the final sample was composed of 385 sixth to ninth graders from nine French junior high schools located in four regions of France (Center Val de Loire, Grand Est, Normandy, and Pays de la Loire). There were 144 sixth graders (37.4%), 78 seventh graders (20.3%), 81 eighth graders (21%), and 82 ninth graders (21.3%). The sample was 60.3% female ($n = 232$) and 39.7% male ($n = 153$), so caution should be exercised when interpreting the results for the total sample, owing to the overrepresentation of girls. The mean age was 12.6 years ($SD = 1.57$, range = 11–17), with no significant difference between boys and girls ($t = .44$, $p = .66$). A total of 42.1% ($n = 60$) of the adolescents came from families with a low socioeconomic status (SES; either primary education only, or only one parent with a high-school diploma), 42.3% ($n = 163$) from families with a medium SES (both parents with a high-school diploma, or one with a university degree), and 15.5% ($n = 60$) from families with a high SES (both parents with university degrees).

Measures

We measured bullying involvement with the French version of the revised Olweus Bully/Victim Questionnaire (Fr-rBVQ; Kubiszewski et al., 2014). First, a definition of bullying is read out to each of the participants, then they respond to the questions. This self-report questionnaire assesses experiences of being victimized (7 items) and experiences of bullying others (7 items) “in the past couple of months.” Various forms of bullying are assessed (verbal, physical, social, etc.). In the present study, we added one other type (i.e., cyberbullying) to each part (victimization/perpetration). Items were rated on a 5-point Likert scale ranging from 1 (*Never*) to 5 (*Several times a week*). Two versions of the global measures were used for analyses: (1) a continuous approach, which yielded two mean scores (one for the victimization items and one for the bullying perpetration items); and (2) a categorical approach, in which participants were classified as pure victims, pure bullies, bully-victims, or non-involved, based on Solberg’s criteria (e.g., participants who had been bullied/bullied others “2 or 3 times a month” or more) were categorized as being involved in bullying (Solberg & Olweus, 2003). In our study, Cronbach’s alphas were .76 for the perpetration scale and .81 for the victimization scale.

We assessed EFs with the Parent Form of the BRIEF (Fournet et al., 2015; Roy et al., 2013). The BRIEF consists of 86 items asking parents whether their adolescents display problems with a specific behavior (1 = *Never*, 2 = *Sometimes*, or 3 = *Often*), with higher ratings indicative of greater perceived impairment (i.e., poorer EF abilities). It contains eight clinical scales reflecting different domains of cognitive function (Initiation, Working Memory, Planning, Organization of Materials, Monitoring, Inhibit, Shift, and Emotional Control). These scales generate two summary indices: the behavioral regulation index (BRI; Inhibition, Shifting, and Emotional Control scales) and the metacognition index (MI; Initiation, Working Memory, Planning, Organization of Materials, and Monitoring). A global executive composite (GEC) score is generated by summing the BRI and MI. *T* scores (scores normed by age and sex) are calculated with a mean of 50 (*SD* = 10). Higher scores on BRIEF scales indicate greater EF problems. The level of clinical significance is set at $t \geq 65$, and *t* scores ≥ 60 are regarded as reflecting *mildly elevated executive difficulties* (Gioia, 2002). In line with Liu et al. (2016), we retained the cutoff score of $t \geq 60$ to defined adolescents as having *EF difficulties*. Finally, a score equal to or above 7 on the BRIEF Inconsistency scale (i.e., high degree of inconsistency in rater responses) led to participants being excluded. The BRIEF has excellent psychometric qualities (Cronbach’s alphas > .85 for internal coherence and test-retest reliability; Fournet et al., 2015). Cronbach’s alphas in this study were between .78 and .89.

Procedure

An information letter was sent to each family and each adolescent. Parents provided their written consent, and children their assent. The mean participation rate was 58% for parents, and 72% for adolescents. The adolescent survey was administered by school staff, and participants completed the questionnaire anonymously during a school lesson. The questionnaire for parents was delivered via the students and completed at home. The BRIEF scale was completed either by the mother ($n = 225$, 58.4%), by the father ($n = 58$, 15.1%) or by both parents ($n = 102$, 26.5%). On average, it took 20 minutes to complete. The study was carried out in accordance with the ethical principles for psychological research involving human participants, and was approved by the relevant education authority.

Data analysis

Any participants with missing data were removed from the database when preparing the data for analysis. The Shapiro-Wilk test and Levene’s test showed that the data did not present normal distribution and equality of variances. We therefore used nonparametric tests. Descriptive statistics were initially computed to obtain data on bullying experience, as well as their association with EF

scores. We examined whether victimization and perpetration were associated with different domains of adolescent EF scores (Spearman correlations), for each sex separately. Adjusted (by age) odds ratios (ORs) and 95% confidence intervals (CIs) were obtained from logistic regression models that assessed the associations between EF difficulties and bullying profiles (i.e., being a bully, a victim, a bully-victim, or noninvolved). To explicitly test for sex differences in the strength of an association between bullying and EF skills, analyses were repeated in a combined sample of male and female adolescents. The OR is the ratio of the odds of an event occurring (here, EF difficulties, $t \geq 60$) in one population (here, pure bully, bully-victim, and pure victim) to the odds of this same event occurring in another population (here, noninvolved adolescents). The level of significance was set at 5%. Statistical analysis was performed using IBM SPSS version 23.

Results

Executive functioning and bullying involvement according to sex

Based on their Fr-rBVQ scores, participants were divided into four bullying groups: noninvolved (55.6%, $n = 214$), victims (26%, $n = 100$), bullies (9.1%, $n = 35$), and bully-victims (9.4%, $n = 36$). Under the categorical approach, a group comparison analysis failed to reveal any difference between boys and girls with regard to the bullying categories, excepted for bully-victims, where boys were overrepresented. Under the continuous approach, analysis revealed higher scores on both perpetration and victimization for boys than for girls. Table 1 shows mean bullying scores and bullying prevalence. No

Table 1. Participants' executive functioning and bullying characteristics.

Variables	Total ($N = 385$)	Girls ($n = 232$, 60.3%)	Boys ($n = 153$, 39.7%)	Group comparisons	
	% (n)	% (n)	% (n)	Chi ²	p
Bullying involvement					
Uninvolved	55.6 (214)	58.2 (135)	51.6 (79)	6.630	ns
Pure victim	26.0 (100)	26.7 (62)	24.8 (38)	.504	ns
Bully-victim	9.4 (36)	6.0 (14)	14.4 (22)	6.034	*
Pure bully	9.1 (35)	9.1 (21)	9.2 (14)	2.747	ns
Bullying scores	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>t</i>	<i>p</i>
Victimization	10.8 (3.91)	10.3 (3.54)	11.4 (4.36)	-2.614	**
Aggression	8.9 (1.88)	8.6 (1.17)	9.3 (2.57)	-3.708	***
Executive function difficulties ($t \geq 60$)	% (n)	% (n)	% (n)	Chi ²	<i>p</i>
Inhibition	24.7 (95)	29.7 (69)	17.0 (26)	8.061	**
Shift	27.0 (104)	29.3 (68)	23.5 (36)	1.563	ns
Emotional control	23.4 (55)	22.4 (52)	24.8 (38)	.302	ns
Initiation	26.8 (77)	22.8 (53)	32.7 (50)	4.551	*
Working memory	22.3 (86)	19.0 (44)	27.5 (42)	3.827	ns
Planning	25.5 (61)	24.1 (56)	27.5 (42)	.533	ns
Organization of materials	14.5 (56)	17.7 (41)	9.8 (15)	4.592	*
Monitoring	21.8 (84)	24.1 (56)	18.3 (28)	1.842	ns
Behavioral Regulation Index	24.4 (94)	25.9 (60)	22.2 (34)	.662	ns
Metacognition Index	24.7 (95)	23.7 (55)	26.1 (40)	.295	ns
Global Executive Composite score	27.0 (104)	26.7 (62)	27.5 (42)	.025	ns
Executive function score¹	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>t</i>	<i>p</i>
Inhibition	53.2 (11.01)	53.9 (11.63)	52.1 (9.95)	1.560	ns
Shifting	52.9 (11.69)	52.1 (11.55)	54.2 (11.84)	-1.717	ns
Emotional control	52.7 (11.37)	52.3 (11.61)	53.3 (11.00)	-.880	ns
Initiation	53.7 (11.38)	52.6 (11.50)	55.3 (11.05)	-2.272	*
Working memory	53.2 (10.06)	52.7 (10.21)	54.1 (9.78)	-1.300	ns
Planning	52.6 (10.33)	52.2 (10.99)	53.3 (9.25)	-1.010	ns
Organization of materials	49.4 (9.35)	50.0 (9.55)	48.4 (8.98)	1.668	ns
Monitoring	52.5 (10.04)	52.8 (10.97)	52.1 (8.46)	.690	ns
Behavioral regulation index	53.5 (11.59)	53.3 (11.82)	53.9 (11.26)	-.565	ns
Metacognition index	52.8 (10.57)	52.6 (11.23)	53.1 (9.49)	-.516	ns
Global executive composite score	53.4 (10.88)	53.1 (11.27)	53.8 (10.27)	-.635	ns

ns: nonsignificant. [†] $p < .07$. * $p < .05$. ** $p < .01$. *** $p < .001$.

¹Higher scores reflect greater executive function difficulties.

differences were found between schools for girls versus boys in terms of bullying roles endorsed ($\chi^2 = 35.3, p = .06$, and $\chi^2 = 28.6, p = .23$), or victimization (Kruskal-Wallis (KW) = 15.4, $p = .10$, and KW = 8.20, $p = .41$) or bullying perpetration (KW = 12.1, $p = .07$, and KW = 14.81, $p = .06$) scores.

We also looked at whether girls and boys differed on the EF variables. Results indicated that boys had higher Initiation scores than girls. Significantly more boys than girls had high Initiation scores, while more girls than boys had high Inhibition and Organization of Materials scores.

Correlations between bullying variables and executive functions

We examined whether links between adolescents' EF difficulties and bullying involvement differed according to sex. As shown in Table 2, all BRIEF scores were significantly correlated with victimization ($r_s = .08-.21, p_s < .05-.01$), except for Shifting and Initiation, especially among girls. For boys, we only found a positive correlation between Inhibition and victimization ($r = .17, p < .01$). The more adolescents were victimized by their peers, the greater their EF difficulties. With regard to perpetration, Inhibition and BRI were positively related to bullying, particularly among boys ($r_s = .20-.32, p_s < .01$). For girls, there was a significant negative correlation between bullying and Organization of Materials ($r = -.12, p < .05$), such that the greater their ability in this EF, the greater their involvement in bullying perpetration.

Association between involvement in bullying (pure victim, bully-victim, or pure bully) and EF Difficulties

Table 3 shows the results of the logistic regression analysis comparing each bullying behavior group with the noninvolved (control) group. As shown in Table 3, the risk of being a pure victim was higher for adolescents with Inhibition, Working Memory, Organization of Materials, or Monitoring difficulties, especially if they were girls ($ORs = 1.6-2.2$). The other EFs did not differ significantly. Bully-victims had higher Inhibition, Emotional Control, Organization of Materials, BRI, MI and GEC scores ($ORs = 1.9-4.5$). Female bully-victims also had Initiation difficulties. By contrast, there were no significant differences between the pure bully and noninvolved groups. Table 3 also reports some marginally significant differences ($p < .07$).

Discussion

The importance of EF skills in social relationships and aggression has been well established in the literature. Nevertheless, the few studies to have investigated the specific associations between EFs and bullying have been limited by methodological constraints that make the results uncertain: more specifically, the failure to simultaneously consider different bullying roles and the specificity of adolescent development and sex differences, and the failure to adequately represent the unity and diversity of EFs in measurements and/or analyses. Therefore, the goal of the current study was to

Table 2. Intercorrelations Between executive function difficulties and bullying involvement for boys and girls.

	Inhibition	Shifting	Emotional control	Initiation	Working memory	Planning	Organization of materials	Monitoring	BRI	MI	GEC
Victimization											
Total	.21**	.07	.11*	.06	.08*	.13**	.11*	.10*	.16**	.11*	.13**
Girls	.24**	.10	.12*	.11*	.12*	.18**	.15*	.14*	.19**	.16**	.19**
Boys	.17*	-.02	.06	-.06	.12	.15	.09	.01	.07	.01	.03
Aggression											
Total	.15**	.09*	.04	.01	.09*	.05	-.04	.01	.11*	.03	.05
Girls	.04	.07	-.07	-.04	.08	.01	-.14*	-.09	.04	-.01	.04
Boys	.32**	.09	.10	-.03	.09	.09	.08	.06	.20**	.06	.12

BRI: behavioral regulation index; MI: metacognition index; GEC: global executive composite score. * $p < .05$. ** $p < .01$.

Table 3. Results of Logistic Regression Analysis With Odds Ratios (And 95% Confidence Intervals) Showing Risk Of Being A Pure Victim, A Pure Bully, Or A Bully-Victim, and P Values from x2 comparisons with noninvolved group, based on BRIEF executive function scores.

		Being a pure victim				Being a bully-victim				Being a pure bully			
EF difficulties		Odds ratio	95% CI	x ² comparison	p	Odds ratio	95% CI	x ² comparison	p	Odds ratio	95% CI	x ² comparison	p
Inhibition	Total	1.84	(1.09-3.12)	5.26	*	2.49	(1.15-5.34)	5.63	*	.68	(.27-1.72)	.66	ns
	Girls	2.02	(1.03-3.96)	4.33	*	3.26	(1.03-10.29)	4.43	*	.29	(.06-1.32)	2.83	†
	Boys	1.18	(.38-3.72)	.85	ns	4.06	(1.43-11.50)	7.52	**	2.04	(.56-7.40)	1.22	ns
Shifting	Total	1.11	(.65-1.89)	.16	ns	1.94	(.95-4.76)	2.81	†	.74	(.32-1.71)	.47	ns
	Girls	1.05	(.54-2.03)	.02	ns	1.95	(.78-4.87)	2.12	ns	1.05	(.30-3.60)	.007	ns
	Boys	.92	(.34-2.45)	.02	ns	1.80	(.69-4.68)	1.48	ns	.59	(.18-1.86)	.81	ns
Emotional control	Total	1.85	(.98-3.79)	1.98	†	2.24	(1.02-4.89)	4.24	*	.70	(.27-1.77)	.57	ns
	Girls	1.85	(.95-3.09)	2.88	†	2.45	(.75-8.05)	2.32	ns	.19	(.02-1.52)	2.95	†
	Boys	.92	(.34-2.45)	.02	ns	1.99	(.68-5.77)	1.66	ns	1.42	(.44-4.55)	.36	ns
Initiation	Total	1.27	(.63-2.55)	.00	ns	1.75	(.81-3.81)	2.08	ns	1.04	(.48-2.28)	.01	ns
	Girls	1.31	(.67-2.58)	.45	ns	3.37	(1.05-10.77)	4.61	*	.92	(.29-2.95)	.01	ns
	Boys	.711	(.29-1.72)	.56	ns	.87	(.30-2.54)	.06	ns	1.03	(.34-3.08)	.00	ns
Working memory	Total	1.64	(1.04-2.84)	3.14	*	1.88	(.83-4.26)	2.39	ns	.93	(.38-2.26)	.02	ns
	Girls	2.00	(1.08-3.55)	3.34	*	2.29	(.65-8.06)	1.76	ns	.54	(.11-2.49)	.63	ns
	Boys	1.30	(.53-3.18)	.34	ns	1.38	(.46-4.10)	.34	ns	1.25	(.39-3.96)	.14	ns
Planning	Total	1.211	(.70-2.08)	.48	ns	1.93	(.94-4.20)	2.82	†	1.14	(.52-2.51)	.12	ns
	Girls	1.272	(.63-2.55)	.45	ns	1.54	(.44-5.35)	.48	ns	.82	(.25-2.60)	.11	ns
	Boys	.626	(.22-1.71)	.83	ns	2.05	(.73-5.75)	1.90	ns	1.53	(.50-4.65)	.58	ns
Organization of materials	Total	1.67	(1.10-3.24)	4.47	*	2.63	(1.11-6.23)	5.15	*	.79	(.26-2.39)	.17	ns
	Girls	2.22	(1.24-4.73)	4.47	*	3.39	(1.02-11.30)	4.37	*	.90	(.24-3.32)	.02	ns
	Boys	1.100	(.26-4.53)	.01	ns	2.93	(.76-11.28)	2.62	ns	.68	(.07-5.98)	.11	ns
Monitoring	Total	1.65	(1.10-2.86)	3.12	*	1.69	(.75-3.82)	.25	ns	.70	(.27-1.77)	.57	ns
	Girls	1.83	(1.04-3.58)	3.23	*	1.43	(.41-4.94)	.33	ns	.53	(.15-1.93)	.92	ns
	Boys	.89	(.29-2.71)	.40	ns	2.30	(.74-7.10)	2.20	ns	1.07	(.27-4.22)	.01	ns
Behavioral regulation index	Total	1.33	(.78-2.29)	1.12	ns	1.98	(1.03-3.83)	4.28	*	.76	(.31-1.83)	.37	ns
	Girls	1.29	(.65-2.54)	.56	ns	2.01	(.79-5.12)	2.22	ns	.32	(.07-1.47)	2.31	ns
	Boys	.87	(.31-2.45)	.06	ns	2.42	(.93-6.54)	3.15	†	1.64	(.50-5.29)	.69	ns
Metacognition index	Total	1.44	(.83-2.47)	1.74	ns	3.21	(1.50-6.87)	9.71	**	1.13	(.50-2.54)	.08	ns
	Girls	1.07	(.53-2.15)	.03	ns	3.10	(.97-9.89)	8.34	**	.85	(.26-2.71)	.07	ns
	Boys	1.17	(.45-3.03)	.10	ns	3.30	(1.16-9.34)	5.39	*	1.52	(.47-4.90)	.51	ns
Global executive composite score	Total	1.31	(.77-2.33)	1.06	ns	2.93	(1.38-6.22)	4.29	**	.55	(.21-1.38)	1.66	ns
	Girls	1.43	(.74-2.77)	1.14	ns	3.37	(1.06-10.67)	4.70	*	.30	(.06-1.37)	2.65	†
	Boys	.96	(.37-2.45)	.00	ns	2.70	(.96-7.54)	3.75	*	.92	(.27-3.14)	.01	ns

EF: executive function; ns: nonsignificant. † $p < .07$. * $p < .05$. ** $p < .01$.

explore the associations between multiple EF skills and bullying behaviors for adolescent boys and girls separately. The results of the present study provide support for previous findings that bullying roles, especially pure victims and bully-victims, are associated with EF difficulties. They also underscore the relevance of applying an overall approach to the bullying problem, encompassing sex differences.

Executive functioning in bullying perpetration and victimization

Preliminary analyses failed to reveal any prominent sex differences in EF scores (excepted for Initiation). In general, boys and girls perform similarly on EF tests (Gur & Gur, 2016). Nevertheless, under our categorical/clinical approach, boys exhibited Initiation problems more often than girls did, while girls exhibited Inhibition and Organization of Materials problems more often than boys did. Boys also reported more frequently engaging in bullying behavior (both victimization and perpetration), in line with prior research (Carbone-Lopez et al., 2010; Hong & Espelage, 2012). Nevertheless, this sex difference disappeared when we applied a categorical approach, except for the bully-victim group. We found the same over-representation of boys in this group as previous studies had done (e.g., Wolke et al., 2001).

As expected, our results showed strong positive associations between high Inhibition and BRI scores and bullying perpetration among boys. This finding is in accordance with previous studies (Jenkins et al., 2018) reporting a correlation between Inhibition problem and bullying among adolescent boys and girls. For girls, a high bullying perpetration score was specifically related to better Organization of Materials (i.e., lower score). *Organization of Materials* refers to the ability to maintain relevant parts of the environment in an orderly way. If substantiated, this is an interesting result, as it suggests a specific form of EF competence (and not impairment) in girls bully. This result is consistent with studies showing a link between proactive or relational aggression, more frequently used by girls, and good planning abilities (Hecht & Latzman, 2017; Rohlf et al., 2018). If further studies confirm this preliminary result, a specific intervention approach may be needed for girls, who have effective planning and organization (goal-directed) abilities, and may use their skills to bully others (e.g., with skillful forms of bullying such as manipulating social relationships; Ellis et al., 2009).

Working Memory and Shifting difficulties were also positively associated with perpetration behavior, in line with Jenkins et al. (2018)'s results for flexibility. In contrast to the latter, we did not find any correlation between Emotional Control and level of bullying perpetration. This is consistent with the findings of Salmivalli and Nieminen (2001) indicating that emotional control problems are not necessarily the primary bullying triggers.

Concerning victimization and as reported in earlier studies (Jenkins et al., 2018; Verlinden et al., 2014), there were significant associations with poor inhibition skills for both sexes. Moreover, for girls, we found significant and positive associations with Emotional Control, Initiation, Working Memory, Planning, Organization of Materials, and Monitoring. BRI, MI and GEC scores were all related to victimization. Adopting a sex-based approach allowed to identify specific relations between EF skills and bullying involvement. Our study suggests EF difficulties especially associated with high frequency of victimization for girls while Jenkins et al. (2018) found this association for both sexes. These discrepancies may reflect differences in the measures used to capture different aspects of EFs (teacher report vs. parent report) and/or in the samples (rural schools in the United States vs. mixed schools in France).

Executive functioning and bullying role

We predicted that adolescent bullies, victims and bully-victims would exhibit poorer EFs than their uninvolved peers. For pure victims, our results suggested that adolescents of both sexes were at risk of being victims if they had high Inhibition difficulties scores. In line with previous research (Op den Kelder et al., 2018; Jenkins et al., 2018; Medeiros et al., 2006; Verlinden et al., 2014), these results

suggest that victims are more liable to exhibit disinhibited or impulsive behavior in daily life . Furthermore, girls with high Working Memory, Organization of Materials, or Monitoring difficulties had approximately twice as high a risk of being victims which is consistent with previous studies (Op den Kelder et al., 2018; Verlinden et al., 2014).

Working memory deficits suggest that adolescent victims may have difficulty remembering and implementing appropriate/efficient behavioral strategies in peer relationships (Monks et al., 2005). This may make victims less able to deal with social situations and more vulnerable to peer rejection (McQuade et al., 2013). Besides, victimization itself may affect working memory (Baumeister et al., 2005). Indeed, authors have previously suggested that socially stressful situations trigger momentary states of cognitive impairment, deficit in working memory or EF difficulties (Riggs et al., 2006).

High Organization of Materials and Monitoring difficulties have also been observed among victims. The former measures the ability to organize, keep track of, or tidy one's belongings, while the latter describes the ability to check work, assess performance, and keep track of one's own and others' efforts (Gioia et al., 2002). This result is congruent with adolescents' working memory (and inhibition) problems. Their limited ability to hold information in memory and manipulate it would prevent them from organizing their work, maintaining objectives and, above all, monitoring (i.e., controlling) them, meaning that they rush and make more mistakes. Chronic victimization may result in some form of cognitive overload, manifesting itself in disorganized patterns. These EF difficulties may not escape the attention of bullies, who would perceive these students as prime targets, being less liable to riposte in a structured and organized manner. Further research is needed to examine (1) whether girls exposed to victimization display different EF deficits than boys, and (2) the role of polyvictimization (or co-occurrence of victimization).

Another prediction was that the pure bully and bully-victim groups would perform more poorly on inhibitory and emotional control than the noninvolved group. Our results only partially confirmed this prediction. Bully-victims performed more poorly on EFs than noninvolved participants, with significantly and clinically higher BRI, MI and GEC scores. The associated risks were noticeably higher (between 2 and 4, depending on the EF) than those of pure victims (between 1 and 2). Bully-victims had a dysregulation profile with difficulty resisting impulses and considering consequences before acting. They are characterized by poor inhibitory control: boys with high Inhibition difficulties were four times more at risk of being bully-victims (three times higher for girls). These findings are in line with studies showing that inhibition problems may increase the likelihood of reactive aggression (Ellis et al., 2009; Raaijmakers et al., 2008).

Being a bully-victim was also associated with high Emotional Control, Organization of Materials, and Initiation difficulties, especially for girls. These findings suggest that there may be sex-related subtypes of bully-victims, and that many bully-victims lack the EF skills needed to inhibit their aggressive behaviors. As expected, female bully-victims were characterized by poor emotional control, displaying an emotionally explosive and labile profile, with exaggerated emotional reactions to seemingly minor situations (Gioia et al., 2002). This profile suggests that their aggressive behaviors were emotionally driven and impulsive (Camodeca et al., 2002; Salmivalli & Nieminen, 2001). Bullying is not necessarily an emotional surge, and proactive bullying may require higher levels of cognitive skills.

Initiation problems among female bully-victims is an unexpected result that reflects difficulty getting going on tasks, activities, and problem-solving approaches (Gioia et al., 2002). It has been suggested that the poor problem-solving strategies of bully-victims prevent them from resolving bullying situations or generating de-escalation strategies (Mahady Wilton et al., 2000), and they may engage in more externalizing behaviors or aggressive coping strategies. This impairment may be both a symptom of their difficulties and a key factor for perpetuating their peer relationship difficulties.

Contrary to our expectations, results showed that EF problems were not risk factors for being a bully. Nevertheless, two trends did emerge (even if only marginally significant). For girls only, high Inhibition and Emotional Control scores had odds ratios close to zero, suggesting that they tend to

be protective factors rather than risk factors for bullying. These results diverged from those of a prior study among children that found associations between bullying behavior and either a global EF deficit (Verlinden et al., 2014) or an inhibitory control deficit (Ellis et al., 2009). However, recent studies have found that bullies do not have inhibition or flexibility deficits (Jenkins et al., 2018; Medeiros et al., 2006). It should be emphasized that beyond the methodological differences, these studies did not consider the possible co-occurrence of perpetration and victimization in peer harassment.

Our study revealed that, compared with noninvolved peers, bully-victims are more likely to have a range of EF difficulties than pure bullies. These results extend findings on the importance of separately considering reactive and proactive forms of bullying for EFs examination. Pure bullies tend to have average levels of the EF skills needed to victimize others, but female bullies seem to be characterized by better inhibition and emotional control skills (i.e., abilities required for proactive, planned aggression applied with coldness) which is not the case for male bullies. These bullies with high EF skills may be able to effectively dominate and control others, and do not seem to fit the picture of bullies with sociocognitive deficits (Camodeca et al., 2002). This is in line with previous results suggesting that pure bullies may even be healthier than their peers (Wolke et al., 2001). In this context of inconsistent data, our results tend to support the representation of pure bullies as having no particular EF difficulties, and even being quite skilled in this respect.

Limitations and future directions

Study findings need to be considered in view of several limitations. First, as this was a cross-sectional study with a small sample, no causal inferences could be made. The results should be deemed preliminary, and must be interpreted in the knowledge that EFs and bullying roles may reciprocally influence each other. These results need to be replicated in a larger sample with equal proportions of boys and girls (which was not the case in this study), using a methodology that can account for the nested structure of the data (e.g., structural equation modeling or multilevel approaches). In addition, owing to the exploratory nature of the current study, we performed multiple analyses without adjustment for multiple tests, which can increase the likelihood of obtaining at least one false-positive result (Althouse, 2016). Additional dedicated studies are therefore needed to confirm our results. Longitudinal data should be used to determine whether EF impairment is the result of aggression (or vice versa) and establish a temporal (or bidirectional) relationship between EFs and bullying involvement. Second, we measured EFs using a behavioral rating questionnaire with possible reporting biases (e.g., selection effect, social desirability). It would also be useful to administer performance-based assessments of adolescents' EFs. Moreover, peer nomination tools should be used to complement bullying self-reports. Third, there are several potential confounders when studying the association between adolescents' EF abilities and bullying involvement that would need to be control in future studies (e.g., socioeconomic status, personality traits, preexisting psychiatric problems, family hardships, or severe stress)

To gain a fuller understanding of the role of EFs in bullying, it is important to consider both the form (e.g., physical, verbal, relational, or proactive/reactive) and the medium (e.g., online) of the perpetration/victimization that is exhibited and/or experienced. These forms are not necessarily linked to equivalent sociocognitive skills or deficits. For example, the relational form of bullying may require higher levels of EFs, regarding planning skills or emotional control (e.g., Garandeau & Cillessen, 2006). Moreover, given their anonymity and the absence of emotional feedback (Ansary, 2020), digital spaces may increase the acting out of young people with impaired EFs. Understanding the onset and chronicity of specific EF concerns could lead to a better understanding of the association with peer victimization. The role of EF skills in bystander responses to school bullying should also be examined.

Conclusions and implications

Despite these limitations, the present study's findings help to fill gaps in the literature regarding EF skills and bullying roles, by taking sex differences into account. Gender socialization practices and/or normative expectations of behavior in boys and girls may have contributed to the sex differences observed in our study in the association between bullying and EFs. The present study underlined the importance of distinguishing bully-victims from bullies or victims, and treating these three categories as separate groups. Bully-victims seems to have low self-control (cognitive and emotional control). The EF patterns of pure bullies indicate that they are not necessarily less efficient, as they engage in cold-blooded action (Winstok, 2009). In terms of EFs, bully-victims tend to be an especially problematic group in need of further attention. Distinguishing between reactive and proactive tendencies should be used to determine the most appropriate intervention strategies in terms of EFs. Bullied adolescents seem to exhibit cognitive deficits similar to those of victims of other types of interpersonal abuse (e.g., sexual abuse, conjugal abuse). The implications of such findings include the need for early and targeted preventive intervention for victims, such as cognitive-control (e.g., mindfulness) and working memory training. EF interventions (Riggs et al., 2006) also should efficiently improve adaptation, regulation, working memory or problem-solving skills in bully-victims or victims, especially female.). Male bully-victims could benefit more from training in self-monitoring/self-control and alternative behaviors to aggressive behavior (e.g., cooperative games). Concerning pure bullies, prevention and intervention aimed at reducing the benefits of aggression relative to prosocial alternatives, social skills and moral education should be more useful than EF training.

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