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School bullying and drug use later in life: A meta-analytic investigation

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School bullying and drug use: Meta-analysis

Maria M. Ttofi[1], David P. Farrington[1], Friedrich Lösel[1,2], Rebecca V. Crago[1], & Nikos Theodorakis[1]

1. Institute of Criminology, University of Cambridge
2. Institute of Psychology, University of Erlangen-Nuremberg, Germany

Corresponding author: Dr. Maria M. Ttofi
Email: mt394@cam.ac.uk
Telephone: +44-1223-767186

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ABSTRACT

The main aim of this paper is to investigate whether there is a significant long-term association between bullying at school and drug use later in life. A meta-analysis is presented based on results from major prospective longitudinal studies with available unadjusted and adjusted effect sizes. Results are based on thorough systematic searches of the literature across 19 databases and 63 journals. The unadjusted summary effect size suggests that youth who bully are at least twice as likely compared with non-involved students to use drugs later in life (OR = 2.22, 95% CI: 1.60 – 3.07). The adjusted summary effect size is markedly reduced to an OR of 1.41 (95% CI: 1.20 – 1.66) suggesting that a lot of variation in the final model is explained by other contributing factors, while bullying has a significant yet small effect over and above the contribution of these factors. Contributing factors include childhood risks falling within the individual, family and school domains that are significantly associated with both the predictor and the outcome. It is concluded that school bullying, drug use and other problem behaviors are intercorrelated, thus highlighting the need to create a meaningful holistic framework for the prevention of drug problems and other associated mental, emotional, and behavioral maladies. Implications for policy and practice arising from these findings are discussed.

Keywords: school bullying; drug use; meta-analysis; prospective longitudinal studies

A vast amount of research has attempted to elucidate the association of substance use with delinquency (Griffin, Botvin, Scheir, Diaz, & Miller, 2000), serious aggression or violence (Weiner, Sussman, Sun, & Dent, 2005), and crime in general (Bennett, Holloway, & Farrington, 2008). These associations have been replicated in empirical studies, and various theoretical models have been suggested to account for the nature and, more importantly, the direction of this relationship (Parker & Auerhahn, 1998).

More recently, scientific interest has been directed toward explaining the higher prevalence of substance use among a specific type of aggressive children from the community, namely students who bully (Adelmann, 2005). Notably, some researchers have suggested a long-term path from school bullying to substance use later in life (Carlisle & Rofes, 2007; Niemela et al., 2011).

This direction of research could potentially have important implications for policy and practice, primarily because of its longitudinal perspective and its focus on non-institutionalized youth from the general community. Is there indeed continuity from school bullying to substance use later in life? If so, it could be argued that early school-based intervention initiatives may have the potential to interrupt this longitudinal path and to prevent substance use related costs (e.g., health problems, hospitalization, drug-related violence, school dropout, an unsuccessful life).

Theoretical Background

Prevalence of Bullying and associated Health, Emotional and School Adjustment Problems of Youth

School bullying is a subset of aggressive behavior but should not be equated with aggression (Salmivalli & Nieminen, 2002). Only recently has there been consensus regarding the definition of bullying to include three core measures, namely:

(a) intentional aggressive behaviors; (b) that typically are repeated and (c) that usually occur in the context of a power imbalance (Crime Disease Control, 2014). This definition has been endorsed in empirical research (Bradshaw, Waasdorp, Goldweber, & Johnson, 2013; Espelage, Low, Rao, Hong, & Little, 2014; Farrington, 1993), although most measures of bullying in the published literature fall short of adequately assessing all three core features of the model. Recently, more carefully designed studies have demonstrated that bullying perpetration and fighting are unique latent constructs and therefore should be tested separately in structural analyses (Espelage et al., 2014, p. 342) although, admittedly, bullying and other externalizing behaviors are correlated. Recent research also has identified more sensitively the predictors associated with children's involvement in different bullying roles as bullies, victims, or bully-victims (Cook, Williams, Guerra, Kim, & Sadek, 2010; Salmivalli & Nieminen, 2002).

Bullying has received the attention of parents, school authorities, and social media as it is one of the most common forms of victimization experienced by school-aged youth (Nansel, Overpeck, Haynie, Ruan, & Scheidt, 2001). Due and colleagues (2005) carried out perhaps the largest study of the prevalence of being bullied (sometimes or more often during the present school term) among nationally representative samples of 11–15 year olds in 28 western industrialized countries (surveying over 4,000 students per country on average). Overall, 18 per cent of boys and 15 per cent of girls were bullied according to this criterion, but there was substantial variation between countries. For example, in the United States 16 per cent of boys and 11 per cent of girls were bullied and in the United Kingdom, 9 per cent of boys and 7 per cent of girls. Despite large cross-national and cultural variations in

prevalence rates, evidence suggests that school bullying is pervasive in both high-income and low-middle income countries.

These prevalence rates are a cause of concern when one considers what seems to be a significant link between school bullying and a range of physical, psychological, and behavioral problems. For example, based on multilevel models adjusted for age and family affluence at the individual and country level, Due and colleagues (2005) found that the odds ratios (ORs) for physical symptoms (e.g., headache, stomach ache, backache, dizziness) among students who were bullied weekly ranged in values from 1.83 to 2.11, suggesting that the odds for having poor physical health were on average two times higher for the victimized students than their non-victimized counterparts. Results of this study showed an even greater association between victimization and psychological symptoms (such as feeling nervous, feeling low, difficulties in getting to sleep, morning tiredness, feeling left out, loneliness, helplessness). In a different cross-national comparison study, based on nationally representative samples of 113,200 students from 25 countries, a similar pattern emerged (Nansel, Craig, Overpeck, Saluja, & Ruan, 2004). Specifically, and despite notable variations in prevalence rates across twenty five countries, Nansel and colleagues (2004) found that involvement in bullying was significantly associated with poorer 'psychosocial adjustment', defined by five composite measures, namely health problems, emotional adjustment, school adjustment, relationships with classmates and alcohol use.

Any suggestion regarding the short-term negative impact of school bullying seems reasonable even to the lay mind. On the other hand, establishing the long-term adverse effects of school bullying, and investigating whether children involved in school bullying are more likely to be faced with adjustment problems later in life, is

more challenging. Previous systematic reviews and meta-analyses support that exposure to bullying during school years increases the likelihood of adverse outcomes up to an average of six to seven years later on. Bullying is linked to increased risk of depression (Ttofi, Farrington, Lösel, & Loeber, 2011a; Farrington, Lösel, Ttofi, & Theodorakis, 2012), violence (Ttofi, Farrington, & Lösel, 2012), and criminal offending, including acts of self-reported delinquency and property offences as well as police arrests and official convictions (Ttofi, Farrington, Lösel, & Loeber, 2011c).

Overall, meta-analytic findings from prospective longitudinal studies are in line with the wider scientific literature on how school bullying poses barriers to the long-term health development of school youth. It follows that a long-term association of school bullying with other forms of problem behavior, such as drug use, would be anticipated. However, the strength of this association in the form of a standardized measure is yet to be established. Furthermore, while some study findings suggest a positive association, findings from other studies do not. To the best of our knowledge, no earlier meta-analysis has investigated the link between school bullying and later drug use by synthesizing the existing evidence across all available studies.

School Bullying and Drug Use: Theoretical Perspectives

A number of studies, primarily cross-sectional in character, aimed to investigate the strength of the relationship between bullying at school (perpetration and victimization) and drug use (e.g. Adelmann, 2005). Results suggest that bullying perpetration at school is a concurrent correlate (Bradshaw et al., 2013: OR = 2.8; 95% CI = 2.4 – 3.2) and long-term predictor (Farrington & Ttofi, 2011: OR = 2.4; 95% CI = 1.2 – 4.8) of drug use. Results for victims are less consistent. While some studies suggest a strong association between bullying victimization and substance use (Kaltiala-Heino et al., 2000: OR = 2.3; 95% CI: 1.5 – 3.4), others indicate a lower

occurrence of substance use among victims of bullying compared with non-involved students (Niemela et al., 2011: OR =0.6; 95% CI = 0.2 – 1.6).

More than 50 cross-sectional studies have examined the association of school bullying and drug use (Valdebenito, 2012). However, an important question arises with regard to what this link actually means, especially when it comes to the longer-term impact of early involvement in risky behavior. Does bullying functions as a causal factor for --or even as a stepping stone towards-- later drug use? Or should the reverse direction of effect be assumed? Further still, are aggressive, delinquent, and other high-risk problem behaviors (including drug use) manifestations of the same underlying propensity (e.g. a deviant or anti-social latent variable)? Or do these problem behaviors constitute separate domains with fairly distinct etiologies? These questions are not trivial, and past empirical studies followed distinct methodological approaches depending on the theoretical stance of the investigators.

A number of studies have highlighted the co-morbidity of school bullying with other externalizing problem behaviors such as conduct problems, delinquency, alcohol, and drug use (Bradshaw et al., 2013; Kaltiala-Heino, Rimpela, Rantanen, & Rimpela, 2000; Nansel et al., 2003) as well as the shared variance in the risk factors predicting these behaviors (Vaugh et al., 2010). This methodological approach is concordant with the position taken by a number of theories, for instance social control theories (e.g., Hirschi, 1969), which state that behaviors such as aggression, delinquency, and drug use co-occur not simply because they are influenced by similar factors, but because they represent manifestations of the same underlying construct. With regard to the argument of comorbidity of externalizing problem behaviors, based on analyses from three independent samples in the Pittsburgh Youth Study, Loeber, Farrington, Stouthamer-Loeber, and van Kammen (1998, p. 129) showed that

aggression, delinquency, conduct problems, and various other challenging behaviors – including drug use– were significantly intercorrelated.

Other researchers have emphasized the distinct nature of aggression, drug use, and other forms of delinquent behavior, as opposed to them being components of a more general single-factor behavioral domain (e.g., Farrell, Kung, White, & Valois, 2000). They argued that a better understanding of the developmental trajectories of specific problem behaviors could contribute toward efforts to identify age ranges when prevention efforts directed at specific problem behaviors are most likely to be successful (Farrell, Sullivan, Esposito, Meyer, & Valois, 2005). Establishing a clear developmental sequence in various problem behaviors is a rather challenging task, and empirical evidence does not seem to clarify whether drug use precedes or follows aggression.

While a notable body of research argues that substance use may function as a trigger for subsequent aggression and violence due to physiological changes (Yudko, Blanchard, Henrie, & Blanchard, 1997) or due to the involvement of drug users with deviant/delinquent groups (Bui, Ellickson, & Bell, 2000), a number of empirical studies suggest the opposite; namely, that drug use may function as a coping mechanism against the experience of stressful life events, including school bullying and peer victimization. Coping theory proposes that adolescents engage in high risk behaviors to cope with increased negative affects resulting from exposure to victimization (Lazarus, 1993). Since bullying is characterized by repeated aggressive acts over time against less powerful (physically or emotionally) individuals, it is plausible that victims of school bullying may engage in substance use as a (maladaptive) way of coping with their negative school experiences. Carlyle and Steinman's research (2007) supports the argument that the co-occurrence of

aggressive behavior and substance use might reflect an adolescent's attempt to cope with victimization and peer rejection.

A somewhat similar theoretical framework is that of Agnew's (1992) general strain theory of crime and deviance, which has been applied in the area of school bullying research in order to explain the higher prevalence of self-harm exhibited by bullied compared with non-bullied students (Hay & Meldrum, 2010). Both coping theory and general strain theory could explain the higher prevalence of substance use among school bullies. Specifically, a recent systematic review and meta-analysis of 153 studies (Cook et al., 2010, p. 75) concluded that the typical bully is one who has negative self-related cognitions, comes from a family environment characterized by conflict and poor parental monitoring, and is more likely to perceive his/her school as having a negative atmosphere. One may argue that the 'typical bully' is more likely to be involved in drug use as a way to cope with stressful life experiences within the family and school.

Most longitudinal research on the association of school bullying with substance use is based on a theoretical framework that presupposes a specific direction of effect. However, and despite the availability of longitudinal data, very little is known about the actual temporal order of these constructs, and whether paths between these constructs may be acting simultaneously or whether one of these variables precedes the other. Although the majority of the existing literature has assumed a specific direction of effect (from either bullying to substance use or the reverse), it may be desirable to examine reciprocal effects between these variables. A scarce number of studies have examined such bidirectional effects with a focus on school bullying. For example, based on prospective longitudinal data from 4000 Australian adolescents, Marsh and colleagues (2004, p. 100) investigated the causal

ordering between school bullying, depression, and self-esteem and established that school bullying at Time1 led to lower self-concepts and higher depression at Time 2, while higher levels of self-concept and lower levels of depression at Time 1 resulted in lower levels of subsequent bullying at Time 2. Looking at a wider body of literature, based on a nationally representative sample of 3614 American adolescents aged 12 to 17, Begle and colleagues (2011) hypothesized longitudinal bidirectional associations between interpersonal victimization and 'high risk behavior' (based on substance use and delinquency). Interestingly, this hypothesis was fully supported for male but not for female adolescents. Similarly, Weiner and colleagues (2005) found that illegal drug use predicted violence and victimization five years later, and that earlier victimization also was associated with later illegal drug use.

The Current Study

Within the described theoretical and empirical context, this study presents a meta-analysis aiming to investigate the long-term link between school bullying and drug use. In particular, it investigates whether bullying might be related to later drug use because of some confounding variable (e.g. low social class) that predicts both. The role of confounding variables can be addressed by investigating to what extent bullying predicts later drug use after controlling for them (Baron & Kenny, 1986). Therefore, this meta-analysis will present data from studies that present unadjusted and adjusted effect sizes (i.e. after controlling for other major childhood risk factors that are related to both school bullying and later outcomes). This approach provides an estimate of the unique contribution of school bullying in drug use *over and above* the effect of other confounding factors. To the best of our knowledge, this is the first known meta-analysis that investigates the link between bullying and later drug use based on prospective longitudinal studies.

The study is part of a wider British Academy Project on 'Health and Criminal Outcomes of Children Involved in School Bullying'. Within this project, two special issues of peer-reviewed journals have been organized (Farrington, Ttofi, & Lösel, 2011; Ttofi, Farrington, & Lösel, 2011b) in which data from longitudinal studies were analyzed to investigate the association between school bullying and various internalizing (e.g. anxiety, depression) and externalizing (e.g. delinquency, violence) problems in later life. Research groups of 29 longitudinal studies participated by providing unpublished data in line with the aims of the project (Farrington et al., 2012).

All contributors to the British Academy Project were asked to investigate: (a) the strength of the relationship between school bullying and later outcomes, and (b) whether this relationship is still significant after controlling for earlier major childhood risk factors (e.g. child, parental, child-rearing, peer, school, socio-economic, and neighborhood) that are significantly correlated with both the predictors (bullying perpetration and victimization) and the outcomes. The contributors were explicitly told that all results were important irrespective of their statistical significance and in fact this can be seen in the published papers of the two edited volumes (Farrington et al., 2011; Ttofi et al., 2011b). In this way, relatively robust conclusions could be drawn about the extent to which school bullying may predict various internalizing and externalizing problems *over and above* the contribution of earlier risk factors.

The present study followed the same analytic approach, using drug use as an outcome. Drug use was not the focus in either of the above-mentioned edited volumes, although results on drug use have been reported in some of these studies as an outcome different from delinquent or anti-social behavior. Therefore, relevant

results, along with further published studies that fall outside the special issues, were combined in a meta-analytic investigation.

Method

Searching strategies and inclusion/exclusion criteria

Beyond activities related to the British Academy Project, extensive literature searches also were carried out. A detailed description of them can be found in a report that was prepared for the Swedish National Council for Crime Prevention (Farrington et al., 2012). It can be downloaded for free from (http://www.bra.se). In total, the same searching strategies were carried out in 19 electronic databases, and a total of 63 journals were hand-searched either online or in print. The searching for relevant papers for this review was completed at the end of May 2014.

Table 1 reports the total number of longitudinal studies that were included in the present review. A total of 30 reports on the association of school bullying with later drug use were located. These reports were based on data analyses from 18 different prospective longitudinal studies. Since more than one published (or unpublished) report could contain data corresponding to the same longitudinal study, the table is divided into two parts. Initially, the table presents the 'included reports' from each longitudinal study on which the current meta-analysis is based. Then, the table presents 'excluded reports', namely reports relevant to each longitudinal study that were excluded from the meta-analysis, although they were relevant to the aims of this review. The table also presents acronyms of the included studies. The reasons for inclusion and exclusion of reports are explained below.

Table 1 About Here

The following inclusion criteria were set in advance (i.e. before commencement of searches) for both published and unpublished reports that were incorporated in the

meta-analytic part of this review: The report clearly indicates that it is concerned with school bullying and not with other more general forms of peer aggression and victimization. Bullying is a special type of aggressive behavior and should not be equated with aggression (Salmivalli & Nieminen, 2002).

The report presents data that are prospective longitudinal in character and chronologically the predictor (bullying perpetration and/or victimization) precedes the outcome (drug use). At Time 1/Baseline period (i.e. when school bullying was measured), study participants were school-aged children from the community. At the follow-up period (i.e. Time 2/Wave 2), the outcome variable of interest is drug use. The report has quantitative data and sufficient statistical information to allow the calculation of an effect size.

We also included follow-up/intervention studies (with before and after measures) since various bullying prevention programs targeted both health-related problems (e.g. depression) and other behavioral problems. In this case, we asked each program evaluator for specific data analyses for the control group that did not receive the intervention. We did not ask for data analyses based on the experimental children because, in the case of efficacious interventions, a reduction in bullying might be followed by a reduction in health or other behavioral outcomes. Specifically, we asked the program evaluators to examine whether bullying at the baseline (i.e. before the implementation of the program) predicted drug use in the follow-up period (i.e. after the implementation of the program) for the control group only. Other published papers also utilized this analytical approach (e.g. Fekkes, Pijpers, Fredriks, Vogel, & Verloove-Vanhorick, 2006, with depression as an outcome). One study would have been included if results from relevant data analyses had been provided (Amundsen & Ravndal, 2008). Another prospective longitudinal and intervention study is included

(i.e. the Raising Healthy Children Study) since the authors present data analyses ensuring that the preventive intervention did not confound the predictive analyses (Kim, Catalano, Haggerty, & Abbott, 2011, p. 137).

Reports could be excluded from the meta-analysis for more than one reason as shown next. The following criteria were set in advance for the exclusion of reports from the meta-analysis despite their relevance to the aims of the current review: Studies with a retrospective measure of school bullying (i.e. retrospective longitudinal studies) were excluded since there was no control of retrospective bias in such designs (e.g. Warner et al., 2004). Longitudinal studies in which there was an overlap in the time measurement of the predictor and the outcome also were excluded. For example, in one report relating to the National Longitudinal Survey of Youth (Higgins, Khey, Dawson-Edwards, & Marcum, 2012), bullying was measured to age 12, while a dichotomous measure of marijuana use at any time in the participants' life also was used, providing a potential overlap between the predictor and the outcome.

Studies based on qualitative data also were excluded (e.g. Carlisle & Rofes, 2007) since such studies do not allow the calculation of an effect size. Reports with quantitative data but insufficient statistical information to allow the calculation of an effect size also were excluded (Farrington, 1993). Results of studies should be based on children from the community and not on clinic samples (Luukkonen, Riala, Hakko, & Rasanen, 2011) so that results could be generalizable to the wider school population.

Drug offenses, which included importing, exporting, delivering, and other drug-related activities, were not used as a proxy for 'drug use' (Luukkonen et al., 2011). For another study, the 'From a Boy to a Man' Finnish Longitudinal Study, we report effect sizes on 'illicit drug use' from the Niemela et al. (2011) paper and exclude

previous reports (i.e. Sourander et al., 2006, 2007a, 2011) that present data on drug offenses. A third study also was excluded as 'selling drugs' could not be used as a proxy to drug use (Wong, 2009).

Reports also were excluded when bullying and drug use were used as predictors of another outcome measure, such as depression (Haavisto et al., 2004), suicidal ideation (Haavisto et al., 2005; Nrugham, Larsson, & Sund, 2008), differences in sexual preference (Warner et al., 2004), or delinquency (Higgins et al., 2012). Reports in which the predictor was part of a wider theoretical construct (e.g., peer aggression and conduct problems in general) also were excluded (Kumpulainen & Roine, 2002).

Reports in which the outcome measure (i.e. drug use) was part of a wider theoretical construct (e.g., a total antisocial behavior scale) also were excluded (Renda, Vassallo, & Edwards, 2011; Vassallo, Edwards, Renda, & Olsson, 2014). Reports in which data analyses presented effect sizes for general substance use (i.e. a combined measure of drug use with alcohol use and/or tobacco use) were excluded (Espelage et al., 2014; Foster et al., 2013; Gamez-Guadix, Orue, Smith, & Calvete, 2013). The current meta-analytic investigation focuses specifically on the long-term association of school bullying with drug use only.

For the 'From a Boy to a Man' Finish Longitudinal study, one report presented only unadjusted effect sizes (Sourander et al., 2007b) and was excluded from the meta-analysis because a more recent report provided both unadjusted and adjusted effect sizes (Niemela et al., 2011). For the Great Smokey Mountain Study, only one report was available, presenting unadjusted effect sizes only (Wolke, Copeland, Angold, & Costello, 2013). In the current paper, a summary effect size across all included studies is presented with and without the inclusion of this study so that fair

estimates can be made with regard to the actual reduction in the effect size once confounds are controlled (see later in the results section).

While a number of reports present data analyses based on drug dependence (e.g. Gibb, Horwood, & Fergusson, 2011) or drug use in general (e.g. McVie, 2010; Niemela et al., 2011), some reports present data analyses separately for different types of drugs (e.g. Renda, Vassallo, & Edwards, 2010; Wolke et al., 2013). Table 2 describes the outcome measures used to obtain relevant effect sizes for each longitudinal study as well as information about study location, sample size, and the type of covariates that were controlled when obtaining an adjusted effect size. Moderator variables that can be used in meta-regressions in order to explain possible heterogeneity in the effect size measures also are presented in Table 2. Moderator variables included the age at the baseline when bullying was measured (range in years: 8.00 to 15.54; M = 12.71; SD = 2.32), the age at the follow-up period when drug use was measured (range in years: 14.00 to 29.50; M = 21.38; SD = 4.92), the length of the follow-up period measured in years (range: 1.00 to 15.50; M = 8.67; SD = 4.72), and the number of confounds controlled when estimating the adjusted effect size (range: 3 to 20; M = 10.38; SD = 5.88).

Table 2 About Here

Combining Effect Sizes within a Report Relevant to an Outcome Measure

Each manuscript could report more than one effect size that could be categorized under drug use. The following rules were set to select an appropriate effect size that would justify inclusion of a report in the meta-analysis.

If a manuscript reported effect sizes separately for younger versus older students, we combined the two measures of association (e.g. Gibb et al., 2011; Hemphill et al.,

2011). We did not find any study with effect sizes reported separately for different gender or ethnic groups.

With regard to the predictor, if different effect sizes were reported separately for each group (e.g. separate parent- or teacher-rated bullying) and the manuscript also provided a combined measure across all groups (e.g. based on a combined parent-teacher report in Gibb et al., 2011), then we chose the latter combined measure. Reports relating to two studies (Renda et al., 2010; Wolke et al., 2013) provided separate effect sizes for 'marijuana use' and 'other illicit drugs' because of the higher prevalence rate of the former illicit drug. These effect sizes were combined for each study.

Combining Effect Sizes Across Reports Relating to the Same Longitudinal Study

As indicated in Table 1, 30 reports from 18 longitudinal studies were included in our review (but not necessarily in the meta-analysis). When separate reports relating to the same longitudinal study presented different effect sizes (e.g., because of differences in the sample size or in the follow-up period that the authors used), the combination of effect sizes across reports is not straightforward as these effect sizes are based on dependent samples. These dependencies must be taken into account because ignoring them will result in standard errors that are too small; in this case, the meta-analyst would need to identify independent sets for analysis (Wilson, 2010).

As a general rule, we chose the most recent published paper. This was the case with the Erlangen-Nuremberg Longitudinal Study of Bullying, for which we have chosen the Bender and Lösel (2011) paper over older reports (i.e. Lösel, Bender, Fehn, & Schulze, 2008). In some cases, older reports provided data consistent with the inclusion criteria set in advance. For example, in the Australian Temperament Project effect sizes were based on an older report (Renda et al., 2010) and more recent

papers (Renda et al., 2011; Vassallo et al., 2014) were excluded for reasons explained above. Table 3 provides the actual effect sizes used in the meta-analyses.

Table 3 About Here

Results

Predictive Association Between Bullying Perpetration at School and Drug Use Later in Life: Unadjusted and Adjusted Effect Sizes

Nine studies provided effect sizes on the association of bullying perpetration with later drug use (Table 3). Among the includable studies, one had a 1-year follow-up (i.e. time lag between the measurement of the predictor and the outcome measure), another had two and a half years of follow-up, a third study had a 9-year follow-up, while the remainder of studies had at least a 10-year follow-up (Table 2). In the meta-analysis, results are presented in the form of Odds Ratio (OR), with an OR larger than the value of 1 suggesting that the odds of drug use are greater for bullies than for non-involved children (and with the value of 1 indicating no significant difference between the two groups). The reference group, namely non-involved students, includes children who indicated in the relevant studies that they were not involved in school bullying incidents as perpetrators, victims, or bully-victims. ORs are presented with their accompanying confidence intervals (CIs). CIs with a value of 1 suggest a non-significant effect that could be attributable to the actual numbers in dichotomies or low base rates of drug use, or to other attributes.

The random effects computational model has been used for the calculation of the summary effect size as it provides more balanced study weights (Borenstein, Hedges, Higgins, & Rothstein, 2009). All includable studies are based on large samples (Table 2). The Erlangen-Nuremberg Longitudinal Study of Bullying (ENLSB) was an outlier, providing an unadjusted effect size of OR = 16.32 (and an

adjusted effect size of OR = 6.90) despite the 9-year gap in measurement points. The substantially larger effects provided in this study are attributable to the study design that included an oversampling of school bullies and victims (Bender & Losel, 2011, p. 100). Data from the ENLSB were excluded because their inclusion in the meta-analysis would lead to a potential overestimation of the summary effect size.

Thus, meta-analytic results are based on the eight remaining studies and provide information on the association of bullying perpetration with drug use later in life. The unadjusted summary effect size across these studies was OR = 2.31 (95% CI: 1.69 to 3.14). For one study (i.e. the Great Smokey Mountain Study), only an unadjusted effect size (with an OR of 3.75; 95% CI: 1.62 to 8.68) was available. Within this meta-analytic investigation, comparisons are made between studies that provided both unadjusted and adjusted effect sizes so that fair estimates are made about the unique contribution of school bullying on later drug use while holding the number of comparison studies constant. In the final meta-analytic model, the unadjusted summary effect size for the remaining seven studies was OR = 2.22 (95% CI: 1.60 to 3.07; p = 0.0001), suggesting that youth who bully, on average are twice as likely as controls (i.e. non-involved students) to be using drugs later in life (Figure 1). This is a substantial effect given that, across studies, the time lag between the two measurement points was an average of nine years (range in years: 1.00 to 15.50; M = 8.67; SD = 4.72). The individual effect sizes for all studies are shown in Figure 1.

Figure 1 About Here

Individual reports for each longitudinal study attempted to examine the unique contribution of school bullying to drug use later in life, namely the extent to which bullying perpetration significantly predicted drug use after controlling for significant confounding factors that were associated with both the predictor and the outcome.

The actual confounding factors used for statistical controls in each study are shown on Table 2. The degree of consistency of statistical controls across studies is an important matter when investigating the unique effect of one factor over and above other confounding factors. As indicated in Table 2, a reasonable level of consistency exists across reports with regard to earlier confounding factors falling within the family domain, such as parental substance use or parental attitudes favoring substance use (in ATP, CHDS and IYDS studies), earlier measures of some sort of family functioning such as poor parental monitoring or discipline (in ATP, ESYTC, IYDS and RHCP studies), family SES (in CSDD and CHDS studies) and family structure (in CSDD and FLS studies). Earlier childhood risk factors falling within the individual domain also have been addressed to an extent, including measures of IQ level or a proxy such as academic performance (in CSDD, CHDS and IYDS studies); levels of impulsivity (in CSDD, ESYTC and RHCP studies) and earlier conduct problems (in CHDS and ENLSB).

The individual effect sizes for each study (as well as the summary effect size across all studies) are shown in Figure 2. The random effects model was used for calculating the average effect size. The heterogeneity test Q, reflecting the total dispersion of effects (Borenstein et al., 2009), was not significant ($Q = 7.77$; $p = 0.26$). The adjusted summary effect size across all studies was markedly reduced (Adjusted OR = 1.41, 95% CI: 1.20 – 1.66, $p = 0.0001$).

Figure 2 About Here

Univariate meta-regressions (i.e. investigating whether effect sizes are related to the length of follow-up period, the number of confounds controlled for in each study, etc) were conducted despite the non-significant results of the heterogeneity test. As expected, results were not significant. As a final step, publication bias analyses

were conducted. Firstly, the Duval and Tweedie's Trim and Fill methods were used to identify possible differences in effect sizes that could be attributable to bias by imputing effect sizes until the error distribution more closely approximates normality, thus offering the best estimate of the unbiased effect size (Borenstein et al., 2009: 286). Two imputed effect sizes are presented on the relevant funnel plot (Figure 3) and the imputed summary effect size (represented by a solid black diamond) has shifted slightly, suggesting a trivial overestimation of the summary effect size.

Figure 3 About Here

Under the fixed effect model, the point estimate and 95% confidence interval for the combined studies are 1.39 and CI: 1.22 to 1.60. Using the Trim and Fill methods, the imputed point estimate and 95% confidence interval are 1.32 and CI: 1.17 to 1.50. Under the random effects model, the point estimate and 95% confidence interval for the combined studies are 1.41 and CI: 1.20 to 1.66. Using the Trim and Fill methods, the imputed point estimate is 1.31 (CI: 1.09 to 1.57).

Furthermore, we conducted Rosenthal's Fail-Safe N test. This method incorporates data from seven studies, which yield a z-value of 4.96 and a corresponding 2-tailed p-value of 0.00001. The Fail-Safe N is 38. This means that we would need to locate and include 38 'null' studies in order for the combined 2-tailed p-value to exceed 0.050. Although our sample of included studies is small, this is a rather robust effect given that it is most unlikely that we have missed out 38 prospective longitudinal studies from the available literature on the association of school bullying with later drug use.

Predictive Association Between Bullying Victimization at School and Later Drug Use: Unadjusted and Adjusted Effect Sizes

An even smaller number of studies (six, given the exclusion of ENLSB data

from the meta-analysis) addressed the link between bullying victimization and later drug use, providing a summary OR of 1.26 (95% CI: 0.93 to 1.69). Upon removal of the GSMS from the final model for reasons explained above, the unadjusted effect size, under the random effects model, was OR = 1.24 (95% CI: 0.88 to 1.74) suggesting no significant differences in the likelihood of drug use later in life between victimized and non-victimized students. After controlling for covariates, the magnitude of the effect size was reduced further (Adjusted OR = 1.02; 95% CI: 0.94 to 1.11). Given the non-significant value of the summary effect size, further sensitivity analyses or meta-regressions are not necessary.

Discussion

Past research has provided conflicting results on the association between bullying victimization and later drug use, with some studies providing substantial effects (Kaltiala-Heino et al., 2000) and others not (Niemela et al., 2011). The current meta-analysis suggests that bullied youth are not at a greater risk of later drug use compared with non-victimized counterparts. However, this finding should be accepted with some consideration given the small number of studies included in the meta-analysis. Future replication studies and updated meta-analytic investigations may shed further light on this issue. Nevertheless, youth who bully are at least twice as likely compared with students who do not bully to use drugs later (OR= 2.22). The adjusted summary effect size is reduced markedly to an OR of 1.41, suggesting that considerable variation in the final model is explained by other contributing factors. These may include childhood risks falling within the individual, family and school domains that are significantly associated with both the predictor and the outcome (Table 2).

This finding is concordant with previous research based on both cross-sectional and longitudinal studies that have highlighted that school bullying is a significant yet not the strongest contributing factor toward drug use. Earlier research has investigated contributing qualities within individual domain, namely hyperactivity and conduct disorder (Barkely, Fischer, Smallish, & Fletcher, 2004), high daring or innovation seeking (Fergusson, Boden & Horwood, 2008) and impulsivity (Conway, Kane, Ball, Poling & Rounsaville, 2003). Risk qualities within the family domain also have been investigated to help explain drug use by young people. For example, Kilpatrick and colleagues (2000), using data from a national household survey, found that exposure to illicit drug abuse by parents increased the risk of substance abuse and dependence among adolescents, while Fergusson and colleagues (2008), based on prospective longitudinal data from New Zealand, provide evidence for the association between parental use of physical punishment and illicit drug use of children in early adulthood. Further, influences of peers at school (e.g., positive peer attitudes towards drugs) (Agrawal, Lynskey, Bucholz, Madden & Heath, 2007) as well as unfavorable socio-economic circumstances (Compton, Thomas, Conway, & Colliver, 2005) have been documented as determinants for drug use.

Within this meta-analytic review, included studies addressed many of the above-mentioned risk factors in their statistical controls. The results generally suggest that bullying has a small effect over and above these early childhood risks. The accumulation of risks across different domains may contribute importantly to later drug use. The heterogeneity test, Q, was not statistically significant, suggesting a similar trend in results across studies. Most adjusted effects across studies fell within the same range, thus rendering moderator analyses unnecessary (e.g., for the

investigation of how effects vary by length of follow-up or number of statistical controls).

The adjusted effect size was highly significant and with precision as shown by the narrow confidence intervals. This is an expected finding given the large samples utilized in each longitudinal study. Thus, school bullying has a significant yet small effect on drug use over and above the contribution of other major childhood risk factors. Although the magnitude of the effect is small, this finding is not trivial, when one considers the average time lag (almost nine years) between the two measurement points as well as the average number of statistical controls utilized by the majority of the studies. Furthermore, the study's reliance on the general school population normally leads to smaller effect sizes than studies of more 'extreme' groups (e.g. clinic samples) that usually provide larger effect sizes.

The findings of the current review are concordant with previous findings on the association of school bullying with later adverse outcomes such as violent offending, general offending, and depression (Farrington et al., 2012; Ttofi et al., 2011 a & c, 2012), School bullying, delinquency, drug use, and other problem behaviors are intercorrelated (Piquero, Connell, Piquero, Farrington, & Jennings, 2013), thus highlighting the need to create a meaningful holistic framework for the prevention of drug problems and other associated mental, emotional, and behavioral maladies (Biglan, Flay, Embry, & Sandler, 2012). We recommend the promotion of high-quality anti-bullying programmes (Ttofi & Farrington, 2011). These could be viewed as a form of early crime prevention as well health promotion. Other more general multiple-component programs may be equally beneficial in interrupting the continuity from school bullying to later adverse outcomes, especially given the inter-

correlations among externalizing problem behaviors and the marked shared variance in the risk factors predicting these behaviors (Loeber et al., 1998).

Limitations and Directions for Future Research

One merit of the current study is that results are generalizable to the wider school community. Nevertheless, as with every research, limitations should be acknowledged. Within this meta-analytic investigation, there was not enough studies that would allow us to examine specific associations with ethnicity despite the fact that previous research has suggested that school bullying is more strongly associated with substance use among ethnic minority youth (Luk, Wang, & Simons-Morton, 2012). Future research should examine the extent to which the longer-term link of bullying with drug use is related to ethnicity (e.g., with larger effect sizes for Blacks compared with Whites) in order to make more precise recommendations for programs for ethnic groups.

Possible differences in associations between different types of school bullying (e.g. physical versus psychological bullying) with drug use should be examined as well as whether such differences are gender-specific. Results from previous research indicate that physical victimization is related more strongly to alcohol use, aggression, and delinquent behaviors among boys than girls. In contrast, relational victimization is related more strongly to physical aggression and marijuana use among girls than boys (Sullivan, Farrell, & Kliewer, 2006). Information available in the included longitudinal research was insufficient to study different types of bullying. Another concern relates to the operationalisation and measurement of bullying using few items in some of these longitudinal studies (e.g. with one item in the Cambridge Study in Delinquent Development).

We included studies based on 'level analyses', namely analyses that investigate the prevalence of adult drug use among youth who bullied at school (and their victims) compared with controls (i.e. non-involved students). A systematic review of 'change analyses' that examines whether changes in bullying from Time 1 to Time 2 are followed by changes in drug use from Time 2 to Time 3 would have been ideal. However, few studies examine this issue, since such analyses would require relevant data over multiple Times. In principle, such analyses would allow safer inferences on causality (Murray, Farrington, & Eisner, 2009). However, in practice, change scores exhibit more variability and are less robust.

Few bullying studies have examined alternative models of whether bullying is a cause or a consequence of drug use. Such studies would shed more light on the temporal sequence and the causal ordering between bullying and other internalizing or externalizing behaviours, including drug use. Establishing a clear developmental sequence in various problem behaviors is important to prevention and intervention efforts. For example, previous research has found that the comorbidity between substance use and depression, and between substance use and conduct disturbance in childhood/adolescence, probably reflects different mediating mechanisms as well as different time frames, with conduct disturbance preceding substance use and depression following it (Silberg, Rutter, D'Onofrio, & Eaves, 2003). These findings suggest that, among children with conduct problems, we are more likely to reduce the longer term likelihood of their using drugs by intervening early in life and thus interrupting another path from drug use to depression. A better understanding of the developmental trajectories of specific problem behaviors may contribute to efforts to identify age ranges when prevention efforts directed at specific problem behaviors are most likely to be successful (Farrell et al., 2005).

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Table 1

A Total of 30 Published/ Unpublished Reports Corresponding to 18 Longitudinal Studies

Reports of Longitudinal Studies included in the Meta-analysis:
Australian Temperament Project; ATP (Renda et al., 2010)
Cambridge Study in Delinquent Development; CSDD (Farrington & Ttofi, 2011)
Christchurch Health and Development Study; CHDS (Gibb et al., 2011)
Edinburgh Study of Youth Transitions and Crime; ESYTC (McVie, 2010)
Erlangen-Nuremberg Longitudinal Study of Bullying; ENLSB (Bender & Lösel, 2011; Lösel et al., 2008)
'From a Boy to a Man' Finnish Longitudinal Study; FLS (Niemela et al., 2011); sub-study of the Nationwide 1981 Birth Cohort Study
Great Smokey Mountain Study; GSMS (Wolke et al., 2013)
International Youth Development Study; IYDS (Hemphill et al., 2011)
Raising Healthy Children Project; RHCP (Kim et al., 2011)
Reports of Longitudinal Studies excluded from the Meta-Analysis:
Australian Temperament Project (Renda et al., 2011; Vassallo et al., 2014)
Cambridge Study in Delinquent Development (Farrington, 1993)
Implementation of the OBPP in Norway (Amudsen & Ravndal, 2008)
Qualitative Retrospective Study of Long-Term Effects of School Bullying (Carlisle & Rofes, 2007)
'From a Boy to a Man' Finnish Longitudinal Study; substudy of the Nationwide 1981 Birth Cohort Study (Haavisto et al., 2004, 2005; Kumpulainen & Roine, 2002; Sourander et al., 2006, 2007a, 2007b, 2011)
National Longitudinal Survey of Youth 1997 (Wong, 2009; Higgins et al., 2012)
Norwegian Short-Term Follow-Up Study (Nrugham et al., 2008)
Project RED (Foster et al., 2013)
Retrospective Study of Gay Men, Lesbian and Bisexual People in the UK (Warner et al., 2004)
Short-Term Follow-Up Study in Midwestern Middle Schools (Espelage et al., 2014)
Short-Term Follow-Up Study in Spain (Gamez-Guadix et al., 2013)
STUDY-70 Project: Follow-up Study of Finnish Inpatient Adolescents (Luukkonen et al., 2011)

Notes: Published and unpublished reports corresponding to each longitudinal study are indicated via citations in parenthesis

Table 2

Description of Studies used in Meta-Analysis

Study name, Location (Sample Size)	Age at Predictors Measurement and at Follow-Up	Data Source	Number/Type of Controls
Australian Temperament Project (ATP) Victoria, Australia (N = 1359)	Bullying: 13.5 Victimization: 13.5 Follow-Up: 23.5	Self-Reports on 'marijuana' and 'other illicit' drug use (separate items)	14 Covariates (problems with understanding; mother smoking; father smoking; mother drinking; father drinking; mother education; father education; occupation of mother; occupation of father; age of mother at baseline; age of father at baseline; low parental monitoring; harsh parental discipline; deviant peers)
Cambridge Study in Delinquent Development (CSDD) London, England (N = 406)	Bullying: 14 Victimization: NA Follow-Up: 29.5	Self-Reports on drug use	20 Covariates (high daring; hyperactivity; high clumsiness; low non-verbal IQ; low verbal IQ; low attainment; high extraversion; high neuroticism; low popularity; low height; low weight; convicted parent; delinquent sibling; young mother; poor child rearing; disrupted family; low family income; poor housing; low social class; large family size)
Christchurch Health and Development Study (CHDS)[1] Christchurch, New Zealand (N ≈ 985)	Bullying: 11.75 Victimization: 14 Follow-Up: 23	Self-Reports on drug dependence	16 Covariates (gender; childhood conduct problem; childhood sexual abuse; deviant peer affiliations; parental attachment; childhood physical abuse; IQ level; parental history of illicit drug use; family living standards; childhood anxiety; withdrawal at age 7-9; teacher-rated academic progress; parental history of

			criminal offending; maternal education; maternal age at child's birth; change of parents)
Edinburgh Study of Youth Transitions and Crime (ESYTC) Edinburgh, England (N = 4299)	Bullying: 13 Victimization: 13 Follow-Up: 14	Self-Reports on drug use	10 Covariates (gender; socio-economic status; impulsivity; peer delinquency; parental separation; parental supervision; parental conflict; parental punishment; neighborhood deprivation; commitment to school)
Erlangen-Nuremberg Longitudinal Study of Bullying (ENLSB) Bavaria, Germany (N = 48)	Bullying: 15.54 Victimization: 15.54 Follow-Up: 24.64	Self-Reports on drug use	3 Covariates (family problems comprehensive index; CBCL internalizing score; CBCL externalizing score)
'From a Boy to a Man' Finnish Longitudinal Study (FLS) Finland (nationwide study) (N ≈ 2304)	Bullying: 8 Victimization: 8 Follow-Up: 18	Self-Reports on illicit drug use	5 Covariates (parental education level; family structure Rutter total score at Age 8; YASR total score; use of other types of drugs at age 18)
Great Smokey Mountain Study (GSMS) North Carolina, USA (N = 1273)	Bullying: 12.5 Victimization: 12.5 Follow-Up: 22.5	Self-Reports on 'marijuana use' and 'other illicit drug use'	0 Covariates (adjusted effect sizes for 'risky or illegal (illegal behavior in adulthood', which includes drug, are presented)
International Youth Development Study (IYDS)	Bullying: 14.4 Victimization: 14.4 Follow-Up: 16.9	Self Reports on marijuana use	9 Covariates (parental attitudes favorable of drug use; gender; impulsivity; attention deficits; academic failure; poor family management; family history of

Victoria, Australia (N = 687 Year 7 and 701 Year 10 students)			antisocial behavior; family conflict; antisocial peers)
Raising Health Children Project (RHCP) Pacific Northwest USA (N = 957)	Bullying: 11.5 Victimization: NA Follow-Up: 21.52	Self-Reports on marijuana use	6 Covariates (gender; ethnicity; low income status; impulsivity; poor family management; antisocial peer affilication)

Notes: NA = Not Applicable

1: the effect size for victimization was adjusted for based on 14 covariates. For bullying perpetration versus drug use, the authors have controlled for either 14 or 16 covariates depending on the age of participants (as results are shown separately for bullying in early childhood and adolescence). We assumed a total control of 16 covariates in the total summary effect size for bullying perpetration versus drug use.

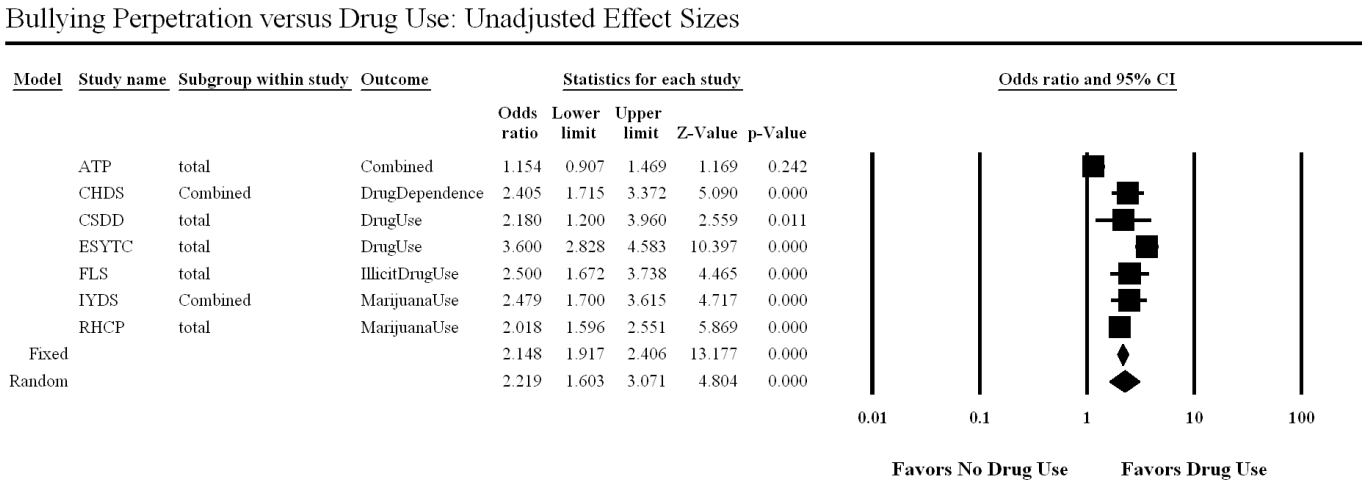
Table 3
Effect size data for drug use

Study name	Unadjusted Effect (bullying perpetration)	Adjusted effect (bullying perpetration)	Unadjusted effect (victimization)	Adjusted effect (victimization)
Australian Temperament Project (ATP)	Marijuana Use OR: 1.154 (CI: 0.914 – 1.456)	Marijuana Use OR: 1.121 (CI: 0.835 – 1.506)	Marijuana Use OR: 1.035 (CI: 0.675 – 1.589)	Marijuana Use OR: 1.449 (CI: 0.865 – 2.430)
	Other illicit drug use OR: 1.155 (CI: 0.901 – 1.481)	Other illicit drug use OR: 1.049 (CI: 0.768 – 1.432)	Other illicit drug use OR: 0.605 (CI: 0.359 – 1.018)	Other illicit drug use OR: 0.735 (CI: 0.404 – 1.337)
Cambridge Study in Delinquent Development (CSDD)	OR: 2.18 (CI: 1.20 – 3.96)	OR: 2.44 (CI: 1.23 – 4.84)	Not applicable	Not applicable
Christchurch Health and Development Study (CHDS)	Middle childhood OR: 2.3 (CI: 1.5 – 3.5)	Middle childhood OR: 1.8 (CI: 0.9 – 3.4)	Combined age OR: 1.2 (CI: 0.4 – 4.0)	Combined age OR: 0.8 (CI: 0.2 – 2.8)
	Adolescence OR: 2.6 (CI: 1.5 – 4.6)	Adolescence OR: 2.0 (CI: 1.1 – 3.7)	Not applicable	Not applicable
Edinburgh Study of Youth Transitions and Crime (ESYTC)	OR: 3.6 (CI: 2.9 – 4.7)	OR: 1.4 (CI: 1.0 – 1.8)	OR: 1.1 (CI: 0.9 – 1.2)	OR: 1.0 (CI: 0.8 – 1.2)
Erlangen-Nuremberg	r = .61	r = .47	r = - .06	r = - .11

Longitudinal Study Of Bullying (ENLSB)	(N = 48)	(N = 44)	(N = 48)	(N = 44)
'From a Boy to a Man' Finnish Longitudinal Study (FLS)	OR: 2.5 (CI: 1.7 – 3.8)	OR: 1.1 (CI: 0.6 – 2.0)	OR: 2.3 (CI: 1.6 – 3.4)	OR: 1.6 (CI: 1.02 – 2.7)
Great Smokey Mountain Study (GSMS)	Marijuana Use OR: 3.64 (CI: 1.73 – 7.65)	Marijuana Use Not applicable	Marijuana Use OR: 1.58 (CI: 0.99 – 2.52)	Marijuana Use Not applicable
	Other illicit drug use OR: 3.86 (CI: 1.53 – 9.73)	Other illicit drug use Not applicable	Other illicit drug use OR: 1.23 (CI: 0.59 – 2.55)	Other illicit drug use Not applicable
International Youth Development Study (IYDS)	Year 7 OR: 2.32 (CI: 1.37 – 3.92)	Year 7 OR: 1.48 (CI: 0.76 – 2.89)	Year 7 OR: 0.93 (CI: 0.54 – 1.62)	Year 7 OR: 0.99 (CI: 0.55 – 1.78)
	Year 10 OR: 2.66 (CI: 1.55 – 4.58)	Year 10 OR: 1.42 (CI: 0.76 – 2.64)	Year 10 OR: 1.41 (CI: 0.83 – 2.40)	Year 10 OR: 1.35 (CI: 0.72 – 2.53)
Raising Health Children Project (RHCP)	r = .19 (N = 957)	b = .10 (N = 957)	Not applicable	Not applicable

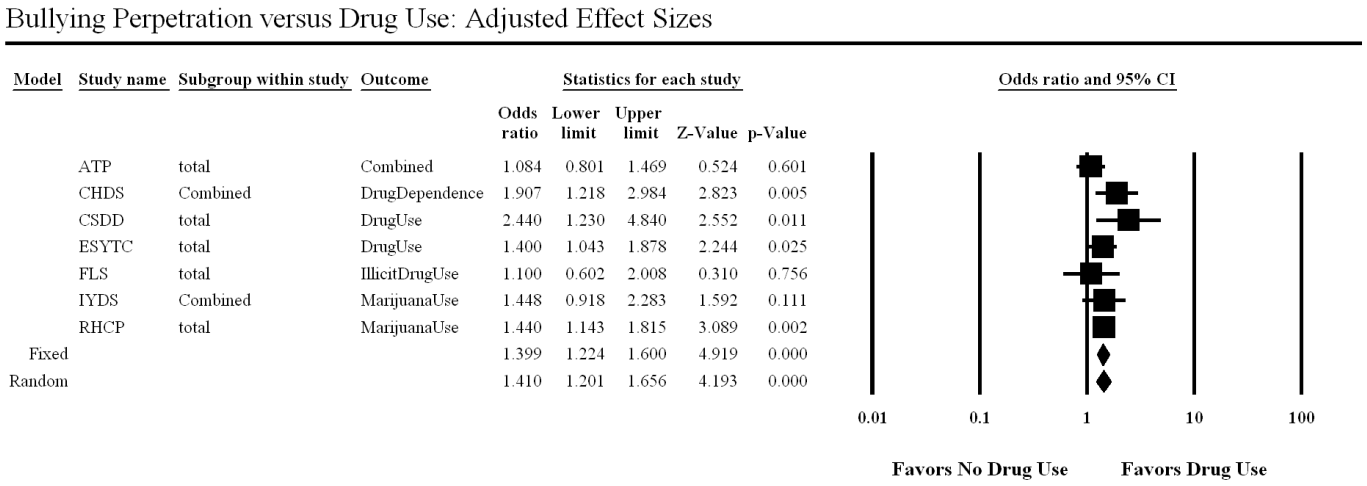
Notes: r = Pearson's correlation coefficient; b = standardized regression coefficient; N = sample size; OR = odds ratio; CI = 95% confidence interval

Figure 1:



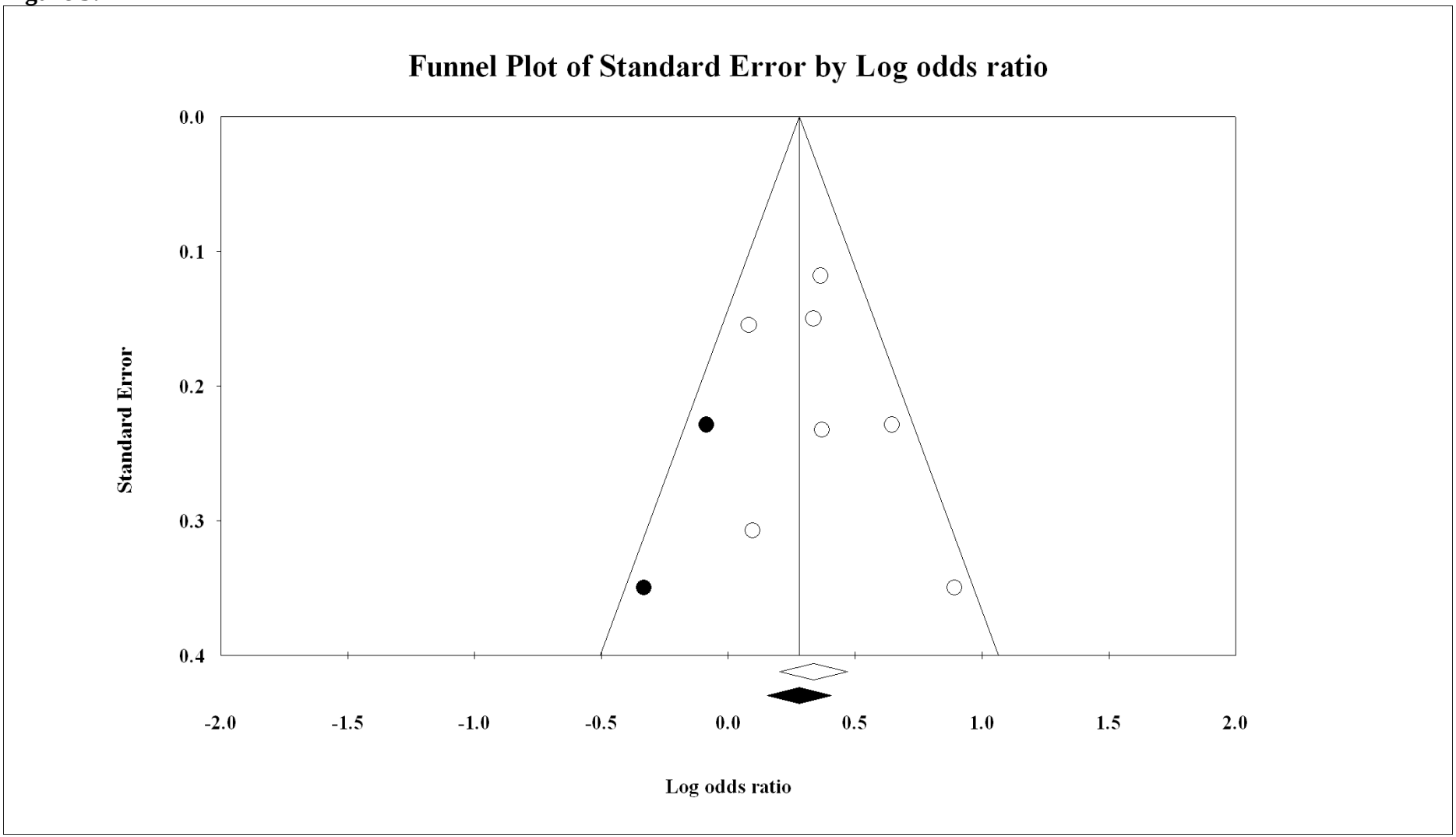
Results from Prospective Longitudinal Studies

Figure 2:



Results from Prospective Longitudinal Studies

Figure 3:


Funnel Plot of Standard Error by Log odds ratio
Standard Error
0.0
0.1
0.2
0.3
0.4
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
Log odds ratio