

How can adolescent aggression be reduced? A multi-level meta-analysis

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Declarations of interest: none

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Abstract

Aggressive behaviour among adolescents has significant social and economic costs. Numerous attempts have been made to intervene to reduce aggression in adolescents. However, little is known about what factors enhance or diminish intervention effectiveness. The present systematic review and meta-analysis, therefore, seeks to quantify the effectiveness of interventions to reduce aggressive behaviour in adolescents and to identify when and for whom such interventions work best. Sixteen databases were searched for randomised controlled trials that assessed interventions to reduce aggression among adolescents. After screening 9795 records, 95 studies were included. A multi-level meta-analysis found a significant overall small-to-medium effect size ($d = 0.28$; 95% CI [0.17, 0.39]). More effective interventions were of shorter duration, were conducted in the Middle East, were targeted at adolescents with higher levels of risk, and were facilitated by intervention professionals. Potentially active ingredients were classified using the Behaviour Change Technique Taxonomy. *Behavioural practice* and *problem solving* were components of more effective interventions targeted at the general population. Overall the findings indicate that psychosocial interventions are effective in reducing adolescent aggression. Future trials need to assess the effect of individual techniques and their combination to identify the key components that can reduce aggression in adolescents.

Keywords: aggression, adolescence, Behavior Change Technique, multi-level meta-analysis.

How can adolescent aggression be reduced? A multi-level meta-analysis

Aggression among adolescents is a worldwide problem. For example, Craig et al. (2009) found that bullying is common in 40 countries across Europe and America. In the United States, Lynne-Landsman, Graber, Nichols, and Botvin (2011) found aggression increases through adolescence, with 51% of their sample presenting high levels of aggressive behaviour at the end of middle school. Aggressive behaviours during adolescence are associated with negative immediate and long-term outcomes for both victims and perpetrators. For example, victims of bullying have more mental health problems during adulthood than those who have not been bullied (Arsenault, 2017) and adolescents who display aggression are more likely to have drug problems, present depressive symptoms and be arrested as an adult (Hyde, Burt, Shaw, Donnellan, & Forbes, 2015; Rhoades, Leve, Eddy, & Chamberlain, 2016). In the US alone, the annual cost of serious aggression among adolescents is over \$21 billion (National Center for Injury Prevention and Control (U.S.). Division of Violence Prevention, 2019).

Many interventions have been developed to prevent and reduce aggressive behaviour in adolescents. Previous reviews have concluded that these interventions are effective (see Appendix A for an overview of 38 previous systematic reviews and meta-analyses including adolescents). However, it is still not clear which specific characteristics and techniques included in these interventions are most effective among adolescents. Only six of these reviews have investigated what works specifically in adolescents: two meta-analyses and four systematic reviews. The meta-analyses have focused on specific interventions involving sports participation (Spruit, Assink, van Vugt, van der Put, & Stams, 2016) and positive youth development (Melendez-Torres et al., 2016), and although the systematic reviews included a broader range of interventions, they did not quantify their effects (Cox et al., 2016;

Gavine, Donnelly, & Williams, 2016; Kelly, 2017; Limbos et al., 2007). Therefore, a meta-analysis that identifies what works to reduce aggression in adolescents is currently unavailable.

Despite the limitations of the previous systematic reviews, some have suggested that interventions aimed at those at greater risk of perpetrating aggression (i.e., targeted interventions) may be more effective than interventions aimed at the general adolescent population (i.e., universal interventions; Gavine et al., 2016; Limbos et al., 2007). The mechanisms underlying effectiveness in universal and targeted interventions might also be different and many reviews focused solely on universal or targeted interventions (see Appendix A). This is important because numerous reviews have concluded that behaviour training and social skills training are the most effective components of interventions that are targeted rather than universal (Fossum, Handegård, Martinussen, & Mørch, 2008; Molina, Dulmus, & Sowers, 2005; Mytton, DiGuseppi, Gough, Taylor, & Logan, 2006; Özabacı, 2011; Wilson & Lipsey, 2007). Identifying which intervention components are effective in improving behaviour is valuable in guiding intervention optimisation. However, without a common language, it is difficult to describe and compare intervention components. For example, Wilson and Lipsey (2007) defined “behavioural strategies” as giving rewards and incentives, whereas Özabacı (2011) characterised learning and practising behavioural responses as “behavioural strategies”. This limitation can be overcome by using a common framework or taxonomy. The present meta-analysis will use the Behaviour Change Technique (BCT) taxonomy version 1 (Michie et al., 2013) to identify the BCTs included in interventions and test which are effective in reducing aggression among adolescents. We will also test whether BCT effectiveness differs between universal and targeted interventions. The BCT taxonomy has been widely used to analyse interventions addressing many health behaviours such as diabetes care (Presseau et al., 2015) and physical activity (Cradock et al.,

2017). The taxonomy includes 93 techniques such as *feedback on behaviour*, *problem solving* and *adding objects to the environment* that aim to change behaviour.

Duration is another characteristic that previous reviews focusing on adolescents have found as a significant moderator of effectiveness. Limbos et al. (2007) suggested in their systematic review that interventions that lasted 12 months or more were more likely to be effective than shorter interventions. However, other reviews have found that longer interventions are not more effective than shorter ones (Fagan & Catalano, 2013).

Systematic reviews and meta-analyses of interventions to reduce aggressive behaviour across children, adolescents and adults have suggested that the existence of other factors in addition to targeting and duration that might moderate intervention effectiveness. However, they have not considered adolescents as a group separate from children and/or adults. Therefore, there is a need to investigate whether these factors moderate the effect of interventions in adolescents as it is possible that interventions need to be specifically tailored for this target group (Yeager, Dahl, & Dweck, 2018).

One of the factors that might moderate the effectiveness of interventions to reduce aggression in adolescents is whether intervention is delivered individually or to a group. Group interventions have been found to be less effective with samples containing high proportions of boys (Sawyer, Borduin, & Dopp, 2015) and targeted interventions to be more effective when delivered individually than to a group (Smedler, Hjern, Wiklund, Anttila, & Pettersson, 2015; Wilson & Lipsey, 2007). The person delivering the intervention has also been found to moderate intervention effectiveness. For example, interventions delivered by a member of the research team were more effective than those delivered by mental health professionals in Sawyer et al.'s (2015) meta-analysis, and interventions delivered by intervention specialists were more effective than those delivered by teachers in Park-

Higgerson, Perumean-Chaney, Bartolucci, Grimley, and Singh (2008)'s quantitative review. School-based interventions have been found to be more effective in high school than in middle school (Hahn et al., 2007) and to be associated with the amount of training the teachers received (Ttofi & Farrington, 2011). The size of the effect of interventions to reduce aggressive behaviours has also been found to vary depending on how the outcome is assessed. For example, both Grove, Evans, Pastor, and Mack's (2008) and Sawyer et al.'s (2015) meta-analyses found that the reduction in aggressive behaviour was more pronounced when the outcome was measured via official records. In the former, that effect was significantly larger than the effect found for self-reports, and in the latter, it was significantly larger than the effect when the outcome was assessed via parent reports. Finally, Ttofi and Farrington (2011) found that anti-bullying school-based interventions evaluated before 2003 were more effective than those evaluated more recently, and interventions implemented in Norway were more effective than those implemented elsewhere. These findings suggest that children from different cultures may vary in the extent to which they engage with interventions to reduce aggressive behaviour and that they may have become less receptive of such interventions over time. In terms of informing our study, these findings indicate that it is important to test whether date of publication and geographical location also moderate the effectiveness of interventions.

Previous studies of the effectiveness of interventions for aggression have used traditional meta-analysis, which is limited by the assumption of independence of effect sizes that prevents more than one effect size from being included from each study. The present study applies a multi-level meta-analysis, which relaxes that assumption. Multi-level meta-analysis allows all effect sizes from studies that report multiple comparisons to be included as the modelling accounts for the dependence of effect sizes nested within studies (Assink & Wibbelink, 2016). Thus, information is maximized and analysis power improved.

In the present study, we aim to identify what works for whom in the reduction of aggressive behaviour. In order to do this, we classify components of the interventions using the BCT taxonomy and test which BCTs are most effective for universal and for targeted interventions separately. In addition, we examine the moderators of intervention effectiveness highlighted in this introduction with the objective of confirming their moderation effect in interventions with adolescents. The moderators that will be examined include characteristics of the intervention such as duration, characteristics of the participants such as gender and aspects of the study design such as outcome informant.

Method

The systematic review protocol was registered on PROSPERO (http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42018088811).

Search Strategy

A database search was undertaken in January 2019 to identify all Randomised Controlled Trials (RCTs) published up to the end of 2018. Only RCTs were included as they provide the best design to assess intervention effectiveness (Higgins & Green, 2011).

Searches were conducted on Web of Science, namely, Web of Science Core Collection, BIOSIS Citation Index, BIOSIS Preview, Current Contents Connect, Data Citation Index, Derwent Innovations Index, Journal and Highly Cited Data, KCI-Korean Journal Database, MEDLINE, Russian Science Citation Index, SciELO, and Zoological Record, as well as in the databases Scopus and PsycINFO. Titles, abstracts and author keywords were searched for four key concepts: (a) adolescents (youth, adolescent, teenager, juvenile, young, minor), (b) intervention (behaviour change, intervention, prevention, experiment, program, reduction, evaluation, strategy, effect, trial), (c) RCT (RCT, Cluster RCT, Group RCT, randomised controlled trial); and (d) aggression (bullying, violence, aggression, physical assault, fighting). The search was limited to articles in English and Spanish, as they were the

languages in which the first author was fluent. The specific search was amended as necessary for each database to account for different search functionalities. In order to account for publication bias, efforts were made to locate grey literature. With that purpose, a similar search was carried out in Open Grey and Proquest Dissertations and Theses.

To ensure all relevant studies were identified, reference lists of relevant systematic reviews were also searched (see Appendix A). In addition, once the relevant studies from both database searches and previous reviews were identified, reference lists –i.e., backward search– and citations –i.e., forward search– were searched for each article retrieved. Forward searches were undertaken with Google Scholar to retrieve unpublished studies and studies that were not listed in the previously mentioned databases. The study selection flow diagram shown in Figure 1 shows the number of articles retrieved from both databases and additional resources and the number of records after duplicates were removed.

Study Selection

Studies were included if they met the following five inclusion criteria: (a) the study design was a RCT or a cluster RCT; (b) the mean age of the participants at baseline was between 10 and 17.99 years old or, if the mean was not reported, the range of ages fell within those limits; (c) the intervention was mainly addressed to the adolescent rather than to the parent or another agent; (d) there was at least one comparison group that was a non-treatment, waiting list, treatment as usual or attention control group; and (e) one of the reported outcomes was a behavioural measure of actual or threatened physical aggression against peers, such as fighting, weapon carrying or bullying.

Studies were excluded if participants were selected due to a specific diagnosis such as Autistic Spectrum Disorder or Attention Deficit Hyperactivity Disorder. However, if the participants were selected due to a diagnosis of Conduct Disorder or Oppositional Defiant

Disorder, the study was still included, as aggressive behaviour is an inherent part of those disorders. Studies were also excluded if the intervention included psychopharmacology and if the comparison group received a competing intervention as opposed to treatment as usual.

First, titles and abstracts of all the records found in the databases, grey literature and previous reviews ($n = 3826$) were screened for inclusion by the first author. Full-texts were obtained when possible and screened by the first author for all the records that appeared to meet the inclusion criteria ($n = 380$). If the full-text could not be found, manuscripts were requested from authors. A second reviewer screened a randomly-selected sample of 10% of the articles ($n = 38$). There was good interrater agreement on study inclusion (Cohen's Kappa = 0.79) with disagreements ($n = 3$) resolved through discussion. Sixty-six studies identified from the initial searches were included. Reference lists and citations of those 66 studies were searched to identify further relevant studies. Screening of the records identified through backward and forward reference searching was undertaken by the first author ($n = 5969$). The flow diagram in Figure 1 shows the number of records included and excluded with reasons for exclusion after the backward and forward reference searches were conducted. A complete list of studies excluded at the full-text stage with reasons for exclusion can be found in Appendix B.

Appraisal of Study Quality

The Cochrane Risk of Bias Tool (Higgins & Green, 2011) was used to assess study quality. The tool grades studies as high, low or unclear risk across the following domains: selection bias (random sequence generation and allocation concealment), performance bias, detection bias, attrition bias, reporting bias and other bias.

The first author assessed the quality of all included studies ($n = 95$). A second reviewer assessed a random sample of 10% of the studies ($n = 10$). The interrater agreement

was poor (Cohen's Kappa = 0.50). After discussion, all disagreements were resolved. A summary of the risk of bias judgements can be found in Figure 2.

Data Extraction

Data to calculate Cohen's *d* was extracted from each study. We used reported effect sizes (ES) where these were quoted (43% of included ES). If a measure of effect size different to Cohen's *d* was reported, such as *r*, it was converted using Decoster's (2012) calculator (25% of ES). For studies with continuous outcomes that did not report effect sizes, means and standard deviations (or standard errors if standard deviations were not reported) from baseline and follow-up were extracted (43% of ES) and Morris' (2008) formula was used to calculate Cohen's *d*. For binary outcomes, percentages or number of events were extracted for baseline and follow-up (6% of ES), Odds Ratio were calculated using Higgins and Green's (2011) formula and then transformed to Cohen's *d*. Authors were contacted when neither effect size nor descriptive statistics were reported (*n* = 30). For the studies whose authors did not reply (*n* = 15) or replied but did not send the data requested (*n* = 10), effect sizes were calculated from inferential statistics if sufficient data were available (8% of ES) using Wilson's (2001) calculator. The remaining studies were excluded from the analysis (*n* = 17). The data extracted from 10% of the studies were checked by a second reviewer with 100% agreement. Multiple effect sizes were obtained from the same study in papers where (a) several outcomes meeting the inclusion criteria were reported, (b) there was more than one intervention group, (c) analyses for different subsamples were reported or (d) there was more than one follow-up.

Study characteristics (e.g., country), design (e.g., RCT or CRCT), participants' characteristics (e.g., age), intervention characteristics (e.g., BCTs) and outcomes (e.g., used measurement) were extracted from all the included studies (*n* = 95). Behaviour change techniques were coded using version 1 of Michie, Atkins, and West's (2014) taxonomy and

extracted from the description of the intervention in each paper by the first author, who had undertaken the BCT Taxonomy Online Training (www.bct-taxonomy.com). Other papers reporting the same study or using the same intervention were searched to complete information about the intervention when required. If the description was unclear or a manual was cited but could not be retrieved, further information was requested from authors. If treatment as usual or attention control groups were used, BCTs were extracted from each group when possible. The BCTs that were applied in both the intervention group and the control group were not used in the analysis as they could not contribute to variance between the groups. A second reviewer coded the BCTs from a random sample of 15% of the studies. There were disagreements on 18 BCTs. Disagreements were discussed and when an agreement could not be reached, a third reviewer was consulted. The rest of the studies were coded by the first author following the principles developed during the interrater discussion.

Analysis

To account for the likely correlation between effect sizes extracted from the same study, a three-level random-effects meta-analysis was performed using the metafor package (Viechtbauer, 2010) for the R environment (R Core Team, 2019) following Assink and Wibbelink's (2016) guidelines (database and code used can be found in Supplementary material). A three-level model accounts for: sampling variance (level 1), variance between effect sizes from the same study (level 2) and variance between studies (level 3). If there was evidence for heterogeneity at level 2 or level 3, moderator analyses were conducted to investigate it. Following Weisz et al. (2017), analyses with categorical moderators were only conducted if each category contained at least five cases as parameters are poorly estimated by limited data.

Sensitivity analyses were used to examine the effect of outliers and risk of bias. Therefore, analyses including and excluding outliers 3 standard deviations (SD) from the

overall effect size and analysis excluding and including studies with a high risk of bias were conducted.

Sampling variance was calculated using Meta-essentials (Suurmond, van Rhee, & Hak, 2017). In order to adjust the CRCT sample sizes, the design effect was calculated using the Intra-Cluster Correlation (ICC) reported in the study as described by Higgins and Green (2011). If ICC was not reported, the ICC was taken from another study that used similar clusters (school vs. classrooms) and outcomes (e.g. self-report, parent-report). Then, the sample size was adjusted using the design effect. In studies with several intervention groups but only one control group, the sample size of the control group was divided by the number of intervention groups. If there were several types of control groups, the non-treatment control group was given preference.

Results

Characteristics of included studies

One hundred and twelve studies met the inclusion criteria of which 95 provided sufficient data to calculate effect sizes allowing inclusion in the analysis. These studies were reported in English between 1979 and 2018. Ninety-one per cent were published (87% in academic journals and 3% in books), while the rest were unpublished (8% were dissertations and one record was an institutional report). All included studies comprised 111,151 young people (53,409 in control groups and 57,742 in intervention groups) with a mean age of 13.36 and 60% male on average. Fifty-four per cent of the studies were cluster RCTs. The trials were conducted in 20 different countries across all continents most commonly the United States (54%). The interventions varied in duration from 20 minutes to 3 years, 79% of them were delivered in schools and 84% were group interventions. Fifty-four per cent of the interventions were delivered to young people with aggressive behaviours or with risk factors

for aggression (targeted interventions) and 46% were delivered to the whole population regardless of risk (universal interventions). Appendix C summarises the characteristics of each study.

Overall study quality was judged as low. Eighty-two per cent of the studies had at least one domain that was assessed as high risk of bias and 98% of the studies did not report enough information to assess all bias risk domains. The risk of bias assessment summary can be found in Figure 2.

Impact of interventions on aggressive behaviour

The 95 included studies produced 283 effect sizes from 115 intervention groups. The overall mean effect size was $d = 0.28$, 95% Confidence Interval (CI) [0.17, 0.39], indicating that psychosocial interventions reduced aggression compared to a control group, with a small-to-medium effect size overall, according to Cohen's (1992) conventions.

There was significant heterogeneity between effect sizes within studies ($\chi^2 (1) = 5597.39, p < .001$) and between studies ($\chi^2 (1) = 134.69, p < .001$). Thus, 0.20% of total variance can be attributed to sampling variance, 8.64% to variance within studies and 91.17% to variance between studies.

A sensitivity analysis was conducted excluding effect sizes that were three SD over or below the mean effect size ($k = 9$). This analysis included 274 effect sizes from 94 studies. The overall effect size was still small but significant ($d = 0.21$, 95% CI [0.14, 0.27]) and heterogeneity was still significant both within ($\chi^2 (1) = 5499.86, p < .001$) and between studies ($\chi^2 (1) = 103.00, p < .001$). The outliers accounted for some variance between studies as, after removing the outliers, 0.62% of the variance was attributed to sampling variance, 14.07% to variance within studies and 85.30% to variance between studies. Inspection of the outliers showed that they did not share any specific characteristics. Therefore, outliers were

preserved in the main analyses, although all the analyses were also conducted excluding the outliers to control for influential cases (see Appendix D for complete results), as suggested by Viechtbauer and Cheung (2010). These analyses produced substantively similar results.

In addition, a sensitivity analysis was conducted excluding studies with a high risk of bias in three or more domains ($n = 13$). This analysis included 233 effect sizes from 82 studies. The overall effect size was marginally larger than including all the studies ($d = 0.31$, 95% CI [0.17, 0.44]). As there was not a substantial difference, the studies with a high risk of bias were kept for the rest of the analyses.

Moderator analyses

In order to explore heterogeneity, moderator analyses (Table 1) were conducted to identify possible intervention, outcome, sample and methodological characteristics that influence intervention effectiveness. At the study level, there was only one significant moderator: geographical location. Studies conducted in the Middle East were significantly more effective than studies conducted in Europe and the United States.

At the intervention level, four significant moderators were found (Table 1). Studies were grouped according to whether the intervention was addressed to the full population regardless of the level of risk of aggression (universal) or targeted to specific adolescents presenting aggressive behaviour or risk factors for aggression (targeted). Targeted interventions had a significantly larger effect size than universal interventions. Interventions delivered by a teacher or member of staff were significantly less effective than interventions delivered by an intervention professional such as a psychologist or a social worker. Interventions were coded according to which kind of specific training the facilitators received. There may be (a) no training, (b) an intervention manual or a detailed description of each session, (c) specific training, or (d) specific training with periodic supervision from a member of the research

Table 1

Results of moderator analysis based on 283 Effect Sizes from 95 studies containing 115 intervention groups.

Moderator variables	#studies/IG ^a	#ES	<i>d</i> ^b (95% CI)	Omnibus test	p-value	Variance level 2 ^c	Variance level 3 ^d
Study level							
RCT vs CRCT				F (1,272) = 1.36	.245	0.026	0.262
RCT	44	100	0.35 (0.18, 0.53)***				
CRCT	51	174	0.22 (0.07, 0.37)**				
Publication year (in years)	95	274	0.001 (-0.01, 0.01)	F(1,272) = 0.02	.898	0.026	0.267
Follow-up (in months)	95	274	-0.003 (-0.01, 0.004)	F(1,272) = 0.61	.436	0.026	0.257
Outcome				F(4,244) = 2.14	.076	0.030	0.272
General aggression	57	75	0.40 (0.25, 0.55)***				
Physical aggression	59	97	0.20 (0.06, 0.34)**				
Bullying	15	44	0.24 (0.08, 0.41)**				
Weapon carrying	9	22	0.17 (-0.02, 0.35)				
Fighting	7	11	0.25 (0.01, 0.48)*				
Informant of outcome				F(2,250) = 1.11	.331	0.029	0.280
Self-report	74	212	0.27 (0.14, 0.40)***				
Teacher report	16	29	0.42 (0.21, 0.63)***				
Observation	7	12	0.37 (-0.15, 0.88)				
Continent				F(2,234) = 12.65	< .001***	0.031	0.209
North America	53	141	0.14 (-0.003, 0.28)				
Europe	23	62	0.21 (0.01, 0.42)*				
Middle East	9	34	1.15 (0.78, 1.52)***				
Intervention level							
Target				F (1,272) = 6.76	.010*	0.026	0.244

Universal	52	142	0.16 (0.02, 0.30) *				
Targeted	63	132	0.39 (0.25, 0.53) ***				
Setting				F(4,252) = 1.96	.100	0.024	0.267
Mainstream school	82	203	0.29 (0.15, 0.42)***				
Alternative school	6	15	0.46 (-0.05, 0.97)				
Psychiatric institution	8	14	-0.18 (-0.61, 0.25)				
Juvenile correctional	6	12	0.68 (0.18, 1.19)**				
Hospital	6	13	0.10 (-0.38, 0.59)				
Facilitator				F(3,232) = 10.76	< .001***	0.006	0.202
Research team	13	31	0.37 (0.07, 0.67)*				
Professional	40	111	0.36 (0.23, 0.49)***				
Teacher	29	77	0.03 (-0.11, 0.17)				
University student	7	16	0.20 (-0.13, 0.52)				
Training				F(3,267) = 3.82	.011*	0.026	0.244
No training	21	36	0.69 (0.40, 0.98)***				
Only manual	15	27	0.33 (0.09, 0.58)**				
Specific training	29	66	0.21 (-0.002, 0.42)				
Training + supervision	48	142	0.16 (0.00, 0.32)*				
Age (mean, in years)	92	268	-0.007 (-0.05, 0.03)	F(1,266) = 0.12	.731	0.027	0.276
Gender (proportion male)	89	258	-0.09 (-0.19, 0.01)	F(1,256) = 2.92	.089	0.026	0.193
Ethnic minority (proportion)	60	174	-0.12 (-0.33, 0.09)	F(1,172) = 1.23	.268	0.037	0.042
SES (proportion low SES)	22	90	0.09 (-0.43, 0.60)	F(1,88) = 0.11	.738	0.041	0.044
Duration (in weeks)	94	272	-0.007 (-0.01, -0.002)**	F(1,270) = 9.06	.003**	0.027	0.229
Contact hours	83	247	-0.003 (-0.01, 0.001)	F(1,245) = 2.44	.120	0.013	0.301
Intensity (hours per week)	83	247	-0.02 (-0.12, 0.09)	F(1,245) = 0.08	.772	0.013	0.319
Group vs individual				F(1,262) = 0.68	.411	0.023	0.284

Group intervention	96	235	0.31 (0.18, 0.44)***				
Individual intervention	15	35	0.16 (-0.15, 0.48)				
Focus				F(6,252) = 0.96	.456	0.026	0.305
Peer aggression	49	134	0.35 (0.17, 0.53) ***				
Anger	9	21	0.54 (0.11, 0.98) *				
Socioemotional development	15	24	0.04 (-0.27, 0.35)				
Drug use	10	41	0.06 (-0.37, 0.48)				
Internalising disorders	6	14	0.22 (-0.30, 0.73)				
Problem behaviours	10	18	0.15 (-0.22, 0.51)				
Cyberbullying	5	7	0.30 (-0.28, 0.88)				

Note. # studies/IG = number of independent studies/intervention groups; # ES = number of effect sizes; d = mean effect size; CI = confidence interval, RCT = Randomised controlled trial, CRCT = Cluster randomised controlled trial, SES = Socioeconomic status

^a For study level moderators, the number of studies is reported, for intervention level moderators, number of intervention groups is reported. ^b

For categorical predictors, ES is Cohen's d for each category. For continuous predictors, ES is β for that specific predictor. ^c Variance between the effect sizes from the same study. ^d Variance between studies.

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

team or a specialist in the intervention. Interventions where no training was reported were significantly more effective than interventions with specific training with or without supervision. Duration of the intervention was also a significant moderator; shorter interventions were more effective.

Behaviour Change Techniques

After accounting for the BCTs present in control groups, interventions included between 0 and 22 BCTs ($M = 8.05$). Sixty-eight different BCTs were present. Appendix C shows the BCTs coded for each specific intervention. The most common BCTs were *Behavioural practice*, *Problem solving* and *Information about social and environmental consequences*, present in 86 (74%), 57 (49%) and 56 (48%) intervention groups respectively.

Given that we found targeted interventions to be more effective than universal and that previous literature has often treated these approaches separately (Fossum et al., 2008; Wilson & Lipsey, 2007), we compared BCT effectiveness separately in universal and targeted interventions. Meta-regression and subgroup analyses were conducted for all the BCTs that were included in at least five intervention groups.

Universal interventions

Forty-five studies reported universal interventions, providing 151 effect sizes from 52 intervention groups. Fifty-three BCTs were identified in total and only 29 were included in 5 or more intervention groups; between 1 and 22 BCTs ($M = 7.53$) were used in each intervention. The most common BCTs were *Behavioural practice* ($k = 38$), *Information about social and emotional consequences* ($k = 28$), *Problem solving* ($k = 25$) and *Instruction on how to perform the behaviour* ($k = 25$).

Number of BCTs included was not a significant moderator of intervention effectiveness ($F(1,140) = 0.33, p = .568$). A meta regression including the BCTs that were

reported in more than 5 intervention groups was conducted. The model was not significant ($F(29,112) = 0.98, p = .499$). Subgroup analyses were conducted for each of these 29 BCTs comparing interventions where the BCT was present to interventions where the BCT was absent. The results indicated that interventions that included *Behavioural practice* ($d = 0.16$) or *Problem solving* ($d = 0.20$) were more effective than interventions that did not include them (*Behavioural practice*: $d = -0.04; t = 2.42, p = .017$; *Problem solving*: $d = 0.03; t = 2.03, p = .044$). Complete results are shown in Appendix E.

Targeted interventions

There were 64 targeted interventions within 52 studies. They reported a total of 132 effect sizes. The 64 targeted intervention groups reported a total of 69 different BCTs. Each intervention reported between 0 and 22 BCTs ($M = 8.38$). The most common BCTs were *Behavioural practice* ($k = 48$), *Problem solving* ($k = 32$) and *Instruction on how to perform the behaviour* ($k = 30$).

The number of BCTs included did not predict intervention effectiveness ($F(1,130) = 0.62, p = .434$). A meta-regression was conducted including the 28 BCTs which were reported in 5 or more interventions. The moderator effect was not significant ($F(28,103) = 0.88, p = .640$). Subgroup analyses conducted for each BCT were non-significant. Complete results are reported in Appendix F.

Discussion

The present multilevel meta-analysis assessed whether psychosocial interventions were effective in reducing aggression among adolescents and attempted to identify which characteristics of the study, the intervention and the adolescents moderated intervention effectiveness. Across all psychosocial interventions included in the review, we found a statistically significant small-to-medium overall effect size of 0.28. This corresponds to a

10% decrease in aggressive behaviour in contrast with a control group (Coe, 2002). This effect size is consistent with previous meta-analyses addressing aggression across children and adolescents. Effect sizes found in previous reviews ranged from 0.09 for school-based interventions (Park-Higgerson et al., 2008) to 0.68 for creative bibliotherapy (Montgomery & Maunders, 2015).

We found that level of risk at baseline was a significant moderator confirming, with quantitative analysis, the findings from previous systematic reviews (Gavine et al., 2016; Limbos et al., 2007). Interventions were more effective when targeted to adolescents with a higher risk of being aggressive than when they are administered to a general adolescent population. One possible explanation for this result is that antisocial behaviour is relatively rare in the general population. Many participants in universal interventions may show limited aggressive behaviours and, therefore, have little scope for change.

In the present study, shorter interventions were found to be more effective than longer interventions. This finding is consistent with Fagan and Catalano's (2013) systematic review. However, Limbos et al.'s (2007) systematic review concluded that targeted interventions that were longer than a year were more effective than those that were shorter. Limbos et al. (2007) compared interventions shorter and longer than a year on the basis of whether they reported effectiveness, instead of calculating effect sizes. One of the strengths of our study is using multi-level meta-analysis in order to use all reported effect sizes in each study, rather than an overall conclusion, which makes our findings more robust. Future research should investigate the minimum duration for an intervention to be effective in order to guide intervention development.

The person who facilitates the intervention was also identified as an important moderator of effectiveness. We found that delivery by intervention professionals was more

effective than delivery by a teacher or member of staff, which is consistent with the findings from previous reviews (Park-Higgerson et al., 2008; Sawyer et al., 2015). It is important to note, however, that interventions delivered by intervention professionals were mostly targeted interventions, while interventions delivered by teachers were mostly universal interventions. This fact might explain this finding as targeted interventions were found to be more effective than universal interventions. We also found that interventions were more effective when facilitators did not receive training. This might seem to contradict the findings from Ttofi and Farrington (2011), who found that for school-based interventions, the more training the teacher received, the more effective the intervention was. However, both of these results could be complementary. It is possible that intervention professionals do not need training to deliver an effective intervention. However, if the intervention is delivered by teachers, they will need a lot of training to deliver an intervention that has the same effect. This interaction of training and facilitator should be investigated in future studies.

Finally, geographical location of the study was also a significant moderator. We found that interventions delivered in the Middle East were more effective than those delivered in Europe or North America. This could be because, in all the studies conducted in the Middle East, the interventions were delivered by a member of the research team or by an intervention professional. In addition, all the interventions evaluated in the Middle East except one (Shechtman & Ifargan, 2009) were targeted interventions. As indicated in our previous moderation analyses, these characteristics are associated with more effective interventions.

We did not find evidence to support the influence on adolescents of other moderators that have been found in previous reviews across children, adolescents and adults, such as age, gender, year of publication, informant of the outcome, and whether the intervention was delivered individually or to a group. It is possible that these characteristics moderate the effectiveness of interventions targeting children and not interventions targeting adolescents.

Although null findings are not equivalent to absence of effect in the population, given the large number of studies included in most of the moderator analyses, it is unlikely that they reflect a lack of statistical power. If future studies confirm that these moderators do indeed have little or no effect with respect to interventions for adolescents, this would have important implications. For example, time to follow-up was not found to moderate intervention effectiveness, suggesting that intervention effects did not diminish over time. This is consistent with the findings of previous reviews (Beelmann & Lösel, 2006; Robinson, Smith, Miller, & Brownell, 1999; Sawyer et al., 2015). However, this conclusion needs to be taken cautiously as in our review the average time to follow-up was 3.65 months. Therefore, effectiveness over longer periods could not be estimated well in this dataset.

This present meta-analysis also aimed to identify which BCTs were effective in reducing aggression and whether those BCTs were different for targeted and universal interventions. For that, we employed the widely-used BCT taxonomy (Michie et al., 2013) to identify individual techniques in interventions reports. We found that both universal and targeted interventions used similar BCTs, namely: *behavioural practice*, *problem solving*, *instruction on how to perform the behaviour* and *information about social and emotional consequences*.

Behavioural practice and *problem solving* were effective in reducing aggression in universal interventions. Universal interventions that included either of these techniques were more effective than those which did not include them. This finding has important implications, as this is the first review to identify specific effective techniques in universal interventions. Previous reviews (Scheckner, Rollin, Kaiser-Ulrey, & Wagner, 2002; Wilson & Lipsey, 2007) did not find any particular strategy to be more effective in universal interventions. Thus, the current review indicated that effective universal interventions “prompt practice or rehearsal of the performance of the behaviour” (Michie et al., 2014, p.

270) and “prompt the person to analyse factors influencing the behaviour and generate or select strategies that include overcoming barriers and/or increasing facilitators” (Michie et al., 2014, p. 259). It is important to note, however, that all the studies included in this meta-analysis which used *behavioural practice* or *problem solving* included them in combination with at least three other BCTs. Therefore, more research is needed to assess their specific effects both on their own and in combination.

We did not find any BCT that significantly improved the effectiveness of targeted interventions. This was unexpected, as previous reviews have found specific intervention components that are effective for targeted interventions (Fossum et al., 2008; Özabacı, 2011; Wilson & Lipsey, 2007). A possible explanation is that the component analysis in previous reviews was different due to the lack of a taxonomy. Thus, previous reviews extracted components that were comprised of a combination of techniques instead of individual behaviour change techniques. For example, Wilson and Lipsey (2007) found that the most effective component was behavioural strategies, which they defined as “Techniques, such as rewards, token economies, contingency contracts, and the like to modify or reduce inappropriate behaviour” (p. 18). This may suggest that what makes targeted interventions effective is the combination of techniques and not the individual techniques. Future research should investigate these combinations further as has been investigated for other behaviours (Dusseldorp, van Genugten, van Buuren, Verheijden, & van Empelen, 2014).

One of the main limitations of the present review database was the poor reporting of the techniques used in the interventions, which makes extracting BCTs difficult. This issue has been mentioned before by Cradock et al. (2017) in their meta-analysis on diet and physical activity. Despite the efforts made to retrieve complete intervention descriptions from manuals and authors, it is likely that not all the BCTs used in the interventions were coded. This issue makes it difficult to analyse the effect of each BCT separately. If we want to

identify which techniques are more effective, it is important that in the future, the interventions are reported in detail. The BCT taxonomy used in this meta-analysis (Michie et al., 2014) provides a helpful common language to report intervention content. More primary intervention studies are also necessary to identify effective techniques. This should include designing interventions that use only one technique or comparing similar interventions that differ only in one technique. Some of the studies included in this meta-analysis have already attempted this. For example, Etscheidt (1984) delivered the same intervention with and without contingent reinforcement and did not find any differences.

Conclusion

This is the first multilevel meta-analysis on interventions to reduce aggressive behaviour in adolescents and the first to examine the role of individual BCTs. We found that psychosocial interventions are effective in reducing aggression among adolescents, especially when they are targeted to young people at greater risk of being aggressive. We found that shorter interventions were more effective than longer interventions, and interventions delivered by intervention professionals were more effective than those delivered by teachers or staff members. Universal interventions were especially effective if they included *behavioural practice* and *problem solving*. More primary studies are needed to identify the effect of individual BCTs and their combination, especially in targeted interventions.

Acknowledgements

The authors wish to thank Brechtje de Mooji for her assistance on the statistical analysis.

This work was supported by the Department of Psychology at the University of Sheffield, NIHR Manchester Biomedical Research Centre and NIHR Greater Manchester Patient Safety Translational Research Centre.

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Appendix A

Overview of previous systematic reviews and meta-analysis

Table A1

Overview of previous systematic reviews and meta-analysis

Reference	Main focus	Type	Years	Age	Moderators found	Effective components
Atienzo, Baxter, and Kaltenthaler (2017)	Interventions in Latin America	SR	Up to 2015	10-24		
Beelmann and Lösel (2006)	Social Skills Training	MA	1971-2000	4-18	Level of risk ⁺ , age ⁺ , intensity of intervention ⁺	Cognitive Behavioural Training
Brännström, Kaunitz, Andershed, South, and Smedslund (2016)	Aggression Replacement Training	SR	1987-2004	Above 12		
Cassidy, Bowman, McGarth, and Matzopoulos (2016)	Media campaigns	SR	1995-2008	10-29		
Cid (2017)	Targeted after-school programs in Latin America	SR	2012-2016	6-20	Level of risk ⁺ , parent commitment ⁺ , gender (m)	
Cooper, Lutembacher, & Faccia (2000)	Violence prevention programs	SR	1980-1999	7-14		Classroom teaching, peer mediation
Cox et al. (2016)	Interventions in Australia	SR	Up to 2013	12-18		Interactive

Fagan and Catalano (2013)	Intervention programs	SR	1992-2012	0-18	Duration of intervention ⁻ , intensity of intervention ⁺	
Fossum, Handegård, Adolfsen, Vis, and Wynn (2016)	Targeted psychosocial and psychopharmacological interventions	MA	1980-2010	2-17	Individual interventions ⁺	Cognitive Behavioural Training
Fossum et al. (2008)	Indicated interventions	MA	1987-2008	Under 18	Age ⁻	Behavioural training
Gaffney, Ttofi and Farrington (2019)	Universal school-based interventions	MA	2009-2016	4-18		
Gavine et al. (2016)	Universal school-based interventions	SR	2002-2014	11-18	Level of risk ⁺	
Grove et al. (2008)	Studies with at least 6 months follow up	MA	1980-2007	Under 19		
Hahn et al. (2007)	Universal school-based interventions	SR	Up to 2004	2-19	Age (more effective in kindergarten and high school)	
Harwood, Lavidor and Rassovsky (2017)	Martial arts	MA	1980-2015	Up to 18		
Howard, Flora and Griffin (1999)	School-based interventions	SR	1993-1997	2-19		
Kelly (2017)	School-based interventions that include	SR	1999-2015	12-17		

	mentoring in the United States					
Limbos et al. (2007)	Interventions in the United States	SR	1990-2006	12-17	Level of risk ⁺ , duration of intervention ⁺	
McCart, Priester, Davies and Azen (2006)	Parent Training and Cognitive Behavioural Training	MA	Up to 2005	Under 18	Age (CBT is more effective in older children)	Behavioural parent training
Melendez-Torres et al. (2016)	Positive youth development interventions	MA	1985-2014	11-18		
Merrel, Gueldner, Ross and Isava (2008)	School-based interventions	MA	1980-2004	4-19		
Molina et al. (2005)	Targeted school-based interventions in the United States	SR	1990-2004	6-12		Cognitive Behavioural Training and Social Skills Training
Montgomery and Maunders (2015)	Creative bibliotherapy	MA	1983-2014	5-15		
Mytton et al. (2006)	Targeted school-based interventions	MA	Up to 2003	2-19	Age ⁺	Social Skills Training
Neville, Goodall, Williams, and Donnelly (2014)	Individual brief interventions targeted to male	SR	Up to 2013	Above 10		Motivational interviewing, social norms

Özabacı (2011)	Targeted Cognitive Behavioural Therapy	MA	1997-2009	6-18	
Park-Higgerson et al. (2008)	School-based interventions	MA	1970-2004	5-17	Level of risk ⁺ , age ⁺ , facilitator (delivered by specialist were more effective than delivered by a teacher)
Robinson, Smith, Miller, and Brownell (1999)	Targeted school-based cognitive behaviour modification	MA	1971-1993	2-19	
Sawyer et al. (2015)	Targeted interventions with at least one-year follow-up	MA	Up to 2010	Under 18	Level of risk ⁺ , gender (f), informant (observation showed the largest effect and parent report the smallest), facilitator (delivered by the researcher were more effective than delivered by professionals)

Scheckner, Rollin, Kaiser-Ulrey, and Wagner (2002)	Universal school-based interventions	SR	1990-1999	2-19	Age (most effective in elementary school), more than one setting, training ⁺	
Smedler et al. (2015)	Intervention programs with at least 6 months follow up	SR	1990-2013	2-19	Level of risk ⁻ , family internal stress ⁺	Good Behaviour Game, Parental Management Training
Silva et al. (2018)	School-based social skills training	MA	2003-2014	8-16		
Smeets et al. (2015)	Targeted Cognitive Behaviour Therapy	MA	2000-2013	Up to 23		
Spruit et al. (2016)	Sports participation	MA	Up to 2015	10-21		
Stoltz, Londen, Deković, Castro, and Prinzie (2012)	Individual targeted school-based interventions	MA	1975-2011	2-12	Age ⁻	
Ttofi, and Farrington (2011)	Universal school-based interventions	MA	1983-2009	3-16	Age ⁺ , duration of intervention ⁺ , intensity of intervention ⁺ , teacher's training ⁺	Parent training, disciplinary methods, playground supervision, classroom management, classroom rules, whole-school policy, school conferences,

Wilson and Lipsey (2007)	School-based interventions	MA	1950-2007	2-19	Level of risk ⁺ , socioeconomic status ⁻ , age ⁻ , duration of intervention ⁺ , intensity of intervention ⁺ , individual interventions	information for parents, cooperative group work. Behavioural strategies
Wilson, Gottfredson, and Najaka (2001)	School-based interventions	MA	Up to 2000	2-19	Level of risk ⁺	Interventions focused on the environment, Cognitive Behavioural Training and Behavioural Training

Note. SR = Systematic review; MA = Meta-analysis; gender (m) = interventions were more effective for males; gender (f) = interventions were more effective for females.

⁺ Interventions were more effective with a higher level of these moderators. ⁻ Interventions were more effective with lower levels of these moderators

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Appendix B

List of excluded studies after full text screening with reasons for exclusion

Reason of exclusion: assignment to groups it is not randomised or the comparison group receives a competing intervention

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Appendix C

Characteristics of included studies

Table B1

Characteristics of included studies

Study	Study design	Participant characteristics	Relevant outcome measure	Interventions	Comparators	Level of intervention	Setting and country	<i>d</i> ^a
Abdulmalik, Ani, Ajuwon, and Omigbodun (2016)	CRCT	N = 40 Age (mean) = 12 100% male	a) Outcome: Aggression Measure: Teacher Rating of Students' Aggressive Behaviours Type: teacher report b) Outcome: Aggression Measure: Self-Rated Aggression Scale Type: self-report	Thinking group 6 sessions 2 sessions/week 40 min/session 5 BCTs: 1.2, 4.1, 4.3, 11.2, 15.4	Waiting list	Targeted	2 public primary schools in Nigeria	(a) 1.2 (b) 0.9
Atria and Spiel (2007)	CRCT	N = 112 Age (mean) = 17 51% male	Outcome: Bullying Measure: Olweus' Bully/Victim Questionnaire Type: self-report Follow-up: (a) post-test (b) 4 months	Viennese Social Competence training 7 months 13 lessons 1.5h/lesson 7 BCTs: 1.1, 1.2, 1.3, 1.7, 5.3, 8.1, 8.2	No treatment	Targeted	Vocational school in Austria	(a) 0.40 (b) 0.22
Baldry and Farrington (2004)	CRCT	N = 239 Age (mean) = 13.33 58% male	a) Outcome: Bullying Measure: Olweus Bully/Victim Questionnaire ("I bullied others") Type: self-report Follow-up: 4 months	Bulli & Puppe 3weeks 3h/week 6 BCTs: 4.2, 5.3, 6.3, 8.1, 8.2, 13.2	No treatment	Universal	e) 2 middle schools f) 1 high school in Italy	(a,e) -0.18 (b,e) -0.13 (c,e) -0.06 (d,e) -0.16 (a,f) -0.03 (b,f) 0.07 (c,f) 0.05 (d,f) 0.04

			<p>b) Outcome: Physical Aggression Measure: Olweus Bully/Victim Questionnaire (“I physically hurt”) Type: self-report Follow-up: 4 months</p> <p>c) Outcome: Threats Measure: Olweus Bully/Victim Questionnaire (“I threatened”) Type: self-report Follow-up: 4 months</p> <p>d) Outcome: Bullying Measure: Olweus Bully/Victim Questionnaire (Direct Bullying) Type: self-report Follow-up: 4 months</p>					
Barekatin, Taghavi, Salehi, and Hasanzadeh (2006)	RCT	N = 36 Age (mean) = 14.17 100% male	<p>Outcome: Aggression Measure: Aggression Questionnaire Type: self-report Follow-up: (a) post-test (b) 2 months</p>	<p>c) Rational Emotive Behavioural therapy 10 weeks 1h/week 2 BCTs: 8.2, 13.2</p> <p>d) Relaxation Therapy 10 weeks 1h/week 6 BCTs: 2.3, 4.2, 8.1, 8.2, 8.6, 12.5</p>	Waiting list	Targeted	Iran	(a,c) 1.11 (a,d) 1.42 (b,c) 1.33 (b,d) 1.49
Betzalel and Shechtman (2017)	RCT	N = 187 Age (mean) = 12.96 63% male	<p>a) Outcome: Violence Measure: Modified National Youth Survey Type: self-report</p>	<p>e) Superhero Bibliotherapy 8 sessions 1 session/week</p>	No treatment	Targeted	2 foster homes in Israel	(a,c,e) 0.26 (b,c,e) 0.21 (a,c,f) -0.56 (b,c,f) 1.14

			Follow-up: (c) post-test (d) 3 months	50 min/session 1 BCT: 16.3				(a,d,e) 0.52 (b,d,e) 0.52 (a,d,f) 0.07 (b,d,f) 0.23
			b) Outcome: Aggression Measure: Buss-Perry Aggression Questionnaire (Physical Aggression + Anger) Type: self-report Follow-up: (c) post-test (d) 3 months	f) Affective Bibliotherapy 8 sessions 1 session/week 50 min/session 1 BCT: 16.3				
Blake et al. (2017)	RCT	N = 144 Age (mean) = 14.48 40% male	Outcome: Aggression Measure: Youth Self Report (Aggressive Behavior) Type: self-report	Sleep SENSE 7 weeks 90 min/week 12 BCTs: 1.1, 1.2, 1.4, 1.5, 2.3, 3.1, 5.4, 8.1, 8.3, 11.2, 12.1, 13.2	Study skills educational program	Universal	University and school in Australia	0.20
Bonell et al. (2015)	CRCT	N = 1144 Age (mean) = 12.11 54% male	Outcome: Aggression Measure: AAYP violence subscale (4 items) Type: self-report	Initiating change Locally in bullying and Aggression Through the School Environment 8 months 3 BCTs: 3.1, 11.2, 12.2	No treatment	Universal	8 secondary schools in the UK	0.01
Bonell et al. (2018)	CRCT	N = 6667 Year 7 44.9% male	Outcome: Aggression Measure: Edinburgh Study of Youth Transitions and Crime Follow-up: (a) 24 months (b) 36 months	Learning Together 3 years 6 meetings per year 5-10 lessons per year 3 BCTs: 3.1, 11.2, 12.2	No treatment	Universal	40 secondary schools in the UK	(a) 0.03 (b) 0.01

Booth (1995)	RCT	N = 53 Age (mean) = 13.42 67% male	a) Outcome: Aggression Measure: Youth Self-Report checklist (Aggression) Type: self-report Follow-up: (c) post-test (d) 4 months b) Outcome: Aggression Measure: Teacher's Report Form (Aggression) Type: teacher report Follow-up: (c) post-test (d) 4 months	Chill-out program: anger control training 12 sessions 45min/session 19 BCTs: 1.3, 1.7, 2.3, 3.1, 3.2, 4.1, 4.2, 4.3, 5.3, 5.6, 6.1, 8.1, 8.2, 10.1, 10.2, 10.3, 10.4, 10.6, 13.2	Treatment as usual 1 BCT: 3.1	Targeted	Suburban junior high school in the US	(a,c) 0.56 (b,c) 1.01 (a,d) 0.25 (b,d) 0.63
Bosworth, Espelage, DuBay, Dahlberg, and Daytner (1996); Bosworth, Espelage, DuBay, Daytner, & Karageorge (2000)	CRCT	N = 558 6 th , 7 th and 8 th grade 46% male	Outcome: Aggression Measure: Modified UT-Health Science Centre Aggression Scale + Conflict Tactic Scale Type: self-report Follow-up: 4 months	SMART Talk 16 weeks 40min/week 8 BCTs: 1.2, 1.8, 4.1, 4.2, 8.1, 8.2, 9.1, 13.2	No treatment	Universal	Suburban middle school in the US	0.04
Botvin, Griffin, and Nichols (2006)	CRCT	N = 4858 6 th grade 51% male	Outcome: Physical aggression (a) Any (b) More than 3 times Type: self-report Follow-up: 3 months Outcome: Fighting (c) Any (d) More than 3 times Type: self-report	Life Skills Training 15 sessions 7 BCTs: 2.7, 6.1, 8.1, 8.2, 8.6, 10.3, 11.2	Standard health education curriculum	Universal	Public and parochial schools in the US	(a) 0.15 (b) 0.05 (c) 0.13 (d) 0.16

Follow-up: 3 months								
Boulton and Flemington (1996)	CRCT	N = 170 Year 7-10 52% male	Outcome: Bullying Type: self-report	Sticks and Stones video watching + discussion 1 session 2 BCTs: 5.6, 9.1	Standard curriculum	Universal	Semi-rural secondary school in the UK	-0.07
Bunford (2016)	RCT	N = 16 Age (mean) = 16.3 100% male	a) Outcome: Physical Aggression Measure: Buss-Perry Aggression Questionnaire (Physical Aggression) Type: self-report b) Outcome: Physical Aggression Measure: Modified Overt Aggression Scale (Physical Aggression) Type: self-report	Interpersonal Skills Group 7 weeks 14 BCTs: 1.1, 1.2, 1.3, 1.6, 1.7, 2.2, 2.7, 4.1, 4.2, 5.3, 5.4, 8.1, 8.6, 8.7,	Waiting list	Targeted	Juvenile correctional facility in the US	(a) 0 (b) 0.11
Cappella and Weinstein (2006)	RCT	N = 134 Age (mean) = 10.5 100% female	a) Outcome: Aggression Measure: Modified Children's Social Behavior Scale (Overt Aggression) Type: peer nominations Follow-up: 3 weeks b) Outcome: Aggression Measure: Modified Children's Social Behavior Scale (Overt Aggression) Type: teacher report Follow-up: 3 weeks	Social Aggression prevention program 10 sessions in 10 weeks 1 session/week 40 minutes/session 7 BCTs: 1.2, 2.7, 4.1, 4.2, 5.3, 6.1, 8.2	Reading club	Universal	6 urban schools in the US	(a) 0.02 (b) -0.05
Carraro, Gobbi, and Moè (2014)	CRCT	N = 210 Age (mean) = 13.27 58% male	Outcome: Physical aggression	Play fighting in physical education 4 weeks 2 h/week	No treatment	Universal	2 suburban junior high schools in Italy	0.61

			Measure: Aggression Questionnaire short version (Physical Aggression) Type: self-report	3 BCTs: 4.1, 6.1, 8.1				
Castillo, Salguero, Fernández- Berrocal, & Balluerka (2013)	CRCT	N = 590 Age (mean) = 13.83 48% male	Outcome: Physical aggression Measure: Aggression Questionnaire (Physical Aggression) Type: self-report Follow-up: 6 months	INTEMO program 6 months 1h/2 weeks 6 BCTs: 1.2, 4.2, 5.3, 8.1, 11.2, 13.2	No treatment	Universal	8 public schools in Spain	0.22
Chapman, Buckley, Sheehan, and Shochet (2013)	CRCT	N = 314 Age (mean) = 13.6	Outcome: Violence Measure: Australian self- report Delinquency Scale (Violence Risk Behaviours) Type: self-report Follow-up: 6 months	Skills for Preventing Injury in Youth + school connectedness component 8 weeks 50min/week 5 BCTs: 4.2, 5.3, 8.1, 11.2, 13.2	No treatment	Universal	5 secondary schools in Australia	1.00
Chaux, Velásquez, Schultze- Krumbholz, & Scheithauer (2016)	CRCT	N = 1075 Age (mean) = 13.36 48% male	Outcome: Bullying Measure: European Cyberbullying Intervention Project Questionnaire (Traditionl Bullying) Type: self-report Follow-up: 6 months	a) Medienhelden long version 15 sessions 45 min/session 8 BCTs: 4.1, 5.3, 6.2, 8.1, 10.3, 11.2, 13.1, 13.2 b) Medienhelden short version 4 sessions 90 min/session 8 BCTs: 4.1, 5.3, 6.2, 8.1, 10.3, 11.2, 13.1, 13.2	Waiting list	Universal	5 schools in Germany	(a) 0.25 (b) 0.14

Cheng et al. (2008)	RCT	N = 166 Age (mean) = 13 66% male	a) Outcome: Fighting Type: self-report b) Outcome: Fighting with injuries Type: self-report c) Outcome: Weapon carrying Type: self-report	Mentoring + home visits + case management + list of community resources Minimum 6 sessions 2 to 6 months 5 BCTs: 1.3, 1.9, 4.1, 8.1, 12.2	Case management + list of community resources	Targeted	2 urban emergency departments in the US	(a) 0.04 (b) 0.19 (c) -0.19
Coleman, Pfeiffer, and Oakland (1992)	RCT	N = 52 Age (mean) = 15.75 74% male	Outcome: Aggression Measure: Behavior Incident Report Type: observation	Aggression Replacement Training 10 weeks 50h/week 20 BCTs: 1.2, 1.4, 2.2, 2.3, 4.1, 4.2, 5.3, 6.1, 6.2 8.1, 8.2, 8.4, 8.6, 9.1, 10.2, 10.4, 10.9, 13.2, 15.2, 15.4	No treatment	Targeted	Residential treatment centre in the US	-0.50
Crooks, Scott, Ellis, and Wolfe (2011); Wolfe et al. (2009)	CRCT	N = 1722 9 th grade 47% male	a) Outcome: Physical aggression Measure: National Longitudinal Survey of Children and Youth Delinquent Behavior Inventory (3 items) Type: self-report Follow-up: 2 years b) Outcome: Physical aggression Measure: National Longitudinal Survey of Children and Youth Delinquent Behavior Inventory (8 items) Type: self-report	Fourth R: skills for youth Relationships + school-level components 21 sessions 1.25h/session 7 BCTs: 2.2, 4.1, 5.1, 5.3, 8.1, 8.2, 13.2	No treatment	Universal	20 high schools in Canada	(a) -0.05 (b) 0.05

Follow-up: 2 years								
Cunningham et al. (2012); Walton et al. (2010)	RCT	N = 726 Age (mean) = 16.8 44% male	Outcome: Aggression Measure: unknown Type: self-report Follow-up: (a) 3 months (b) 6 months (c) 12 months	d) Computer brief intervention + brochure 1 session 30 minutes 10 BCTs: 1.3, 1.9, 2.2, 5.3, 6.2, 8.1, 9.2, 12.5, 13.2, 15.1 e) Therapist brief intervention + brochure 1 session 35 minutes 12 BCTs: 1.3, 1.6, 1.9, 2.2, 3.1, 5.3, 6.2, 8.1, 9.2, 12.5, 13.2, 15.1	Brochure 12.5	Targeted	Level I trauma centre in the US	(a,d) 0.17 (a,e) 0.30 (b,d) 0.00 (b,e) 0.10 (c,d) 0.06 (c,e) 0.28
Densley, Adler, Zhu, and Lambine (2017)	CRCT	N = 391 Age range: 12 – 14 60% male	Outcome: Violence Measure: Delinquency Inventory (3 items) Type: self-report Follow-up: (a) post-test (b) 1 month	Growing Against Gangs and Violence 5 weeks 6 sessions/5 weeks 4 BCTs: 5.1, 5.3, 8.1, 13.2	No treatment	Universal	4 schools in the UK	(a) 0.55 (b) 0.88
DeSmet et al. (2018)	CRCT	N = 249 8th grade 41.5% male	Outcome: Bullying Type: self-report Follow-up: (a) post-test (b) 1 month	Friendly ATTAC 1 session 6 BCTs: 2.2, 4.1, 6.3, 10.3, 13.1, 14.2	Waiting list	Universal	2 secondary schools in Belgium	(a) 0.09 (b) 0.35
Domino (2013)	CRCT	N = 336 Age (mean) = 12.2 46% male	Outcome: Bullying Measure: Peer Relations Questionnaire (Perpretation) Type: self-report	Take the lead 16 weeks 45 min/week 8 BCTs: 1.2, 4.1, 5.3, 6.2, 8.1, 8.2, 11.2, 13.4	Waiting list	Universal	Suburban middle school in the US	0.66

Eron et al. (2002)	CRCT	N = 2181 4 th grade 61% male	Outcome: Aggression Measure: Peer Nomination Inventory (Aggression) + Teacher Report Form (Aggression) Type: peer and teacher report	a) Yes I Can curriculum + teacher consultation 16 months 1h/week 1 BCT: 12.2 b) Yes I Can curriculum + teacher consultation + small- group training 16 months 2h/week 10 BCTs: 1.2, 2.1, 2.2, 4.1, 5.2, 5.3, 8.1, 8.2, 10.2, 10.3, 10.6	No treatment	Universal and targeted	16 schools in the US	(a) -0.45 (b) -0.62
Espelage, Low, Polanin, and Brown (2013)	CRCT	N = 3616 Age (mean) = 11.24 52% male	Outcome: Fighting Measure: University of Illinois Fighting Scale Type: self-report	Second Step: Student success Through Prevention 15 weeks 50 min/week 15 BCTs: 1.2, 1.4, 1.9, 2.2, 4.1, 5.1, 5.3, 6.1, 8.1, 8.2, 8.6, 9.3, 11.2, 13.2, 15.4	Waiting list	Universal	36 schools in the US	0.20
Etscheidt (1984)	CRCT	N = 30 Age (mean) = 15.17 80% male	Outcome: Aggression Type: Observation Follow-up: (a) post-test (b) 2 weeks (c) 1 month	(c) Cognitive behavioural interpersonal problem solving 3 weeks 2.5h/week 15 BCTs: 1.1, 1.2, 1.4, 1.8, 2.1, 4.1, 4.2, 5.3, 5.6, 6.2, 8.1, 8.2, 9.3, 10.5, 10.6	Instruction in social skills	Targeted	School for chronically disruptive adolescents in the US	(a,c) 2.77 (a,d) 4.08 (b,c) 1.84 (b,d) 3.96

				(d) Cognitive behavioural interpersonal problem solving + reinforcement contingent 3 weeks 2.5h/week 15 BCTs: 1.1, 1.2, 1.4, 1.8, 2.1, 4.1, 4.2, 5.3, 5.6, 6.2, 8.1, 8.2, 9.3, 10.3, 10.6				
Farrell, Meyer, and White (2001)	CRCT	N = 626 Age (mean) = 11.7 50% male	Outcome: (a) Threatening (b) Weapon carrying (c) Threatening with a weapon (d) Fighting Measure: Problem Behavior Frequency Scales (Violent Behavior) Type: self-report Follow-up: (e) Post-test (f) 6 months	Responding in Peaceful and Positive Ways 25 weeks 50 min/week 6 BCTs: 1.2, 4.1, 8.1, 8.2, 12.3, 15.2	No treatment	Universal	3 public middle schools in the US	(a,e) 0.05 (b,e) 0.14 (c,e) -0.06 (d,e) 0.51 (a,f) 0.10 (b,f) 0.29 (c,f) 0 (d,f) 0.05
Farrell, Meyer, Sullivan, and Kung (2003)	CRCT	N = 476 Age (mean) = 12.8 47% male	Outcome: Violence Measure: Problem Behavior Frequency Scale (Violent Behaviors) Type: self-report Follow-up: (a) post-test (b) 6 months	Responding in Peaceful and Positive Ways 6 th Grade + Responding in Peaceful and Positive Ways 7 th Grade + peer mediation 9 BCTs: 1.2, 1.9, 4.1, 4.3, 8.1, 9.3, 12.3, 13.2, 15.2	Responding in Peaceful and Positive Ways	Universal	2 middle schools in the US	(a) -0.11 (b) 0.03

Farrell, Valois, and Meyer (2002)	RCT	N = 204 6 th grade 55% male	Outcome: Physical Aggression Measure: Problem Behavior Frequency Scale (Physical Aggression) Type: self-report Follow-up: (a) post-test (b) 12 months	Responding in Peaceful and Positive Ways 6 th grade 25 lessons 2 lessons/week 17 BCTs: 1.2, 1.8, 2.7, 3.1, 4.1, 4.2, 5.3, 6.1, 6.2, 8.1, 8.2, 9.2, 11.2, 12.3, 13.1, 15.2, 15.4	No treatment	Universal	Rural middle school in the US	(a) 0.28 (b) 0.01
Feindler, Ecton, Kingsley, and Dubey (1986)	CRCT	N = 21 Age range: 13-18 100% male	Outcome: Physical Aggression Type: Disciplinary records	The art of self-control 12 sessions in 8 weeks 13 BCTs: 1.2, 2.2, 2.3, 4.1, 4.2, 5.2, 5.3, 6.1, 8.1, 8.2, 10.2, 11.2, 15.4	Waiting list	Targeted	Psychiatric treatment facility in the US	0.13
Fekkes (2005)	CRCT	N = 2848 Age (mean) = 10.1 50% male	Outcome: Bullying Type: self-report Follow-up: (a) post-test (b) 1 year	Olweus anti-bullying program 9 months 7 BCTs: 1.1, 1.9, 2.2, 7.1, 8.1, 10.4, 10.11	No treatment	Universal	50 elementary schools in the Netherlands	(a) -0.06 (b) -0.10
Flewellling et al. (1999); Ringwalt, Graham, Paschall, Felwellling, and Browne (1996)	RCT	N = 255 Age (mean) = 14 100% male	Outcome: Weapon carrying Type: self-report Follow-up: (a) 6 months (b) 18 months	c) Supporting Adolescents with Guidance and Employment (SAGE): Afrocentric rites of passage (ROP) + summer job training and placement (JTP) + Junior Achievement (JA) ROP: 7 months (biweekly 2h seminars + mentoring) JTP: 6 weeks JA: 3 months (weekly sessions)	Waiting list	Targeted	US	(a,c) -0.37 (a,d) -0.24 (b,c) -0.16 (b,d) -0.25

				7 BCTs: 1.2, 3.1, 4.1, 5.3, 8.1, 8.2, 10.2				
				d) SAGE: JTP + JA JTP: 6 weeks JA: 3 months (weekly sessions) 3 BCTs: 4.1, 8.1, 10.2				
Foshee et al. (2014)	CRCT	N = 1886 Age (mean) = 13.9 49% male	Outcome: weapon carrying Type: self-report Follow-up: 1 year	Safe Dates 4 months 5 BCTs: 5.3, 6.3, 8.1, 12.5, 13.2	No treatment	Universal	14 public schools in the US	0.20
Franco, Amutio, López-González, Oriol, and Martínez-Taboada (2016)	RCT	N = 27 Age (mean) = 15.85 59% male	Outcome: Physical aggression Measure: Aggression Questionnaire (Physical Aggression) Type: self-report	Meditacion Fluir 10 sessions 1 h/week 6 BCTs: 1.4, 4.1, 8.1, 8.3, 11.2, 13.2	Waiting list	Targeted	High school in Spain	0.80
Friedman, Terras, and Glassman (2002)	RCT	N = 201 Age (mean) = 15.5 100% male	Outcone: Violence Measure: Adolescent Drug Abuse Diagnosis (Violent Offenses) Type: self-report Follow-up: 6 months	Botvin Life Skills Training + Prothow/Sith anti-violence + Values Clarification + Treatment as usual 9 weeks 5h/week 15 BCTs: 1.2, 1.3, 4.1, 4.2, 5.1, 5.3, 6.1, 6.3, 8.2, 10.3, 10.9, 11.2, 13.2, 13.5, 15.4	Treatment as usual	Targeted	Residential treatment facility in the US	-0.06
Garaigordobil and Martínez-Valderrey (2015)	CRCT	N = 176 Age range: 13 – 15 44% male	Outcome: Bullying Measure: Cyberbullying: Screening of Peer Harassment (Bullying) Type: self-report	Cyberprogram 2.0 19 weeks 1h/week 7 BCTs: 1.2, 4.1, 5.3, 5.6, 8.1, 11.2, 13.2	No treatment	Universal	3 secondary schools in Spain	0.84

Gilberg (1982)	RCT	N = 30 Age (mean) = 16.46 100% male	Outcome: Aggression Measure: Classroom Observation Checklist for Aggressiveness Type: Observation	Cognitive role-taking training 8 weeks 1h/week 3 BCTs: 2.2, 5.3, 8.1	1. Telling stories 2. No treatment	Targeted	School for boys in the US	0.75
Goldbeck and Schmid (2003)	RCT	N = 50 Age (mean) = 10.2 50% male	Outcome: Aggression Measure: Child Behavior Checklist (Aggression) Type: parent-report	Autogenic relaxation training 8 weeks 30 min/week 9 BCTs: 1.2, 2.3, 2.4, 4.1, 8.1, 8.3, 8.6, 11.2, 12.5	Waiting list	Targeted	Outpatient paediatric setting in Germany	0.28
Goldstein et al. (2018)	RCT	N = 70 Age (mean) = 17.45 100% female	a) Outcome: Physical Aggression Measure: Aggression Questionnaire (Physical Aggression) b) Outcome: Physical Aggression Measure: Peer Conflict Scale (Overt Aggression) c) Outcome: Reactive Aggression Measure: Peer Conflict Scale (Reactive Physical Aggression) d) Outcome: proactive aggression Measure: Peer Conflict Scale (Proactive Physical Aggression)	Juvenile Justice Anger Management Treatment for Girls + treatment as usual 8 weeks 2 sessions/week 90min/session 19 BCTs: 1.1, 1.2, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 8.1, 8.2, 8.6, 10.1, 10.2, 10.4, 11.2, 12.3, 13.2, 15.4	Treatment as usual	Targeted	3 residential juvenile justice facilities in the US	(a) 0.70 (b) 0.74 (c) 0.77 (d) 0.51

Goldstein, Dovidio, Kalbeitzer, Weil, and Strachan (2007)	CRCT	N = 12 Age (mean) = 15.8 100% female	a) Outcome: Aggression Measure: Aggression Questionnaire Type: self-report b) Outcome: Physical aggression Measure: Aggression Questionnaire (Physical Aggression) Type: self-report	Anger Management for Female Juvenile Offenders + treatment as usual 9 weeks 3h/week 13 BCTs: 1.1, 1.2, 1.4, 1.5, 4.2, 6.1, 8.1, 8.2, 10.2, 10.3, 11.2, 12.4, 15.4	Treatment as usual	Targeted	Residential juvenile justice facility in the US	(a) 4.10 (b) 0.78
Gottfredson, Cross, Wilson, Connell, and Rorie (2010); Gottfredson, Cross, Wilson, Rorie, and Connell (2010)	RCT	N = 447 Age (mean) = 12.22 54% male	Outcome: Aggression Measure: All Star questionnaire Type: self-report	All Stars + homework assistance + leisure activities + attendance monitoring and rewarding 30 weeks 3 sessions/week 3h/session 13 BCTs: 1.2, 1.3, 2.1, 3.2, 4.1, 6.2, 6.3, 8.1, 10.1, 10.2, 10.4, 13.3, 14.4	No treatment	Targeted	5 urban middle schools in the US	0.08
Griffin Jr, Holliday, Frazier, and Braithwaite (2009)	RCT	N = 199 8 th grade 62% male	Outcome: Violence Measure: Monitoring the Future survey (5 items) Type: self-report	Building Resiliency and Vocational Excellence 6 months 10 BCTs: 1.3, 2.7, 3.1, 5.3, 6.1, 6.2, 6.3, 8.1, 8.6, 10.3	No treatment	Targeted	Middle school in the US	-0.17
Guerra and Slaby (1990)	RCT	N = 165 Age (mean) = 17.17 50% male	Outcome: Aggression Measure: Behavior Rating Scale (Aggressive Behavior) Type: staff report	Cognitive mediation training 12 weeks 1h/week	1. Basic skills sessions 2. No treatment	Targeted	Juvenile correctional facility in the US	0.82

				10 BCTs: 1.2, 1.3, 2.4, 4.1, 4.2, 4.3, 5.3, 8.1, 8.2, 13.2				
Gusmões, Sañudo, Valente, and Sanchez (2018)	CRCT	N = 8247 Age range: 11 - 15 49.1% male	a) Outcome: Bullying Type: self-report Follow-up: (c) 6 months (d) 18 months b) Outcome: Physical Aggression Type: self-report Follow-up: (c) 6 months (d) 18 months	Unplugged 12 weeks 1 lesson/week 50 min/lesson 16 BCTs: 1.2, 1.3, 2.1, 2.2, 2.3, 4.1, 4.2, 5.1, 5.3, 5.4, 6.2, 8.1, 8.2, 8.6, 13.1, 13.4	No treatment	Universal	72 elementary schools in Brazil	(a,c) 0 (b,c) -0.05 (a,d) -0.03 (b,d) -0.06
Hanewinkel, Isensee, Maruska, Sargent, and Morgenstern (2010)	CRCT	N = 3490 Age (mean) = 12.63 50% male	Outcome: Bullying Measure: unknown Type: self-report Follow-up: 1 month	Smokefree Class competition: be smart, don't start 6 months 3 BCTs: 1.1, 1.8, 10.6	No treatment	Universal	Schools in Germany	0.03
Harrington, Giles, Hoyle, Feeney, and Yungbluth (2001)	CRCT	N = 1655 Age (mean) = 12 45% male	Outcome: Violence Measure: items from delinquency scales Type: self-report Follow-up: (a) post-test (b) 1 year	All stars 5 BCTs: 1.3, 1.9, 5.3, 6.2, 6.3	No treatment	Universal	14 middle schools in the US	(a) -0.04 (b) -0.06
Hecht et al. (2008); Nieri, Apkarian, Kulis, and Marsiglia (2015)	CRCT	N = 581 Age (mean) = 11 46% male	a) Outcome: fighting Type: self-report Follow-up: 1 month b) Outcome: weapon carrying Type: self-report	Keepin' it REAL 10 sessions + 5 booster sessions 45 min/session 10 BCTs: 1.2, 4.1, 5.3, 6.1, 6.2, 6.3, 8.1, 11.2, 12.3, 13.3	No treatment	Universal	30 public schools in the US	(a) 0.01 (b) 0.17

Follow-up: 1 month

Herrmann and McWhirter (2003)	CRCT	N = 216 7 th , 8 th and 9 th grade 45% male	a) Outcome: Aggression Measure: Missouri Peer Relations Inventory (Aggression) Type: self-report b) Outcome: Aggression Measure: Missouri Peer Relations Inventory (Aggression) Type: parent-report c) Outcome: Aggression Type: official records	Student-Created Aggression Replacement Education 8weeks 30 min/week 8 BCTs: 2.3, 4.1, 4.2, 4.3, 8.1, 8.2, 11.2, 15.4	Enter here curriculum	Targeted	2 alternative schools in the US	(a) 0.03 (b) 0.01 (c) -0.19
Hudley and Graham (1993)	RCT	N = 24 Age (mean) = 10.5 100% male	a) Outcome: Aggression Measure: Teacher Checklist (aggression) Type: teacher report b) Outcome: Reactive Aggression Measure: Teacher Checklist (reactive aggression) Type: teacher report	Attribution retraining program 6 weeks 2h/week 4 BCTs: 1.4, 4.2, 4.3, 8.1	1. Building thinking skills 2. No treatment	Targeted	Two elementary schools in the US	a) 0.59 b) 0.52
Huey (1984)	RCT	N = 48 8 th -9 th grade 100% male	Outcome: Aggression Measure: Walker Problem Behavior Identification Checklist (Acting-Out) Type: teacher report	1. Counsellor-led assertive training 4 weeks 2.5h/week 4 BCTs: 2.2, 6.1, 8.1, 10.2 2. Peer-led assertive training 4 weeks	1. Counsellor-led discussion group 2. Peer-led discussion group 3. No treatment	Targeted	Urban high school in the US	1.19

				2.5h/week 4 BCTs: 2.2, 6.1, 8.1, 10.3				
Johnston, Rivara, Drosch, Dunn, and Copass (2002)	RCT	N = 631 Age (mean) = 16.4 65.2% male	Outcome: Weapon carrying Type: self-report Follow-up: (a) 3 months (b) 6 months	Behaviour Change Counselling 1 session of 20 minutes 3 BCTs: 3.1, 13.3, 15.1	No treatment	Universal	Emergency department in the US	(a) -0.10 (b) 0.19
Jones (1991)	RCT	N = 18 Age (mean) = 13.75 50% male	Outcome: Aggression Measure: Behavior Incident Report Type: observation	a) Aggression Replacement Training 10 weeks 3h/week 19 BCTs: 1.2, 1.4, 2.2, 4.1, 4.2, 5.3, 6.1, 6.2, 8.1, 8.2, 8.4, 8.6, 9.1, 10.2, 10.4, 10.9, 13.2, 15.2, 15.4 b) Moral reasoning 10 weeks 1 h/week 3 BCTs: 1.2, 6.2, 13.2	No treatment	Targeted	High school in Australia	(a) 0.75 (b) -0.06
Jordans et al. (2010)	CRCT	N = 325 Age (mean) = 12.7 51% male	Outcome: Physical aggression Measure: Aggression Questionnaire (Physical Aggression) Type: self-report	Classroom-based intervention 5 weeks 3h/week 5 BCTs: 8.1, 11.2, 12.5, 13.2, 15.4	Waiting list	Targeted	4 schools in Nepal	0.11
Karataş (2011)	RCT	N = 36 9 th -11 th grade 50% male	Outcome: Aggression Measure: Scale of Determining Conflict Resolution Behavior (Aggression) Type: self-report	Psychodrama 10 weeks 1 session/week 90-120 min/session 4 BCTs: 2.7, 8.1, 11.2, 13.4	1. No treatment 2. Interaction group	Targeted	High school in Turkey	1.70

Karataş and Gökçakan (2009)	RCT	N = 36 9 th grade 48% male	a) Outcome: Aggression Measure: Aggression Scale Type: self-report b) Outcome: Physical aggression Measure: Aggression Scale (Physical Aggression) Type: self-report	c) Cognitive Behavior Therapy 10 sessions 1 session/week 90-120 min/session 1 BCT: 3.1 d) Psychodrama 14 sessions 1 session/week 90-120 min/session 2 BCTs: 2.7, 11.2	No treatment	Targeted	High school in Turkey	(a,c) 4.42 (b,c) 3.37 (a,d) 2.51
Kärnä et al. (2013)	CRCT	N = 19191 8 th and 9 th grade	a) Outcome: Bullying Measure: Olweus' Bully/Victim Questionnaire (Bullying) Type: self-report b) Outcome: Bullying Measure: Participant Role Questionnaire (Bullying) Type: peer nominations	KiVa Antibullying program + internet forum 13-23 lessons 6 BCTs: 3.1, 5.3, 8.1, 12.2, 12.5, 13.2	No treatment	Universal and targeted	78 schools in Finland	(a) 0.04 (b) 0 (b,m) 0.11 (b,f) 0
Kazdin, Esveldt-Dawson, French, and Unis (1987)	RCT	N = 56 Age (mean) = 10.9 80% male	Outcome: Aggression Measure: School Behavior Checklist (aggression) Type: teacher-report Follow-up: (a) 1 month (b) 1 year	c) Cognitive behavioural problem solving skills training 10 weeks 1.5h/week 10 BCTs: 1.2, 2.2, 3.1, 6.1, 7.4, 8.1, 10.2, 10.4, 14.1, 14.2 d) Nondirective relationship theory 10 weeks 1.5h/week	Sessions with therapist 4 BCTs: 3.1, 7.4, 14.2, 14.3	Targeted	Psychiatric hospital in the US	(a,c) 0.96 (a,d) 0.24 (b,c) 0.65 (b,d) -0.21

				6 BCTs: 3.1, 3.3, 7.4, 10.2, 14.2, 14.3				
Kliewer et al. (2011)	CRCT	N = 258 7 th grade 45% male	a) Outcome: Physical Aggression Measure: Problem Behavior Frequency Scale (Physical Aggression) Type: self-report Follow-up: (c) 2 months (d) 6 months b) Outcome: Aggression Measure: Teacher Report Form (Aggressive Behavior) Type: teacher report Follow-up: (c) 2 months (d) 6 months	e) Standard expressive writing 5 weeks 1h/week 3 BCTs: 4.1, 6.1, 8.1 f) Enhanced expressive writing 5 weeks 1h/week 3 BCTs: 4.1, 6.1, 8.1	Non-emotional writing 3 BCTs: 4.1, 6.1, 8.1	Targeted	3 urban middle schools in the US	(a,c,e) -0.12 (b,c,e) 0.48 (a,c,f) -0.12 (b,c,f) 0.17 (a,d,e) -0.02 (b,d,e) -0.09 (a,d,f) -0.09 (b,d,f) -0.06
Komro et al. (2004); Perry et al. (2003)	CRCT	N = 6237 Age (mean) = 13 52% male	a) Outcome: physical aggression Measure: Physical Violence Scale Type: self-report b) Outcome: Weapon carrying Measure: Weapon Carrying Scale Type: self-report	c) Drug Abuse Resistance Education 10 weeks 13 BCTs: 1.2, 1.4, 5.1, 5.3, 6.2, 8.1, 8.2, 9.1, 9.2, 10.4, 10.11, 12.3, 13.2 d) Drug Abuse Resistance Education + Play and Learning Under supervision 14weeks 15 BCTs: 1.2, 1.4, 4.1, 5.1, 5.3, 6.2, 8.1, 8.2, 9.1, 9.2, 10.4, 10.11, 12.2, 12.3, 13.2	Waiting list	Universal	24 middle schools in the US	(a,c,m) -0.03 (a,d,m) 0.1 (a,c,f) -0.13 (a,d,f) -0.03 (b,c,m) 0.07 (b,d,m) 0.10 (a,c,f) -0.11 (a,d,f) -0.07

Kozina (2018)	CRCT	N = 73 8th grade 47% male	Outcome: Physical Aggression Measure: Aggression Scale for Pupils and Students Type: self-report Follow-up: (a) post-test (b) 6 months	My friends 10 workshops + 2 booster sessions 1 session/week 45 min/workshop 7 BCTs: 1.2, 4.1, 8.1, 10.3, 10.9, 11.2, 15.4	No treatment	Universal	2 urban schools in Slovenia	(a) 0.54 (b) 0.45
Krahé and Busching (2015); Möller, Krahé, Busching, and Krause (2012)	RCT	N = 683 Age (mean) = 13.3 50% male	Outcome: Physical aggression Measure: unknown Type: self-report Follow-up: (a) 18 months (b) 30 months	Class-based intervention 5 weeks 1.5 h/week 6 BCTs: 2.3, 5.3, 7.1, 8.1, 8.2, 13.2	No treatment	Universal	10 secondary schools in Germany	(a) 0 (b) -0.14
Lee, Hallberg, and Hassard (1979)	RCT	N = 30 9 th grade 80% male	a) Outcome: Aggression Measure: Self-rated scale Type: self-report b) Outcome: Aggression Type: peer nominations	Assertion training 8 weeks 50 min/week 7 BCTs: 1.2, 2.2, 2.3, 6.1, 6.2, 8.1, 15.2	1. How to make a decision 2. No treatment	Targeted	Secondary school in Canada	(a) 1.16 (b) 0.08
Li and Chen (2017)	RCT	N = 40 Age (mean) = 10.13 40% male	Outcome: physical aggression Measure: Aggression Questionnaire (physical aggression) Type: self-report	Neurofeedback training program 20 sessions 3 sessions/week 30 min/session 4 BCTs: 2.7, 4.1, 8.1, 8.7	Developing training course	Targeted	Schools in China	0.02
Lindstrom Johnson, Jones, and Cheng (2015)	RCT	N = 200 Age (mean) = 16.68 40% male	Outcome: Fighting Measure: United States Youth Risk Behavior Surveillance System (Violence)	Healthy futures 5 months 1 session/month 6 BCTs: 1.2, 3.1, 1.3, 8.1, 3.2, 1.6	TAU	Universal	Paediatric primary care clinic in the US	0.05

			Type: self-report					
Lochman, Burch, Curry, and Lampron (1984); Lochman, Lampron, Burch, and Curry (1985)	RCT	N = 76 Age (mean) = 11.17 100% male	Outcome: Aggression Measure: Missouri Children's Behavior Checklist (Aggression) Type: parent and teacher report Follow-up: 1 month	a) Anger coping 12 weeks 1h week 9 BCTs: 1.2, 4.2, 5.3, 6.1, 6.2, 8.1, 8.2, 8.6, 15.4 b) Goal setting 12 weeks 1h week 3 BCTs: 1.3, 2.5, 10.3 c) Anger coping + goal setting 12 weeks 1h week 12 BCTs: 1.2, 1.3, 2.5, 4.2, 5.3, 6.1, 6.2, 8.1, 8.2, 8.6, 10.3, 15.4	No treatment	Targeted	8 suburban schools in the US	(a) 0.30 (b) -0.60 (c) 0.30
Moody (1981)	RCT	N = 24 Age (mean) = 13.9 100% male	a) Outcome: Aggression Measure: Pittsburgh Adjustment Survey Scales (Aggressive Behavior) Type: teacher report b) Outcome: Aggression Type: teacher observation	Assertion training 5 weeks 1.5h/week 11 BCTs: 2.2, 4.1, 5.3, 5.4, 5.6, 6.1, 6.2, 8.1, 8.2, 8.6, 10.4	1. Group counselling 2. No treatment	Targeted	Middle school in US	(a) -1.04 (b) -2.26
Moore and Shannon (1993)	RCT	N = 58 Age (mean) = 14	Outcome: Aggression Measure: Formal Incident Report (aggressive behavior) Type: observation	Anger control treatment 10 weeks 2.5h/week 7 BCTs: 2.3, 2.7, 4.2, 10.2, 10.4, 14.1, 15.4	Treatment as usual 4 BCTs: 2.7, 10.2, 10.4, 14.1	Targeted	Residential treatment facility in the US	-0.06

Multisite Violence Prevention Project (2014)	CRCT	N = 2780 6 th grade 65% male	a) Outcome: Physical Aggression Measure: Behavioral Assessment System for Children + Problem Behavior Frequency Scale Type: teacher + parent + self-report Follow-up: (c) post-test (d) 2 years b) Outcome: Aggression Measure: Behavioral Assessment System for Children Type: teacher-report Follow-up: (c) post-test (d) 2 years	Guiding Responsibility and Expectations for Adolescents for Today and Tomorrow (GREAT) for students + GREAT for teachers 1 year 20 sessions 15 BCTs: 1.2, 1.9, 4.1, 4.2, 5.3, 6.1, 8.1, 8.2, 9.3, 10.6, 11.2, 12.3, 13.2, 15.2, 15.4	No treatment	Universal	37 middle schools in the US	(a,c) 0.08 (b,c) 0.01 (a,d) 0.03 (b,d) 0.06
Newton (1994)	RCT	N = 48 7 th and 8 th grade 76% male	Outcome: Violence Measure: school referrals Type: official records	Aim high: students helping students (mentoring program) 16 weeks 1h/week 2 BCTs: 3.1, 3.2	No treatment	Targeted	Urban middle school in the US	0.72
Nocentini and Menesini (2016)	CRCT	N = 1045 Age (mean) = 10.93 49% male	Outcome: Bullying Measure: Florence Bullying Scale (perpetration) + Olweus' global key question (bullying)	KiVa 10 lessons 90 min/lesson 9 BCTs: 1.2, 1.8, 4.1, 4.3, 5.3, 8.1, 12.2, 12.5, 13.1	No treatment	Universal and targeted	13 schools in Italy	0.21
Parker and Kupersmidt (2016)	CRCT	N = 118 Age (mean) = 11.7	Outcome: Aggression Type: teacher report	Moment 4 weeks 20 lessons 1 lesson/day	Waiting list	Universal	Middle-schools in the US	1.21

				15min/lesson 12 BCTs: 1.2, 1.4, 2.1, 4.1, 4.3, 6.1, 8.1, 8.2, 8.3, 8.6, 9.1, 11.2				
Parker, Kupersmidt, Mathis, Scull, and Sims (2014)	CRCT	N = 111 Age (mean) = 10.09 42% male	Outcome: Aggression Measure: Child Behavior Checklist (Aggression) Type: Teacher report	Master Mind 20 lessons 4 weeks 1 lesson/day 15 min/lesson 15 BCTs: 1.2, 1.4, 4.1, 4.3, 5.3, 6.1, 8.1, 8.3, 8.6, 9.1, 10.4, 10.5, 11.2, 13.4, 15.4	Waiting list	Universal	2 elementary schools in the US	0.54
Petit (1998)	RCT	N = 90 Age (mean) = 16 47.30% male	a) Outcome: Aggression Measure: Teacher's Report Form (Aggression) Type: teacher report b) Outcome: Anger-Out Measure: State-Trait Anger Expression Inventory (Anger-Out) Type: self-report	Anger Management for Youth: Stemming Aggression and Violence 9 weeks 2 sessions/week 50 min/session 16 BCTs: 1.1, 1.2, 1.5, 2.2, 2.3, 3.1, 4.1, 4.2, 4.3, 5.3, 5.5, 8.1, 8.2, 8.6, 10.3, 15.4	1. No treatment 2. Educational videos	Targeted	Alternative education centres in the US	(a) -0.64 (b) -0.08
Puskar, Ren, and McFadden (2015)	RCT	N = 179 Age (mean) = 15.61 48% male	a) Outcome: Physical aggression Type: self-report Follow-up: (c) post-test (d) 6 (e) 12 months b) Outcome: Anger-out Measure: State-Trait Anger Expression Inventory 2 (Anger-Out)	Teaching Kids to Cope with Anger 8 weeks 1 h/week 7 BCTs: 1.2, 4.1, 4.2, 5.3, 8.1, 11.2, 13.2	No treatment	Universal	3 rural public high schools in the US	(a,c) -0.26 (b,c) -0.02 (a,d) 0.07 (b,d) 0.11 (a,e) -0.08 (b,e) -0.00

			Type: self-report Follow-up: (c) post-test (d) 6 months (e) 12 months					
Şahin (2012)	RCT	N = 38 6 th grade	Outcome: Bullying Measure: Scale of Identifying Bullying Type: self-report Follow-up: 2 months	Empathy training 11 sessions 1 session/week 75 min/session 6 BCTs: 2.2, 3.1, 4.1, 6.1, 6.2, 8.1	Discussion about daily issues	Targeted	Primary schools in Turkey	6.36
Shechtman (2000)	RCT	N = 70 Age range: 10 – 16 71% male	a) Outcome: Aggression Measure: Youth Self Report (Aggression) Type: self-report b) Outcome: Aggression Measure: Teacher Report Form (Aggression) Type: teacher report	Bibliotherapy and clarifying processes 10weeks 45 min/week 13 BCTs: 1.1, 1.2, 3.3, 4.1, 4.2, 4.3, 5.3, 5.6, 6.3, 8.1, 8.2, 9.2, 11.2	Waiting list	Targeted	Special education classrooms in 10 schools in Israel	(a) 0.63 (b) 0.42
Shechtman and Ifargan (2009)	CRCT	N = 904 5 th , 6 th , 7 th and 8 th grade 57% male	a) Outcome: Aggression Measure: Aggression Questionnaire Type: self-report b) Outcome: Physical aggression Measure: Aggression Questionnaire (Physical Aggression) Type: self-report c) Outcome: Physical aggression	d) Psychoeducational intervention 4 months 1h/week 5 BCTs: 1.1, 1.2, 1.3, 3.1, 8.1 e) Counselling 4 months 1h/week 8 BCTs: 1.1, 1.2, 1.3, 4.1, 4.2, 5.3, 5.6, 10.4	No treatment	f) Universal g) Targeted	Elementary and junior high schools in Israel	(a,d,f) 0.37 (b,d,f) 0.28 (c,d,f) 0.37 (a,e,f) 0.39 (a,e,f) 0.31 (a,e,f) 0.26 (a,d,g) 0.72 (b,d,g) 0.65 (c,d,g) 0.35 (a,e,g) 0.66 (a,e,g) 0.55 (a,e,g) 0.45

		Measure: Illinois Aggression Scale (Physical Aggression) Type: self-report							
Shetgiri, Kataoka, Lin, and Flores (2011)	CRCT	N = 108 9 th grade 42% male	Outcome: Fighting (a) Last 3 months (b) Last 12 months Type: self-report Follow-up: 1 month	School-based violence and substance use prevention program + field trips and community service 7 months 40 min/week 10 BCTs: 1.2, 1.3, 2.2, 3.1, 4.1, 5.1, 6.2, 8.1, 11.2, 13.2	No treatment	Targeted	Urban high school in the US	(a) 0.05 (b) -0.16	
Shinde et al. (2018)	CRCT	N = 13035 9 th grade 54% male	Outcome: Violence Type: self-report	a) Strengthening Evidence Base on School-Based Interventions for Promoting Adolescent Health Program (SEHER) delivered by counsellor + AEP 8 months Several activities each month, one assembly per week 3 BCTs: 3.1, 8.1, 10.4 b) SEHER delivered by teacher + AEP 8 months Several activities each month, one assembly per week 3 BCTs: 3.1, 8.1, 10.4	Adolescent Education Program (AEP)	Universal and targeted	Government-run secondary schools in India	(a) 0.21 (b) -0.17	

Shlafer, McMorris, Sieving, and Gower (2013); Sieving et al. (2011)	RCT	N = 253 Age (mean) = 15.59 100% female	Outcome: Violence Measure: Add Health (5 items) Type: self-report	Prime Time 18months 1 session /week 11 BCTs: 1.2, 2.3, 2.4, 3.1, 8.1, 10.2, 10.9, 11.2, 12.2, 13.1, 13.2	No treatment	Targeted	US	-0.12
Silvia et al. (2010); Silvia et al. (2011)	CRCT	N = 10717 6th grade 49% male	a) Outcome: Physical Aggression Measure: Problem Behavior Frequency Scale (Aggression) Type: self-report b) Outcome: Weapon carrying Measure: Problem Behavior Frequency Scale (Weapons-related) Type: self-report c) Outcome: Physical aggression Measure: Problem Behavior Frequency Scale (Not weapons-related) Type: self-report	Responding in Peaceful and Positive Ways + Best Behavior program 3 school years 16 lessons/school year 50 min/lesson 22 BCTs: 1.2, 1.9, 4.1, 4.2, 4.3, 5.3, 6.1, 8.1, 8.2, 8.6, 9.3, 10.3, 10.6, 10.11, 11.2, 12.3, 13.1, 13.2, 14.2, 14.8, 15.2, 15.4	No treatment	Universal	40 middle schools in the US	(a) -0.01 (b) -0.05 (c) -0.01
Simon, Sussman, Dahlberg, and Dent (2002); Sussman et al. (1997); Sussman, Dent, and Stacy	CRCT	N = 2863 Age (mean) = 16.8 55% male	a) Outcome: Violence Type: self-report Follow-up: 1 year b) Outcome: Weapon carrying Type: self-report Follow-up: 1 year	Project Towards No Drug Abuse 3 weeks 2.5h/week 12 BCTs: 1.9, 3.2, 4.1, 4.2, 4.3, 5.3, 6.2, 6.3, 8.2, 9.2, 11.2, 13.2	No treatment	Targeted	21 continuation high schools in the US	(a,m) 0.11 (a,f) -0.06 (b,m) 0.22 (b,f) -0.17

(2002);
Sussman, Dent,
Stacy, and
Craig (1998)

Singh (2017)	RCT	N = 126 Age (mean) = 13.4 56% male	a) Outcome: Physical Aggression Measure: Aggression Questionnaire (Physical Aggression) Type: self-report b) Outcome: Aggression Measure: Aggression Questionnaire Type: self-report	Social Cognitive intervention 6 weeks 1 session/week 70 min/session 12 BCTs: 1.2, 2.2, 2.3, 2.4, 2.7, 4.2, 4.3, 5.3, 5.4, 8.1, 8.6, 9.2	Study skills	Targeted	Schools in India	(a) 1.03 (b) 0.96
Stallard et al. (2010); Stallard et al. (2013)	CRCT	N = 5761 Years 8, 9, 10 and 11 53% male	Outcome: Bullying Measure: Olweus Bully/Victim Questionnaire (Bullying) Type: self-report Follow-up: (a) post-test (b) 6 months	Resourceful Adolescent Programme 11 sessions 1h/session 7 BCTs: 1.2, 3.1, 8.1, 8.2, 11.2, 13.2, 13.4	1. Standard curriculum with facilitators 2. No treatment	Universal	8 schools in the UK	(a) 0.05 (b) 0.05
Stevens, Bourdeaudhuij, and Oost (2000)	CRCT	N = 1104 Age range: 10 – 16	Outcome: Bullying Measure: Bullying Inventory (Bullying) + Life in School Checklist (Bully) Type: self-report Follow-up: (a) post-test (b) 1 year	c) Flemish anti-bullying intervention + support from research group 4 weeks 1.5h/week 9 BCTs: 3.3, 4.1, 5.3, 6.1, 8.1, 8.2, 10.1, 13.2, 14.2 d) Flemish anti-bullying intervention 4 weeks	No treatment	Universal	(e) 9 primary schools (f) 9 secondary schools in Belgium	(a,c,e) 0.18 (a,d,e) 0.15 (a,c,f) -0.21 (a,d,f) 0.09 (b,c,e) 0.44 (b,d,e) 0.52 (b,c,f) -0.10 (b,d,f) 0.09

				1.5h/week 9 BCTs: 3.3, 4.1, 5.3, 6.1, 8.1, 8.2, 10.1, 13.2, 14.2				
Stoltz et al. (2013)	CRCT	N = 271 4 th grade 71% male	Outcome: (a) Reactive Aggression (b) Proactive Aggression Measure: Teacher Rating of Aggression (child version) Type: self-report Outcome: (c) Reactive Aggression (d) Proactive Aggression Measure: Teacher Rating of Aggression Type: teacher report Outcome: (e) Reactive Aggression (f) Proactive Aggression Measure: Teacher Rating of Aggression (parent version) Type: parent report (h) Mother (i) Father g) Outcome: Aggression Measure: Social Information Processing test Type: self-report	Stay Cool Kids 8 weeks 1 session/week 45 min/session 11 BCTs: 1.2, 1.3, 1.8, 2.3, 4.2, 8.1, 8.2, 8.6, 11.2, 13.2, 13.4	No treatment	Targeted	48 elementary schools in the Netherlands	(a) 0.21 (b) 0.22 (c) 0.28 (d) 0.30 (e,h) 0.32 (f,h) 0.18 (e,i) 0.11 (f,i) 0.3 (g) 0
Swaim and Kelly (2008)	CRCT	N = 1492 7 th and 8 th grade 47% male	Outcome: Physical aggression Type: self-report	Resolve it, Solve it 2 years 2 BCTs: 6.1, 12.5	No treatment	Universal	6 rural middle schools in the US	(m) -2.19 (f) 0.17

Uzunoglu and Baysan Arabaci (2017)	RCT	N = 16 Age (mean) = 16 50% male	Outcome: Anger-out Measure: State-Trait Anger Expression Inventory (Anger-Out) Type: self-report	Anger Management Education Program 6 weeks 1 session/week 60 min/session 5 BCTs: 1.2, 4.1, 4.2, 4.3, 8.1	Waiting list	Targeted	Psychiatric hospital in Turkey	0.63
Van Manen, Prins, and Emmelkamp (2004)	RCT	N = 97 Age (mean) = 11.2 100% male	a) Outcome: Reactive Aggression Measure: Teacher Rating Scale for Reactive and proactive Aggression (Reactive Aggression) Type: teacher-report b) Outcome: Proactive Aggression Measure: Teacher Rating Scale for Reactive and proactive Aggression (Proactive Aggression) Type: teacher-report	c) Social cognitive intervention program 11 weeks 70min/week 16 BCTs: 1.2, 2.7, 4.1, 4.2, 5.3, 7.1, 8.1, 8.6, 9.2, 10.4, 10.6, 10.9, 13.2, 14.3, 14.4, 15.4 d) Social skills training 11 weeks 70min/week 6 BCTs: 6.1, 7.1, 8.1, 8.2, 10.2, 14.1	Waiting list	Targeted	Outpatient mental health clinic in the Netherlands	(a,c) 0.55 (b,c) 0.17 (a,d) 0.17 (b,d) -0.51
Wade, Smith, Duncan, and Lubans (2018)	CRCT	N = 361 Age (mean) = 12.7 100% male	Outcome: Aggression Measure: Aggression Scale Type: self-report	Acting Teens Avoiding Screen Time 8 months 9 BCTs: 1.1, 2.2, 2.3, 3.1, 4.1, 5.3, 8.1, 8.7, 13.1	Waiting list	Targeted	14 secondary schools in Australia	0.10
Wagner, Hospital, Graziano, Morris and Gil (2014)	RCT	N = 514 Age (mean) = 16.24 59% male	Outcome: Aggression Measure: Timeline Follow-Back (1 item) Type: self-report Follow-up: (a) post-test (b) 3 months (c) 6 months	Guided self-change 5 weeks 1 session/week 8 BCTs: 1.2, 1.3, 2.2, 2.3, 3.1, 5.1, 6.2, 9.2	TAU	Targeted	16 high schools in the US	(a) 0.23 (b) -0.21 (c) -0.39

Yorgun (2007)	RCT	N = 24 9 th and 10 th grade	a) Outcome: Violence Measure: Violent Behavior Checklist (Physical violence) Type: self-report b) Outcome: Proactive aggression Measure: Violent Behavior Checklist (Instrumental violence) Type: self-report	Violence Management training 8 weeks 2 sessions/week 50 min/session 14 BCTs: 1.2, 1.4, 3.3, 4.1, 4.2, 4.3, 5.3, 8.1, 8.2, 8.6, 9.3, 12.4, 13.2, 15.4	No treatment	Targeted	School in Turkey	(a) -0.20 (b) 0.63
Zimmerman (1987)	CRCT	N = 36 Age (mean) = 15.75 100% male	a) Outcome: Aggression Measure: Behavior Incident Report (aggression intensity) Type: observation b) Outcome: Aggression Measure: Behavior Incident Report (aggression frequency) Type: observation	Aggression Replacement Training 10 weeks 3h/week 22 BCTs: 1.2, 1.4, 2.2, 2.3, 4.1, 4.2, 5.3, 6.1, 6.2, 8.1, 8.2, 8.4, 8.6, 9.1, 10.1, 10.2, 10.4, 10.5, 10.9, 13.2, 15.2, 15.4	No treatment	Targeted	Youth residential facility for delinquent boys in the US	a) 0.42 b) 0.43

Notes. Subscales used are between brackets under the measure. If follow-up is not indicated, the measure was taken only within one week after the intervention; m = males; f = females.

^a Effect sizes in Cohen's *d*. Letters in brackets indicate for which outcome, follow-up and intervention group is the effect size.

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Appendix D

Analyses without outliers

Table C1

Results of moderator analyses for study characteristics based on 265 ESs from 94 studies

Moderator variables	# studies	#ES	ES ^a (95% CI)	Omnibus test	p-value	Variance level 2 ^b	Variance level 3 ^c
RCT vs CRCT				F (1,263) = 1.08	0.300	0.011	0.076
RCT	43	96	0.35 (0.18, 0.53)***				
CRCT	51	169	0.17 (0.09, 0.26)***				
Publication year	94	265	0.001 (-0.01, 0.01)	F(1,263) = 0.12	0.733	0.011	0.077
Follow-up (in months)	94	265	-0.003 (-0.01, 0.001)	F(1,263) = 1.92	0.167	0.011	0.072
Outcome				F(4,235) = 1.72	0.147	0.012	0.080
General aggression	57	68	0.29 (0.18, 0.39)***				
Physical aggression	59	96	0.16 (0.07, 0.24)***				
Bullying	14	43	0.18 (0.07, 0.28)**				
Weapon carrying	9	22	0.13 (0.01, 0.25)*				
Fighting	7	11	0.20 (0.05, 0.35)*				
Reactive aggression	4	8	--				
Proactive aggression	4	8	--				
Anger-out	3	5	--				
Threatening	2	4	--				
Informant of outcome				F(2,241) = 2.01	0.137	0.012	0.069
Self-report	73	207	0.19 (0.12, 0.26)***				
Teacher report	16	29	0.34 (0.19, 0.50)***				
Observation	7	8	0.27 (-0.14, 0.67)				
Parent report	4	9	--				
Peer report	4	7	--				
Official records	3	3	--				
Continent				F(2,225) = 8.97	<.001***	0.003	0.054
North America	53	135	0.11 (0.03, 0.19)**				
Europe	23	62	0.19 (0.08, 0.30)***				

Middle East	8	31	0.64 (0.41, 0.87)***
Latin America	1	20	--
Africa	1	2	--
East Asia	4	10	--
Oceania	4	5	--

Note. # studies = number of independent studies; # ES = number of effect sizes; d = mean effect size; CI = confidence interval, RCT = Randomised controlled trial, CRCT = Cluster randomised controlled trial, SES = Socioeconomic status, -- = not included in analysis due to lack of data

^a For categorical predictors, ES is Cohen's d for each category. For continuous predictors, ES is β for that specific predictor.

^b Variance between the effect sizes from the same study.

^c Variance between studies.

*p < 0.05; **p < 0.01; ***p < 0.001.

Results of moderator analysis for intervention characteristics based on 265 ESs from 112 intervention groups

Moderator variables	#IG	#ES	d ^a (95% CI)	Omnibus test	p-value	Variance level 2 ^b	Variance level 3 ^c
Methodological characteristics							
Target				F (1,263) = 4.71	0.031*	0.011	0.074
Universal	52	141	0.14 (0.06, 0.23) **				
Targeted	60	124	0.28 (0.18, 0.37) ***				
Setting				F(4,243) = 1.91	0.109	0.011	0.065
Mainstream school	80	199	0.20 (0.13, 0.27)***				
Alternative school	5	12	0.14 (-0.17, 0.45)				
Psychiatric institution	8	13	0.02 (-0.27, 0.30)				
Juvenile correctional	6	11	0.58 (0.25, 0.91)***				
Hospital	6	13	0.09 (-0.17, 0.35)				
Community	2	4	--				
Home	2	8	--				
Facilitator				F(3,226) = 8.91	< .001***	0.007	0.072
Research team	12	29	0.11 (-0.10, 0.32)				
Professional	40	110	0.29 (0.20, 0.38)***				
Teacher	28	74	0.02 (-0.08, 0.12)				
University student	7	16	0.25 (0.01, 0.49)*				
Police officer	2	6	--				
Adult volunteer	3	8	--				
Peer	1	1	--				
Computer-based	2	3	--				
Training				F(3,258) = 4.38	0.005**	0.011	0.069
No training	19	32	0.48 (0.28, 0.68)***				
Only manual	15	26	0.27 (0.11, 0.44)**				
Specific training	29	65	0.21 (0.09, 0.34)***				
Training + supervision	47	139	0.11 (0.01, 0.20)*				
Sample characteristics							
Age (mean)	89	259	-0.01 (-0.03, 0.02)	F(1,257) = 0.17	0.684	0.011	0.074
Gender (proportion male)	87	250	-0.02 (-0.09, 0.05)	F(1,248) = 0.42	0.517	0.011	0.069

Ethnic minority (proportion)	60	172	-0.15 (-0.32, 0.02)	F(1,170) = 3.22	0.074	0.003	0.031
SES (proportion low SES)	22	89	0.09 (-0.08, 0.27)	F(1,87) = 1.13	0.290	0.012	0.002
Intervention characteristics							
Duration (in weeks)	91	263	-0.004 (-0.01, -0.001)*	F(1,261) = 7.09	0.008**	0.011	0.071
Contact hours	80	239	-0.002 (-0.004, -0.00)*	F(1,237) = 4.94	0.027*	0.013	0.088
Intensity (hours per week)	80	239	-0.03 (-0.09, 0.04)	F(1,237) = 0.72	0.398	0.013	0.096
Group vs individual				F(1,253) = 0.72	0.398	0.006	0.082
Group intervention	93	226	0.22 (0.14, 0.30)***				
Individual intervention	15	35	0.14 (-0.05, 0.32)				
Community intervention	2	6	--				
Focus				F(6,243) = 1.10	0.364	0.011	0.062
Peer aggression	46	127	0.20 (0.10, 0.29) ***				
Anger	9	20	0.37 (0.11, 0.63) **				
Socioemotional development	15	23	0.18 (-0.01, 0.36)				
Drug use	10	41	0.03 (-0.17, 0.23)				
Internalising disorders	6	14	0.21 (-0.05, 0.47)				
Problem behaviours	10	18	0.05 (-0.14, 0.25)				
Cyberbullying	5	7	0.28 (-0.01, 0.58)				
Mindfulness	3	4	--				
Dating violence	2	3	--				
Vocational training	2	3	--				

Note. # studies = number of independent studies; # ES = number of effect sizes; d = mean effect size; CI = confidence interval, RCT = Randomised controlled trial, CRCT = Cluster randomised controlled trial, SES = Socioeconomic status, -- = not included in analysis due to lack of data

a For categorical predictors, ES is Cohen's d for each category. For continuous predictors, ES is β for that specific predictor.

b Variance between the effect sizes from the same study.

c Variance between studies.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table C3

Results of BCT analyses for universal interventions based on 139 ESs from 48 intervention groups

BCT No.	BCTs	#IG present	#ES present	ES present (95% CI)	ES absent (95% CI)	t-value	p-value	Difference
1.1	Goal setting (behavior)	6	11	0.09 (-0.07, 0.25)	0.11 (0.05, 0.17)*	0.25	0.803	-0.02
1.2	Problem solving	23	80	0.14 (0.06, 0.23)*	0.08 (-0.00, 0.16)	1.15	0.253	0.06
1.3	Goal setting (outcome)	5	29	0.08 (-0.10, 0.26)	0.11 (0.05, 0.17)*	0.34	0.736	-0.03
1.4	Action planning	5	11	0.13 (-0.08, 0.34)	0.11 (0.05, 0.17)*	0.21	0.832	0.02
1.5	Review behavior goal(s)	1	1	--	--	--	--	--
1.6	Discrepancy between current behavior and goal	1	1	--	--	--	--	--
1.8	Behavioral contract	5	6	0.08 (-0.09, 0.25)	0.11 (0.05, 0.17)*	0.31	0.754	-0.03
1.9	Commitment	6	20	0.01 (-0.13, 0.15)	0.13 (0.07, 0.19)*	1.52	0.130	-0.12
2.1	Monitoring of behavior by others without feedback	2	20	--	--	--	--	--
2.2	Feedback on behavior	5	27	0.04 (-0.12, 0.19)	0.12 (0.06, 0.18)*	0.97	0.332	-0.08
2.3	Self-monitoring of behavior	3	23	--	--	--	--	--
2.7	Feedback on outcome(s) of behavior	3	8	--	--	--	--	--
3.1	Social support (unspecified)	12	24	0.08 (-0.04, 0.19)	0.12 (0.05, 0.18)*	0.64	0.524	-0.04
3.2	Social support (practical)	1	1	--	--	--	--	--
3.3	Social support (emotional)	2	8	--	--	--	--	--
4.1	Instruction on how to perform a behavior	25	83	0.15 (0.07, 0.23)*	0.07 (-0.00, 0.14)	1.60	0.112	0.08
4.2	Information about antecedents	10	56	0.05 (-0.06, 0.16)	0.13 (0.06, 0.19)*	1.22	0.226	-0.08
4.3	Re-attribution	5	13	0.07 (-0.13, 0.27)	0.11 (0.05, 0.17)*	0.39	0.697	-0.04
5.1	Information about health consequences	6	33	0.15 (-0.01, 0.30)	0.10 (0.04, 0.17)*	0.54	0.590	0.05
5.3	Information about social and environmental consequences	28	93	0.13 (0.05, 0.20)*	0.09 (-0.00, 0.17)	0.7	0.469	0.04
5.4	Monitoring of emotional consequences	2	21	--	--	--	--	--

5.6	Information about emotional consequences	3	5	--	--	--	--	--
6.1	Demonstration of the behavior	14	35	0.13 (0.02, 0.25)*	0.10 (0.03, 0.17)*	0.50	0.620	0.03
6.2	Social comparison	9	37	0.10 (-0.04, 0.24)	0.11 (0.05, 0.18)*	0.13	0.895	-0.01
6.3	Information about others' approval	5	15	0.06 (-0.11, 0.24)	0.11 (0.05, 0.18)*	0.57	0.571	-0.05
7.1	Prompts/cues	2	4	--	--	--	--	--
8.1	Behavioral practice/rehearsal	38	117	0.13 (0.07, 0.20)*	0.04 (-0.07, 0.15)	1.48	0.142	0.09
8.2	Behavior substitution	19	82	0.07 (-0.02, 0.16)	0.14 (0.06, 0.21)*	1.16	0.246	-0.07
8.3	Habit formation	2	2	--	--	--	--	--
8.6	Generalisation of target behavior	6	35	0.08 (-0.08, 0.25)	0.11 (0.05, 0.18)*	0.34	0.737	-0.03
9.1	Credible source	6	11	0.06 (-0.17, 0.29)	0.11 (0.05, 0.17)*	0.45	0.654	-0.05
9.2	Pros and cons	3	10	--	--	--	--	--
9.3	Comparative imagining of future outcomes	4	16	--	--	--	--	--
10.3	Non-specific reward	6	19	0.16 (-0.02, 0.33)	0.10 (0.04, 0.17)*	0.57	0.570	0.05
10.4	Social reward	7	20	0.05 (-0.10, 0.20)	0.12 (0.06, 0.18)*	0.80	0.424	-0.06
10.5	Social incentive	1	1	--	--	--	--	--
10.6	Non-specific incentive	4	15	--	--	--	--	--
10.9	Self-reward	1	2	--	--	--	--	--
10.11	Future punishment	6	27	0.01 (-0.15, 0.18)	0.12 (0.06, 0.18)*	1.24	0.219	-0.11
11.2	Reduce negative emotions	19	42	0.16 (0.06, 0.25)*	0.08 (0.01, 0.15)*	1.29	0.199	0.08
12.1	Restructuring the physical environment	1	1	--	--	--	--	--
12.2	Restructuring the social environment	6	13	0.07 (-0.06, 0.20)	0.11 (0.05, 0.17)*	0.64	0.523	-0.04
12.3	Avoidance/reducing exposure to cues of behavior	7	33	0.06 (-0.08, 0.20)	0.12 (0.05, 0.18)*	0.72	0.474	-0.06
12.5	Adding objects to the environment	4	7	--	--	--	--	--
13.1	Identification of self as role model	7	36	0.10 (-0.06, 0.25)	0.11 (0.05, 0.17)*	0.18	0.854	-0.02
13.2	Framing/reframing	22	65	0.11 (0.03, 0.20)*	0.11 (0.03, 0.19)*	0.10	0.920	0.01

13.3	Incompatible belief	2	4	--	--	--	--	--
13.4	Valued self-identity	4	24	--	--	--	--	--
14.2	Punishment	4	19	--	--	--	--	--
14.8	Reward alternative behavior	1	9	--	--	--	--	--
15.1	Verbal persuasion about capability	1	2	--	--	--	--	--
15.2	Mental rehearsal of successful performance	4	23	--	--	--	--	--
15.4	Self-talk	6	19	0.15 (-0.02, 0.31)	0.10 (0.04, 0.17)*	0.47	0.641	0.04

Note. BCT = Behaviour Change Technique; # IG = number of intervention groups; # ES = number of effect sizes; CI = confidence interval; -- = not included in analysis due to lack of data; meta-regression with number of BCTs: $F(1,137) = 0.07, p = .789$; meta-regression including all the BCTs that are reported in 5 IG or more: $F(29,109) = 0.95, p = .547$.

* $p < 0.05$

Results of BCT analyses for targeted interventions based on 127 ESs from 63 intervention groups

BCT No.	BCTs	#IG present	#ES present	ES present (95% CI)	ES absent (95% CI)	t-value	p-value	Difference
1.1	Goal setting (behavior)	8	24	0.46 (0.09, 0.83)*	0.29 (0.11, 0.47)*	0.83	0.409	0.17
1.2	Problem solving	31	64	0.34 (0.14, 0.54)*	0.30 (0.09, 0.51)*	0.32	0.749	0.04
1.3	Goal setting (outcome)	15	43	0.16 (-0.13, 0.45)	0.39 (0.20, 0.59)*	1.36	0.176	-0.23
1.4	Action planning	8	11	0.67 (0.21, 1.14)*	0.27 (0.10, 0.45)*	1.59	0.114	0.40
1.5	Review behavior goal(s)	2	3	--	--	--	--	--
1.6	Discrepancy between current behavior and goal	2	5	--	--	--	--	--
1.7	Review outcome goal(s)	3	8	--	--	--	--	--
1.8	Behavioral contract	2	11	--	--	--	--	--
1.9	Commitment	5	14	0.07 (-0.45, 0.60)	0.35 (0.18, 0.52)*	0.92	0.327	-0.27
2.1	Monitoring of behavior by others without feedback	2	3	--	--	--	--	--
2.2	Feedback on behavior	20	36	0.27 (-0.01, 0.64)	0.35 (0.15, 0.54)*	0.48	0.631	-0.08
2.3	Self-monitoring of behavior	15	35	0.22 (-0.08, 0.52)	0.36 (0.17, 0.55)*	0.80	0.427	-0.14
2.4	Self-monitoring of outcome(s) of behavior	4	5	--	--	--	--	--
2.5	Monitoring outcome(s) of behavior by others without feedback	2	2	--	--	--	--	--
2.7	Feedback on outcome(s) of behavior	7	10	0.68 (0.26, 1.10)*	0.28 (0.11, 0.45)*	1.83	0.069	0.41
3.1	Social support (unspecified)	11	24	0.30 (0.07, 0.52)*	0.33 (0.16, 0.50)*	0.32	0.746	-0.03
3.2	Social support (practical)	4	10	--	--	--	--	--
3.3	Social support (emotional)	3	6	--	--	--	--	--
4.1	Instruction on how to perform a behavior	28	54	0.28 (0.08, 0.49)*	0.36 (0.15, 0.57)*	0.60	0.547	-0.08
4.2	Information about antecedents	26	60	0.41 (0.20, 0.62)*	0.25 (0.05, 0.45)*	1.28	0.204	0.16
4.3	Re-attribution	12	29	0.47 (0.15, 0.79)*	0.27 (0.09, 0.46)*	1.06	0.290	0.20

5.1	Information about health consequences	3	6	--	--	--	--	--
5.2	Salience of consequences	2	2	--	--	--	--	--
5.3	Information about social and environmental consequences	27	54	0.28 (0.08, 0.48)*	0.36 (0.16, 0.55)*	0.64	0.521	-0.07
5.4	Monitoring of emotional consequences	3	6	--	--	--	--	--
5.5	Anticipated regret	1	2	--	--	--	--	--
5.6	Information about emotional consequences	4	13	--	--	--	--	--
6.1	Demonstration of the behavior	17	27	0.35 (0.06, 0.65)*	0.31 (0.13, 0.49)*	0.25	0.806	0.04
6.2	Social comparison	16	30	0.15 (-0.16, 0.45)	0.38 (0.20, 0.56)*	1.29	0.199	-0.23
6.3	Information about others' approval	5	9	0.08 (-0.40, 0.57)	0.35 (0.18, 0.53)*	1.04	0.301	-0.27
7.1	Prompts/cues	2	4	--	--	--	--	--
8.1	Behavioral practice/rehearsal	46	88	0.35 (0.17, 0.52)*	0.25 (-0.02, 0.51)	0.72	0.473	0.10
8.2	Behavior substitution	25	55	0.24 (0.01, 0.46)*	0.38 (0.19, 0.58)*	1.13	0.260	-0.15
8.3	Habit formation	2	2	--	--	--	--	--
8.4	Habit reversal	3	4	--	--	--	--	--
8.6	Generalisation of target behavior	16	35	0.35 (0.06, 0.64)*	0.31 (0.13, 0.50)*	0.24	0.812	0.04
8.7	Graded tasks	3	4	--	--	--	--	--
9.1	Credible source	3	4	--	--	--	--	--
9.2	Pros and cons	7	19	0.42 (0.01, 0.82)*	0.31 (0.13, 0.48)*	0.49	0.626	0.11
9.3	Comparative imagining of future outcomes	2	4	--	--	--	--	--
10.1	Material incentive (behavior)	4	11	--	--	--	--	--
10.2	Material reward (behavior)	16	28	0.21 (-0.09, 0.52)	0.36 (0.17, 0.54)*	0.82	0.413	-0.14
10.3	Non-specific reward	9	12	-0.04 (-0.45, 0.38)	0.37 (0.21, 0.54)*	1.84	0.068	-0.41
10.4	Social reward	9	22	0.41 (0.12, 0.71)*	0.31 (0.13, 0.48)*	0.73	0.468	0.11
10.5	Social incentive	2	4	--	--	--	--	--
10.6	Non-specific incentive	3	8	--	--	--	--	--

10.9	Self-reward	6	8	0.36 (-0.09, 0.81)	0.32 (0.15, 0.49)*	0.18	0.860	0.04
11.2	Reduce negative emotions	16	35	0.43 (0.13, 0.72)*	0.28 (0.08, 0.47)*	0.82	0.413	0.15
12.2	Restructuring the social environment	2	4	--	--	--	--	--
12.3	Avoidance/reducing exposure to cues of behavior	1	4	--	--	--	--	--
12.4	Distraction	2	3	--	--	--	--	--
12.5	Adding objects to the environment	3	4	--	--	--	--	--
13.1	Identification of self as role model	2	2	--	--	--	--	--
13.2	Framing/reframing	19	45	0.33 (0.06, 0.59)*	0.32 (0.13, 0.52)*	0.03	0.979	0.00
13.3	Incompatible belief	1	1	--	--	--	--	--
13.4	Valued self-identity	2	10	--	--	--	--	--
13.5	Identity associated with changed behavior	1	1	--	--	--	--	--
14.1	Behavior cost	2	4	--	--	--	--	--
14.3	Remove reward	1	2	--	--	--	--	--
14.4	Reward approximation	2	3	--	--	--	--	--
15.1	Verbal persuasion about capability	2	6	--	--	--	--	--
15.2	Mental rehearsal of successful performance	4	6	--	--	--	--	--
15.4	Self-talk	16	26	0.38 (0.08, 0.68)*	0.30 (0.12, 0.49)*	0.45	0.654	0.08
16.3	Vicarious consequences	2	8	--	--	--	--	--

Note. BCT = Behaviour Change Technique; # IG = number of intervention groups; # ES = number of effect sizes; CI = confidence interval; -- = not included in analysis due to lack of data; meta-regression with number of BCTs: $F(1,125) = 0.02, p = .900$; meta-regression including all the BCTs that are reported in 5 IG or more: $F(27,99) = 0.79, p = 0.756$.

* $p < 0.05$

Appendix E

BCT analyses for universal interventions

Table D1

Results of BCT analyses for universal interventions based on 142 ESs from 52 intervention groups

BCT No.	BCTs	#IG present	#ES present	ES present (95% CI)	ES absent (95% CI)	t-value	p-value	Difference
1.1	Goal setting (behavior)	6	11	0.10 (-0.14, 0.34)	0.12 (0.03, 0.20)*	0.14	0.889	-0.02
1.2	Problem solving	25	82	0.20 (0.08, 0.31)*	0.03 (-0.08, 0.15)	2.03	0.044	0.17*
1.3	Goal setting (outcome)	5	29	0.08 (-0.18, 0.34)	0.12 (0.03, 0.21)*	0.27	0.785	-0.04
1.4	Action planning	6	12	0.25 (-0.04, 0.54)	0.10 (0.02, 0.20)*	0.96	0.341	0.15
1.5	Review behavior goal(s)	1	1	--	--	--	--	--
1.6	Discrepancy between current behavior and goal	1	1	--	--	--	--	--
1.8	Behavioral contract	5	6	0.09 (-0.16, 0.34)	0.12 (0.03, 0.20)*	0.23	0.818	-0.03
1.9	Commitment	6	20	0.01 (-0.20, 0.22)	0.13 (0.04, 0.22)*	1.08	0.281	-0.12
2.1	Monitoring of behavior by others without feedback	2	21	--	--	--	--	--
2.2	Feedback on behavior	5	27	0.04 (-0.19, 0.28)	0.12 (0.04, 0.21)*	0.64	0.523	-0.08
2.3	Self-monitoring of behavior	3	23	--	--	--	--	--
2.7	Feedback on outcome(s) of behavior	3	8	--	--	--	--	--
3.1	Social support (unspecified)	12	25	0.13 (-0.02, 0.29)	0.11 (0.02, 0.20)*	0.26	0.794	0.02
3.2	Social support (practical)	1	1	--	--	--	--	--
3.3	Social support (emotional)	2	8	--	--	--	--	--
4.1	Instruction on how to perform a behavior	25	84	0.17 (0.06, 0.28)*	0.06 (-0.04, 0.16)	1.64	0.104	0.11
4.2	Information about antecedents	10	56	0.06 (-0.10, 0.21)	0.13 (0.04, 0.22)*	0.88	0.378	-0.08
4.3	Re-attribution	5	14	0.19 (-0.09, 0.47)	0.11 (0.02, 0.20)*	0.54	0.591	0.08

5.1	Information about health consequences	6	33	0.15 (-0.08, 0.38)	0.11 (0.02, 0.20)*	0.35	0.725	0.04
5.3	Information about social and environmental consequences	28	94	0.15 (0.05, 0.26)*	0.06 (-0.06, 0.18)	1.40	0.239	0.09
5.4	Monitoring of emotional consequences	2	21	--	--	--	--	--
5.6	Information about emotional consequences	3	5	--	--	--	--	--
6.1	Demonstration of the behavior	14	38	0.14 (-0.02, 0.29)	0.11 (0.01, 0.21)*	0.29	0.772	0.03
6.2	Social comparison	9	37	0.11 (-0.09, 0.31)	0.12 (0.02, 0.21)*	0.05	0.961	-0.01
6.3	Information about others' approval	5	15	0.07 (-0.18, 0.31)	0.12 (0.03, 0.21)*	0.41	0.681	-0.06
7.1	Prompts/cues	2	4	--	--	--	--	--
8.1	Behavioral practice/rehearsal	38	119	0.16 (0.07, 0.25)*	-0.04 (-0.18, 0.11)	2.42	0.017	0.20*
8.2	Behavior substitution	19	83	0.09 (-0.04, 0.22)	0.13 (0.02, 0.24)*	0.44	0.658	-0.04
8.3	Habit formation	3	3	--	--	--	--	--
8.6	Generalisation of target behavior	6	36	0.16 (-0.07, 0.40)	0.11 (0.02, 0.20)*	0.43	0.669	0.05
9.1	Credible source	6	12	0.19 (-0.11, 0.49)	0.11 (0.02, 0.20)*	0.54	0.590	0.08
9.2	Pros and cons	3	10	--	--	--	--	--
9.3	Comparative imagining of future outcomes	4	16	--	--	--	--	--
10.3	Non-specific reward	6	19	0.17 (-0.07, 0.42)	0.11 (0.02, 0.20)*	0.51	0.611	0.07
10.4	Social reward	7	20	0.07 (-0.14, 0.28)	0.12 (0.03, 0.21)*	0.44	0.661	-0.05
10.5	Social incentive	1	1	--	--	--	--	--
10.6	Non-specific incentive	4	15	--	--	--	--	--
10.9	Self-reward	1	2	--	--	--	--	--
10.11	Future punishment	6	27	0.02 (-0.23, 0.26)	0.13 (0.04, 0.22)*	0.85	0.397	-0.11
11.2	Reduce negative emotions	19	43	0.20 (0.06, 0.33)*	0.07 (-0.04, 0.17)	1.52	0.131	0.13
12.1	Restructuring the physical environment	1	1	--	--	--	--	--
12.2	Restructuring the social environment	6	13	0.07 (-0.11, 0.26)	0.12 (0.03, 0.20)*	0.48	0.632	-0.05

12.3	Avoidance/reducing exposure to cues of behavior	7	33	0.06 (-0.14, 0.27)	0.13 (0.03, 0.22)*	0.54	0.593	-0.06
12.5	Adding objects to the environment	4	8	--	--	--	--	--
13.1	Identification of self as role model	7	36	0.10 (-0.12, 0.32)	0.12 (0.03, 0.21)*	0.11	0.914	-0.01
13.2	Framing/reframing	22	65	0.12 (-0.01, 0.24)	0.11 (0.00, 0.22)*	0.07	0.945	0.01
13.3	Incompatible belief	2	4	--	--	--	--	--
13.4	Valued self-identity	4	24	--	--	--	--	--
14.2	Punishment	4	19	--	--	--	--	--
14.8	Reward alternative behavior	1	9	--	--	--	--	--
15.1	Verbal persuasion about capability	1	2	--	--	--	--	--
15.2	Mental rehearsal of successful performance	4	23	--	--	--	--	--
15.4	Self-talk	6	19	0.17 (-0.07, 0.40)	0.11 (0.02, 0.20)*	0.49	0.628	0.06

Note. BCT = Behaviour Change Technique; # IG = number of intervention groups; # ES = number of effect sizes; CI = confidence interval; -- = not included in analysis due to lack of data

* $p < 0.05$

Appendix F

BCT analyses for targeted interventions

Table E1

Results of BCT analyses for targeted interventions based on 132 ESs from 64 intervention groups

BCT No.	BCTs	#IG present	#ES present	ES present (95% CI)	ES absent (95% CI)	t-value	p-value	Difference
1.1	Goal setting (behavior)	9	27	0.65 (0.10, 1.20)*	0.41 (0.14, 0.68)*	0.77	0.441	0.24
1.2	Problem solving	32	67	0.47 (0.20, 0.75)*	0.43 (0.14, 0.73)*	0.26	0.794	0.04
1.3	Goal setting (outcome)	15	43	0.16 (-0.26, 0.59)	0.57 (0.29, 0.85)*	1.63	0.105	-0.40
1.4	Action planning	9	15	1.00 (0.37, 1.63)*	0.37 (0.11, 0.63)*	1.87	0.064	0.63
1.5	Review behavior goal(s)	2	4	--	--	--	--	--
1.6	Discrepancy between current behavior and goal	2	5	--	--	--	--	--
1.7	Review outcome goal(s)	3	8	--	--	--	--	--
1.8	Behavioral contract	3	13	--	--	--	--	--
1.9	Commitment	5	14	0.07 (-0.76, 0.90)	0.49 (0.24, 0.74)*	0.95	0.343	-0.42
2.1	Monitoring of behavior by others without feedback	3	5	--	--	--	--	--
2.2	Feedback on behavior	21	37	0.60 (0.21, 0.99)*	0.39 (0.10, 0.68)*	0.94	0.347	0.21
2.3	Self-monitoring of behavior	15	35	0.27 (-0.16, 0.69)	0.53 (0.25, 0.80)*	1.05	0.297	-0.26
2.4	Self-monitoring of outcome(s) of behavior	4	5	--	--	--	--	--
2.5	Monitoring outcome(s) of behavior by others without feedback	2	2	--	--	--	--	--
2.7	Feedback on outcome(s) of behavior	7	10	0.75 (0.20, 1.29)*	0.42 (0.17, 0.67)*	1.19	0.238	0.33
3.1	Social support (unspecified)	12	26	0.49 (0.19, 0.78)*	0.45 (0.20, 0.69)*	0.38	0.706	0.04
3.2	Social support (practical)	4	10	--	--	--	--	--
3.3	Social support (emotional)	3	6	--	--	--	--	--

4.1	Instruction on how to perform a behavior	30	57	0.48 (0.19, 0.77)*	0.43 (0.14, 0.72)*	0.33	0.746	0.05
4.2	Information about antecedents	27	63	0.54 (0.25, 0.84)*	0.38 (0.10, 0.66)*	1.09	0.279	0.16
4.3	Re-attribution	12	29	0.47 (-0.03, 0.97)	0.45 (0.17, 0.73)*	0.07	0.942	0.02
5.1	Information about health consequences	3	6	--	--	--	--	--
5.2	Saliency of consequences	2	2	--	--	--	--	--
5.3	Information about social and environmental consequences	28	56	0.42 (0.14, 0.70)*	0.49 (0.22, 0.75)*	0.52	0.606	-0.07
5.4	Monitoring of emotional consequences	3	6	--	--	--	--	--
5.5	Anticipated regret	1	2	--	--	--	--	--
5.6	Information about emotional consequences	5	15	0.47 (0.02, 0.92)*	0.45 (0.21, 0.70)*	0.09	0.926	0.02
6.1	Demonstration of the behavior	18	29	0.66 (0.28, 1.04)*	0.39 (0.12, 0.65)*	1.41	0.162	0.28
6.2	Social comparison	18	33	0.57 (0.11, 1.02)*	0.42 (0.14, 0.70)*	0.56	0.575	0.15
6.3	Information about others' approval	5	9	0.08 (-0.67, 0.83)	0.50 (0.24, 0.75)*	1.04	0.302	-0.42
7.1	Prompts/cues	2	4	--	--	--	--	--
8.1	Behavioral practice/rehearsal	48	92	0.51 (0.25, 0.76)*	0.29 (-0.06, 0.64)	1.36	0.177	0.16
8.2	Behavior substitution	26	58	0.36 (0.06, 0.66)*	0.52 (0.25, 0.79)*	1.07	0.288	-0.17
8.3	Habit formation	2	2	--	--	--	--	--
8.4	Habit reversal	3	4	--	--	--	--	--
8.6	Generalisation of target behavior	16	35	0.54 (0.15, 0.94)*	0.43 (0.16, 0.70)*	0.57	0.571	0.12
8.7	Graded tasks	3	4	--	--	--	--	--
9.1	Credible source	3	4	--	--	--	--	--
9.2	Pros and cons	7	19	0.58 (0.02, 1.14)*	0.44 (0.19, 0.69)*	0.49	0.628	0.14
9.3	Comparative imagining of future outcomes	3	6	--	--	--	--	--
10.1	Material incentive (behavior)	4	11	--	--	--	--	--
10.2	Material reward (behavior)	16	29	0.32 (-0.10, 0.74)	0.50 (0.23, 0.77)*	0.78	0.439	-0.18

10.3	Non-specific reward	10	15	0.37 (-0.20, 0.94)	0.47 (0.21, 0.73)*	0.33	0.742	-0.10
10.4	Social reward	9	22	0.58 (0.21, 0.95)*	0.43 (0.18, 0.68)*	0.90	0.368	0.15
10.5	Social incentive	2	4	--	--	--	--	--
10.6	Non-specific incentive	4	10	--	--	--	--	--
10.9	Self-reward	6	8	0.65 (0.07, 1.23)*	0.44 (0.18, 0.69)*	0.73	0.470	0.21
11.2	Reduce negative emotions	16	36	0.49 (0.06, 0.93)*	0.44 (0.15, 0.73)*	0.21	0.833	0.06
12.2	Restructuring the social environment	2	4	--	--	--	--	--
12.3	Avoidance/reducing exposure to cues of behavior	1	4	--	--	--	--	--
12.4	Distraction	2	4	--	--	--	--	--
12.5	Adding objects to the environment	3	4	--	--	--	--	--
13.1	Identification of self as role model	2	2	--	--	--	--	--
13.2	Framing/reframing	19	45	0.41 (0.04, 0.79)*	0.47 (0.20, 0.75)*	0.29	0.775	-0.06
13.3	Incompatible belief	1	1	--	--	--	--	--
13.4	Valued self-identity	2	10	--	--	--	--	--
13.5	Identity associated with changed behavior	1	1	--	--	--	--	--
14.1	Behavior cost	2	4	--	--	--	--	--
14.3	Remove reward	1	2	--	--	--	--	--
14.4	Reward approximation	2	3	--	--	--	--	--
15.1	Verbal persuasion about capability	2	6	--	--	--	--	--
15.2	Mental rehearsal of successful performance	4	6	--	--	--	--	--
15.4	Self-talk	16	27	0.61 (0.20, 1.02)*	0.41 (0.13, 0.68)*	0.93	0.354	0.21
16.3	Vicarious consequences	2	8	--	--	--	--	--

Note. BCT = Behaviour Change Technique; # IG = number of intervention groups; # ES = number of effect sizes; CI = confidence interval; -- = not included in analysis due to lack of data

* $p < 0.05$