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

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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, DiGuiseppi, 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 Özabaci (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 | *d*[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 $\beta$ 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.

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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 Matzopoulus (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, Lutenbacher, & 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, |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | information for parents, cooperative group work. |
| 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 | 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 | *d*[a] |
|---|---|---|---|---|---|---|---|---|
| Abdulmalik, Ani, Ajuwon, and Omigbodun (2016) | CRCT | N = 40<br>Age (mean) = 12<br>100% male | a) Outcome: Aggression<br>Measure: Teacher Rating of Students' Aggressive Behaviours<br>Type: teacher report<br><br>b) Outcome: Aggression<br>Measure: Self-Rated Aggression Scale<br>Type: self-report | Thinking group<br>6 sessions<br>2 sessions/week<br>40 min/session<br>5 BCTs: 1.2, 4.1, 4.3, 11.2, 15.4 | Waiting list | Targeted | 2 public primary schools in Nigeria | (a) 1.2<br>(b) 0.9 |
| Atria and Spiel (2007) | CRCT | N = 112<br>Age (mean) = 17<br>51% male | Outcome: Bullying<br>Measure: Olweus' Bully/Victim Questionnaire<br>Type: self-report<br>Follow-up:<br>(a) post-test<br>(b) 4 months | Viennese Social Competence training<br>7 months<br>13 lessons<br>1.5h/lesson<br>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<br>(b) 0.22 |
| Baldry and Farrington (2004) | CRCT | N = 239<br>Age (mean) = 13.33<br>58% male | a) Outcome: Bullying<br>Measure: Olweus Bully/Victim Questionnaire ("I bullied others")<br>Type: self-report<br>Follow-up: 4 months | Bulli & Pupe<br>3weeks<br>3h/week<br>6 BCTs: 4.2, 5.3, 6.3, 8.1, 8.2, 13.2 | No treatment | Universal | e) 2 middle schools<br>f) 1 high school in Italy | (a,e) -0.18<br>(b,e) -0.13<br>(c,e) -0.06<br>(d,e) -0.16<br>(a,f) -0.03<br>(b,f) 0.07<br>(c,f) 0.05<br>(d,f) 0.04 |

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

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

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| Booth (1995) | RCT | N = 53<br>Age (mean) = 13.42<br>67% male | a) Outcome: Aggression<br>Measure: Youth Self-Report checklist (Aggression)<br>Type: self-report<br>Follow-up:<br>(c) post-test<br>(d) 4 months<br><br>b) Outcome: Aggression<br>Measure: Teacher's Report Form (Aggression)<br>Type: teacher report<br>Follow-up:<br>(c) post-test<br>(d) 4 months | Chill-out program: anger control training<br>12 sessions<br>45min/session<br>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<br>1 BCT: 3.1 | Targeted | Suburban junior high school in the US | (a,c) 0.56<br>(b,c) 1.01<br>(a,d) 0.25<br>(b,d) 0.63 |
| Bosworth, Espelage, DuBay, Dahlberg, and Daytner (1996); Bosworth, Espelage, DuBay, Daytner, & Karageorge (2000) | CRCT | N = 558<br>6th, 7th and 8th grade<br>46% male | Outcome: Aggression<br>Measure: Modified UT-Health Science Centre Aggression Scale + Conflict Tactic Scale<br>Type: self-report<br>Follow-up: 4 months | SMART Talk<br>16 weeks<br>40min/week<br>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<br>6th grade<br>51% male | Outcome: Physical aggression<br>(a) Any<br>(b) More than 3 times<br>Type: self-report<br>Follow-up: 3 months<br><br>Outcome: Fighting<br>(c) Any<br>(d) More than 3 times<br>Type: self-report | Life Skills Training<br>15 sessions<br>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<br>(b) 0.05<br>(c) 0.13<br>(d) 0.16 |

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| | | | Follow-up: 3 months | | | | | |
| Boulton and Flemington (1996) | CRCT | N = 170<br>Year 7-10<br>52% male | Outcome: Bullying<br>Type: self-report | Sticks and Stones video watching + discussion<br>1 session<br>2 BCTs: 5.6, 9.1 | Standard curriculum | Universal | Semi-rural secondary school in the UK | -0.07 |
| Bunford (2016) | RCT | N = 16<br>Age (mean) = 16.3<br>100% male | a) Outcome: Physical Aggression<br>Measure: Buss-Perry Aggression Questionnaire (Physical Aggression)<br>Type: self-report<br><br>b) Outcome: Physical Aggression<br>Measure: Modified Overt Aggression Scale (Physical Aggression)<br>Type: self-report | Interpersonal Skills Group<br>7 weeks<br>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<br>(b) 0.11 |
| Cappella and Weinstein (2006) | RCT | N = 134<br>Age (mean) = 10.5<br>100% female | a) Outcome: Aggression<br>Measure: Modified Children's Social Behavior Scale (Overt Aggression)<br>Type: peer nominations<br>Follow-up: 3 weeks<br><br>b) Outcome: Aggression<br>Measure: Modified Children's Social Behavior Scale (Overt Aggression)<br>Type: teacher report<br>Follow-up: 3 weeks | Social Aggression prevention program<br>10 sessions in 10 weeks<br>1 session/week<br>40 minutes/session<br>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<br>(b) -0.05 |
| Carraro, Gobbi, and Moè (2014) | CRCT | N = 210<br>Age (mean) = 13.27<br>58% male | Outcome: Physical aggression | Play fighting in physical education<br>4 weeks<br>2 h/week | No treatment | Universal | 2 suburban junior high schools in Italy | 0.61 |

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| | | | Measure: Aggression Questionnaire short version (Physical Aggression)<br>Type: self-report | 3 BCTs: 4.1, 6.1, 8.1 | | | | |
| Castillo, Salguero, Fernández-Berrocal, & Balluerka (2013) | CRCT | N = 590<br>Age (mean) = 13.83<br>48% male | Outcome: Physical aggression<br>Measure: Aggression Questionnaire (Physical Aggression)<br>Type: self-report<br>Follow-up: 6 months | INTEMO program<br>6 months<br>1h/2 weeks<br>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<br>Age (mean) = 13.6 | Outcome: Violence<br>Measure: Australian self-report Delinquency Scale (Violence Risk Behaviours)<br>Type: self-report<br>Follow-up: 6 months | Skills for Preventing Injury in Youth + school connectedness component<br>8 weeks<br>50min/week<br>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<br>Age (mean) = 13.36<br>48% male | Outcome: Bullying<br>Measure: European Cyberbullting Intervention Project Questionnaire (Traditionl Bullying)<br>Type: self-report<br>Follow-up: 6 months | a) Medienhelden long version<br>15 sessions<br>45 min/session<br>8 BCTs: 4.1, 5.3, 6.2, 8.1, 10.3, 11.2, 13.1, 13.2<br><br>b) Medienhelden short version<br>4 sessions<br>90 min/session<br>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<br>(b) 0.14 |

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| Cheng et al. (2008) | RCT | N = 166<br>Age (mean) = 13<br>66% male | a) Outcome: Fighting<br>Type: self-report<br><br>b) Outcome: Fighting with injuries<br>Type: self-report<br><br>c) Outcome: Weapon carrying<br>Type: self-report | Mentoring + home visits + case management + list of community resources<br>Minimum 6 sessions<br>2 to 6 months<br>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<br>(b) 0.19<br>(c) -0.19 |
| Coleman, Pfeiffer, and Oakland (1992) | RCT | N = 52<br>Age (mean) = 15.75<br>74% male | Outcome: Aggression<br>Measure: Behavior Incident Report<br>Type: observation | Aggression Replacement Training<br>10 weeks<br>50h/week<br>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<br>9th grade<br>47% male | a) Outcome: Physical aggression<br>Measure: National Longitudinal Survey of Children and Youth Delinquent Behavior Inventory (3 items)<br>Type: self-report<br>Follow-up: 2 years<br><br>b) Outcome: Physical aggression<br>Measure: National Longitudinal Survey of Children and Youth Delinquent Behavior Inventory (8 items)<br>Type: self-report | Fourth R: skills for youth Relationships + school-level components<br>21 sessions<br>1.25h/session<br>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<br>(b) 0.05 |

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

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| Eron et al. (2002) | CRCT | N = 2181<br>4th grade<br>61% male | Outcome: Aggression<br>Measure: Peer Nomination Inventory (Aggression) + Teacher Report Form (Aggression)<br>Type: peer and teacher report | a) Yes I Can curriculum + teacher consultation<br>16 months<br>1h/week<br>1 BCT: 12.2<br><br>b) Yes I Can curriculum + teacher consultation + small-group training<br>16 months<br>2h/week<br>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<br>(b) -0.62 |
| Espelage, Low, Polanin, and Brown (2013) | CRCT | N = 3616<br>Age (mean) = 11.24<br>52% male | Outcome: Fighting<br>Measure: University of Illinois Fighting Scale<br>Type: self-report | Second Step: Student success Through Prevention<br>15 weeks<br>50 min/week<br>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<br>Age (mean) = 15.17<br>80% male | Outcome: Aggression<br>Type: Observation<br>Follow-up:<br>(a) post-test<br>(b) 2 weeks<br>(c) 1 month | (c) Cognitive behavioural interpersonal problem solving<br>3 weeks<br>2.5h/week<br>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<br>(a,d) 4.08<br>(b,c) 1.84<br>(b,d) 3.96 |

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| | | | | (d) Cognitive behavioural interpersonal problem solving + reinforcement contingent<br>3 weeks<br>2.5h/week<br>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<br>Age (mean) = 11.7<br>50% male | Outcome:<br>(a) Threatening<br>(b) Weapon carrying<br>(c) Threatening with a weapon<br>(d) Fighting<br>Measure: Problem Behavior Frequency Scales (Violent Behavior)<br>Type: self-report<br>Follow-up:<br>(e) Post-test<br>(f) 6 months | Responding in Peaceful and Positive Ways<br>25 weeks<br>50 min/week<br>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<br>(b,e) 0.14<br>(c,e) -0.06<br>(d,e) 0.51<br>(a,f) 0.10<br>(b,f) 0.29<br>(c,f) 0<br>(d,f) 0.05 |
| Farrell, Meyer, Sullivan, and Kung (2003) | CRCT | N = 476<br>Age (mean) = 12.8<br>47% male | Outcome: Violence<br>Measure: Problem Behavior Frequenct Scale (Violent Behaviors)<br>Type: self-report<br>Follow-up:<br>(a) post-test<br>(b) 6 months | Responding in Peaceful and Positive Ways 6th Grade + Responding in Peaceful and Positive Ways 7th Grade + peer mediation<br>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 6th Grade + peer mediation<br>5 BCTs: 4.1, 8.1, 1.2, 15.2, 12.3 | Universal | 2 middle schools in the US | (a) -0.11<br>(b) 0.03 |

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| Farrell, Valois, and Meyer (2002) | RCT | N = 204<br>6th grade<br>55% male | Outcome: Physical Aggression<br>Measure: Problem Behavior Frequency Scale (Physical Agression)<br>Type: self-report<br>Follow-up:<br>(a) post-test<br>(b) 12 months | Responding in Peaceful and Positive Ways 6th grade<br>25 lessons<br>2 lessons/week<br>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<br>(b) 0.01 |
| Feindler, Ecton, Kingsley, and Dubey (1986) | CRCT | N = 21<br>Age range: 13-18<br>100% male | Outcome: Physical Aggression<br>Type: Disciplinary records | The art of self-control<br>12 sessions in 8 weeks<br>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<br>Age (mean) = 10.1<br>50% male | Outcome: Bullying<br>Type: self-report<br>Follow-up:<br>(a) post-test<br>(b) 1 year | Olweus anti-bullying program<br>9 months<br>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<br>(b) -0.10 |
| Flewelling et al. (1999); Ringwalt, Graham, Paschall, Felwelling, and Browne (1996) | RCT | N = 255<br>Age (mean) = 14<br>100% male | Outcome: Weapon carrying<br>Type: self-report<br>Follow-up:<br>(a) 6 months<br>(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)<br>ROP: 7 months (biweekly 2h seminars + mentoring)<br>JTP: 6 weeks<br>JA: 3 months (weekly sessions) | Waiting list | Targeted | US | (a,c) -0.37<br>(a,d) -0.24<br>(b,c) -0.16<br>(b,d) -0.25 |

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| | | | | 7 BCTs: 1.2, 3.1, 4.1, 5.3, 8.1, 8.2, 10.2<br><br>d) SAGE: JTP + JA<br>JTP: 6 weeks<br>JA: 3 months (weekly sessions)<br>3 BCTs: 4.1, 8.1, 10.2 | | | | |
| Foshee et al. (2014) | CRCT | N = 1886<br>Age (mean) = 13.9<br>49% male | Outcome: weapon carrying<br>Type: self-report<br>Follow-up: 1 year | Safe Dates<br>4 months<br>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<br>Age (mean) = 15.85<br>59% male | Outcome: Physical aggression<br>Measure: Aggression Questionnaire (Physical Aggression)<br>Type: self-report | Meditacion Fluir<br>10 sessions<br>1 h/week<br>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<br>Age (mean) = 15.5<br>100% male | Outcone: Violence<br>Measure: Adolescent Drug Abuse Diagnosis (Violent Offenses)<br>Type: self-report<br>Follow-up: 6 months | Botvin Life Skills Training + Prothow/Sith anti-violence + Values Clarification + Treatment as usual<br>9 weeks<br>5h/week<br>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<br>Age range: 13 – 15<br>44% male | Outcome: Bullying<br>Measure: Cyberbullying: Screening of Peer Harassment (Bullying)<br>Type: self-report | Cyberprogram 2.0<br>19 weeks<br>1h/week<br>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 |

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| Gilberg (1982) | RCT | N = 30<br>Age (mean) = 16.46<br>100% male | Outcome: Aggression<br>Measure: Classroom Observation Checklist for Aggressiveness<br>Type: Observation | Cognitive role-taking training<br>8 weeks<br>1h/week<br>3 BCTs: 2.2, 5.3, 8.1 | 1. Telling stories<br><br>2. No treatment | Targeted | School for boys in the US | 0.75 |
| Goldbeck and Schmid (2003) | RCT | N = 50<br>Age (mean) = 10.2<br>50% male | Outcome: Aggression<br>Measure: Child Behavior Checklist (Aggression)<br>Type: parent-report | Autogenic relaxation training<br>8 weeks<br>30 min/week<br>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<br>Age (mean) = 17.45<br>100% female | a) Outcome: Physical Aggression<br>Measure: Aggression Questionnaire (Physical Aggression)<br><br>b) Outcome: Physical Aggression<br>Measure: Peer Conflict Scale (Overt Aggression)<br><br>c) Outcome: Reactive Aggression<br>Measure: Peer Conflict Scale (Reactive Physical Aggression)<br><br>d) Outcome: proactive aggression<br>Measure: Peer Conflict Scale (Proactive Physical Aggression) | Juvenile Justice Anger Management Treatment for Girls + treatment as usual<br>8 weeks<br>2 sessions/week<br>90min/session<br>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<br>(b) 0.74<br>(c) 0.77<br>(d) 0.51 |

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| Goldstein, Dovidio, Kalbeitzer, Weil, and Strachan (2007) | CRCT | N = 12<br>Age (mean) = 15.8<br>100% female | a) Outcome: Aggression<br>Measure: Aggression Questionnaire<br>Type: self-report<br><br>b) Outcome: Physical aggression<br>Measure: Aggression Questionnaire (Physical Aggression)<br>Type: self-report | Anger Management for Female Juvenile Offenders + treatment as usual<br>9 weeks<br>3h/week<br>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<br>(b) 0.78 |
| Gottfredson, Cross, Wilson, Connell, and Rorie (2010); Gottfredson, Cross, Wilson, Rorie, and Connell (2010) | RCT | N = 447<br>Age (mean) = 12.22<br>54% male | Outcome: Aggression<br>Measure: All Star questionnaire<br>Type: self-report | All Stars + homework assistance + leisure activities + attendance monitoring and rewarding<br>30 weeks<br>3 sessions/week<br>3h/session<br>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<br>8th grade<br>62% male | Outcome: Violence<br>Measure: Monitoring the Future survey (5 items)<br>Type: self-report | Building Resiliency and Vocational Excellence<br>6 months<br>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<br>Age (mean) = 17.17<br>50% male | Outcome: Aggression<br>Measure: Behavior Rating Scale (Aggressive Behavior)<br>Type: staff report | Cognitive mediation training<br>12 weeks<br>1h/week | 1. Basic skills sessions<br><br>2. No treatment | Targeted | Juvenile correctional facility in the US | 0.82 |

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| | | | | 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<br>Age range: 11 - 15<br>49.1% male | a) Outcome: Bullying<br>Type: self-report<br>Follow-up:<br>(c) 6 months<br>(d) 18 months<br><br>b) Outcome: Physical Aggression<br>Type: self-report<br>Follow-up:<br>(c) 6 months<br>(d) 18 months | Unplugged<br>12 weeks<br>1 lesson/week<br>50 min/lesson<br>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<br>(b,c) -0.05<br>(a,d) -0.03<br>(b,d) -0.06 |
| Hanewinkel, Isensee, Maruska, Sargent, and Morgenstern (2010) | CRCT | N = 3490<br>Age (mean) = 12.63<br>50% male | Outcome: Bullying<br>Measure: unknown<br>Type: self-report<br>Follow-up: 1 month | Smokefree Class competition: be smart, don't start<br>6 months<br>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<br>Age (mean) = 12<br>45% male | Outcome: Violence<br>Measure: items from delinquency scales<br>Type: self-report<br>Follow-up:<br>(a) post-test<br>(b) 1 year | All stars<br>5 BCTs: 1.3, 1.9, 5.3, 6.2, 6.3 | No treatment | Universal | 14 middle schools in the US | (a) -0.04<br>(b) -0.06 |
| Hecht et al. (2008); Nieri, Apkarian, Kulis, and Marsiglia (2015) | CRCT | N = 581<br>Age (mean) = 11<br>46% male | a) Outcome: fighting<br>Type: self-report<br>Follow-up: 1 month<br><br>b) Outcome: weapon carrying<br>Type: self-report | Keepin' it REAL<br>10 sessions + 5 booster sessions<br>45 min/session<br>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<br>(b) 0.17 |

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

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| | | | | 2.5h/week<br>4 BCTs: 2.2, 6.1, 8.1, 10.3 | | | | |
| Johnston, Rivara, Droesch, Dunn, and Copass (2002) | RCT | N = 631<br>Age (mean) = 16.4<br>65.2% male | Outcome: Weapon carrying<br>Type: self-report<br>Follow-up:<br>(a) 3 months<br>(b) 6 months | Behaviour Change Counselling<br>1 session of 20 minutes<br>3 BCTs: 3.1, 13.3, 15.1 | No treatment | Universal | Emergency department in the US | (a) -0.10<br>(b) 0.19 |
| Jones (1991) | RCT | N = 18<br>Age (mean) = 13.75<br>50% male | Outcome: Aggression<br>Measure: Behavior Incident Report<br>Type: observation | a) Aggression Replacement Training<br>10 weeks<br>3h/week<br>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<br><br>b) Moral reasoning<br>10 weeks<br>1 h/week<br>3 BCTs: 1.2, 6.2, 13.2 | No treatment | Targeted | High school in Australia | (a) 0.75<br>(b) -0.06 |
| Jordans et al. (2010) | CRCT | N = 325<br>Age (mean) = 12.7<br>51% male | Outcome: Physical aggression<br>Measure: Aggression Questionnaire (Physical Aggression)<br>Type: self-report | Classroom-based intervention<br>5 weeks<br>3h/week<br>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<br>$9^{th}$-$11^{th}$ grade<br>50% male | Outcome: Aggression<br>Measure: Scale of Determining Conflict Resolution Behavior (Aggression)<br>Type: self-report | Psychodrama<br>10 weeks<br>1 session/week<br>90-120 min/session<br>4 BCTs: 2.7, 8.1, 11.2, 13.4 | 1. No treatment<br><br>2. Interaction group | Targeted | High school in Turkey | 1.70 |

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

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

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| Kozina (2018) | CRCT | N = 73<br>8th grade<br>47% male | Outcome: Physical Aggression<br>Measure: Aggression Scale for Pupils and Students<br>Type: self-report<br>Follow-up:<br>(a) post-test<br>(b) 6 months | My friends<br>10 workshops + 2 booster sessions<br>1 session/week<br>45 min/workshop<br>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<br>(b) 0.45 |
| Krahé and Busching (2015); Möller, Krahé, Busching, and Krause (2012) | RCT | N = 683<br>Age (mean) = 13.3<br>50% male | Outcome: Physical aggression<br>Measure: unknown<br>Type: self-report<br>Follow-up:<br>(a) 18 months<br>(b) 30 months | Class-based intervention<br>5 weeks<br>1.5 h/week<br>6 BCTs: 2.3, 5.3, 7.1, 8.1, 8.2, 13.2 | No treatment | Universal | 10 secondary schools in Germany | (a) 0<br>(b) -0.14 |
| Lee, Hallberg, and Hassard (1979) | RCT | N = 30<br>9th grade<br>80% male | a) Outcome: Aggression<br>Measure: Self-rated scale<br>Type: self-report<br><br>b) Outcome: Aggression<br>Type: peer nominations | Assertion training<br>8 weeks<br>50 min/week<br>7 BCTs: 1.2, 2.2, 2.3, 6.1, 6.2, 8.1, 15.2 | 1. How to make a decision<br><br>2. No treatment | Targeted | Secondary school in Canada | (a) 1.16<br>(b) 0.08 |
| Li and Chen (2017) | RCT | N = 40<br>Age (mean) = 10.13<br>40% male | Outcome: physical aggression<br>Measure: Aggression Questionnaire (physical aggression)<br>Type: self-report | Neurofeedback training program<br>20 sessions<br>3 sessions/week<br>30 min/session<br>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<br>Age (mean) = 16.68<br>40% male | Outcome: Fighting<br>Measure: United States Youth Risk Behavior Surveillance System (Violence) | Healthy futures<br>5 months<br>1session/month<br>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 |

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

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| Multisite Violence Prevention Project (2014) | CRCT | N = 2780<br>6th grade<br>65% male | a) Outcome: Physical Aggression<br>Measure: Behavioral Assessment System for Children + Problem Behavior Frequency Scale<br>Type: teacher + parent + self-report<br>Follow-up:<br>(c) post-test<br>(d) 2 years<br><br>b) Outcome: Aggression<br>Measure: Behavioral Assessment System for Children<br>Type: teacher-report<br>Follow-up:<br>(c) post-test<br>(d) 2 years | Guiding Responsibility and Expectations for Adolescents for Today and Tomorrow (GREAT) for students + GREAT for teachers<br>1 year<br>20 sessions<br>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<br>(b,c) 0.01<br>(a,d) 0.03<br>(b,d) 0.06 |
| Newton (1994) | RCT | N = 48<br>7th and 8th grade<br>76% male | Outcome: Violence<br>Measure: school referrals<br>Type: official records | Aim high: students helping students (mentoring program)<br>16 weeks<br>1h/week<br>2 BCTs: 3.1, 3.2 | No treatment | Targeted | Urban middle school in the US | 0.72 |
| Nocentini and Menesini (2016) | CRCT | N = 1045<br>Age (mean) = 10.93<br>49% male | Outcome: Bullying<br>Measure: Florence Bullying Scale (perpetration) + Olweus' global key question (bullying) | KiVa<br>10 lessons<br>90 min/lesson<br>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<br>Age (mean) = 11.7 | Outcome: Aggression<br>Type: teacher report | Moment<br>4 weeks<br>20 lessons<br>1 lesson/day | Waiting list | Universal | Middle-schools in the US | 1.21 |

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| | | | | 15min/lesson<br>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<br>Age (mean) = 10.09<br>42% male | Outcome: Aggression<br>Measure: Child Behavior Checklist (Aggression)<br>Type: Teacher report | Master Mind<br>20 lessons<br>4 weeks<br>1 lesson/day<br>15 min/lesson<br>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<br>Age (mean) = 16<br>47.30% male | a) Outcome: Aggression<br>Measure: Teacher's Report Form (Aggression)<br>Type: teacher report<br><br>b) Outcome: Anger-Out<br>Measure: State-Trait Anger Expression Inventory (Anger-Out)<br>Type: self-report | Anger Management for Youth: Stemming Aggression and Violence<br>9 weeks<br>2 sessions/week<br>50 min/session<br>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<br><br>2. Educational videos | Targeted | Alternative education centres in the US | (a) -0.64<br>(b) -0.08 |
| Puskar, Ren, and McFadden (2015) | RCT | N = 179<br>Age (mean) = 15.61<br>48% male | a) Outcome: Physical aggression<br>Type: self-report<br>Follow-up:<br>(c) post-test<br>(d) 6<br>(e) 12 months<br><br>b) Outcome: Anger-out<br>Measure: State-Trait Anger Expression Inventory 2 (Anger-Out) | Teaching Kids to Cope with Anger<br>8 weeks<br>1 h/week<br>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<br>(b,c) -0.02<br>(a,d) 0.07<br>(b,d) 0.11<br>(a,e) -0.08<br>(b,e) -0.00 |

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

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| | | | Measure: Illinois Aggression Scale (Physical Aggression)<br>Type: self-report | | | | | |
| Shetgiri, Kataoka, Lin, and Flores (2011) | CRCT | N = 108<br>9th grade<br>42% male | Outcome: Fighting<br>(a) Last 3 months<br>(b) Last 12 months<br>Type: self-report<br>Follow-up: 1 month | School-based violence and substance use prevention program + field trips and community service<br>7 months<br>40 min/week<br>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<br>(b) -0.16 |
| Shinde et al. (2018) | CRCT | N = 13035<br>9th grade<br>54% male | Outcome: Violence<br>Type: self-report | a) Strengthening Evidence Base on School-Based Interventions for Promoting Adolescent Health Program (SEHER) delivered by counsellor + AEP<br>8 months<br>Several activities each month, one assembly per week<br>3 BCTs: 3.1, 8.1, 10.4<br><br>b) SEHER delivered by teacher + AEP<br>8 months<br>Several activities each month, one assembly per week<br>3 BCTs: 3.1, 8.1, 10.4 | Adolescent Education Program (AEP) | Universal and targeted | Government-run secondary schools in India | (a) 0.21<br>(b) -0.17 |

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| Shlafer, McMorris, Sieving, and Gower (2013); Sieving et al. (2011) | RCT | N = 253<br>Age (mean) = 15.59<br>100% female | Outcome: Violence<br>Measure: Add Health (5 items)<br>Type: self-report | Prime Time<br>18months<br>1 session /week<br>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<br>6th grade<br>49% male | a) Outcome: Physical Aggression<br>Measure: Problem Behavior Frequency Scale (Aggression)<br>Type: self-report<br><br>b) Outcome: Weapon carrying<br>Measure: Problem Behavior Frequency Scale (Weapons-related)<br>Type: self-report<br><br>c) Outcome: Physical aggression<br>Measure: Problem Behavior Frequency Scale (Not weapons-related)<br>Type: self-report | Responding in Peaceful and Positive Ways + Best Behavior program<br>3 school years<br>16 lessons/school year<br>50 min/lesson<br>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<br>(b) -0.05<br>(c) -0.01 |
| Simon, Sussman, Dahlberg, and Dent (2002); Sussman et al. (1997); Sussman, Dent, and Stacy | CRCT | N = 2863<br>Age (mean) = 16.8<br>55% male | a) Outcome: Violence<br>Type: self-report<br>Follow-up: 1 year<br><br>b) Outcome: Weapon carrying<br>Type: self-report<br>Follow-up: 1 year | Project Towards No Drug Abuse<br>3 weeks<br>2.5h/week<br>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<br>(a,f) -0.06<br>(b,m) 0.22<br>(b,f) -0.17 |

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| (2002); Sussman, Dent, Stacy, and Craig (1998) | | | | | | | | |
| Singh (2017) | RCT | N = 126<br>Age (mean) = 13.4<br>56% male | a) Outcome: Physical Aggression<br>Measure: Aggression Questionnaire (Physical Aggression)<br>Type: self-report<br><br>b) Outcome: Aggression<br>Measure: Aggression Questionnaire<br>Type: self-report | Social Cognitive intervention<br>6 weeks<br>1 session/week<br>70 min/session<br>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<br>(b) 0.96 |
| Stallard et al. (2010); Stallard et al. (2013) | CRCT | N = 5761<br>Years 8, 9, 10 and 11<br>53% male | Outcome: Bullying<br>Measure: Olweus Bully/Victim Questionnaire (Bullying)<br>Type: self-report<br>Follow-up:<br>(a) post-test<br>(b) 6 months | Resourceful Adolescent Programme<br>11 sessions<br>1h/session<br>7 BCTs: 1.2, 3.1, 8.1, 8.2, 11.2, 13.2, 13.4 | 1. Standard curriculum with facilitators<br><br>2. No treatment | Universal | 8 schools in the UK | (a) 0.05<br>(b) 0.05 |
| Stevens, Bourdeaudhuij, and Oost (2000) | CRCT | N = 1104<br>Age range: 10 – 16 | Outcome: Bullying<br>Measure: Bullying Inventory (Bullying) + Life in School Checklist (Bully)<br>Type: self-report<br>Follow-up:<br>(a) post-test<br>(b) 1 year | c) Flemish anti-bullying intervention + support from research group<br>4 weeks<br>1.5h/week<br>9 BCTs: 3.3, 4.1, 5.3, 6.1, 8.1, 8.2, 10.1, 13.2, 14.2<br><br>d) Flemish anti-bullying intervention<br>4 weeks | No treatment | Universal | (e) 9 primary schools<br>(f) 9 secondary schools<br>in Belgium | (a,c,e) 0.18<br>(a,d,e) 0.15<br>(a,c,f) -0.21<br>(a,d,f) 0.09<br>(b,c,e) 0.44<br>(b,d,e) 0.52<br>(b,c,f) -0.10<br>(b,d,f) 0.09 |

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| | | | | 1.5h/week<br>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<br>4th grade<br>71% male | Outcome:<br>(a) Reactive Aggression<br>(b) Proactive Aggression<br>Measure: Teacher Rating of Aggression (child version)<br>Type: self-report<br><br>Outcome:<br>(c) Reactive Aggression<br>(d) Proactive Aggression<br>Measure: Teacher Rating of Aggression<br>Type: teacher report<br><br>Outcome:<br>(e) Reactive Aggression<br>(f) Proactive Aggression<br>Measure: Teacher Rating of Aggression (parent version)<br>Type: parent report<br>(h) Mother<br>(i) Father<br><br>g) Outcome: Aggression<br>Measure: Social Information Processing test<br>Type: self-report | Stay Cool Kids<br>8 weeks<br>1 session/week<br>45 min/session<br>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<br>(b) 0.22<br>(c) 0.28<br>(d) 0.30<br>(e,h) 0.32<br>(f,h) 0.18<br>(e,i) 0.11<br>(f,i) 0.3<br>(g) 0 |
| Swaim and Kelly (2008) | CRCT | N = 1492<br>7th and 8th grade<br>47% male | Outcome: Physical aggression<br>Type: self-report | Resolve it, Solve it<br>2 years<br>2 BCTs: 6.1, 12.5 | No treatment | Universal | 6 rural middle schools in the US | (m) -2.19<br>(f) 0.17 |

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| Uzunoglu and Baysan Arabaci (2017) | RCT | N = 16<br>Age (mean) = 16<br>50% male | Outcome: Anger-out<br>Measure: State-Trait Anger Expression Inventory (Anger-Out)<br>Type: self-report | Anger Management Education Program<br>6 weeks<br>1 session/week<br>60 min/session<br>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<br>Age (mean) = 11.2<br>100% male | a) Outcome: Reactive Aggression<br>Measure: Teacher Rating Scale for Reactive and proactive Aggression (Reactive Aggression)<br>Type: teacher-report<br><br>b) Outcome: Proactive Aggression<br>Measure: Teacher Rating Scale for Reactive and proactive Aggression (Proactive Aggression)<br>Type: teacher-report | c) Social cognitive intervention program<br>11 weeks<br>70min/week<br>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<br><br>d) Social skills training<br>11 weeks<br>70min/week<br>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<br>(b,c) 0.17<br>(a,d) 0.17<br>(b,d) -0.51 |
| Wade, Smith, Duncan, and Lubans (2018) | CRCT | N = 361<br>Age (mean) = 12.7<br>100% male | Outcome: Aggression<br>Measure: Aggression Scale<br>Type: self-report | Acting Teens Avoiding Screen Time<br>8 months<br>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<br>Age (mean) = 16.24<br>59% male | Outcome: Aggression<br>Measure: Timeline Follow-Back (1 item)<br>Type: self-report<br>Follow-up:<br>(a) post-test<br>(b) 3 months<br>(c) 6 months | Guided self-change<br>5 weeks<br>1session/week<br>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<br>(b) -0.21<br>(c) -0.39 |

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| Yorgun (2007) | RCT | N = 24<br>9th and 10th grade | a) Outcome: Violence<br>Measure: Violent Behavior Checklist (Physical violence)<br>Type: self-report<br><br>b) Outcome: Proactive aggression<br>Measure: Violent Behavior Checklist (Instrumental violence)<br>Type: self-report | Violence Management training<br>8 weeks<br>2 sessions/week<br>50 min/session<br>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<br>(b) 0.63 |
| Zimmerman (1987) | CRCT | N = 36<br>Age (mean) = 15.75<br>100% male | a) Outcome: Aggression<br>Measure: Behavior Incident Report (aggression intensity)<br>Type: observation<br><br>b) Outcome: Aggression<br>Measure: Behavior Incident Report (aggression frequency)<br>Type: observation | Aggression Replacement Training<br>10 weeks<br>3h/week<br>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<br>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 $\beta$ 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 C2

*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 $\beta$ 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

Table C4

*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 | Salience 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

*$p < 0.05$