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Emotion regulation training as a treatment element for externalizing problems in adolescence: A randomized controlled micro-trial

Lysanne W. te Brinke [a,1,*], Ankie T.A. Menting [a], Hilde D. Schuiringa [a], Maja Deković [b], John R. Weisz [c], Bram O. de Castro [d,2]

[a] Department of Developmental Psychology, Utrecht University, Heidelberglaan 1, 3584, CS, Utrecht, the Netherlands
[b] Department of Clinical Child and Family Studies, Utrecht University, Heidelberglaan 1, 3584, CS, Utrecht, the Netherlands
[c] Department of Psychology, Harvard University, 33 Kirkland Street Cambridge, MA, 02138, United States
[d] Department of Developmental Psychology, Utrecht University, 80125, 3508, TC, Utrecht, the Netherlands

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ABSTRACT

Improving interventions for externalizing problems in adolescence may require determining which treatment elements actually produce change. In this micro-trial, we tested a treatment element addressing one widely-hypothesized mechanism underlying externalizing problems: emotion regulation. We tested whether emotion regulation could be improved via training, whether adolescents who received such training would subsequently show reduced externalizing problems, and which training approach and sequence was most effective. We randomized 108 adolescents with elevated externalizing problems (71.3% boys, M_{age} = 13.66, SD = 1.10) to a control condition or an experimental condition teaching emotion regulation through either a cognitive or behavioral approach, in alternated sequences. Effects of the modules were assessed before and after the modules, and with weekly assessments. The results showed a positive effect of the experimental training on self-reported use of adaptive emotion regulation strategies. However, self-reported externalizing problems decreased more in the control condition than in the experimental condition. No mediation, approach (cognitive versus behavioral) or sequence (cognitive-behavioral versus behavioral-cognitive sequence) effects were found. These findings illustrate that change in a proposed mechanism may not be accompanied by change in targeted problems; this highlights the importance of testing the hypothesized impact of specific treatment elements on targeted mental health problems.

Trial registration: This trial was registered in the Dutch Trial Register (NTR7334, July 10th, 2018) and the study protocol was published (te Brinke, Schuiringa, Menting, Deković, & de Castro, 2018).

1. Introduction

If left untreated, externalizing problems form a serious risk factor for the development of adverse outcomes later in life, such as rejection by peers, school failure, crime involvement and psychopathology (Odgers et al., 2008; Pardini & Fite, 2010). Thus, clinicians need effective interventions to target these problems. Over the past decades, numerous interventions have been developed for externalizing problems in adolescence, but the overall effects of these interventions are only small to moderate (McCart, Priester, Davies, & Azen, 2006), and the effectiveness of youth psychotherapy for externalizing problems has even decreased over time (Weisz et al., 2019). To optimize interventions, it is important to examine not only overall effects of treatment packages, but also specific effects of distinct treatment elements (Chorpita, Daleiden, & Weisz, 2005; Leijten et al., 2015). This randomized controlled micro-trial therefore zooms in on a specific treatment element that targets an important underlying mechanism of externalizing problems: emotion regulation.

Emotion regulation can be defined as the extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying

* Corresponding author.
E-mail addresses: L.W.teBrinke@uu.nl, tebrinke@essb.eur.nl (L.W. te Brinke), A.T.A.Menting@uu.nl (A.T.A. Menting), H.D.Schuiringa@uu.nl (H.D. Schuiringa), M.Dekovic@uu.nl (M. Deković), John_Weisz@harvard.edu (J.R. Weisz), B.Castro@uu.nl, B.Castro@uva.nl (B.O. de Castro).
[1] Present Address: Erasmus School of Social and Behavioral Sciences, Erasmus University Rotterdam, the Netherlands.
[2] Present Address: Department of Developmental Psychopathology, University of Amsterdam.

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emotional reactions (Thompson, 1994). It is a multi-modal construct, that entails both trait-level abilities (e.g., emotion regulation difficulties) and specific adaptive or maladaptive strategies (e.g., reappraisal or rumination) (Aldao, Gee, De Los Reyes, & Seager, 2016). Both trait-level abilities and specific emotion regulation strategies are related to externalizing problems (Röll et al., 2012). Emotion regulation difficulties predict, for example, increases in aggression during adolescence (Herts, McLaughlin, & Hatzenbuehler, 2012; McLaughlin, Hatzenbuehler, Mennin, & Nolen-Hoeksema, 2011), whereas adaptive emotion regulation strategies, such as problem solving, are related to decreases in psychopathology (Aldao & Dixon-Gordon, 2014; de Castro, Merk, Koops, Veerman, & Bosch, 2005).

Aspects of emotion regulation training (e.g., anger management, cognitive problem solving) are incorporated in many evidence-based interventions for externalizing problems in adolescence (Garland, Hawley, Brookman-Frazee, & Hurlburt, 2008; Menting, Albrecht, & de Castro, 2016). Overall, these evidence-based interventions seem to have positive effects (McRae & Gross, 2020). A meta-analysis shows that for children and adolescents with various psychopathological symptoms, psychosocial interventions that include emotion regulation training elements result in decreases in emotion regulation difficulties and increases in (adaptive) emotion regulation skills (Moltrecht, Deighton, Patalay, & Edbrooke-Childs, 2020). In addition, a study among preadolescent boys with externalizing problems showed that the Stop Now and Plan program had a positive effect on emotion regulation skills (Derella, Johnston, Loeber, & Burke, 2019).

Emotion regulation has thus been identified as an important underlying mechanism and treatment target for externalizing problems. Many interventions for externalizing problem are, however, so-called *cocktail treatment packages* (Leijten et al., 2015) that consist of multiple treatment elements, or in other words, multiple sets of clinical techniques or strategies (Chorpita et al., 2005). The effects of these cocktail treatments are typically evaluated with large-scale randomized controlled trials. As a result, our understanding of the "sum of the parts" (i.e., overall effects of treatment packages) is quite extensive, whereas relatively little is known about the "parts that make up the sum" (i.e., emotion regulation training as a treatment element). This is unfortunate, since this knowledge may be used to enhance efficiency and (cost) effectiveness of interventions for adolescents with externalizing problems (Leijten et al., 2015).

Micro-trials have been proposed as a suitable research method to examine the effects of specific treatment elements (Leijten et al., 2015; Lochman, Boxmeyer, Kassing, Powell, & Stromeyer, 2019). These trials can be defined as experimental studies that test the effects of focused environmental manipulations that are designed to suppress specific risk mechanisms (Howe, Beach, & Brody, 2010). The first goal of the current study is, therefore, to examine through a micro-trial design, the direct and indirect effects of emotion regulation training as a treatment element for externalizing problems in adolescence. Given what we already know about the overall effects of interventions that target emotion regulation (Moltrecht et al., 2020), we hypothesized that the experimental emotion regulation training would result in improvements in emotion regulation and decreases in externalizing problems. Moreover, we hypothesized that improvement in emotion regulation would mediate the effects of the experimental training on externalizing problems.

Aside from the fact that interventions for externalizing problems in adolescence include multiple treatment elements, there are also large differences between intervention protocols in the way in which they target emotion regulation (Moltrecht et al., 2020), since different *treatment approaches* (i.e., the modalities in which treatment elements are delivered) are used. Emotion regulation strategies involve either *cognitions* (i.e., cognitive strategies such as reappraisal) or *behaviors* (i.e., behavioral strategies such as distraction) (Naragon-Gainey, McMahon, & Chacko, 2017). Consequently, interventions that target emotion regulation also differ in the degree to which they use a cognitive or behavioral approach (Menting et al., 2016). Some interventions have, for example, a stronger focus on cognitive strategies, and train these strategies through cognitive approaches (i.e., "thought exercises" such as cognitive restructuring), whereas other interventions focus more on behavioral strategies through behavioral approaches (i.e., "behavioral exercises" such as role-play).

The relative effects of these different approaches are, however, not clear. On the one hand, Sukhodolsky, Kassinove, and Gorman (2004) argued that treatment elements that are "more behavioral", are more effective for youth with externalizing problems than elements that are "less behavioral". On the other hand, a meta-analysis by Candelaria, Fedewa, and Ahn (2012) found that anger management interventions for youth that used role-play (a behavioral approach) were relatively ineffective compared to interventions that used, for example, problem solving (a cognitive approach). The second goal of the current study was, therefore, to examine the contrasting hypotheses that: (1) a cognitive approach to emotion regulation training is more effective than a behavioral approach, and (2) a behavioral approach to emotion regulation training is more effective than a cognitive approach.

In line with the variety *between* treatment packages in the way emotion regulation is targeted, there is also variety *within* treatment packages. Cognitive and behavioral approaches are frequently offered in conjunction across different phases of the treatment, without specifying or examining their most optimal sequence. Theoretically, both sequences seem plausible. According to treatment motivation theories (e.g., DiClemente & Velasquez, 2002), cognitive treatment aspects (i.e., considering change) need to precede behavioral aspects (i.e., acting on desired change). Thus, it may be most optimal if a cognitive approach precedes a behavioral approach. Alternatively, learning theories (e.g., Shuell, 1986), imply that abstract cognitive instructions are more easily understood after behavioral exercises have established some initial familiarity with the to-be-learned constructs. Thus, it may also be that it is most optimal if a behavioral approach precedes a cognitive approach. The last goal of the current study was, therefore, to examine the contrasting hypotheses that: (1) it is more effective to receive a cognitive approach before a behavioral approach, and (2) it is more effective to receive a behavioral approach before a cognitive approach.

1.1. Current study

The current study uses a micro-trial design to examine the effects of emotion regulation training as a treatment element for adolescents with externalizing problems. Participating adolescents were randomly assigned to either an experimental or control condition. The experimental manipulation consisted of a manualized experimental emotion regulation training that was developed for the current study, based on emotion regulation elements of evidence-based interventions, and consisted of two modules: a cognitive (Think Cool) and behavioral (Act Cool) module. Adolescents in the experimental condition followed both modules, but the sequence was alternated. The effects of the experimental manipulation were examined with assessments before and after each of the two experimental modules. These pre-post measurements were supplemented with continuing weekly assessments during a baseline period and the two experimental phases/modules, because this enabled us to examine not only whether the experimental group, on average, fared better than the control group, but also whether individual adolescents experienced benefits from the experimental modules. Thus, both inter-individual (between-group) differences and intra-individual (within-person) change were examined.

2. Method

2.1. Design

The design of this study was a randomized controlled parallel-group experiment with two conditions (experimental condition versus control

condition), and two arms in the experimental condition (cognitive-behavioral sequence versus behavioral-cognitive sequence). Participants were recruited from ten Dutch high schools for regular and special education,[3] and randomly assigned to either the experimental or control condition. Randomization took place at the individual level, by means of computer-generated random numbers. Participants in the experimental condition received either first the cognitive and then the behavioral module or the reverse sequence. To minimize contamination between the two sequence groups within schools, individual participants were not randomly assigned to a sequence. Rather, participants from the same school who started with the experimental training at the same time, followed the same sequence. In successive waves at the same school, the sequence was reversed. Ethical approval for this study was granted by an independent medical ethics committee of the University Medical Center Utrecht.

2.2. Eligibility criteria

The following inclusion criteria were used: a subclinical or clinical level of externalizing problems as reported by teachers (externalizing subscale > 84th percentile, T-score > 60) and average or above average intelligence (estimated IQ score > 80). Participants were excluded if they experienced severe Autism Spectrum symptoms as reported by their teacher (autism spectrum score > 98th percentile, Sum-score > 89) and/or if their language, auditory or visual skills were severely hindered (as evidenced by an indication of the school psychologist that the adolescent possessed insufficient Dutch language skills to understand the training and questionnaires, or had an auditory or visual disability).

2.3. Procedure

First, participating schools sent an information letter and consent form to all adolescents who were eligible to participate in the study according to the on-site contact person (typically a school psychologist). After informed consent was obtained from both the adolescent and the parent(s) of adolescents aged 12–15 (for adolescents aged 16 informed consent of a parent was not required), teachers filled out the screening measures. Next, information about the adolescent's IQ was provided by the school. If IQ information was not available, or derived from an intelligence test administered more than 2 years ago, a short IQ test was administered (see screening measures).

Subsequently, adolescents who met the inclusion criteria participated in three phases of the experiment: a baseline phase, first experimental phase, and second experimental phase (see Fig. 1). During the two experimental phases, adolescents in the experimental condition received the cognitive and behavioral experimental module, both consisting of five individual sessions. Data collection consisted of adolescent, teacher, and parent reports (T1 = Pretest, T2 = Posttest phase one, T3 = Posttest phase two), and continuing weekly adolescent self-report measurements (3 weeks during baseline, 7 weeks during phase one, 7 weeks during phase two[4]). Adolescent questionnaires at T1-T3 were administered individually at school by a trained research assistant, whereas teachers and parents filled out the questionnaires on paper/online. Weekly measurements were administered via a smartphone application. At T2 and T3, adolescents received a monetary reward for filling out the questionnaires.

2.4. Participants

The participant flow is displayed in Fig. 1. In total, 152 adolescents were assessed for eligibility. Of these adolescents, 33 adolescents did not meet the eligibility criteria. In addition, 11 adolescents could not participate due to practical issues (e.g., internships outside school). Thus, the total sample consisted of 108 adolescents (71.3% boys, M_{age} = 13.66, SD = 1.10). The majority of adolescents (94.4%) was born in the Netherlands. However, for 60.2% of the sample, at least one parent was born in a different country than the Netherlands, and therefore, these adolescents were considered of non-Dutch ethnicity (Keij, 2000). Of these adolescents, 52% had a Moroccan-Dutch background, 14% a Turkish-Dutch background, 9% an African-Dutch background, and 25% a different ethnic background. The majority of participating adolescents came from low socio-economic backgrounds, with 12.3% of mothers and 10.0% of fathers completing only primary education, and 55.6% of mothers and 52.5% of fathers completing only lower secondary education.

Data availability ranged across assessments from 93.1% to 99.1% percent for adolescent self-reports, from 83.3% to 100.0% for teacher reports, and from 58.3% to 67.6% for parent reports (see Fig. 1). The weekly questionnaire was completed on average on 9 out of the 17 measurement weeks (with 1001 available data points). Little's Missing Completely At Random (MCAR) test showed that adolescent self-reports ($\chi 2/df = 0.98$, $p = .192$), teacher reports ($\chi 2/df = 0.64$, $p = .669$), parent reports ($\chi 2/df = 1.38$, $p = .192$), and weekly measurements ($\chi 2/df = 0.94$, $p = .954$) were missing completely at random.

2.5. Measures

2.5.1. Screening measures

Externalizing problems. Externalizing problems were measured with the broadband externalizing scale of the Teacher Report Form age 6–18 (Achenbach & Rescorla, 2001). This scale consists of 32 items (e.g., "Fights a lot"), rated on a 3-point scale from 0 *(not true)* to 2 *(very true or often true)*. T-scores were constructed, based on the Dutch norm scores (Verhulst & van der Ende, 2001). During the screening of the current study, Cronbach's alpha was .92.

Autism spectrum symptoms. Teachers reported the severity of autism spectrum symptoms with the Autism Spectrum Questionnaire (van der Ploeg & Scholte, 2014). This questionnaire consists of 24 items (e.g., "Exhibits odd, repetitive behaviors"), rated on a 5-point scale from 1 *(totally not agree)* to 5 *(totally agree)*. Percentile scores were based on the Dutch norm scores (van der Ploeg & Scholte, 2014). Cronbach's alpha was .84 in the current study.

Intelligence. Intelligence was assessed with the Wechsler Intelligence Scale for Children (WISC; Kort et al., 2005). A full-scale IQ score from the adolescents' clinical file was used in case the WISC was

[3] In the Netherlands, adolescents with behavioral difficulties follow either "regular education" or "special education". In special education, classrooms are smaller, but children can receive additional support in both types of education. Research shows that children who are placed in either regular or special education schools do not differ prior to placement in social, emotional, behavioral and academic functioning (Zweers, Bijstra, de Castro, Tick, & van de Schoot, 2019). Therefore, the current study included adolescents from both types of education.

[4] In the original design of the study, 3-week breaks were planned after the first and second experimental module (see te Brinke et al., 2018). However, during the data collection, some sessions needed to be rescheduled. As a result, the 3-week break period could not be analyzed as a 'break' period. Therefore, the assessment during these week were added to the experimental phase. Subsequently, to make sure that weekly self-report measurements of the first and second experimental phase were equally long and did not overlap, the data of week 11 and 19 was disregarded.

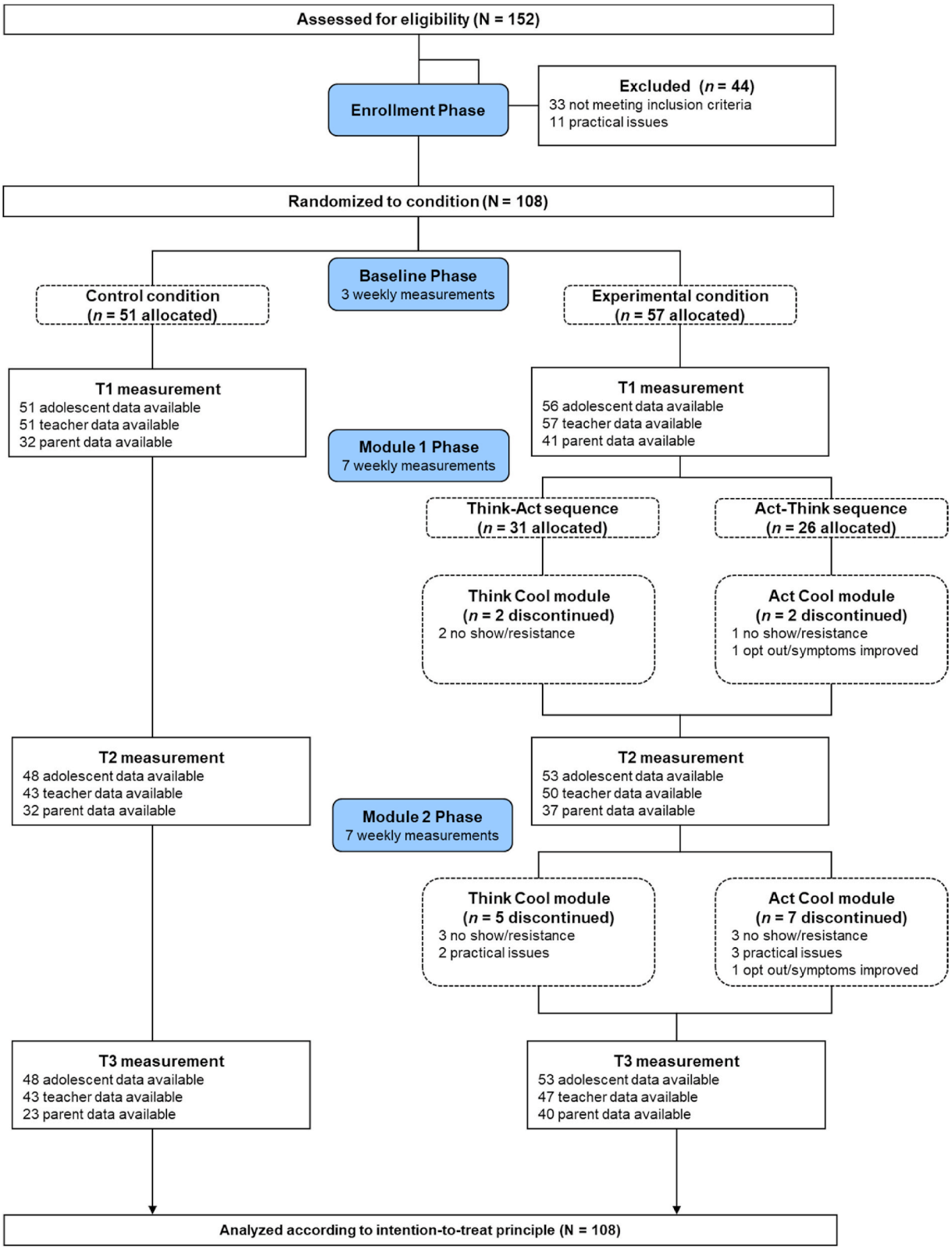

Fig. 1. Participant flow diagram.

administered within 24 months before the start of the study. If this score was not available, the subtests "Block Design" and "Vocabulary" were administered. Subsequently, total-IQ was estimated with the formula for approximation of Full Scale IQ (FIQ; Silverstein, 1970). FIQ estimates are found to be reliable and strongly correlated with the total-IQ (Hrabok, Brooks, Fay-McClymont, & Sherman, 2014). In the current study, FIQ estimates were used for 80% of the adolescents.

2.5.2. T1-T3 emotion regulation measures

Emotion regulation difficulties. Emotion regulation difficulties were

measured with a short version of the Difficulties in Emotion Regulation Scale (DERS; de Castro et al., 2018; Gratz & Roemer, 2004; Neumann, van Lier, Gratz, & Koot, 2010). Adolescents rated 15 items (e.g., "when I am upset, I become out of control") on a 5-point scale from 1 *(almost never)* tot 5 *(almost always)*. Mean scores were constructed, with a higher score being indicative of more emotion regulation difficulties. Cronbach's alpha ranged from 0.89 to 0.91 across measurement moments.

Emotion regulation strategies. The anger scale of the Fragebogen zur Erhebung der Emotions regulation bei Kinder und Jugendlichen (FEEL-KJ; Cracco, van Durme, & Braet, 2015; Grob & Smolenski, 2009) was used to assess emotion regulation strategies. Items (e.g., "If I feel angry… I do something fun") were rated on a 5-point scale from 1 (*never*) to 5 (*almost always*). The questionnaire distinguishes adaptive (14 items) and maladaptive (10 items) emotion regulation strategies. Mean scores were constructed, with a higher score being indicative of more frequent use of adaptive or maladaptive strategies. Cronbach's alpha ranged from 0.86 to 0.93 for adaptive strategies and from 0.71 to 0.76 for maladaptive strategies.

2.5.3. T1-T3 externalizing problem measures

Externalizing problems were assessed from a multi-informant perspective, with the ASEBA-questionnaires (Achenbach & Rescorla, 2001). Adolescents (Youth Self Report), their Teachers (Teacher Report Form), and their Parents (Child Behavior Checklist) completed respectively the 32, 32, and 35 items of the broadband externalizing scale of the Dutch ASEBA versions (Verhulst & van der Ende, 2001). For the teacher pre-test report, the screening scores were used, as the screening took place just before the start of the study. All items (e.g., "Fights a lot/I fight a lot") were rated on a 3-point scale from 0 *(not true)* to 2 *(very true or often true)*. Mean scores were constructed, with a higher score being indicative of more externalizing problems. Cronbach's alpha ranged from 0.84 to 0.89 for adolescent reports, from 0.90 to 0.94 for teacher reports, and from 0.91 to 0.92 for parent reports.

2.5.4. Weekly measures

Emotion regulation difficulties. Weekly emotion regulation difficulties were measured with a 3-item scale, based on the DERS (Gratz & Roemer, 2004). Items (e.g., "how often did you become so angry this week, that you could not control yourself?") were rated on a 5-point scale with the following answer options: 1 (*never),* 2 *(a few times),* 3 *(two to three times),* 4 *(four to five times),* 5 *(more often, …times)*. Cronbach's alpha ranged from 0.82 to 0.87 across measurement phases. The baseline-average score of the weekly emotion regulation scale was significantly positively correlated with the T1-score of the full-scale DERS (see Supplementary materials Table S1).

Aggression. Weekly aggression (hitting, kicking and swearing) was measured with a 3-item scale, based on the YSR (Achenbach & Rescorla, 2001). Items (e.g., "how often did you *hit* someone this week?") were rated on the same 5-point scale as the weekly emotion regulation scale. Cronbach's alpha ranged from 0.77 to 0.81 across measurement phases. The baseline-average of the weekly aggressive behavior scale was significantly positively correlated with the T1-score of the YSR (see Supplementary materials Table S1).

2.6. The experimental training

Participants in the experimental condition received the manualized experimental Think Cool Act Cool emotion regulation training (te Brinke, Albrecht, Matthys, Schuiringa, & Menting, 2017). The training was delivered individually at the participants' school, by an experienced clinician (e.g., clinical psychologist or social worker). The content of the training is based on elements of evidence-based treatments for adolescents with externalizing problems targeting emotion regulation (e.g., Currie, Wood, Williams, & Bates, 2012; Lochman, Wells, & Lenhart, 2008). The training consists of an introduction session and two modules (cognitive "Think Cool" and behavioral "Act Cool"). Both modules consist of 5 individual 45-min sessions, and incorporate a three-step approach of regulating emotions; 1. Emotion awareness, 2. Emotion regulation, 3. Problem solving. In the Think Cool module, these steps are practiced through a cognitive approach, whereas the Act cool module uses a behavioral approach. Care was taken to ensure that both modules are identical in all other ways, such as dosage, timing, structure and lay out of materials. Emotion awareness was practiced with an 'anger thermometer' in both modules, but the modules differed in the use of cognitions or behaviors as anchors. In addition, the modules differed in the regulation strategies that were trained in the cognitive (cognitive distraction, cognitive relaxation, cognitive reappraisal) and behavioral (behavioral distraction, behavioral relaxation, behavioral modification) module. Lastly, problem solving was practiced through cognitive problem solving (i.e., understanding a problem from multiple perspectives, thinking about possible solutions and consequences, choosing the most suitable solution) or behavioral problem solving (i.e., behavioral exercises of specific problem-solving skills such as asking for help). For more information about the content of the training, see te Brinke, Schuiringa, Menting, Deković, & de Castro (2018).

2.7. Care as usual

Participants in both the experimental condition and control condition received care-as-usual (CAU). Thus, the experimental training was added on CAU. Information about CAU was available for 35 adolescents in the experimental condition and 32 adolescents in the control condition (62.0% of the sample). School psychologists indicated that the majority of these adolescents did not receive additional care outside of the school context (experimental condition = 65.6%, control condition = 60.0%). The remaining adolescents either received family-focused care (experimental condition = 11.4%, control condition = 15.6%), child-focused care (experimental condition = 11.4%, control condition = 6.3%), pharmacotherapy (experimental condition = 14.3%, control condition = 6.3%), or were placed in foster care/detention (experimental condition = 2.9%, control condition = 6.3%).

2.8. Exposure and delivery of the experimental training

2.8.1. Exposure

In total, 16 adolescents (28%) in the experimental condition discontinued the experimental training (see Fig. 1). Exposure did not differ between the Think Cool ($M = 3.74$, $SD = 1.78$) and Act Cool ($M = 4.02$, $SD = 1.62$) module ($t(56) = -1.28$, $p = .206$). Adolescents who continued the intervention followed on average 9 out of the 10 sessions.

2.8.2. Delivery

The modules were carried-out by 10 experienced clinicians (clinical psychologists and social workers). Before the start of the study, all participating clinicians received a two-day training course, guided by the developers of the training manual (te Brinke et al., 2017). During the intervention period, care was taken to ensure quality of delivery through ongoing consultation and supervision meetings (for more information, see te Brinke et al., 2018).

To measure whether the experimental modules were delivered as intended, all sessions were audiotaped. Subsequently, 104 randomly selected sessions (23.5% of all delivered sessions) were independently coded by four trained research assistants on two main components of treatment integrity: adherence to the training manual and differentiation between modules (McLeod, Southam-Gerow, & Weisz, 2009). The coding scheme was based on previous studies (e.g., McLeod, Smith, Southam-Gerow, Weisz, & Kendall, 2015; Schuiringa, van Nieuwenhuijzen, de Castro, Lochman, & Matthys, 2017), and all components were rated on a 4-point scale (1 = *totally not,* 2 = *slightly,* 3 = *mostly,* 4 = *totally*). To assess inter-rater reliability, 40% of all coded sessions were coded by two raters.

Adherence to training manual. To measure treatment adherence,

coders rated the degree to which clinicians delivered general session content (e.g., 'Discussed homework assignment', 4 items per session), session-specific content (e.g., 'Performed helping thoughts exercise', 6–13 items per session), and session-specific goals (e.g., 'Adolescent learns to identify problems', 2–3 items per session). Interrater reliability ranged from good (0.63 for general content) to excellent (0.81 for session-specific content) (Cicchetti, 1994). Treatment adherence may be considered good in both modules, with high average percentages scored as 'totally' or 'mostly' for general session content (Think Cool: $M_{\%} = 76.89$, $SD = 27.23$, Act Cool: $M_{\%} = 68.46$, $SD = 27.70$, $F(1,102) = 2.44$, $p = .121$), session-specific content (Think Cool: $M_{\%} = 85.27$, $SD = 19.41$, Act Cool: $M_{\%} = 84.42$, $SD = 24.40$, $F(1,102) = 0.04$, $p = .843$), and session-specific goals (Think Cool: $M_{\%} = 90.88$, $SD = 22.06$, Act Cool: $M_{\%} = 90.85$, $SD = 23.88$, $F(1,102) = 0.01$, $p = .995$).

Differentiation between modules. Treatment differentiation (the extent to which treatment modules differ from one another and/or match their underlying theory; Schulte et al., 2009) was measured by coding both positive differentiation (e.g., 'There was a focus a cognitions/behavior', 3 items per session) and negative differentiation (e.g., 'The clinician included content of the opposing module', 2 items per session). Interrater reliability ranged from good (0.65 for negative differentiation) to excellent (0.77 for positive differentiation). Overall, differentiation between the two modules was high, with trainers displaying high degrees of theoretical focus (positive differentiation scored as 'totally': Think Cool: $M_{\%} = 90.39$, $SD = 24.99$, Act Cool: $M_{\%} = 82.35$, $SD = 25.26$, $F(1,102) = 2.63$, $p = .108$). Moreover, clinicians seemed to include little content of the opposing modules (negative differentiation scored as 'totally not'; Think Cool: $M_{\%} = 88,46$, $SD = 25.47$, Act Cool:

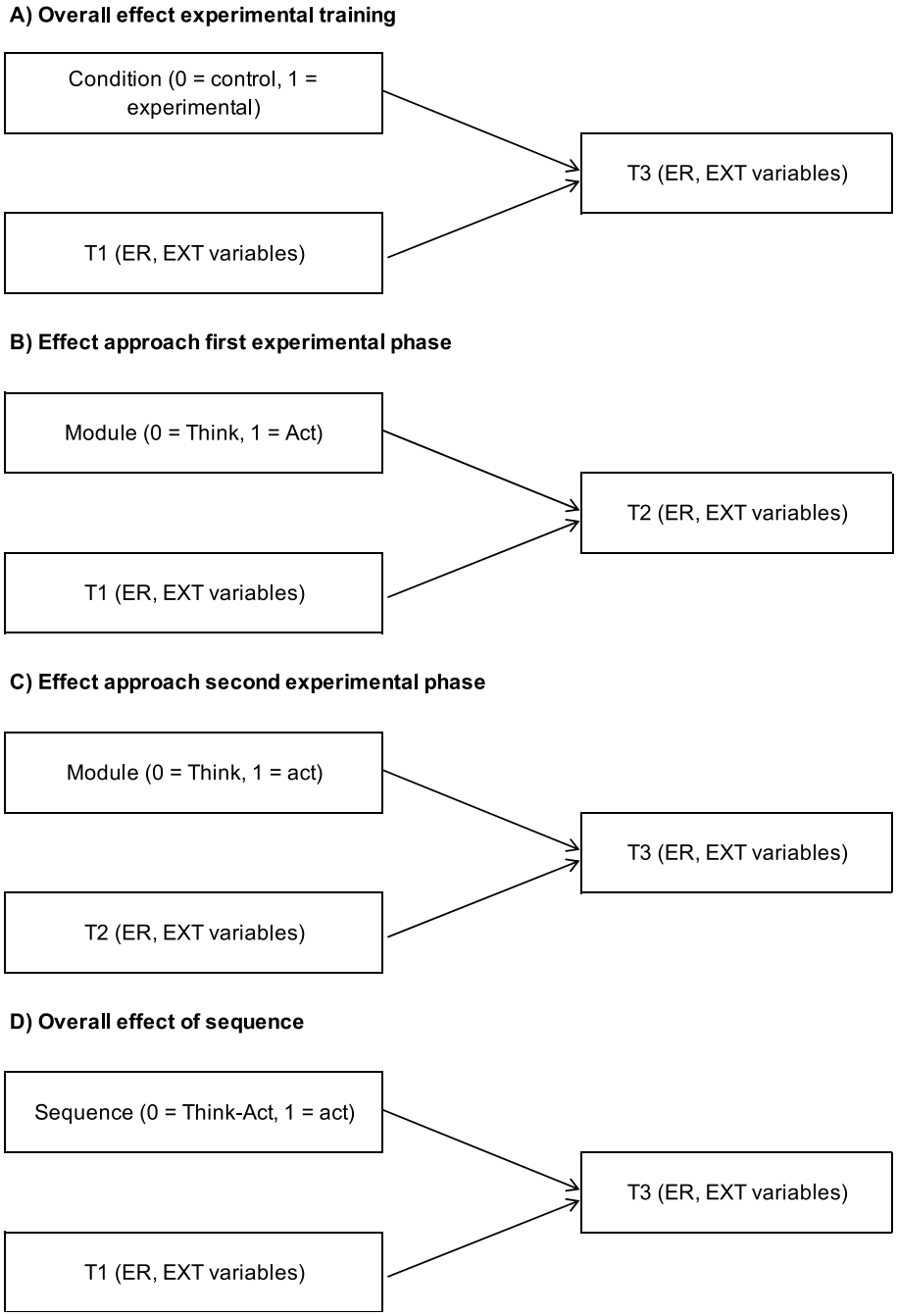

Fig. 2. Graphical display of SEM path analyses.

$M_{\%} = 86{,}28$, $SD = 30.13$, $F(1{,}102) = 0.16$, $p = .691$).

2.9. Data analyses

Differences between the experimental and control condition at baseline were examined with ANOVAs and Chi-square tests. Next, between-group differences between the control condition and experimental condition, and between the Think-Act sequence and Act-Think sequence were examined with a series of Structural Equation Modeling (SEM) path analyses in Mplus version 8.1, using the MLR estimator (Muthén and Muthén, 2017). The analyses were performed for each outcome variable separately. For a graphical display of the path analyses see Fig. 2. The advantage of this approach is that all randomized participants can be included in the analyses, because a Full Information Maximum Likelihood (FIML) estimation approach is used. In addition, the MLR estimator produces standard errors that are robust in the case of a non-normal distribution (Muthén and Muthén, 2017).

To examine whether the experimental emotion regulation training was effective in improving emotion regulation skills and decreasing externalizing problems, T3 was regressed on T1 and condition (0 = control condition, 1 = experimental condition). To examine which approach (Think Cool versus Act Cool) was more effective during the first experimental phase, T2 was regressed on T1 and module (0 = Think Cool, 1 = Act Cool). To examine which approach was more effective during the second experimental phase, T3 was regressed on T2 and module (0 = Act Cool, 1 = Think Cool). To examine whether it is more effective to receive the cognitive module followed by the behavioral module (sequence Think Cool + Act Cool) or vice versa (sequence Act Cool + Think Cool), T3 was regressed on T1 and sequence (0 = Think-Act, 1 = Act-Think). For all regression analyses, effect size estimates were computed as Cohen's *d,* with a two-step approach, as recommended by Feingold (2019). First, the pooled standard deviation was calculated ($\sqrt{(SD^2_{group1} + SD^2_{group2})/2}$), and subsequently, Cohen's *d* was calculated by using the MODEL CONSTRAINT option in Mplus. An effect size of $d = 0.2$ was considered small, $d = 0.5$ medium and $d = 0.8$ large (Cohen, 1992).

To examine whether the effect of condition (0 = control condition, 1 = experimental condition) on externalizing problems was mediated by changes in emotion regulation, mediation analyses were performed in Mplus, using the ANCOVA model as recommended by Valente and MacKinnon (2017). The mediation was estimated as the effect of the experimental training on the change in externalizing problems from T1 to T3 (using latent change score specification), through its effect on the change in emotion regulation from T1 to T3. All parameters were estimated through bootstrapping, generated from 1000 resamples.

Subsequently, within-person change during the Think Cool and Act Cool module was examined with Piecewise Hierarchical Linear Growth Models in HLM8, using the RML estimator (Raudenbush, Bryk, Cheong, & Congdon, 2019). Hierarchical models are best suited to examine trajectories of change, because these models take the nested structure of the data into account, with weekly measurements (Level 1) nested within participants (Level 2) (Tasca & Gallop, 2009). Another advantage of this framework is that it handles unbalanced designs efficiently, allowing the number of observations to vary across participants. Weekly emotion regulation and aggression were entered as dependent variables, and models were examined separately for participants in the control condition, Think-Act sequence and Act-Think sequence, because we were specifically interested in within-person (Level 1) change. All time coefficients were modeled as random effects, which allows for variation across participants.

First, the stability of emotion regulation difficulties and aggression during the baseline period (Week 1–3) was examined, with univariate linear growth models. If the change during baseline was not significantly different from zero (i.e., baseline stability), weekly baseline assessments were coded as "0" in subsequent models, to model the average level of emotion regulation difficulties and aggression before the start of the experimental manipulation. Subsequent weekly assessments were scaled, to represent the change in outcome across a one-unit change in time during the first (Week 4–10) and second (Week 11–17) experimental phase. To examine within-person change during the cognitive and behavioral module, piecewise linear growth models were examined, in which the slopes of the first and second experimental phase were modeled simultaneously.

3. Results

3.1. Preliminary analyses

Correlations among study variables at pretest are displayed in the supplementary materials (Table S1). The two conditions and the two sequence groups did not differ significantly at pretest in demographic or screening variables (Table 1). Moreover, ANOVAs indicated that participants did not differ significantly in emotion regulation or externalizing problems at pretest (Supplementary materials Table S2).

3.2. Between-group differences

Mean scores are reported in Table 2. The results of path analyses for approach and sequence are displayed in Table 3.

3.2.1. Direct effects of the experimental training

There was a significant overall effect of the experimental emotion regulation training, with a small effect size, on adaptive emotion regulation strategies ($\beta = 0.16$, $p = .011$, 95% CI = [0.04, 0.29], $d = 0.32$). Examination of the means (Table 2) shows that from T1 to T3, the use of adaptive emotion regulation strategies increased for adolescents in the experimental condition, but decreased for adolescents in the control condition. Thus, the experimental training resulted in an increase in the reported use of adaptive emotion regulation strategies. There were, however, no significant effects of the experimental training on emotion regulation difficulties ($\beta = 0.05$, $p = .565$, 95% CI = [-0.12, 0.23], $d = 0.10$) or maladaptive emotion regulation strategies ($\beta = 0.08$, $p = .275$, 95% CI = [-0.07, 0.23], $d = 0.16$).

With regard to externalizing problems, there was a significant effect with a small effect size on self-reported externalizing problems ($\beta = 0.13$, $p = .026$, 95% CI = [0.02, 0.25], $d = 0.27$). Examination of the means (Table 2) shows, that from T1 to T3, the decrease in self-reported externalizing problems was, unexpectedly, larger in the control condition than in the experimental condition. There were no significant effects of the experimental training on externalizing problems as reported by teachers, ($\beta = 0.04$, $p = .561$, 95% CI = [-0.10, 0.18], $d = 0.08$) or parents ($\beta = 0.03$, $p = .837$, 95% CI = [-0.22, 0.27], $d = 0.04$).[5]

3.2.2. Indirect effects of the experimental training

Subsequently, we performed mediation analyses. The direct effects of the change in emotion regulation on change in externalizing problems were not significant (see Supplementary Materials Table S3). The indirect effects of the experimental training on self-reported externalizing problems through emotion regulation difficulties ($\beta = 0.01$, 95% CI [0.00, 0.01], $p = .147$), adaptive regulation strategies ($\beta = 0.00$, 95% CI [-0.00, 0.01], $p = .919$), and maladaptive strategies ($\beta = 0.00$, 95% CI [−0.00, 0.01], $p = .295$) were also not significant.

For teacher-reported externalizing problems, the indirect effects for

[5] We conducted post-hoc multi-group analyses in Mplus to check whether school type moderated the main effects of the experimental training. The model constraint option showed that the effect of condition on all outcome variables was not significantly different between school type (0 = regular education, 1 = special education). Thus, the effect of experimental condition did not depend on school context. Results of these analyses are available from the first author upon request.

Table 1
Means, Standard Deviations (in Brackets) and Group Differences for Demographic and Screening Variables for the Control Condition (n = 51) Versus the Experimental Condition (n = 57), and for the Think-Act Sequence Group (n = 31) Versus the Act-Think Sequence Group (n = 26).

	Control condition		Experimental condition				Think-Act sequence		Act-Think sequence			
	M	*SD*	*M*	*SD*	*F*/χ	*p*	*M*	*SD*	*M*	*SD*	*F*/χ	*p*
Externalizing (T-score)[a]	69.02	6.11	68.81	5.00	0.04	.843	69.10	5.78	68.46	3.97	0.23	.636
Autism symptoms (Sum)[b]	73.31	8.23	70.89	10.47	1.75	.188	71.87	10.02	69.73	11.07	0.59	.447
IQ-score	92.88	10.65	91.51	9.74	0.49	.485	93.58	10.55	89.04	8.20	3.20	.079
Age	13.53	1.12	13.77	1.09	1.30	.256	13.87	1.02	13.65	1.16	0.56	.457
Gender (% male)	70.60		71.90		0.24	.878	74.20		69.20		0.17	.678
Ethnicity (% non-Dutch)	66.70		54.40		1.69	.193	48.40		61.59		0.99	.321

Note.
[a] Subclinical threshold T-score = 60, Clinical threshold T-score = 64.

[b] Clinical threshold Sum-score = 89.

Table 2
Means and Standard Deviations (brackets) for Emotion Regulation and Externalizing Behavior at Three Measurement Moments for the Control Condition (n = 51) versus the Experimental Condition (n = 57), and for the Think-Act Sequence Group (n = 31) versus the Act-Think Sequence Group (n = 26).

	Conditions				Sequences		
	Pre-test (T1)	In-between test (T2)	Post-test (T3)		Pre-test (T1)	In-between test (T2)	Post-test (T3)
ER Difficulties							
Control condition	2.47 (0.82)	2.19 (0.72)	2.12 (0.68)	Think-Act sequence	2.60 (0.75)	2.50 (0.88)	2.35 (0.91)
Experimental condition	2.55 (0.83)	2.41 (0.86)	2.23 (0.79)	Act-Think sequence	2.50 (0.93)	2.29 (0.83)	2.06 (0.57)
ER Adaptive strategies							
Control condition	2.66 (0.83)	2.54 (1.01)	2.47 (1.05)	Think-Act sequence	2.77 (0.51)	2.83 (0.74)	2.90 (0.69)
Experimental condition	2.87 (0.66)	2.87 (0.80)	2.94 (0.82)	Act-Think sequence	2.99 (0.80)	2.91 (0.87)	2.99 (0.98)
ER Maladaptive strategies							
Control condition	2.46 (0.69)	2.20 (0.75)	2.15 (0.67)	Think-Act sequence	2.69 (0.60)	2.58 (0.60)	2.51 (0.58)
Experimental condition	2.66 (0.67)	2.43 (0.67)	2.37 (0.64)	Act-Think sequence	2.63 (0.75)	2.25 (0.71)	2.17 (0.67)
EXT Self-reported							
Control condition	0.41 (0.23)	0.36 (0.29)	0.29 (0.22)	Think-Act sequence	0.51 (0.20)	0.45 (0.25)	0.43 (0.25)
Experimental condition	0.48 (0.23)	0.40 (0.25)	0.40 (0.26)	Act-Think sequence	0.45 (0.26)	0.34 (0.25)	0.38 (0.27)
EXT Teacher-reported							
Control condition	0.79 (0.34)	0.76 (0.38)	0.72 (0.41)	Think-Act sequence	0.78 (0.32)	0.67 (0.40)	0.78 (0.45)
Experimental condition	0.78 (0.29)	0.70 (0.42)	0.73 (0.45)	Act-Think sequence	0.77 (0.25)	0.75 (0.45)	0.68 (0.46)
EXT Parent-reported							
Control condition	0.49 (0.32)	0.49 (0.30)	0.42 (0.26)	Think-Act sequence	0.40 (0.25)	0.30 (0.27)	0.36 (0.25)
Experimental condition	0.38 (0.24)	0.32 (0.24)	0.36 (0.25)	Act-Think sequence	0.35 (0.22)	0.34 (0.19)	0.36 (0.27)

Note. ER = Emotion Regulation, measured on a scale from 1 to 5. EXT = Externalizing Problems, measured on a scale from 0 to 2.

Table 3
Between-Group Effects of Approach and Sequence on Emotion Regulation Difficulties and Externalizing problems during the First Experimental Phase (Effect of Module 0 = Think, 1 = Act on T2 with T1 as Covariate), the Second Experimental Phase (Effect of Module 0 = Act, 1 = Think on T3 with T2 as Covariate), and the Total Experimental Phase (Effect of Sequence 0 = Think-Act, 1 = Act-Think on T3 with T1 as Covariate).

	First Experimental Phase			Second Experimental Phase			Total Experimental Phase		
	β [95% CI]	*p*	*d*	β [95% CI]	*p*	*d*	β [95% CI]	*p*	*d*
ER Difficulties	−0.08 [-0.29, 0.13]	.464	−0.15	0.01 [-0.11, 0.12]	.888	0.02	−0.10 [-0.22, 0.02]	.109	−0.21
ER Adaptive strategies	−0.03 [-0.23, 0.17]	.749	−0.06	−0.01 [-0.19, 0.16]	.894	−0.02	−0.04 [-0.27, 0.18]	.722	−0.08
ER Maladaptive strategies	−0.23 [0.50, 0.03]	.086	−0.46	−0.05 [-0.24, 0.13]	.582	−0.10	−0.22 [-0.49, 0.04]	.097	−0.45
EXT Self-reported	−0.10 [-0.29, 0.08]	.281	−0.21	**0.16 [0.05, 0.27]**	**.005**	**0.33**	0.03 [-0.11, 0.17]	.379	0.06
EXT Teacher-reported	0.02 [-0.27, 0.31]	.883	0.04	−0.16 [-0.33, 0.01]	.066	−0.32	−0.08 [-0.25, 0.08]	.327	−0.16
EXT Parent-reported	0.08 [-0.25, 0.41]	.618	0.18	−0.15 [-0.34, 0.04]	.113	−0.30	−0.03 [-0.19, 0.13]	.721	−0.06

emotion regulation difficulties (β = 0.00, 95% CI [-0.02, 0.02], *p* = .842), adaptive regulation strategies (β = - 0.00, 95% CI [-0.02, 0.01], *p* = .008), and maladaptive strategies (β = - 0.00, 95% CI [-0.01, 0.01], *p* = .863) were also not significant.

Finally, for parent-reported externalizing problems, the indirect effects for emotion regulation difficulties (β = 0.00, 95% CI [-0.01, 0.01], *p* = .935), adaptive regulation strategies (β = 0.00, 95% CI [-0.01, 0.01], *p* = .998), and maladaptive strategies (β = 0.01, 95% CI [-0.01, 0.01], *p* = .835) were also not significant. Thus, the effects of the experimental training on changes in externalizing problems were not mediated by changes in emotion regulation.

3.3. Effects of approach

During the first experimental phase, there were no significant effects of approach (Table 3, first column). Thus, adolescents who first received the Think Cool module did not differ at T2 in emotion regulation or externalizing problems from adolescents who first received the Act Cool module. During the second experimental phase, there were no significant effects of approach on the different aspects of emotion regulation (Table 3, second column). There was, however, a significant effect of approach on self-reported externalizing problems. Examination of the means shows that from T2 to T3, adolescents who received the Act Cool

module decreased slightly in self-reported externalizing problems from T2-T3, whereas adolescents who received the Think Cool module increased. This effect was, however, not found for teacher- or parent-reported externalizing problems.

3.4. Effects of sequence

There were no significant effects of sequence (Table 3, third column). Thus, the average change in emotion regulation or externalizing problems from T1 to T3 did not differ between the two sequence conditions.

3.5. Within-person change

The results of the univariate and piecewise growth models are displayed in Table 4, and the mean scores on the weekly measure in Table 5. The participants reported relatively low levels of emotion regulation difficulties and aggression on the weekly measures.

Baseline stability (model A) was established for both emotion regulation difficulties and aggression in all three groups (i.e., control condition, Think-Act sequence, and Act-Think sequence). None of the slopes of the piecewise model (model B) were, however, significantly different from zero. Thus, weekly emotion regulation and aggression stayed stable during the first and second experimental phase.

4. Discussion

In this micro-trial, we examined the overall effects, approach effects (cognitive approach versus behavioral approach), and sequence effects (cognitive-behavioral sequence versus behavioral-cognitive sequence) of an experimental emotion regulation training. The results indicated that the training had a positive effect on the self-reported use of adaptive emotion regulation strategies, but no effects were found for maladaptive emotion regulation strategies and emotion regulation difficulties. Moreover, unexpectedly, the decrease in self-reported externalizing problems was larger in the control condition than in the experimental condition, whereas teacher- and parent reported externalizing behavior problems did not change over time. No systematic effects of approach or sequence were found.

The finding that the self-reported use of adaptive emotion regulation strategies increased for adolescents who followed the experimental training, but decreased for adolescents in the control condition, seems to imply that the emotion regulation skills of adolescents with externalizing problems indeed improve from the treatment element emotion regulation training. This conclusion is in line with previous meta-analytic research (Moltrecht et al., 2020). Contrary to our expectations, however, the training did not have an effect on the self-reported use of maladaptive regulation strategies and trait-level emotion regulation difficulties, whereas previous research suggests that overall effects on emotion dysregulation (i.e., $g = -0.46, -0.52$) might actually be stronger than effects on (adaptive) emotion regulation (i.e., $g = 0.36, 0.43$) (Moltrecht et al., 2020). A possible explanation for the current study's lack of effects on emotion regulation difficulties and maladaptive strategies might be that the experimental training had a stronger focus on enhancing the use of adaptive strategies than on decreasing the use of maladaptive strategies. Participating adolescents did not explicitly learn how they could avoid using maladaptive strategies. Thus, following the intervention, adolescents may have enhanced their emotion regulation repertoire in order to flexibly use adaptive strategies, without diminishing the maladaptive strategies in their repertoire. This explanation is consistent with the idea that it is not the ability to use specific regulation strategies, but the flexibility in adapting regulatory responses across different situations, that is particularly important for psychological well-being (Aldao, Sheppes, & Gross, 2015).

Contrary to our expectations, the experimental emotion regulation training did not have a positive effect on externalizing problems according to parents and teachers. The training had even a small negative effect on self-reported externalizing problems. Moreover, mediation analyses showed that the effects of the experimental training on externalizing problems were not mediated by changes in emotion regulation. Although this is, to our knowledge, the first micro-trial that examined the specific effects of emotion regulation training as a treatment element, these findings are in contrast with research indicating that changes in (adaptive) emotion regulation skills co-occur with changes in externalizing symptoms (e.g., group CBT for childhood irritability; Derella et al., 2019). Several factors could potentially explain the lack of

Table 5
Available Data, Means and Standard Deviations of the Weekly Measure.

			Weekly ER difficulties		Weekly Aggression	
Week number	Phase	% data available	*M*	*SD*	*M*	*SD*
1	Baseline	90%	1.99	0.92	2.12	1.10
2	Baseline	72%	1.95	0.94	2.11	1.02
3	Baseline	70%	1.96	1.07	2.02	1.15
4	Phase 1	56%	1.82	0.85	1.92	1.04
5	Phase 1	64%	1.76	0.78	1.71	0.91
6	Phase 1	58%	1.78	0.93	1.89	1.01
7	Phase 1	57%	1.84	0.94	1.87	0.99
8	Phase 1	53%	1.77	0.92	1.86	0.86
9	Phase 1	44%	1.88	1.06	2.05	1.07
10	Phase 1	45%	1.74	0.97	2.01	1.05
11	Phase 2	44%	1.69	0.82	1.83	0.83
12	Phase 2	48%	1.71	1.00	1.82	0.93
13	Phase 2	43%	1.60	0.87	1.86	0.93
14	Phase 2	41%	1.74	0.96	1.76	0.90
15	Phase 2	30%	1.71	1.01	1.78	0.87
16	Phase 2	29%	1.65	0.71	1.87	1.07
17	Phase 2	25%	1.83	0.74	2.09	1.05

Table 4
Within-person Effects of Change in Weekly Emotion Regulation Difficulties and Aggression during Baseline (Univariate Model A) and During the First and Second Experimental Phase (Piecewise Model B).

	Weekly ER difficulties				Weekly Aggression			
	Coëfficiënt	*SE*	*t* ratio	*p*	Coëfficiënt	*SE*	*t* ratio	*p*
Control group								
Model A: Baseline slope	−0.14	0.07	−2.00	.051	−0.14	0.08	−1.69	.097
Model B: Phase 1 slope	−0.04	0.02	−1.94	.058	−0.02	0.02	−0.91	.367
Model B: Phase 2 slope	0.01	0.02	0.31	.759	0.02	0.03	0.79	.432
Sequence group Think-Act								
Model A: Baseline slope	−0.06	0.08	−0.75	.458	−0.03	0.09	−0.38	.707
Model B: Phase 1 slope	−0.01	0.02	−0.27	.785	−0.02	0.02	−0.77	.445
Model B: Phase 2 slope	−0.01	0.03	−0.25	.803	0.02	0.03	0.61	.547
Sequence group Act-Think								
Model A: Baseline slope	−0.05	0.07	−0.77	.448	−0.19	0.10	−1.87	.074
Model B: Phase 1 slope	−0.04	0.02	−1.68	.106	−0.03	0.03	−1.31	.203
Model B: Phase 2 slope	−0.02	0.02	−0.63	.536	−0.03	0.02	−1.31	.202

positive effects on externalizing problems. First, it may be that the current experimental emotion regulation training was too short to have positive effects on more distal outcomes such as externalizing problems. This interpretation is in line with conceptualizations of micro-trial research, in which a focus on proximal (i.e., skill improvements), rather than distal (i.e., symptom reductions) outcomes is stressed (Leijten et al., 2015). It is thus possible that for externalizing problems, training effects become only apparent sometime after intervention termination, when adolescents have had time to practice the learned skills (Larsson, Andersson, Stern, & Zetterqvist, 2020). Second, it may be that emotion regulation training is, by itself, not sufficient to improve externalizing problems. This might imply that emotion regulation training is only an effective treatment element for externalizing problems when it is combined with other treatment elements (i.e., motivational enhancement), as typically done in evidence-based cocktail treatments (e.g., group interventions; Derella et al., 2019; Lochman et al., 2008). Relatedly, delivery format might also have played a role. In the current study, the experimental modules were delivered individually, whereas many previous cocktail treatments included group delivery. It is possible that group delivery would have produced larger effects, due to opportunities to practice skills directly in interaction with peers. An alternative implication of the present findings may be that emotion regulation training is a non-essential treatment element for externalizing problems. However, before drawing such conclusions, more research is needed that examines the effects of treatment elements through the use of "factorial" (i.e., contrasting emotion regulation with/without motivational interview) or "dismantling" (i.e., removing emotion regulation training as a treatment element) micro-trial designs (Collins, Murphy, Nair, & Strecher, 2005; Leijten et al., 2015).

These explanations do, however, not apply to the current's study's *negative* between-group effect on self-reported externalizing problems. Specifically, we found that the decrease in self-reported externalizing problems was larger in the control condition than in the experimental condition. A possible explanation for this finding may be that some adolescents in the control condition received a more powerful – personalized – intervention (Ng & Weisz, 2016). A recent study shows that interventions for youths with externalizing problems may be most effective when they are delivered in a flexible, transdiagnostic way (Evans et al., 2020). It should be noted, however, that the current's study's experimental emotion regulation training was added on to care-as-usual, and that the majority of adolescents in both the experimental and control condition did not receive additional psychological interventions. Thus, we do not have reason to believe that the control condition was more powerful than the experimental condition.

Alternatively, the unexpected findings for self-reported externalizing problems, may be an artefact of the limited behavior insight that adolescents with externalizing problems may have. Previous research indicated that the general agreement between adolescent self-reports, on one hand, and teacher- or parent-reports of behavior problems, on the other hand, is low (Salbach-Andrae, Lenz, & Lehmkuhl, 2009), and that especially adolescents with clinical levels of behavior problems tend to underreport externalizing problems such as delinquency (Asscher et al., 2014) It is possible that participating adolescents in the current study did not identify their externalizing problems as problematic at pre-test, and that their reference frame subsequently shifted during the intervention (i.e., response shift bias; Rioux & Little, 2020), because both modules included extensive exercises and psycho-education on identifying problematic situations and behaviors. Thus, the current study's findings for self-reported externalizing problems, may also be explained by an increased problem insight, which (some) adolescents in the experimental group could have experienced. Interestingly, our results indicated that during the second experimental phase, adolescents who received the cognitive module on top of the behavioral module, *increased* slightly in their self-reported externalizing problems. Since the cognitive module included a step-wise approach to cognitive problem-solving strategies, and focused on problem-understanding, it may be that this module enhanced the longer-term insight of adolescents into their own externalizing problems.

With regard to effects of approach, no further differences between the cognitive and behavioral approach were found. Thus, for adolescents with externalizing problems, a cognitive and behavioral approach to emotion regulation training may be equally (in)effective. Moreover, the sequence in which the cognitive and behavioral approach were offered, did not have an effect on emotion regulation or externalizing problems. Although findings for approach and sequence need to be interpreted with caution due to the relatively low sample size of the two sequence groups that were included in this set of analyses, these findings may implicate that the treatment modality of emotion regulation training does not matter. The current study's findings do not mean, however, that differences between a cognitive and behavioral emotion regulation training approach are irrelevant for all adolescents with externalizing problems. Differences between cognitive and behavioral approaches to emotion regulation training appear, for example, to be more profound for adolescents with externalizing problems and intellectual disabilities (Brinke, Schuiringa, & Matthys, 2021).

It should be noted that in the current study, individual differences such as cognitive functioning, gender and approach preferences were not taken into account. Moreover, participant inclusion was based on high levels of externalizing problems rather than (cognitive or behavioral) emotion regulation difficulties. For future research, it might therefore be fruitful to match intervention module selection to the assessment of underlying mechanisms. As previous research indicates that girls report to use more cognitive emotion regulation strategies in response to feelings of anger than boys (Brinke, Menting, Schuiringa, Zeman, & Deković, 2021), it may also be interesting to examine whether approach effects (i.e., cognitive versus behavioral treatment approach) are moderated by gender. Another avenue for future research might be to offer adolescents a choice between a cognitive or behavioral approach, since treatment choice might enhance treatment motivation. This suggestion is in line with a study that examined the effects of an individually delivered cognitive-behavioral intervention for depression, in which adolescents were given the choice to start with a cognitive or behavioral focused component (Richardson et al., 2014). After 12-months, adolescents who received the personal approach choice intervention showed greater improvement in depressive symptoms than adolescents who received care as usual.

The current study supplemented between-group analyses with within-person analyses of intensive longitudinal data. Specifically, adolescents reported their weekly emotion regulation difficulties and aggression symptoms via a smartphone application. These data were analyzed on the within-person level, in order to examine whether individual adolescents benefited from the experimental emotion regulation modules. The results showed that weekly emotion regulation and aggression stayed stable during the first and second experimental phase. Thus, with regard to emotion regulation difficulties and aggression, individual adolescents did not seem to benefit from the cognitive or behavioral approach of the experimental emotion regulation training. These findings thus confirm our conclusion from the between-group analyses. At the same time, these findings also indicate that the lack of between-group effects of approach and sequence, may not necessarily be a consequence of the relatively low sample size, since analyses with repeated measurements (i.e., 17 weeks in this study) require fewer participants to reach adequate power (Bolger, Davis, & Rafaeli, 2003).

4.1. Strengths and limitations

Strengths of the current study include the focus on an experimental emotion regulation training, which enabled us to zoom in on specific effects of the treatment element emotion regulation. In addition, the current study included a thorough assessment of treatment adherence and differentiation, and included multiple assessments, which enabled us to examine not only between-group differences, but also within-

person change. Moreover, between-group differences in externalizing problems were measured from a multi-informant perspective, which may specifically be important for adolescents with behavior problems, who may have limited insight into their own behavior problems (Asscher et al., 2014).

In evaluating the findings of this study, some limitations need to be considered. First, it should be noted that although participants were randomly assigned to the control or intervention condition, allocation to the sequence groups was not random. In order to minimize the possibilities for contamination between the cognitive and behavioral approach, participants from the same school started with the experimental training at the same time. The sequence was reversed in successive waves. Although the two sequence groups did not differ at baseline, this design might have limited the power to detect approach and sequence effects, because the analyses on approach and sequence were performed with a relatively small sample size. The sample size was also slightly smaller than originally planned (te Brinke et al., 2018), due to recruitment difficulties. Moreover, multiple separate SEM models were performed, which might have inflated type I error rates. Second, the questionnaire that was used to measure within-person change was not validated, and mean levels on the subscales appeared to be relatively low. Therefore, the possibility cannot be ruled out that the lack of within-person differences between the cognitive and behavioral approach was a consequence of a possible floor effect of the weekly measure. Third, the percentage of adolescents from non-Dutch ethnicity was higher in comparison to the general population (CBS, 2018), and the average socio-economic status of our sample was relatively low (CBS, 2019). Although this could be considered a strength, since these groups of adolescents have an increased risk for the development of externalizing problems (Duinhof et al., 2020), and are historically underrepresented in (mental) health research (e.g., Okazaki & Sue, 1995), this may at the same time limit the generalizability of our findings.

5. Conclusion and implications

Notwithstanding these limitations, the current micro-trial showed, for the first time, that emotion regulation training has a positive impact on the adaptive emotion regulation strategies of adolescents with externalizing problems. On its own, emotion regulation training may, however, not be sufficient as a school-based treatment element for externalizing problems during adolescence, and the modality in which emotion regulation training is delivered (i.e., through a cognitive or behavioral approach), does not seem to matter. These findings highlight the importance of testing specific treatment elements to gauge their individual impact on mental health problems that are targeted in treatment.

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Compliance with ethical standards

This study was performed in line with the principles of the Declaration of Helsinki. Informed consent was obtained from all individual participants included in the study. Ethical approval was granted by the Ethics Committee of the University Medical Centre Utrecht.

Declarations of interest

The authors declare no conflict of interest.

Author statement

LB, AM, HS and BC conceptualized the study; LB conducted and supervised data collection, HS and AM provided guidance; LB analyzed the data and drafted the manuscript; AM, HS, MD and BC provided guidance and feedback on the manuscript; JW critically reviewed the manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.brat.2021.103889.

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