Additional Information on the Methods in the SBO proposal 2018

1. Outcome measures

A distinction is made between primary outcome measures used to evaluate improvement in mental health due to the intervention, secondary outcome measures assessing mechanisms by which mental health is improved, i.e., enhancement of emotion regulation skills, and control measures used to take into account any confounding or moderating factors.

1.1 Primary outcome measures

Child Behavior Checklist (CBCL) / Teacher Report Form (TRF)
Positive And Negative Affect Schedule (PANAS-C)
Kidscreen-27

1.2 Secondary outcome measures (the selected subscales are described in Table 1 below on page 5)

Alexithymia questionnaire (AQ)
Emotion Regulation Index for Children and Adolescents (ERICA)
Emotional Awareness Questionnaire (EAQ)
Children's Emotion Management Scales (CEMS)
Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA)
Questionnaire on Emotion Regulation in Chidren and Adolescents (FEEL-KJ)
Emotion Regulation Checklist (ERC)

1.3 Control measures and descriptives

Structured Clinical Interview for DSM Disorders (SCID-junior)
Wechsler Intelligence Scale for Children, third edition (WISC-III), abbreviated version.
This version is highly correlated with the full IQ score (.92) (Grégoire, 2000).

Children's Depression Inventory-2 (CDI-2)
State-Trait Anxiety Inventory for Children (STAIC)
Perceived Stress Scale for Children (PSS-C)
Self Perception Profile for Children (SPPC) or Self Perception Profile for Adolescents (SPPA)

Effortful Control Scale (ECS): age not specified, but research has shown children as young as 8 years to be able to complete this questionnaire (Wiersema & Roeyers, 2007).
Experiences-in-Close-Relationships-Scale-Revised- Child- version (ECR-RC)
Behavior Rating Index of Executive Function (BRIEF)
Child and Adolescent Service Intensity Instrument (CASII)

Adult Self Report (ASR)
Parent State-Trait Anxiety Inventory (STAI)
Parenting Stress Index (PSI)
Questionnaire on Emotion Regulation in adults (FEEL-E)
Beck Depression Inventory (BDI)
Parent Positive And Negative Affect Schedule (PANAS)

1.4 References

Adult Self Report (ASR). Achenbach, T.M. & Rescorla, L.A. (2003). Manual for the ASEBA Adult Forms & Profiles. Burlington, Vermont: University of Vermont, Research Center for Children, Youth, & Families.

Alexithymia questionnaire. Rieffe, C., Oosterveld, P., & Meerum Terwogt, M. (2006). An alexithymia questionnaire for children: Factorial and concurrent validation results. *Personality and Individual Differences, 40*, 123-133.

Beck Depression Inventory –II (BDI-II). Beck, A.T., Steer, R.A., Brown, G.K. (2002). BDI-II-NL handleiding. De Nederlandse versie van de Beck Depression Inventory - second edition. Lisse: Swets en Zeitlinger. Nederlandse vertaling en bewerking: A.J.W. van der Does.

Behavior Rating Index of Executive Function (BRIEF). Gioia, G.A., Isquith, P.K., Guy, S.C., Kenworthy, L. (2000). Behavior rating inventory of executive function. Child Neuropsychology, 6, 235–8.

Child and Adolescent Service Intensity Instrument (CASII). Fallon, T., Pumariega, A., Sowers, W., Klaehn, R., Huffine, C., Vaughan, T., et al. (2006). A level of care instrument for children's systems of care: construction, reliability and validity. *Journal of child and family studies, 15*, 143-155.

Child Behavior Checklist (CBCL). Achenbach TM, Rescorla LA. Manual for the ASEBA school-age forms & profiles Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families; 2001.

Children's Depression Inventory (CDI-2). Bodden, D., Braet, C., & Stikkelbroek, Y. (2016). CDI-2 Screeningsvragenlijst voor depressie bij kinderen en jongeren. Amsterdam: Hogrefe Uitgevers B.V. Original: Kovacs, M. (2004). Children's Depression Inventory 2. Toronto, Canada: Multi-Health Systems Inc.

Children's Emotion Management Scales (CEMS). S. Zeman, J., Shipman, K., & Penza-Clyve, S. (2001). Development and initial validation of the Children's Sadness Management Scale. *Journal of Nonverbal Behavior, 25,* 540–547.

Experiences-in-Close-Relationships-Scale-Revised- Child- version (ECR-RC). Brenning, K., Soenens, B., Braet, C., & Bosmans, G. (2011). An adaptation of the Experiences in Close Relationships Scale-Revised for use with children and adolescents. *Journal of Social and Personal Relationships, 28*, 1048-1072.

Effortful control scale (ECS). Lonigan, C. J., & Phillips, B. M. (2001). Temperamental influences on the development of anxiety disorders. In M. W. Vasey, & M. R. Dadds (Eds.), The developmental psychopathology of anxiety (pp. 60–91). New York: Oxford University Press.

Emotional awareness questionnaire (EAQ). Rieffe, C., Meerum Terwogt, M., Petrides, K.V., Cowan, C., Miers, A.C., Tolland, A. (2007). Psychometric properties of the Emotion Awareness Questionnaire for children. *Personality and Individual Differences, 43*, 95-105.

Emotion regulation questionnaire-CA (ERQ-CA). Gullone, E., & Taffe, J. (2012). The Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA): A psychometric evaluation. *Psychological Assessment, 24*, 409-417.

Emotion Regulation Index for Children and Adolescents (ERICA). MacDermott, S.T., Gullone, E., Allen, J.S. et al. (2010). *Journal of Psychopathology and Behavioral Assessment, 32*, 301.

FEEL-E. Grob, A. & Horowitz, L.M., Fragebogen zur Erhebung der Emotionsregulation bei Erwachsenen (FEELE). (2010). Bern: Huber.

FEEL-KJ. Grob A, Smolenski C. Fragebogen zur Erhebung der Emotionsregulation bei Kindern und Jugendlichen (FEEL-KJ). Bern: Huber Verlag; 2005./ FEEL-KJ. Cracco E, Van Durme K, Braet C (2015) Validation of the FEEL-KJ: An Instrument to Measure Emotion Regulation Strategies in Children and Adolescents. PLoS ONE 10(9): e0137080. https://doi.org/10.1371/journal.pone.0137080

KIDSCREEN-27. The KIDSCREEN Group Europe. (2006). The KIDSCREEN Questionnaires - Quality of life questionnaires for children and adolescents. Handbook. Lengerich: Pabst Science Publishers.

Positive And Negative Affect Schedule (PANAS/PANAS-C). Ebesutani, C., Regan, J., Smith, A, Reise, S., Higa-McMillan, C. & Chorpita, B. (2012). The 10-Item Positive and Negative Affect Schedule for Children, Child and Parent Shortened Versions: Application of Item Response Theory for More Efficient Assessment. *Journal of Psychopathology Behavioral Assessment*, *34*:191–203.

Parenting Stress Index (PSI). Nijmeegse Ouderlijke Stress Index (verKort) (NOSIK). Brock, A.J.L.L. de, Vermulst, A.A., Gerris, J.R.M. & Abidin, R.R. (1992). NOSI, Nijmeegse Ouderlijke Stress Index. Experimentele versie. Handleiding. Lisse: Swets & Zeitlinger.

Perceived Stress Scale forChildren (PSS-C). White, B. P. (2014). The Perceived Stress Scale for Children: A Pilot Study in a Sample of 153 Children. *International Journal of Pediatrics and Child Health, 2*, 45-52.

Structured Clinical Interview for DSM Disorders (SCID-junior). Braet C, Wante L, Bögels SM, Roelofs J. SCID-Junior. Unpublished manuscript. 2015.

Self Perception Profile for Adolescents (SPPA). Harter S. The Self-Perception Profile for Adolescents. Unpublished Manual, University of Denver; 1988.

Self Perception Profile for Children (SPPC). Veerman J., Straathof M., Treffers P., Van den Bergh B., ten Brink L., Harcourt, Lisse, 2004,
Bewerking van het Self Perception Profile for Children van S. Harter (1985).

State-Trait Anxiety Inventory (STAI). Spielberger, C.D., Gorsuch, R.L., Lushene, R., Vagg, P.R., Jacobs, G.A., 1983. Manual for the State-Trait Anxiety Inventory. Consulting Psychologists Press, Palo Alto, CA.

State-Trait Anxiety Inventory for Children (STAIC). Spielberger, C. D., Edwards, C. D., Lushene, R. E., Montuori, J. and Platzek, D. 1973. Preliminary test manual for the State–Trait Anxiety Inventory for children, Palo Alto, CA: Consulting Psychologists Press, Inc.

Teacher Report Form (TRF). Achenbach, T. M. (1991). Manual for the Teacher's report form and 1991 profile. Burlington, VT: University of Vermont.

Wechsler Intelligence Scale for Children, third edition abbreviated (WISC-III). Wechsler, D. (1991). Wechsler Intelligence Scale for Children (3rd ed.). New York: Psychological Corporation. Grégoire, J. (2000). L'évaluation clinique de l'intelligence de l'enfant: Théorie et pratique du WISC-III. Liège: Mardaga.

Table 1: Overview SBO measures+ age range

Participant	Informant	Instrument	Age	Measure	WP1	WP2	WP3
Child	Child	STAIC	9-12	State-Trait Anxiety	x	x	x
		CDI-2	8-21	Depression	x	x	x
		PANAS-C	7-14	Positive Afffect/Negative Affect	x	x	
		ECS	8+	Effortful Control Scale	x		x
		AQ	9-15	Alexithymia	x		
		ERICA	9-16	Emotional control, emotional awareness	x	x	x
		EAQ	9-15	Emotional awareness	x	x	x
		CEMS	6+	Suppression, dysregulation, coping	x	x	x
		ERQ-CA	10-18	Reappraisal, supression	x	X	x
		FEEL-KJ	4-16	ER strategies	x	x	x
		PSS-C	5-18	Stress	x		
		WISC-III	6-16	IQ	x	x	x
	Parent	CBCL	6-18	Behavioral/emotional problems	x	x	x
		Kidscreen-27	8-18	Quality of life	x	x	x
		SCID-junior	8-17	DSM-5 based clinical interview	x	x	x
		BRIEF	5-18	Executive functioning	x		x
		PSI	N/A	Parental stress		x	
		ERC	6-12	Lability/negativity, ER	x	x	x
		FEEL	18-65	ER strategies parents		x	
		PANAS	18+	Positive/negative affect		x	
	Teacher/caregiver	TRF	6-18	Behavioral/emotional problems	x	x	x
		CASII	6-18	Level of care	x		
Parent	Parent	BDI-II	18+	Depression		x	
		STAI	14-69	State-trait anxiety		x	
		ASR	18-59	Behavioral/emotional problems		x	

2. Additional Information on the Studies in Work Package 2

Study II.1: Before the experimental challenges of arousal induction, a **validation and baseline assessment** is necessary. During a baseline of 10 minutes, children and their mothers will watch a neutral video clip while we are simultaneously recording (from both) the pupil size and heart rate (including RSA). After this baseline, we will also ask them to complete a modified heartbeat detection task. In the standard version of this task, the heart rate is recorded and participants have to estimate the amount of heartbeats within a given interval. Commonly 3 intervals of varying length (e.g., 20 seconds, 30 seconds, or 45 seconds) are provided. To increase reliability, particularly in youths, in a previous study we doubled the amount of trials (i.e., 2 for each interval) with solid findings [55]. After calculating the resulting Physiological Level Variables' (PLVs) synchrony indexes from these baseline measures, validation will be tested by comparing these to ER measures.

<u>The goal of studies 2, 3, and 4 is to elicit arousal at different levels of processing, namely on the physiological/biological, the affective, and the cognitive levels.</u>

Study II.2: This study will use **the startle task (ST**), a well-known and validated task in both children [73] and adults [74], to probe the initial physiological response to an occurring stressor, thus *biological arousal*. Using a standard variant of this task, all participants will encounter auditory startle probes (white noise at 95DB, 15-20 trials) via headphones during simultaneous positive and negative picture presentations (35 pictures per category). These positive, negative, and neutral pictures will be presented for 8 seconds duration each, will be age-appropriate and will be drawn from the updated International Affective Picture System (IAPS). Jittered intertrial intervals between the stimuli will allow participants' physiology to return to baseline. Startle probes will appear intermittent and not contingent on the valence of the picture. During this task, synchrony will be assessed by simultaneously recording from the child-mother dyad whereas only the child will perform the startle task. The goal is to assess to what extent mothers are synchronized and 'feel' the startle of their child, also in response to the differently valenced picture categories.

Study II.3: This experiment will probe arousal on the *cognitive* level by asking the child-mother dyad to watch **unsolvable puzzles**, which have previously been described to increase arousal [75]. The dyad will then be asked to discuss possible solutions to these puzzles. During the watching period and the discussion time, PLVs (cf. study 1) will be recorded and compared against self-reported ER strategies used during the challenge.

Study II.4: This experiment probes *affective arousal*. Specifically, during this arousal challenge, the dyad will watch short child-age-appropriate **film clips that have emotion inducing properties. We have already worked with short film clips in the lab and tested these.** These include

clips from nature documentaries or popular clips from movies (e.g., Wall-E, Nature documentaries). The dyad will watch positive, sad, and neutral clips and will be asked to discuss it afterwards. Each clip will be shown for around 8 minutes.

Importantly, **during the re-rest at time point 2**, the child will be required to apply the acquired emotion regulation (ER) skills since time point 1 during the same tasks and challenged. The main hypothesis is that comparing the PLVs during posttest with PLVs at pretest will demonstrate better ER after SS-ERT (hypothesis 3) whereby SS-ERT+EC will be compared with SS-ERT only (hypothesis 4). During the post-test and to avoid habituation effects, participants will encounter new stimuli during each challenge, also from each respective emotional category, and will be asked to apply their skills to these.

Study II.5: Moderator analyses will evaluate for each of the tasks if the synchrony index at Time 1, act as moderator in the RPCT in year 4 (hypothesis 5, Study 5).

3. Additional Information on the Studies in Work Package 3

Study II.6-8: Flexibility studies. The tasks that we will use to test the flexibility hypotheses are based on tasks that already have been successfully applied in our earlier work in children or adapted from paradigms that were successfully used in prior research. As in WP2, before the tasks children will be asked to sit still and relax and to watch a neutral video clip, while resting EEG, pupil size and heart rate (HR) are recorded providing baseline measurement. Total duration of the test session, including physiological preparation and breaks is less than 2 hours. After completion, children will rate the pictures on valence and arousal using the computer based Self-Assessment Manikin. In study 6-8, ERP measures and analyses will form the main focus, while supplemented with indices of arousal (HR, pupil size).

Study 6: A computer version of a cued task-switching paradigm, which incorporates the Wisconsin Card Sorting Test (WCST). On every trial, the child sees 1 card (of 24 target cards) below on the computer screen and has to press a button corresponding with one of the 4 cards shown in the above half of the screen, based on a certain rule (shape, colour, number), which is not known beforehand. The instruction is to find the sorting rule. When the right rule is applied, positive feedback in the form of a smiling smiley icon is presented. If the child fails to apply the right rule, a sad smiley icon is presented on the screen. Every trial is preceded by a cue signaling either to repeat the rule used on the previous trial or to switch to a different one. Switch costs (the difference in reaction time between switch and repeat trials), cue-related (e.g., cue-P3) and feedback-related ERPs (e.g., feedback-related negativity: FRN) will be measured and analyzed. These measures will inform us about *cognitive flexibility, external feedback processing, and anticipation of switching task rules*. For all details of the task, see [76].

Study 7: A cognitive reappraisal task. We will use a task similar to the task applied in our earlier work in children [37, 70] with slight adaptations. In the original task, children have to watch different pictures with a negative valence (chosen from The International Affective Picture System (IAPS)), suitable for children [37, 70] presented on the computer screen, and are instructed to down-regulate their negative emotions via cognitive reappraisal when viewing these pictures. Pictures are shortly presented on the screen followed by a short auditory story providing either a negative or a neutral interpretation after which the same picture is presented again. An example of a negative interpretation is "this is an angry aggressive dog"; and of neutral interpretation "this dog is brown". Differences in brain responses to the pictures after hearing negative and neutral interpretations (late positive potential: LPP) informs about the success of cognitive reappraisal in down-regulating emotional reactivity to the presented picture. In the current version, we will use short simple stories to keep the load on working memory low, which ensures suitability of the task for young children [84]. In addition, in contrast to our earlier work, the tasks will consist of 2 separate blocks. In the first block, 50% of the trials will start with the presentation of a negative picture, followed by a negative or neutral interpretation, in turn followed by presentation of the same picture (similar procedure as in our original studies). However, here we will introduce neutral pictures in the other 50% of trials, followed by a neutral or positive interpretation, in turn followed by the same picture, which enables to test *children's ability to down-regulate negative emotions and to up-regulate positive emotions.* In the second block, only the pictures with negative valence used in the first block will be presented (twice, once with a neutral, once with a negative interpretation). In contrast to block 1, a trial starts with a fixation cross, followed by either a neutral or negative auditory interpretation of the picture to be presented, in turn followed by a cue (circle) which stays for 6s on the screen, finally followed by a picture with a negative valence. Children are instructed to apply the interpretation that they heard when the circle appears on the screen. In contrast to block 1, where in a trial the same picture is presented before and after interpretation, this approach enables us to better investigate *the ability to apply cognitive reappraisal in anticipation of negative events (stimulus preceding negativity: SPN), or anticipatory ER.*

Study 8: The responsiveness to internal feedback task (RIFT) [67]. As this task has not been used in children yet, we will first pilot this task in a group of children, who do not participate in one of the other studies or in the training, and make adaptations if needed. In this task, children watch pictures with a negative valence presented on a computer screen and are instructed to down-regulate their emotions elicited by these pictures (pictures again chosen from the IAPS). However different from the cognitive reappraisal task, now they can choose to switch to another strategy, namely distraction, if they think that they do not succeed in down-regulating their negative emotions. Reappraisal (reframing a situation's affective meaning) and distraction (disengagement of attention from affective meaning) were chosen because these are two very commonly used ER strategies. The negative valence of the presented pictures will be varied in intensity across trials. This is done because reappraisal has been shown to be more effective when negative valence is relatively low, while distraction is more effective in case of higher levels of negative valence, hence switching to distraction when negative valence

is high, reflects adaptive ER flexibility [67]. In contrast to the original paradigm used in adults, children will hear a neutral interpretation of the picture that will appear (as is done in our cognitive reappraisal task). Children are instructed to use cognitive reappraisal on each trial, while they receive later during the trial the option to maintain this strategy or to switch to a distraction strategy when they feel they do not succeed down-regulating their negative emotions. Pictures remain on the screen for 8s, after 4s a short during tone is presented after which children can choose to stick to reappraisal or to switch to distraction by pressing the spacebar. This will cause 4 smaller neutral pictures to appear in the 4 corners of the screen enabling disengagement of attention from affective meaning, while the central picture remains on the screen for the remainder of the picture presentation. By investigating heart rate deceleration and brain activity reflecting emotional reactivity (e.g., LPP) before choices to stick to cognitive reappraisal and choices to switch to distraction, *will inform us about whether children will switch ER strategies and crucially whether they switch strategies in response to internal feedback.* Interoceptive sensitivity is a necessary but not sufficient condition for this latter aspect. The study by Birk & Bonanno [67] showed that adults generally switched ER strategies in accord with internal feedback and that switching in this manner was supportive of well-being, while it diminished well-being if switching was unrelated to internal feedback.

Study 9: Validation study. During a study with the heartbeat-counting task during 3 intervals with a beforehand-unknown length, heartbeat is recorded. The accuracy of counting one's heartbeat provides a measure of IS, which reflects *the ability to monitor internal bodily signals*, which has been linked to ER in prior research [55]. See [77] for details. Results will be correlated with the results of the flexibility tasks, well-being and with ER measures to test the validation hypothesis.

Study 10: Moderator analyses. We will use moderator analyses to evaluate for each of the tasks whether the flexibility measures act as moderators in the RPCT in year 4 (the moderator hypothesis).