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A brief version of the Scale of Emotional Development – Short

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Abstract

Background The *Scale of Emotional Development – Short* (*SED-S*) captures the level of emotional development in persons with a disorder of intellectual development (DID) with 200 items on five developmental levels. The study aims to develop a brief version of the SED-S.

Methods Based on item analysis (proportions, χ^2-test, Spearman's ρ and corrected item–total correlation), a brief version of the SED-S was developed in a sample of 224 adults with a DID (n_1) and validated in a second independent matched sample (n_2 = 223).

Results Item reliability ranged per item set from Cronbach's α = 0.835 to 0.924. Weighted kappa resulted in κ_ω = 0.743 ($P < 0.001$, 95% confidence interval = 0.690–0.802). Overall agreement of the brief version with the original SED-S was P_O = 0.7. The brief version of the SED-S showed weaknesses in distinguishing level 2 from the adjacent levels.

Conclusions The brief version of the SED-S showed good reliability and moderate to good validity results. Items of phase 2 and, to some degree, of phase 5 should be revised to further improve the psychometric properties of the scale.

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Keywords adults, assessment, disorders of intellectual development, emotional development, validity

Introduction

In the past 50 years, the humanitarian perspective has led to a paradigm change in working with persons with neurodevelopmental disorders. Nowadays, the focus is on the strengths and rights of affected persons to enable them to participate in society in the way they individually chose (US General Assembly, 2006). Thus, a comprehensive perspective in maintaining their mental health and possibilities of participation in social life is pivotal.

A special target group is persons with a disorder of intellectual development (DID), a group of aetiologically diverse conditions characterised by below-average intellectual functioning and adaptive behaviour, which manifests in early childhood and persists throughout a lifetime [International Classification of Diseases 11th Revision, World Health Organization (WHO) 2019/2021]. Affected persons often have to deal with comorbid mental health issues or behaviours that challenge their friends and families (Einfeld *et al.* 2011; Sheehan *et al.* 2015; Schützwohl *et al.* 2016). A recent meta-analysis found a pooled point prevalence of 33.6% of co-occurring

mental health issues in people with a DID (Mazza *et al.* 2020). Also, challenging behaviours may impact quality of life and mental health. In her seminal work, Sally-Ann Cooper described point prevalence rates of challenging behaviours of 22.5% in persons with an intellectual disability (Cooper *et al.* 2007). Despite this high occurrence of mental ill-health in this population, additional mental disorders often remain undiagnosed as, for example, reported by Peña-Salazar *et al.* (2020) who detected previously undiagnosed mental disorders in 29.6% of the systematically evaluated cases. Challenging behaviours and mental disorders may not only affect the individual but also lead to social exclusion (Weber & Rojahn 2019); therefore, an understanding of the factors underlying such behaviours is needed along with targeted treatment strategies. The origins of challenging behaviours are divers and may be caused by environmental or individual factors (Hastings *et al.* 2013). Among many other causes, delays of emotional development (ED) are associated with more severe forms of problem behaviours (Sappok *et al.* 2014). The level of ED can be assessed with the *Scale of Emotional Development – Short (SED-S)*, a measure that is based on the ED approach described by Anton Došen (Moss *et al.* 1997; Došen 2005a; Došen *et al.* 2010; Sappok *et al.* 2016). The ED perspective may help to understand the origins of challenging behaviours, to further improve the diagnostic process and to apply a targeted treatment strategy accordingly (Sappok *et al.* 2021, 2022). Hereby, the diagnostic process may be complemented by assessment of the emotional reference age of the respective person (Došen 2005a; Sappok & Zepperitz 2019).

The first phase in the model of ED is the phase of *Adaptation*, which focuses on the integration of sensory information and external stimuli (Došen 2005a, 2005b; Sappok *et al.* 2012, 2022). In the second phase, the *Socialisation* phase, between 7 and 18 months old, social bonds and basic trust develop, while in the third phase (between 19 and 36 months old), *First Individuation*, the recognition and expression of one's own will are of particular importance (Sappok *et al.* 2022). In the phase of *Identification* – phase 4 – with emotional reference ages from 4 to 7 years, the ego formation and theory of mind are key (Sappok *et al.* 2022). In the fifth phase, from ages 8–12 years (*Reality Awareness*), moral development, logical thinking and self-differentiation further develop (Sappok *et al.* 2022). Recently, a sixth phase, *Social Individuation*, has been added to the model for the ages between 13 and 17 years, in which identity formation, abstract thinking and self-reflection further differentiate (Tarasova *et al.* 2022). For adults with a DID, especially for those who show challenging behaviours, the developmental perspective is crucial to understand the underlying emotional needs and to find more targeted treatment options to help maintain mental health and well-being (Sappok *et al.* 2014, 2021).

Although the relevance of the level of ED in adults with a DID is increasingly recognised (Sappok *et al.* 2012; Griffith *et al.* 2013; Schützwohl *et al.* 2016), only a few instruments exist to measure it. Based on the Scale for Emotional Development – Revised (Vandevelde *et al.* 2016), the Network of Europeans on Emotional Development developed a scientifically sound instrument, the *SED-S*. The SED-S consists of 200 binary items with five items in each of the five phases and eight domains, that is: (1) relating to his or her own body, (2) relating to significant others, (3) dealing with change – object permanence, (4) differentiating emotions, (5) relating to peers, (6) engaging with the material world, (7) communicating with others and (8) regulating affect (Sappok *et al.* 2016). The SED-S provides the current level of ED on domain and overall level in children and adults with a DID. It is provided by experts in developmental psychology in a semi-structured interview with close caregivers and takes about 30–60 min to apply (Sappok *et al.* 2016, 2022). In 160 typically developed children, the SED-S showed a weighted kappa of 0.95 and 81% exact agreement between the chronological age of the children and the emotional reference age as assessed with the scale (Sappok *et al.* 2019). Thus, a proof of concept could be guaranteed. A study in 118 children with a DID aged 3–17 years revealed no associations between their chronological and emotional ages, indicating the independence of the biological age and the overall scale score in children with developmental delays (Sterkenburg *et al.* 2021). The internal consistency of the SED-S was high; Cronbach's α was 0.99 in typically developed children (Sappok *et al.* 2019), 0.94 in children with a DID (Sterkenburg *et al.* 2021) and 0.92 in adults with a DID without

mental disorders (Meinecke & Sappok 2021). The inter-rater reliability score was 1.0 (Sappok *et al.* 2019). Despite the need for further analysis of its psychometric properties, the SED-S is a scientifically sound measure for the assessment of the level of ED in persons with a DID.

However, the application of the SED-S in clinical practice is limited by its duration of 30–60 min (Sappok *et al.* 2016). Moreover, a trained expert is needed for the assessment. Therefore, a brief version of the SED-S, which can be applied by other professions, for example, dentists, general practitioners or physiotherapists and also caregivers and relatives, might be useful to gain a general impression of the level of ED before a more comprehensive assessment is performed if needed. In addition, the overall level of ED may be sufficient in certain cases, and the assessment of the whole profile may not be needed. Thus, the aim of the current study is to develop a brief version of the SED-S to evaluate the overall phase of ED. This brief version of the SED-S should match the overall score as assessed with the original version of the SED-S to a high degree.

Methods

Study design

The present study is an item analysis study to develop and validate a brief version of the SED-S. The SED-S data of an eligible sample were used in a cross-validation design by generating statistical twins. Sample 1 was used to analyse the 200 items of the SED-S and to select the most favourable items for the brief version, while sample 2 was used to validate the brief version by comparing the agreement between the overall level of ED determined with the brief version and the overall score determined with the SED-S as reference.

Participants

In the study, patients from the Berlin Center for Mental Health in Developmental Disabilities (*Behandlungszentrum für psychische Gesundheit bei Entwicklungsstörungen*, Berlin, Germany) and the St. Lukas-Klinik (n = 52), Liebenau, were recruited from May 2017 to December 2019. Participants were excluded from the study (1) if they had a comorbid diagnosis of dementia or other amnestic syndromes, (2) if they were younger than 18 years at the time of the survey or (3) if the SED-S interview was incomplete. Finally, an eligible sample of 447 adults (n = 395 from Berlin and n = 52 from Liebenau) aged between 18 and 76 years remained.

Measures

The SED-S is a semi-structured interview to assess the current level of ED on domain and overall level in children and adults with a DID (Sappok *et al.* 2016, 2018). The SED-S consists of 200 binary items (yes/no), with five items in each phase and domain. The SED-S interview was conducted and evaluated by trained experts with close caregivers or relatives who were familiar with the typical behaviour of the person.

Statistical analysis

Statistical twins

The procedure of generating statistical twins is adapted from Bacher (2002). To generate random statistical twins with the eligible sample of 447 adults with a DID, a propensity score analysis for each participant concerning the characteristics sex, severity of DID and level of ED was executed. Using this propensity score, the eligible sample was divided by hand into two subsamples (sample 1 and sample 2). The comparability of the two generated samples regarding the previously mentioned characteristics was confirmed by χ^2-test for the characteristic gender, due to the binarity of the item, and Mann–Whitney U-test for the characteristics severity of DID and level of ED due to the non-parametric categorisation of these items.

Item analysis and item selection

In a first step, in sample 1, the 200 items were analysed in five item sets according to the five emotional levels they represent. For each item, (1) the *item frequency* (f_i) of yes-answers per phase was calculated, and (2) a *χ^2-test* or *Fisher's exact test* between corresponding and adjacent phases to test these frequencies for significance, (3) *Spearman's rank correlation coefficient* (ρ) between the item and the corresponding phase and (4) the *item–total correlation* per phase were assessed. The test for significance

between corresponding and adjacent phases needed different calculations because there were only eight persons with an overall level 5 for ED in sample 1, whereas in the other groups, there were more than 36 persons. *Fisher's exact test* can deal with significant imbalance between subsample sizes as between levels 4 and 5. So, *Fisher's exact test* was used for the comparison of the item frequencies of phase 4 with those of phase 5; for all other comparisons, the χ^2-test was applied.

Four criteria were defined for the item selection process:

1 The item should be answered in the affirmative with a frequency of 60% ($f_i \geq 0.600$) within the corresponding phase (Bühner 2011).
2 These frequencies should differ significantly from the adjacent phases ($P < 0.05$).
3 *Spearman's rank correlation coefficient* of an item should be in the middle range (ρ = 0.3–0.8) (Bühner 2011).
4 The item–total correlation should be at least 0.3 (Bühner 2011).

Additionally, each phase and domain should be represented in the brief version with two items, so the brief version contained 80 items at the end of the item selection process. Consequently, only the two best items per domain and phase that matched the previous defined criteria were selected for the brief version. If several items were statistically equally suitable for the brief version, the relevance of the item content was also considered in the selection process.

Reliability of the brief version

For each set of 16 items per phase, the internal consistency was calculated per *Kuder–Richardson formula* due to the dichotomy of the items. For the resulting Cronbach's α value, a value of at least 0.8 per phase would be considered acceptable for further analyses according to Glascoe (2005).

Validation of the brief version

The brief version was validated in the independent sample 2. The overall level of ED determined with the 80 items of the brief version was compared with the final score of the original SED-S comprising 200 items as reference. Therefore, the *relative* and *exact agreements* per level of ED, the *overall agreement* and *weighted kappa*, and *sensitivity*, *specificity* and *accuracy* were calculated. The relative and exact agreement between the SED-S and its brief version would be perfect at a value of 1 (Bortz & Döring 2006). For our purpose, we considered a value of *exact agreement* of at least 0.70 per phase and for the *overall agreement* as favourable. According to Grouven *et al.* (2007), a *weighted kappa* value of 0.61–0.8 is assessed as good, while a greater value than 0.8 is assessed as very good. The sensitivity of the newly developed brief version should be at least 0.7 per phase to validate it as a good screening instrument to assess the level of ED with an accuracy similar to that of the SED-S, and the specificity and accuracy should be at least 0.8 per phase (Glascoe 2005).

Results

Descriptive analysis of the study sample

The demographic and clinical data, including challenging behaviours and psychiatric disorders, and the levels of ED of samples 1 and 2 are summarised in Table 1.

Here, also the values of the χ^2-test and Mann–Whitney *U*-test for samples 1 and 2 concerning the characteristics gender, severity of DID and level of ED are presented. In both subsamples, 36 participants scored in stage 1 of ED, 55 participants in stage 2 of ED, 76 (sample 1) and 75 (sample 2) participants in stage 3 of ED, 49 participants in stage 4 of ED and 8 participants each in stage 5 of ED.

Item analysis

The results of the item analysis for the selected items are represented phasewise in Tables 2–6, while the results of the item analysis for all 200 items of the SED-S can be seen in Tables A1–A5. The brief version included 16 items of the original SED-S per level – two items per phase and domain.

Phase 1 item analysis

In phase 1, 11 items met all four criteria indicating good item reliability, three items met three criteria and two items met two criteria (Table 2).

Of those 16 selected items, 13 met the frequency criterion of at least 60% yes-answers (criterion 1), 12

Table 1 Demographic and clinical data and SED-S overall scores

	Sample 1 (n_1 = 224)	Sample 2 (n_2 = 223)	U/χ^2 (d.f.)	*P*
Demographic data				
Male gender, *n* (%)	129 (57.6)	128 (57.4)	0.002 (1)	0.968
Age, *M* (SD)	36.5 (13.09)	37.3 (12.62)		
Clinical data				
Level of DID			24.641	0.798
F70.x, *n* (%)	51 (22.8)	53 (23.8)		
F71.x, *n* (%)	70 (31.3)	71 (31.8)		
F72.x, *n* (%)	76 (33.9)	71 (31.8)		
F73.x, *n* (%)	27 (12.1)	28 (12.6)		
Challenging behaviour, *n* (%)	102 (45.5)	107 (48.0)		
Psychiatric disorders, *n* (%)	181 (80.8)	180 (80.7)		
F1x.x, *n* (%)	2 (0.9)	3 (1.3)		
F2x.x, *n* (%)	24 (10.7)	26 (11.7)		
F3x.x, *n* (%)	29 (12.3)	26 (11.7)		
F4x.x, *n* (%)	23 (10.3)	19 (8.5)		
F6x.x, *n* (%)	5 (2.2)	6 (2.7)		
F8x.x, *n* (%)	63 (28.1)	59 (26.5)		
Phase of ED			24.959	0.990
Phase 1, *n* (%)	36 (16.1)	36 (16.1)		
Phase 2, *n* (%)	55 (24.6)	55 (24.7)		
Phase 3, *n* (%)	76 (33.9)	75 (33.6)		
Phase 4, *n* (%)	49 (21.9)	49 (22.0)		
Phase 5, *n* (%)	8 (3.6)	8 (3.6)		

DID, disorder of intellectual development; ED, emotional development; SD, standard deviation; SED-S, Scale of Emotional Development – Short.

differentiated significantly from phase 2 (criterion 2) and all items showed Spearman's rank correlation coefficient between 0.3 and 0.8 (criterion 3) and an item–total correlation above 0.3 (0.567–0.748; criterion 4).

Phase 2 item analysis

In phase 2, none of the selected items met all four criteria of the item selection (Table 3).

Eight items met three criteria. Of these, three items showed a frequency of yes-answers lower than 60%, four items did not correlate in the middle range (criterion 3) and one item (Obj2_2) had an inter-item correlation lower than 0.3 (criterion 4). Eight items met only two criteria, but because most of these were significantly different from adjacent phases, they were selected for the brief version. As can be seen in Table A2, two items met all four criteria of the item selection (C2_5 and A2_5). Nonetheless, they were not included in the brief version because they did not differentiate from phase 1, while all finally selected items differed well from both adjacent phases.

Overall, in the final 16 selected items, only 5 met the frequency criterion of at least 60% yes-answers (criterion 1), 10 differentiated significantly from phase 1 and 11 from phase 3 (criterion 2), 4 showed Spearman's rank correlation coefficient between 0.3 and 0.8 (criterion 3) and most (15) showed an item–total correlation above 0.3 (0.298–0.591; criterion 4).

Phase 3 item analysis

The selected items of phase 3 included five items, which met all four criteria (cf. Table 4).

Seven items met three criteria, and all of them did not meet criterion 3 (*Spearman's rank correlation coefficient*). Four items met two criteria, all of them did not meet criterion 3 again, three items had a frequency of yes-answers lower than 60% and one item (Obj3_3) did not differ significantly from the adjacent phases. Although the psychometric properties of this item did not fully meet the criteria, it was chosen because of its content ('Intentionally looks for things and people that can no longer be seen/heard'), which was considered an important observable behaviour in this phase.

Of the 16 selected items, 13 met the frequency criterion of at least 60% yes-answers (criterion 1), 8 differentiated significantly from phase 2 and 11 from phase 4 (criterion 2), 5 showed Spearman's rank correlation coefficient between 0.3 and 0.8 (criterion 3) and all items revealed an item–total correlation above 0.3 (0.389–0.556; criterion 4).

Phase 4 item analysis

Among the selected items in phase 4, 12 items met all four criteria (Table 5).

Three items did not meet the 60% yes-answers criterion, and one item had no Spearman correlation coefficient in the middle range. Furthermore, all selected items for phase 4 differed significantly from phase 3, while only three of them differed from phase 5. In total, among all 40 phase 4 items, only five differed significantly from phase 5 (cf. Table A4).

Table 2 Phase 1: item analysis data

Item	Item frequency f_i yes-answers per phase					Item specificity χ^2-test compared with	Spearman's rank correlation coefficient ρ	Corrected item–total correlation
	1	2	3	4	5	2		
BI_1	**0.667**	**0.436**	**0.092**	**0.000**	**0.000**	**0.031**	**−0.549****	**0.680**
BI_3	**0.694**	**0.400**	**0.158**	**0.082**	**0.000**	**<0.01**	**−0.461****	**0.598**
Oth1_1	**0.722**	**0.291**	**0.053**	**0.000**	**0.000**	**<0.01**	**−0.558****	**0.630**
Oth1_5	0.583	0.455	0.145	0.041	0.000	0.230	−0.461**	0.567
Obj1_2	**0.611**	**0.073**	**0.026**	**0.000**	**0.000**	**<0.01**	**−0.482****	**0.613**
Obj1_5	**0.833**	**0.309**	**0.039**	**0.000**	**0.000**	**<0.01**	**−0.617****	**0.748**
EI_1	**0.778**	**0.618**	**0.224**	**0.000**	**0.000**	**0.110**	**−0.598****	**0.740**
EI_5	**0.639**	**0.436**	**0.158**	**0.082**	**0.000**	**0.059**	**−0.446****	**0.592**
PI_2	**0.694**	**0.436**	**0.132**	**0.020**	**0.000**	**0.016**	**−0.527****	**0.624**
PI_4	0.556	0.455	0.303	0.061	0.000	0.346	−0.404**	0.584
MI_3	**0.722**	**0.364**	**0.132**	**0.000**	**0.000**	**<0.01**	**−0.536****	**0.697**
MI_4	**0.556**	**0.291**	**0.092**	**0.000**	**0.000**	**0.012**	**−0.461****	**0.596**
CI_1	**0.611**	**0.327**	**0.026**	**0.000**	**0.000**	**<0.01**	**−0.533****	**0.674**
CI_5	**0.639**	**0.345**	**0.118**	**0.000**	**0.000**	**<0.01**	**−0.500****	**0.604**
AI_1	**0.694**	**0.436**	**0.171**	**0.041**	**0.000**	**0.016**	**−0.496****	**0.670**
AI_2	**0.806**	**0.400**	**0.171**	**0.000**	**0.000**	**<0.01**	**−0.566****	**0.698**

The relevant frequencies of the corresponding phase per column are highlighted in grey. Items in black and bold met all four item selection criteria. Items in grey and bold met three criteria. Items without highlighting fulfilled two criteria. Item abbreviations: items of domain 'Body' = Bx_x, items of domain 'Others' = Othx_x, items of domain 'Object Permanence' = Objx_x, items of domain 'Differentiating Emotions' = Ex_x, items of domain 'Peers' = Px_x, items of domain 'Material' = Mx_x, items of domain 'Communication' = Cx_x and items of domain 'Affect Regulation'.

*$P < 0.05$.

**$P < 0.01$.

In the final item set for phase 4, 13 out of 16 met the frequency criterion of at least 60% yes-answers (criterion 1), all selected items differentiated well from phase 3 but only 4 out of 16 from phase 5 (criterion 2), most (15 out of 16) showed Spearman's rank correlation coefficient between 0.3 and 0.8 (criterion 3) and all items revealed an item–total correlation above 0.3 (0.407–0.686; criterion 4).

Phase 5 item analysis

Among the selected items of phase 5, only two differed significantly from phase 4 (Table 6).

One item met all four criteria, one item met two criteria, while all the other 14 items met three criteria. The criterion they did not meet was the significant differentiation from phase 4. Therefore, more emphasis was placed on the content of the items; for example, the item Oth5_2 ('Conforms to social norms and rules even when no authority figures are present') did not differ significantly from phase 4 but was nevertheless selected because of its importance in content, as this behaviour is considered to be particularly relevant in this phase.

In summary, 15 out of the 16 selected items for phase 5 met the frequency criterion of at least 60% yes-answers (criterion 1), only 2 selected items differentiated well from phase 4 (criterion 2), most (15 out of 16) showed Spearman's rank correlation coefficient between 0.3 and 0.8 (criterion 3) and all items revealed an item–total correlation above 0.3 (0.443–0.786; criterion 4).

Reliability of the brief version

Cronbach's α values of the selected item set in sample 1 showed a mean value of 0.880. The value was lowest for phase 2 (0.835) and highest for phase 1 (0.924).

Validity of the brief version in sample 2

The correlation of the overall phase of ED determined with the brief version in sample 2 and the overall

Table 3 Phase 2: item analysis data

Item	Item frequency f_i yes-answers per phase					Item specificity χ^2-test compared with		Spearman's rank correlation coefficient ρ	Corrected item–total correlation
	1	2	3	4	5	1	3		
B2_2	**0.389**	**0.582**	**0.395**	**0.204**	**0.125**	**0.072**	**0.034**	**−0.214****	**0.542**
B2_5	**0.472**	**0.545**	**0.329**	**0.122**	**0.125**	**0.494**	**0.013**	**−0.306****	**0.412**
Oth2_1	0.389	0.509	0.316	0.082	0.125	0.261	0.026	−0.283**	0.446
Oth2_4	0.194	0.436	0.171	0.020	0.000	0.017	0.001	−0.272**	0.413
Obj2_2	**0.583**	**0.673**	**0.303**	**0.102**	**0.000**	**0.386**	**<0.001**	**−0.441****	**0.298**
Obj2_3	**0.361**	**0.418**	**0.211**	**0.000**	**0.000**	**0.586**	**0.010**	**−0.350****	**0.476**
E2_3	**0.194**	**0.655**	**0.474**	**0.184**	**0.125**	**<0.001**	**0.040**	**−0.142***	**0.473**
E2_4	**0.583**	**0.800**	**0.697**	**0.469**	**0.250**	**0.025**	**0.186**	**−0.173****	**0.591**
P2_1	0.222	0.564	0.447	0.122	0.125	0.003	0.189	−0.163**	0.416
P2_3	0.278	0.527	0.592	0.286	0.000	0.019	0.460	−0.068	0.457
M2_2	0.194	0.436	0.250	0.000	0.000	0.017	0.025	−0.258**	0.407
M2_5	**0.528**	**0.564**	**0.316**	**0.102**	**0.000**	**0.737**	**0.005**	**−0.372****	**0.546**
C2_2	0.083	0.527	0.211	0.041	0.000	<0.001	<0.001	−0.216**	0.460
C2_3	0.278	0.527	0.276	0.061	0.000	0.019	0.004	−0.279**	0.446
A2_2	**0.250**	**0.636**	**0.579**	**0.367**	**0.250**	**<0.001**	**0.507**	**0.021**	**0.465**
A2_3	**0.417**	**0.673**	**0.566**	**0.245**	**0.375**	**0.016**	**0.215**	**−0.171****	**0.462**

The relevant frequencies of the corresponding phase per column are highlighted in grey. Items in black and bold met all four item selection criteria. Items in grey and bold met three criteria. Items without highlighting fulfilled two criteria. Item abbreviations: items of domain 'Body' = Bx_x, items of domain 'Others' = Othx_x, items of domain 'Object Permanence' = Objx_x, items of domain 'Differentiating Emotions' = Ex_x, items of domain 'Peers' = Px_x, items of domain 'Material' = Mx_x, items of domain 'Communication' = Cx_x and items of domain 'Affect Regulation'.
*$P < 0.05$.
**$P < 0.01$.

results of the original SED-S are presented in Table 7. The values ranged from 0.321 for phase 2 to 0.972 for phase 1 with an overall agreement between the scales of 0.684.

The *weighted kappa* for the agreement of the brief version and the original version SED-S was $\kappa_\omega = 0.743$ ($P < 0.001$, SE(κ) = 0.029, 95% confidence interval = 0.690–0.802).

The results for *sensitivity*, *specificity* and *accuracy* for each phase are shown in Table 8.

The sensitivity values varied from 0.309 (phase 2) to 0.972 (phase 1), while specificity values were above 0.8 in all phases. Mean sensitivity/specificity values were 0.681 and 0.918, respectively. The overall accuracy of the brief version of the SED-S was 0.880. The *overall agreement* of the overall phase of ED determined with the newly developed brief version with the original version of the SED-S was $P_O = 0.700$.

Discussion

This study aimed to develop a brief version of the SED-S to assess the overall phase of ED in adults with DID. In a first sample, the items of the SED-S were analysed to select those with the best psychometric properties for the brief version. Interestingly, in most phases, the frequency of at least 60% yes-answers was achieved for most items. However, in phase 2 only, a third met the frequency criterion indicating that the described behaviours for phase 2 often cannot be detected in adults with a DID. Thus, more often observable behaviours typical for phase 2 should be defined and included in the phase 2 item set of the SED-S. With respect to the item specificity as determined by significant differences from adjacent phases, the differentiation between phases 1 and 2 was overall satisfying for phase 1 items (12 out of 16). The phase 2 items, however, differed less often from phase

Table 4 Phase 3: item analysis data

Item	Item frequency f_i yes-answers per phase					Item specificity χ^2-test compared with		Spearman's rank correlation coefficient ρ	Corrected item–total correlation
	1	2	3	4	5	2	4		
B3_1	**0.139**	**0.345**	**0.684**	**0.612**	**0.375**	**<0.001**	**0.408**	**0.315****	**0.440**
B3_4	**0.194**	**0.545**	**0.895**	**0.878**	**0.625**	**<0.001**	**0.766**	**0.461****	**0.520**
Oth3_1	0.417	0.727	0.816	0.571	0.250	0.228	0.003	0.022	0.510
Oth3_2	0.278	0.600	0.632	0.347	0.125	0.713	0.002	−0.038	0.496
Obj3_3	0.389	0.727	0.829	0.714	0.500	0.161	0.128	0.160**	0.441
Obj3_4	**0.083**	**0.436**	**0.789**	**0.653**	**0.375**	**<0.001**	**0.091**	**0.351****	**0.539**
E3_1	0.361	0.600	0.737	0.469	0.375	0.098	0.002	0.041	0.520
E3_3	0.306	0.618	0.750	0.510	0.375	0.106	0.006	0.087	0.459
P3_2	0.028	0.200	0.382	0.041	0.000	0.026	<0.001	0.004	0.389
P3_3	0.028	0.327	0.539	0.224	0.000	0.016	<0.001	0.093	0.511
M3_2	**0.194**	**0.382**	**0.776**	**0.673**	**0.375**	**<0.001**	**0.203**	**0.327****	**0.523**
M3_3	0.222	0.455	0.618	0.286	0.000	0.063	<0.001	−0.008	0.354
C3_1	0.083	0.273	0.553	0.286	0.375	0.001	0.003	0.172**	0.523
C3_2	0.083	0.527	0.645	0.449	0.250	0.176	0.031	0.159**	0.406
A3_3	0.222	0.636	0.776	0.510	0.375	0.079	0.002	0.125*	0.556
A3_5	**0.000**	**0.182**	**0.671**	**0.408**	**0.250**	**<0.001**	**0.004**	**0.324****	**0.489**

The relevant frequencies of the corresponding phase per column are highlighted in grey. Items in black and bold met all four item selection criteria. Items in grey and bold met three criteria. Items without highlighting fulfilled two criteria. Item abbreviations: items of domain 'Body' = Bx_x, items of domain 'Others' = Othx_x, items of domain 'Object Permanence' = Objx_x, items of domain 'Differentiating Emotions' = Ex_x, items of domain 'Peers' = Px_x, items of domain 'Material' = Mx_x, items of domain 'Communication' = Cx_x and items of domain 'Affect Regulation'.

*$P < 0.05$.

**$P < 0.01$.

1 (10 out of 16) and phase 3 (11 out of 16). Similarly, only half of the phase 3 items (8 out of 16) significantly differentiated from phase 2 and 11 out of 16 from phase 4. The phase 4 items were highly specific compared with phase 3; however, the differentiation to phase 5 items was not satisfying: only 4 out of 16 were specific for phase 4 compared with phase 5, and of the phase 5 items, only 2 out of 16 differentiated significantly from phase 4. Criteria 3, Spearman's rank correlation coefficient between 0.3 and 0.8, could be achieved by most selected items in phases 1, 4 and 5. However, for phases 2 and 3, only 4 out of 16 (phase 2) and 5 out of 16 (phase 3) met the predefined requirements. The item–total correlation above 0.3 (criterion 4) could be achieved by all selected items in all phases except one item in phase 2 with a correlation coefficient of 0.298. The correlation was best for phase 1 items (0.567–0.748), followed by the phase 5 items ranging from 0.443 to 0.786 and phase 4 items (0.407–0.686), reduced for phase 3 items (0.389–0.556) and phase 2 items (0.298–0.591).

To conclude, phase 2 items show lowest item frequencies, specificities, rank correlation coefficients and item–total correlations. Phase 1 items showed best psychometric properties with high frequencies, specificity and correlation indices. Phase 3 items showed weaknesses in differentiating from phase 2 and overall low Spearman's rank correlations (11 out of 16 were below 0.3). Phase 4 and 5 items revealed good psychometric properties except for the differentiation from each other. In summary, the SED-S items for phase 2 should be rephrased to increase their validity, and the items of phases 4 and 5 may be revised to improve the distinction between these two levels of ED.

Reliability for the selected items for the brief version of the SED-S revealed Cronbach's α of 0.880 ranging from 0.835 (phase 2) to 0.924 (phase 1). This is lower than the internal consistency reported by Sappok *et al.* (2019) for the original SED-S validated in typically developed children (0.99) and also below the values found by Sterkenburg *et al.* (2021) in

Table 5 Phase 4: item analysis data

Item	Item frequency f_i yes-answers per phase					Item specificity χ^2-test/Fisher's exact test compared with		Spearman's rank correlation coefficient ρ	Corrected item–total correlation
	1	2	3	4	5	3	5		
B4_1	0.028	0.091	0.276	0.592	0.250	<0.001	0.078	0.415**	0.564
B4_2	**0.056**	**0.291**	**0.737**	**0.898**	**1.00**	**0.028**	**0.455**	**0.627****	**0.671**
Oth4_3	**0.000**	**0.073**	**0.289**	**0.653**	**0.750**	**<0.001**	**0.460**	**0.534****	**0.516**
Oth4_5	**0.000**	**0.073**	**0.329**	**0.612**	**0.625**	**0.002**	**0.633**	**0.500****	**0.567**
Obj4_1	**0.389**	**0.527**	**0.789**	**0.939**	**0.750**	**0.023**	**0.140**	**0.403****	**0.492**
Obj4_3	0.306	0.655	0.684	0.878	0.250	0.013	0.001	0.260**	0.407
E4_2	0.000	0.073	0.329	0.571	0.875	0.007	0.104	0.509**	0.525
E4_4	**0.056**	**0.055**	**0.171**	**0.735**	**0.750**	**<0.001**	**0.650**	**0.549****	**0.530**
P4_2	**0.000**	**0.109**	**0.303**	**0.694**	**0.500**	**<0.001**	**0.245**	**0.505****	**0.502**
P4_5	**0.000**	**0.236**	**0.474**	**0.776**	**0.625**	**0.001**	**0.303**	**0.515****	**0.661**
M4_1	**0.000**	**0.109**	**0.513**	**0.694**	**0.500**	**0.045**	**0.245**	**0.519****	**0.650**
M4_5	**0.083**	**0.255**	**0.592**	**0.898**	**0.625**	**<0.001**	**0.074**	**0.550****	**0.648**
C4_3	**0.000**	**0.182**	**0.592**	**0.939**	**0.375**	**<0.001**	**0.001**	**0.611****	**0.686**
C4_4	**0.000**	**0.073**	**0.487**	**0.796**	**0.375**	**0.001**	**0.024**	**0.572****	**0.633**
A4_3	**0.000**	**0.200**	**0.447**	**0.633**	**0.625**	**0.043**	**0.628**	**0.454****	**0.555**
A4_4	0.000	0.018	0.342	0.571	0.500	0.012	0.498	0.496**	0.607

The relevant frequencies of the corresponding phase per column are highlighted in grey. Items in black and bold met all four item selection criteria. Items in grey and bold met three criteria. Items without highlighting fulfilled two criteria. Item abbreviations: items of domain 'Body' = Bx_x, items of domain 'Others' = Othx_x, items of domain 'Object Permanence' = Objx_x, items of domain 'Differentiating Emotions' = Ex_x, items of domain 'Peers' = Px_x, items of domain 'Material' = Mx_x, items of domain 'Communication' = Cx_x and items of domain 'Affect Regulation'.

*$P < 0.05$.

**$P < 0.01$.

children with DID (0.94) and by Meinecke & Sappok (2021) in adults with DID without mental health problems (0.92). One reason may be the reduced number of items in the newly developed brief version of the SED-S. However, according to Glascoe (2005), Cronbach's $\alpha \geq 0.8$ can be regarded as sufficient, and therefore, the brief version of the SED-S can be regarded as reliable.

In a second sample, the item set selected for the brief version was analysed concerning their validity and overall agreement with the original SED-S results. As expected from the item analysis, the agreement was best for phase 1 with a correlation of the brief version with the original version of 0.972, while phase 2 results of the brief version showed a low correlation with the original version (0.321). The overall correlation of two versions of the scale was 0.684. The *weighted kappa* for the accordance of the brief version and the original version SED-S was $\kappa_\omega = 0.743$, which can be regarded as 'good' according to Grouven *et al.* (2007).

Concerning the validity analysis, best values could be observed again in phase 1 with a sensitivity of 0.972 and a specificity of 0.936, while phase 2 showed lowest sensitivity values (0.309) and phase 3 showed lowest specificity values (0.791). Overall, sensitivity values were lower than specificity values (0.681 vs. 0.918). The overall accuracy of the brief version of the SED-S with the original version of the SED-S was 0.880. The *overall agreement* of the overall level of ED determined with the newly developed brief version with the original version of the SED-S was $P_O = 0.700$. According to Glascoe (2005), the sensitivity values are just below good (>0.7), the specificity of 0.918 can be interpreted as good (>0.8) and the overall agreement just meets the Glascoe criteria (>0.7).

In summary, the brief version of the SED-S showed good reliability and moderate to good validity results. However, items of phase 2 and, to some degree, of phase 5 should be revised to further improve the

Table 6 Phase 5: item analysis data

Item	Item frequency f_i yes-answers per phase					Item specificity Fisher's exact test compared with	Spearman's rank correlation coefficient ρ	Corrected item–total correlation
	1	2	3	4	5	4		
B5_3	0.028	0.018	0.132	0.510	0.875	0.057	0.469**	0.504
B5_4	0.056	0.127	0.316	0.531	0.875	0.070	0.362**	0.570
Oth5_2	0.000	0.200	0.329	0.653	0.875	0.205	0.411**	0.617
Oth5_5	0.000	0.018	0.263	0.490	0.625	0.373	0.471**	0.507
Obj5_1	**0.000**	**0.109**	**0.289**	**0.551**	**1.00**	**0.014**	**0.492****	**0.633**
Obj5_5	0.083	0.273	0.579	0.714	1.00	0.088	0.485**	0.608
E5_3	0.000	0.000	0.132	0.388	0.625	0.191	0.443**	0.619
E5_5	0.000	0.000	0.066	0.327	0.625	0.111	0.346**	0.555
P5_3	0.028	0.073	0.211	0.510	0.875	0.057	0.459**	0.678
P5_5	0.028	0.018	0.079	0.122	0.500	0.025	0.229**	0.443
M5_4	0.000	0.000	0.079	0.367	0.625	0.161	0.442**	0.531
M5_5	0.000	0.036	0.211	0.408	0.750	0.078	0.434**	0.601
C5_2	0.000	0.000	0.303	0.755	1.00	0.130	0.653**	0.786
C5_3	0.000	0.000	0.118	0.408	0.750	0.078	0.471**	0.551
A5_1	0.000	0.036	0.289	0.531	0.750	0.222	0.494**	0.543
A5_3	0.000	0.036	0.132	0.306	0.625	0.090	0.369**	0.483

The relevant frequencies of the corresponding phase per column are highlighted in grey. Items in black and bold met all four item selection criteria. Items in grey and bold met three criteria. Items without highlighting fulfilled two criteria. Item abbreviations: items of domain 'Body' = Bx_x, items of domain 'Others' = Othx_x, items of domain 'Object Permanence' = Objx_x, items of domain 'Differentiating Emotions' = Ex_x, items of domain 'Peers' = Px_x, items of domain 'Material' = Mx_x, items of domain 'Communication' = Cx_x and items of domain 'Affect Regulation'.
*$P < 0.05$.
**$P < 0.01$.

Table 7 Correlation analysis of the overall ED results of the brief version with the original version in sample 2

Brief version of the SED-S	Original SED-S				
	1	2	3	4	5
1	0.972	0.214	0.000	0.000	0.000
2	0.028	0.321	0.092	0.000	0.000
3	0.000	0.446	0.776	0.128	0.000
4	0.000	0.018	0.118	0.851	0.500
5	0.000	0.000	0.013	0.021	0.500

Highlighted in grey are the correlations between the level of ED determined with the brief version and the original version of the SED-S as reference.
ED, emotional development; SED-S, Scale of Emotional Development – Short.

Table 8 Sensitivity, specificity and accuracy of the overall level of emotional development of the brief version compared with the original version of the Scale of Emotional Development – Short as reference in sample 2

Phase	Sensitivity	Specificity	Accuracy
1	0.972	0.936	0.942
2	0.309	0.946	0.789
3	0.787	0.791	0.789
4	0.837	0.925	0.906
5	0.500	0.991	0.973

psychometric properties of the scale, especially when the brief version is used.

The low psychometric properties of phase 5 items may be caused by the small size sample size ($n = 16$) of this subgroup. In the phase 2 analysis, however, $n = 110$ persons were included. Therefore, the sample size cannot explain the low frequencies and discrimination values of the items of phase 2. Many of those determined in phase 2 with the original SED-S

were assigned in phase 3 with the brief version. One reason may be the heterogeneous profiles of participants. Moreover, the behaviours itemised for the SED-S for persons with an emotional reverence age of 7–18 months so far may be less indicative for this phase of ED, and items should therefore be rephrased.

The brief version of the SED-S was deliberately created with a different goal than the SED-S and the Scale for Emotional Development – Revised 2 (SED-R2), which are further developed versions of the SEO (scheme of ED). Both scales intent to assess a *profile* over different developmental domains as well as an overall score of ED. Hereby, the overall score is based on the domain results, while in the brief version, the overall level of ED can also be obtained without the domain level. However, the information of all different aspects of ED is acknowledged in the brief version as two items per phase and domain are included. The advantage of the brief version is that it is less time-consuming as its predecessors, the SED-S and the SED-R2. The brief version may help to initiate engagement with the developmental approach and reduce barriers. It cannot replace the more comprehensive versions, which need to be applied in more complex cases and difficult circumstances. Hence, the different versions should be used complementary, depending on the context and individual variables.

When applying the brief version of the SED-S, only an overall result will be given. Thus, the main limitation of the brief version of the SED-S is the loss of information of the developmental profile. For adults with a DID and challenging behaviours, it is highly recommended to apply the comprehensive version of the SED-S to use targeted treatment strategies to help reduce challenging behaviours, avoiding overload, and thus promote well-being and mental health. However, in case of mental well-being and the absence of challenging behaviours, a short version may be supportive, for example, for general practitioners, dentists, therapists, caregivers and families to get a quick insight in the overall level of emotional functioning. Also, for the level of DID, short assessment instruments such as the Disability Assessment Scale of the WHO exist, which of cause cannot replace a comprehensive assessment of intellectual functioning. Still, in uncomplicated situations and living circumstances, a quick insight in the overall level of ED of a person may be supportive to align the interaction and communication accordingly.

In conclusion, a brief version of the SED-S has been developed that assesses the overall level of ED in adults with a DID. Overall, reliability and validity results are sufficient; however, the scale should be applied with caution in case of autism spectrum disorder, challenging behaviours or psychiatric disorders. In these cases, more detailed information about the respective strength and difficulties of a person may be drawn from the profile of ED, which is not available when applying the brief version of the scale. Moreover, interpretation of phase 2 vs. phase 3 and phase 5 vs. phase 4 should be performed with caution due to difficulties of the brief version with differentiation of the respective phases of ED. As the SED-S has been expanded in the meantime with phase 6, the differentiation of phases 5 and 6 needs to be assessed in the future.

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Conflict of interest

Tanja Sappok and Brian Barrett received royalties from Hogrefe and Kohlhammer for the publication of the Scale of Emotional Development – Short and other book projects. This paper is part of the master thesis of Sabrina Lutter.

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Ethics approval statement

The collection of data used in this study received ethical approval from Charité – Universitätsmedizin

Berlin [EA2/193/16 (approval granted: February 2017)]. Moreover, the ethics committee of the Königin Elisabeth Herzberge Hospital Berlin agreed with the execution of the study at the hospital in Berlin (22 November 2016), and for Liebenau, the ethics committee of Stiftung Liebenau agreed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available because of privacy or ethical restrictions.

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APPENDIX A

Table A1 Phase 1: item analysis of all items of Scale of Emotional Development – Short

Item	Item frequency f_i yes-answers per phase					Item specificity χ^2-test compared with	Spearman's rank correlation coefficient ρ	Corrected item–total correlation
	1	2	3	4	5	2		
BI_1	0.667	0.436	0.092	0.000	0.000	0.031	−0.549**	0.680
BI_2	0.556	0.309	0.079	0.061	0.000	0.019	−0.419**	0.556
BI_3	0.694	0.400	0.158	0.082	0.000	0.006	−0.461**	0.598
BI_4	0.139	0.091	0.000	0.020	0.000	0.474	−0.210**	0.245
BI_5	0.583	0.309	0.171	0.000	0.000	0.009	−0.440**	0.562
OthI_1	0.722	0.291	0.053	0.000	0.000	0.000	−0.558**	0.630
OthI_2	0.472	0.382	0.132	0.020	0.000	0.393	−0.410**	0.539
OthI_3	0.333	0.164	0.039	0.000	0.000	0.060	−0.350**	0.385
OthI_4	0.500	0.400	0.158	0.020	0.000	0.347	−0.417**	0.583
OthI_5	0.583	0.455	0.145	0.041	0.000	0.230	−0.461**	0.567
ObjI_1	0.750	0.291	0.079	0.000	0.000	0.000	−0.556**	0.741
ObjI_2	0.611	0.073	0.026	0.000	0.000	0.000	−0.482**	0.613
ObjI_3	0.389	0.036	0.000	0.000	0.000	0.000	−0.392**	0.465
ObjI_4	0.528	0.055	0.000	0.000	0.000	0.000	−0.464**	0.515
ObjI_5	0.833	0.309	0.039	0.000	0.000	0.000	−0.617**	0.748
EI_1	0.778	0.618	0.224	0.000	0.000	0.110	−0.598**	0.740
EI_2	0.444	0.382	0.145	0.000	0.000	0.552	−0.407**	0.484
EI_3	0.472	0.236	0.132	0.020	0.000	0.019	−0.366**	0.465
EI_4	0.472	0.364	0.105	0.000	0.000	0.302	−0.434**	0.407
EI_5	0.639	0.436	0.158	0.082	0.000	0.059	−0.446**	0.592
PI_1	0.611	0.255	0.079	0.000	0.000	0.001	−0.485**	0.343
PI_2	0.694	0.436	0.132	0.020	0.000	0.016	−0.527**	0.624
PI_3	0.417	0.236	0.118	0.000	0.000	0.068	−0.364**	0.412
PI_4	0.556	0.455	0.303	0.061	0.000	0.346	−0.379**	0.584
PI_5	0.361	0.327	0.184	0.020	0.000	0.739	−0.315**	0.446
MI_1	0.583	0.200	0.039	0.000	0.000	0.000	−0.484**	0.541
MI_2	0.389	0.236	0.013	0.000	0.000	0.119	−0.417**	0.486
MI_3	0.722	0.364	0.132	0.000	0.000	0.001	−0.536**	0.697
MI_4	0.556	0.291	0.092	0.000	0.000	0.012	−0.461**	0.596
MI_5	0.278	0.273	0.132	0.000	0.000	0.958	−0.295**	0.420
CI_1	0.611	0.327	0.026	0.000	0.000	0.008	−0.533**	0.674
CI_2	0.333	0.073	0.026	0.000	0.000	0.001	−0.339**	0.353
CI_3	0.639	0.455	0.092	0.000	0.000	0.085	−0.541**	0.716
CI_4	0.083	0.291	0.079	0.000	0.000	0.017	−0.217**	0.358
CI_5	0.639	0.345	0.118	0.000	0.000	0.006	0.500**	0.604
AI_1	0.694	0.436	0.171	0.041	0.000	0.016	−0.496**	0.670
AI_2	0.806	0.400	0.171	0.000	0.000	0.000	−0.566**	0.698
AI_3	0.472	0.473	0.171	0.020	0.000	0.996	−0.420**	0.523
AI_4	0.667	0.382	0.092	0.020	0.000	0.008	−0.518**	0.564
AI_5	0.806	0.527	0.355	0.184	0.000	0.007	−0.429**	0.509

*$P < 0.05$.
**$P < 0.01$.

Table A2 Phase 2: item analysis of all items of Scale of Emotional Development – Short

Item	Item frequency f_i yes-answers per phase					Item specificity χ^2-test compared with		Spearman's rank correlation coefficient ρ	Corrected item–total correlation
	1	2	3	4	5	1	3		
B2_1	0.417	0.255	0.105	0.000	0.000	0.105	0.024	−0.376**	0.385
B2_2	0.389	0.582	0.395	0.204	0.125	0.072	0.034	−0.214**	0.542
B2_3	0.333	0.327	0.066	0.020	0.000	0.952	0.000	−0.358**	0.282
B2_4	0.333	0.455	0.145	0.000	0.000	0.250	0.000	−0.375**	0.389
B2_5	0.472	0.545	0.329	0.122	0.125	0.494	0.013	−0.306**	0.412
Oth2_1	0.389	0.509	0.316	0.082	0.125	0.261	0.026	−0.283**	0.446
Oth2_2	0.611	0.764	0.658	0.265	0.000	0.119	0.191	−0.321**	0.484
Oth2_3	0.583	0.655	0.605	0.408	0.250	0.492	0.565	−0.163**	0.403
Oth2_4	0.194	0.436	0.171	0.020	0.000	0.017	0.001	−0.272**	0.413
Oth2_5	0.222	0.509	0.342	0.102	0.250	0.006	0.055	−0.163**	0.418
Obj2_1	0.194	0.273	0.092	0.041	0.000	0.394	0.006	−0.229**	0.414
Obj2_2	0.583	0.673	0.303	0.102	0.000	0.386	0.000	−0.441**	0.298
Obj2_3	0.361	0.418	0.211	0.000	0.000	0.586	0.010	−0.350**	0.476
Obj2_4	0.139	0.218	0.066	0.000	0.000	0.343	0.010	−0.232**	0.388
Obj2_5	0.111	0.327	0.250	0.143	0.000	0.019	0.332	−0.064	0.274
E2_1	0.194	0.582	0.316	0.224	0.125	0.000	0.002	−0.124*	0.467
E2_2	0.556	0.727	0.632	0.551	0.250	0.091	0.250	−0.094	0.498
E2_3	0.194	0.655	0.474	0.184	0.125	0.000	0.040	−0.142*	0.473
E2_4	0.583	0.800	0.697	0.469	0.250	0.025	0.186	−0.173**	0.591
E2_5	0.611	0.545	0.474	0.367	0.250	0.536	0.417	−0.181**	0.299
P2_1	0.222	0.564	0.447	0.122	0.125	0.003	0.189	−0.163**	0.416
P2_2	0.083	0.364	0.539	0.367	0.000	0.002	0.046	0.130*	0.350
P2_3	0.278	0.527	0.592	0.286	0.000	0.019	0.460	−0.068	0.457
P2_4	0.056	0.145	0.224	0.122	0.000	0.180	0.261	0.038	0.241
P2_5	0.083	0.273	0.395	0.286	0.375	0.027	0.147	0.148*	0.256
M2_1	0.250	0.418	0.224	0.000	0.000	0.100	0.017	−0.289**	0.368
M2_2	0.194	0.436	0.250	0.000	0.000	0.017	0.025	−0.258**	0.407
M2_3	0.194	0.273	0.053	0.000	0.000	0.394	0.000	−0.294**	0.395
M2_4	0.167	0.364	0.066	0.061	0.000	0.042	0.000	−0.241**	0.367
M2_5	0.528	0.564	0.316	0.102	0.000	0.737	0.005	−0.372**	0.546
C2_1	0.111	0.418	0.079	0.020	0.000	0.002	0.000	−0.261**	0.468
C2_2	0.083	0.527	0.211	0.041	0.000	0.000	0.000	−0.216**	0.460
C2_3	0.278	0.527	0.276	0.061	0.000	0.019	0.004	−0.279**	0.446
C2_4	0.278	0.400	0.197	0.061	0.000	0.232	0.011	−0.260**	0.386
C2_5	0.722	0.800	0.368	0.143	0.000	0.389	0.000	−0.508**	0.631
A2_1	0.750	0.673	0.566	0.327	0.125	0.430	0.215	−0.320**	0.510
A2_2	0.250	0.636	0.579	0.367	0.250	0.000	0.507	0.021	0.465
A2_3	0.417	0.673	0.566	0.245	0.375	0.016	0.215	−0.171**	0.462
A2_4	0.111	0.291	0.079	0.020	0.000	0.043	0.001	−0.213**	0.323
A2_5	0.556	0.709	0.500	0.184	0.125	0.134	0.016	−0.330**	0.415

*$P < 0.05$.
**$P < 0.01$.

Table A3 Phase 3: item analysis of all items of Scale of Emotional Development – Short

Item	Item frequency f_i yes-answers per phase					Item specificity χ^2-test compared with		Spearman's rank correlation coefficient ρ	Corrected item–total correlation
	1	2	3	4	5	2	4		
B3_1	0.139	0.345	0.684	0.612	0.375	0.000	0.408	0.315**	0.440
B3_2	0.278	0.582	0.737	0.673	0.375	0.062	0.445	0.205**	0.428
B3_3	0.444	0.655	0.632	0.184	0.125	0.787	0.000	−0.230**	0.364
B3_4	0.194	0.545	0.895	0.878	0.625	0.000	0.766	0.461**	0.520
B3_5	0.194	0.582	0.526	0.204	0.125	0.529	0.000	−0.091	0.154
Oth3_1	0.417	0.727	0.816	0.571	0.250	0.228	0.003	0.022	0.510
Oth3_2	0.278	0.600	0.632	0.347	0.125	0.713	0.002	−0.038	0.496
Oth3_3	0.139	0.527	0.737	0.755	0.625	0.013	0.819	0.372**	0.417
Oth3_4	0.167	0.345	0.447	0.306	0.000	0.241	0.114	0.043	0.296
Oth3_5	0.111	0.273	0.592	0.408	0.125	0.000	0.044	0.200**	0.471
Obj3_1	0.167	0.218	0.263	0.102	0.000	0.554	0.028	−0.074	0.207
Obj3_2	0.194	0.309	0.289	0.184	0.000	0.809	0.181	−0.065**	0.225
Obj3_3	0.389	0.727	0.829	0.714	0.500	0.161	0.128	0.160**	0.441
Obj3_4	0.083	0.436	0.789	0.653	0.375	0.000	0.091	0.351**	0.539
Obj3_5	0.000	0.036	0.184	0.041	0.000	0.011	0.019	0.079	0.155
E3_1	0.361	0.600	0.737	0.469	0.375	0.098	0.002	0.041	0.520
E3_2	0.111	0.309	0.408	0.204	0.000	0.247	0.018	0.019	0.315
E3_3	0.306	0.618	0.750	0.510	0.375	0.106	0.006	0.087	0.459
E3_4	0.028	0.164	0.632	0.898	0.500	0.000	0.001	0.604**	0.371
E3_5	0.083	0.236	0.408	0.327	0.375	0.040	0.359	0.190**	0.412
P3_1	0.028	0.145	0.553	0.327	0.250	0.000	0.013	0.266**	0.504
P3_2	0.028	0.200	0.382	0.041	0.000	0.026	0.000	0.004	0.389
P3_3	0.028	0.327	0.539	0.224	0.000	0.016	0.000	0.093	0.511
P3_4	0.000	0.109	0.303	0.286	0.125	0.008	0.840	0.238**	0.423
P3_5	0.028	0.145	0.342	0.224	0.250	0.011	0.160	0.183**	0.462
M3_1	0.056	0.400	0.342	0.082	0.000	0.497	0.001	−0.083	0.347
M3_2	0.194	0.382	0.776	0.673	0.375	0.000	0.203	0.327**	0.523
M3_3	0.222	0.455	0.618	0.286	0.000	0.063	0.000	−0.008	0.354
M3_4	0.111	0.309	0.211	0.061	0.000	0.200	0.023	−0.129*	0.141
M3_5	0.028	0.145	0.224	0.265	0.125	0.261	0.595	0.177**	0.348
C3_1	0.083	0.273	0.553	0.286	0.375	0.001	0.003	0.172**	0.523
C3_2	0.083	0.527	0.645	0.449	0.250	0.176	0.031	0.159**	0.406
C3_3	0.056	0.364	0.474	0.306	0.125	0.209	0.063	0.115*	0.183
C3_4	0.028	0.091	0.303	0.224	0.125	0.004	0.338	0.192**	0.437
C3_5	0.000	0.255	0.500	0.429	0.125	0.005	0.435	0.265**	0.486
A3_1	0.333	0.455	0.671	0.388	0.250	0.013	0.002	0.036	0.493
A3_2	0.167	0.418	0.539	0.653	0.250	0.170	0.208	0.255**	0.396
A3_3	0.222	0.636	0.776	0.510	0.375	0.079	0.002	0.125*	0.556
A3_4	0.306	0.527	0.763	0.531	0.500	0.005	0.007	0.151*	0.563
A3_5	0.000	0.182	0.671	0.408	0.250	0.000	0.004	0.324**	0.489

*$P < 0.05$.
**$P < 0.01$.

Table A4 Phase 4: item analysis of all items of Scale of Emotional Development – Short

	Item frequency f_i yes-answers per phase					Item specificity χ^2-test/Fisher's exact test compared with		Spearman's rank correlation coefficient ρ	Corrected item–total correlation
Item	1	2	3	4	5	3	5		
B4_1	0.028	0.091	0.276	0.592	0.250	0.000	0.078	0.415**	0.564
B4_2	0.056	0.291	0.737	0.898	1.00	0.028	0.455	0.627**	0.671
B4_3	0.028	0.036	0.382	0.776	0.625	0.000	0.303	0.586**	0.546
B4_4	0.000	0.036	0.250	0.367	0.000	0.161	0.037	0.313**	0.407
B4_5	0.028	0.127	0.289	0.224	0.000	0.421	0.158	0.151*	0.206
Oth4_1	0.000	0.145	0.487	0.633	0.875	0.110	0.175	0.513**	0.588
Oth4_2	0.000	0.018	0.289	0.449	0.625	0.068	0.294	0.449**	0.479
Oth4_3	0.000	0.073	0.289	0.653	0.750	0.000	0.460	0.534**	0.516
Oth4_4	0.000	0.055	0.184	0.306	0.250	0.115	0.554	0.299**	0.326
Oth4_5	0.000	0.073	0.329	0.612	0.625	0.002	0.633	0.500**	0.567
Obj4_1	0.389	0.527	0.789	0.939	0.750	0.023	0.140	0.403**	0.492
Obj4_2	0.139	0.200	0.276	0.224	0.000	0.517	0.158	0.040	0.133
Obj4_3	0.306	0.655	0.684	0.878	0.250	0.013	0.001	0.260**	0.407
Obj4_4	0.250	0.509	0.697	0.857	0.500	0.041	0.037	0.361**	0.410
Obj4_5	0.194	0.527	0.461	0.531	0.250	0.444	0.138	0.117*	0.250
E4_1	0.028	0.073	0.184	0.510	0.250	0.000	0.163	0.381**	0.491
E4_2	0.000	0.073	0.329	0.571	0.875	0.007	0.104	0.509**	0.525
E4_3	0.000	0.127	0.289	0.551	0.750	0.003	0.255	0.452**	0.488
E4_4	0.056	0.055	0.171	0.735	0.750	0.000	0.650	0.549**	0.530
E4_5	0.000	0.055	0.184	0.429	0.250	0.003	0.292	0.369**	0.421
P4_1	0.028	0.055	0.342	0.673	0.750	0.000	0.507	0.538**	0.602
P4_2	0.000	0.109	0.303	0.694	0.500	0.000	0.245	0.505**	0.502
P4_3	0.000	0.036	0.184	0.367	0.125	0.022	0.175	0.331**	0.415
P4_4	0.028	0.109	0.329	0.633	0.500	0.001	0.367	0.459**	0.595
P4_5	0.000	0.236	0.474	0.776	0.625	0.001	0.303	0.515**	0.661
M4_1	0.000	0.109	0.513	0.694	0.500	0.045	0.245	0.519**	0.650
M4_2	0.000	0.036	0.263	0.367	0.125	0.216	0.175	0.330**	0.382
M4_3	0.000	0.145	0.408	0.449	0.250	0.650	0.255	0.335**	0.414
M4_4	0.056	0.073	0.303	0.571	0.125	0.003	0.023	0.383**	0.471
M4_5	0.083	0.255	0.592	0.898	0.625	0.000	0.074	0.550**	0.648
C4_1	0.000	0.018	0.368	0.265	0.375	0.231	0.398	0.319**	0.372
C4_2	0.000	0.036	0.408	0.673	0.500	0.004	0.284	0.538**	0.655
C4_3	0.000	0.182	0.592	0.939	0.375	0.000	0.001	0.611**	0.686
C4_4	0.000	0.073	0.487	0.796	0.375	0.001	0.024	0.572**	0.633
C4_5	0.000	0.091	0.500	0.857	0.750	0.000	0.371	0.639**	0.699
A4_1	0.000	0.236	0.395	0.490	0.625	0.295	0.373	0.356**	0.464
A4_2	0.000	0.000	0.118	0.347	0.125	0.002	0.205	0.354**	0.408
A4_3	0.000	0.200	0.447	0.633	0.625	0.043	0.628	0.454**	0.555
A4_4	0.000	0.018	0.342	0.571	0.500	0.012	0.498	0.496**	0.607
A4_5	0.000	0.000	0.079	0.204	0.125	0.041	0.514	0.271**	0.319

*$P < 0.05$.
**$P < 0.01$.

Table A5 Phase 5: item analysis of all items of Scale of Emotional Development – Short

Item	Item frequency f_i yes-answers per phase					Item specificity Fisher's exact test compared with	Spearman's rank correlation coefficient ρ	Corrected item–total correlation
	1	2	3	4	5	4		
B5_1	0.000	0.000	0.053	0.204	0.375	0.258	0.321**	0.367
B5_2	0.000	0.055	0.132	0.245	0.625	0.043	0.319**	0.343
B5_3	0.028	0.018	0.132	0.510	0.875	0.057	0.499**	0.504
B5_4	0.056	0.127	0.316	0.531	0.875	0.070	0.424**	0.570
B5_5	0.000	0.036	0.066	0.306	0.625	0.090	0.378**	0.529
Oth5_1	0.028	0.036	0.132	0.184	0.625	0.017	0.271**	0.402
Oth5_2	0.000	0.200	0.329	0.653	0.875	0.205	0.484**	0.617
Oth5_3	0.000	0.000	0.039	0.286	0.375	0.446	0.373**	0.411
Oth5_4	0.028	0.036	0.053	0.224	0.500	0.116	0.284**	0.351
Oth5_5	0.000	0.018	0.263	0.490	0.625	0.373	0.471**	0.507
Obj5_1	0.000	0.109	0.289	0.551	1.00	0.014	0.492**	0.633
Obj5_2	0.056	0.200	0.342	0.408	0.625	0.223	0.293**	0.365
Obj5_3	0.111	0.291	0.539	0.816	1.00	0.228	0.514**	0.557
Obj5_4	0.028	0.164	0.487	0.755	0.750	0.639	0.538**	0.635
Obj5_5	0.083	0.273	0.579	0.714	1.00	0.088	0.485**	0.608
E5_1	0.000	0.000	0.118	0.306	0.625	0.090	0.402**	0.513
E5_2	0.000	0.036	0.118	0.429	0.625	0.257	0.436**	0.510
E5_3	0.000	0.000	0.132	0.388	0.625	0.191	0.443**	0.619
E5_4	0.000	0.018	0.066	0.388	0.375	0.633	0.405**	0.502
E5_5	0.000	0.000	0.066	0.327	0.625	0.111	0.424**	0.555
P5_1	0.000	0.018	0.092	0.367	0.625	0.161	0.423**	0.475
P5_2	0.028	0.000	0.092	0.265	0.250	0.650	0.300**	0.454
P5_3	0.028	0.073	0.211	0.510	0.875	0.057	0.459**	0.678
P5_4	0.028	0.018	0.105	0.327	0.625	0.111	0.374**	0.594
P5_5	0.028	0.018	0.079	0.122	0.500	0.025	0.229**	0.443
M5_1	0.028	0.200	0.434	0.755	1.00	0.130	0.546**	0.667
M5_2	0.000	0.073	0.237	0.592	0.750	0.331	0.503**	0.570
M5_3	0.000	0.091	0.342	0.714	0.625	0.446	0.541**	0.648
M5_4	0.000	0.000	0.079	0.367	0.625	0.161	0.442**	0.531
M5_5	0.000	0.036	0.211	0.408	0.750	0.078	0.434**	0.601
C5_1	0.000	0.000	0.066	0.265	0.500	0.175	0.373**	0.473
C5_2	0.000	0.000	0.303	0.755	1.00	0.130	0.653**	0.786
C5_3	0.000	0.000	0.118	0.408	0.750	0.078	0.471**	0.551
C5_4	0.000	0.000	0.105	0.551	0.625	0.502	0.527**	0.607
C5_5	0.000	0.000	0.132	0.286	0.500	0.209	0.371**	0.523
A5_1	0.000	0.036	0.289	0.531	0.750	0.222	0.494**	0.543
A5_2	0.000	0.018	0.013	0.184	0.375	0.215	0.298**	0.322
A5_3	0.000	0.036	0.132	0.306	0.625	0.090	0.369**	0.483
A5_4	0.000	0.055	0.237	0.510	0.500	0.627	0.443**	0.523
A5_5	0.000	0.000	0.026	0.061	0.250	0.140	0.201**	0.241

*$P < 0.05$.
**$P < 0.01$.

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