



Emotions or attention – what are predictors for the development of childhood psychopathology? A longitudinal study with pre- and elementary school children

Hanna Christiansen¹ · Oliver Hirsch² · Ashkan Beheshti¹ · Mira-Lynn Chavanon¹

Accepted: 10 May 2021 / Published online: 20 May 2021
© The Author(s) 2021

Abstract

Current debate has identified the factors emotion knowledge (EK) and attention as specific trajectories longitudinally influencing psychopathological development in childhood. The “Emotion Knowledge Hypothesis” assumes that children with great emotion skills have high self-regulating abilities that result in lower cognitive load and stronger attention capacities. Attention problems are thus perceived as a consequence of reduced EK. According to the competing “Attention Effect Hypothesis”, attention problems and EK deficits are associated because of impaired learning capacities due to attention problems. According to this hypothesis, attention problems are predictive of impaired EK. If those specific trajectories are disrupted, this might attenuate the development of later behavior problems. The present study tests those competing hypotheses replicating previous studies in this field to shed light on potential psychopathology trajectories. A total of 136 pre- and elementary school children as well as their teachers participated in this study. Children’s symptoms of inattention as well as their emotional competences were assessed 3 times over a 12-month period. We applied multilevel structural equation modelling and cross-lagged panel models for data analysis. Overall, we noted a drop in inattention scores and rise in emotional competences over the one-year course, indicating maturation effects. There was a significant but very small effect for attention scores predicting emotional competences. With respect to the question whether interventions should focus on the “Emotion Knowledge” or “Attention Effect” hypothesis, our findings imply that none of them has superiority over the other. Therefore, both emotion knowledge and attention are crucial for development, and that children with deficits in either domain should receive targeted interventions in order to disrupt potentially harmful developmental pathways.

Keywords ADHD · Emotion knowledge · Attention effect · Children

Introduction

Successful emotion regulation (ER) is a key factor in mental health (Riechmann et al., 2017; Sheppes et al., 2015). When seeking a definition of emotion regulation, there is general agreement that ER refers to all people’s efforts to influence “which emotions they have, when they have them, and how

they experience and express” them (Gross, 1998). Emotions are elicited by internal or external events and constitute time-limited, situationally-bound qualitative states coupled with changes in feelings, expression and physiology (Christiansen et al., 2019; Mauss et al., 2005). They require that we are aware of and direct our attention to the activating event, and that we value or appraise the event with regard to our goals. This results in relevant action tendencies (approach vs. withdrawal), physiological activation (central and peripheral), and expressive behaviors (Gross & Jazaieri, 2014). Emotions are at work during the guiding sensory processing, decision making, or information processing regarding the best course of action. However, this regulation of emotions might also fail and can thus result in potentially harmful experiences of emotions that situation specific manifest in intensity, duration, frequency, or type (Groß, 2014; Gross & Jazaieri, 2014).

✉ Hanna Christiansen
christih@staff.uni-marburg.de

¹ Department of Psychology, Clinical Child and Adolescent Psychology, Philipps University Marburg, Gutenbergstr. 18, D-35037 Marburg, Germany

² FOM University of Applied Sciences, Birlenbacher Str. 17, D-57078 Siegen, Germany

Such failure is associated with a wide range of problem behaviors and mental disorders (Stringaris & Goodman, 2009; Trentacosta & Fine, 2010), and even early childhood markers of dysfunctional emotion regulation are known to be predictive of later psychopathology. In this relation, a recent meta-analysis demonstrated negative emotionality and impaired self-regulation to be predictive of psychopathology before the age of 18 years (Kostyrka-Allchorne et al., 2019).

To successfully regulate emotions, we need to correctly perceive and label them (Izard et al., 2011). This is called emotion knowledge, and is a prerequisite of the ER appraisal phase. Emotion knowledge (EK) is defined as “the ability to understand relatively unambiguous cues of discrete emotions expressed in traditional channels (facial expressions, vocalizations, gestures, social contexts).” (Trentacosta & Fine, 2010), p. 1–2). Language abilities are a key factor for the expression of emotion knowledge. Garner and Waajid (2008) enumerate facets of EK as receptive and expressive knowledge of emotion (i.e., the traditional index of emotion recognition and expression skills), emotion situation knowledge (i.e., knowledge of which situations cause specific emotion states) and behavioral EK (i.e., ability to recognize the emotion states related to facial, vocal, or behavioural actions). Poor EK has been linked to severe mental disorders in adulthood (Beheshti et al., 2020; Hirsch et al., 2018; Hirsch et al., 2019) as well as to behavior problems, internalizing and externalizing disorders in childhood and adolescence (Trentacosta & Fine, 2010).

With respect to child development, EK is shown to be crucial for the development of social competence and later behavioral adjustment. In this relation, the comprehensive meta-analysis by Trentacosta and Fine (2010) demonstrated significant, albeit small effects ($r = .22$) for the association between EK and social competence; that is, the higher the emotion knowledge was, the higher the social competence scores were. The same study also demonstrated that lower levels of EK were associated with higher levels of behavioral adjustment factors in children and adolescents, i.e., internalizing ($r = -.17$) and externalizing ($r = -.17$) problems. In addition, Bornstein and colleagues (2010) argued that higher social competence in young children predicts fewer symptoms of behavioural adjustment problems in late childhood and early adolescence. This is explained with EK being a predictive factor of social competence as the identification, reception and comprehension of affective messages enables us to understand social situations, and this skill guides children’s social skills and interactions. Social competence is linked to reduced risk behaviour, and the higher the social competences, the lower the risk of children to exhibit deviant behaviours such as internalizing or externalizing problems (Bornstein et al., 2010). Furthermore, preschool children’s social functioning is better predicted by contextually driven facets of EK

(emotion situation knowledge and behavioural EK) than by basic facets of EK (receptive and expressive knowledge of emotion) (Heinze et al., 2015).

Attention deficit/hyperactivity disorder (ADHD) is a highly prevalent mental disorder of the externalizing spectrum, and numerous studies have shown that children with ADHD experience significant and impairing difficulties with their peers (Hoza, 2007; Hoza et al., 2005). Most likely due to the core symptoms of inattention, hyperactivity and impulsivity, these children are experienced as being intrusive (Landau & Milich, 1988; Whalen et al., 1979), having difficulties in perceiving social cues, and lack adequate proper responses (Landau & Milich, 1988). In the study by Hoza et al. (2005), the majority of children (52%) with ADHD aged seven to nine years were rejected by their peers, as just 1% were popular. Long-term studies have shown that peer-rejection is a significant predictor of an adverse ADHD course (Mrug et al., 2012), accompanied by higher rates of anti-social behavior (Barkley et al., 2004; Dalsgaard et al., 2013), substance abuse (Dalsgaard et al., 2014), low family functioning and quality of life (Schermelleh-Engel et al., 2003). Thus, symptoms of inattention, hyperactivity and impulsivity are associated with significant impairment over the course of the disorder. It remains unclear, however, which of the symptoms is causative for such effects. One could argue that attention is the crucial factor, as only attention allows us to perceive behavior as socially competent or not. With respect to attention, there are two competing hypotheses targeting the association between emotion knowledge and ADHD.

The “Emotion Knowledge Hypothesis” assumes that children with high emotion skills, especially EK, also possess generally high self-regulating competences that result in lower cognitive load and higher attention capacities (Izard et al., 2011). Children with low EK on the other hand experience higher cognitive load in emotionally-relevant situations, resulting in greater attentional demands (Hoehl et al., 2010). Attention problems are thus perceived as a consequence of reduced EK. In this relation, Wang (2008) suggests that the interpretation and appraisal of an event situation involved in cognitive processes can be schematized by EK as it provides a knowledge structure that enables the individual to fully appreciate an event’s emotional meaning and personal significance. Different longitudinal and cross-lagged panel studies have supported this hypothesis by demonstrating that higher emotional competences resulted in less severe attention problems in pre- and elementary school children (Rhoades et al., 2011; von Salisch et al., 2017; Trentacosta et al., 2006). Garner and Waajid (2008) investigated the role of social functioning in young children’s school competence and found that EK mediates both teacher-child and peer relationships, as it helps children regulate their emotional experiences and negotiate social exchanges with others.

The “Attention Effect Hypothesis” on the other hand states that attention problems and deficits in emotion regulation, especially EK, are associated because of impaired learning capacities due to attention problems (Kats-Gold & Priel, 2009; Schultz et al., 2001; Trentacosta & Izard, 2007). According to this hypothesis, attention problems are thus predictive of impaired ER and EK in the long term. Longitudinal studies have also supported this line of research. After controlling for children’s verbal ability in preschool, teacher reports of attentional control and caregiver reports of behavioral control in preschool predicted children’s emotion expression knowledge and emotion situation knowledge two years later (Schultz et al., 2001). A study assessing emotion competence over the course of one year demonstrated that the relation between teacher ratings of emotion regulation and academic competence was primarily indirect through the effect of emotion regulation on teacher ratings of attention (Trentacosta & Izard, 2007). Further, Izard et al. (2011), reported that cognitive circuits of the anterior cingulate and orbitofrontal cortex are responsible for activation of emotion schemas involved in behavior control. In this relation, perceiving the emotional signals and adaptive responses is highly dependent on the capacity for attentional focus and inhibitory control, which can negatively or positively influence the development of ER.

Furthermore, and addressing ADHD’s psychopathology, Posner et al. (2014) articulated the “Dyscontrol” and “Affectivity” hypotheses that harmonize with the neuropsychological aspects of the “Emotion Knowledge” and “Attention Effect” hypotheses. Based on the “Dyscontrol Hypothesis”, resembling the “Attention Effect”, anomalies within frontolimbic circuits result in capacity impairments to inhibit emotional responses. On the other hand, according to the “Affectivity Hypothesis” and in conjunction with “Emotion Knowledge”, negative, emotionally-responsive behaviour in patients with ADHD is primarily the result of dysfunctional emotional processing associated with the amygdala and medial prefrontal cortex (Christiansen et al., 2019).

Moreover, both are relevant hypotheses with respect to etiological models for disorders such as ADHD and therefore also relevant for deciding the direction of potential interventions targeting those impairments. If on the one hand an early EK impairment is indicative of later attention problems that often result in significant impairment over the life span (Christiansen et al., 2019), then early interventions targeting EK could be a means of disrupting this pathway. On the other hand, if early attention problems are predictive of impaired EK, that too will most likely result in poor ER (an impairment associated with significant mental disorders from childhood to adulthood as described above), then early attention training might disrupt such impairing trajectories.

In addition, previous research approves, though contextually dependent, the presence of sex differences regarding the manifestations of ADHD and behavioural adjustment. In this regard, girls tend to manifest more inattention criteria as well as internalizing problems while boys tend to be more hyperactive and impulsive, and are thus more often diagnosed with externalizing problems (Young et al., 2015). However, studies focusing on the relationship of sex differences and social competence result in heterogeneous findings. For instance, there are studies reporting higher scores of social functioning for girls, arguing that girls seem to be more competent in identifying the intentions of others or in generating efficient solutions to social problems (Abdi, 2010; Ren & Wyver, 2016; Walker, 2005). On the other hand, there are studies reporting no such sex differences (Hukkelberg & Ogden, 2020; Veiga et al., 2017). Huang & Macek (2020) report contradictory findings for Chinese boys as those were found to exhibit high social skills; an ability that is highly reinforced in Chinese boys both by their parents and teachers.

The aim of the current study is thus to contribute to these research findings with a cross-lagged panel study targeting attention and EK in pre- and elementary school children over the course of a year. We focus on pre- and elementary school children as antecedent pathways of social competence and behavioural adjustment in early adolescents are possibly rooted in the development of those in early childhood and the interaction of such factors are considerably manifested in the very beginning of the school age. As language abilities are a crucial factor for ER and EK, and as EK’s development depends on developing symbolic processes and on acquiring language (Izard et al., 2011), language development needs to be considered as a significant moderating factor (von Salisch et al., 2015, 2017). The second aim of this study is thus to test different models of EK and attention with the potential moderators language skills, age and sex.

Summing up, we target the following research questions: 1) is attention predictive of emotion knowledge over the course of one year? (“Attention Effect Hypothesis”); 2) is emotion knowledge predictive of attention over the course of one year? (“Emotion Knowledge Hypothesis”); 3) is the relation of emotion knowledge/attention on attention/emotion knowledge moderated by child age, sex and language abilities?

Methods

Participants

A total of $N = 136$ pre- and elementary school children, none with a diagnosis of ADHD, as well as their teachers participated in the study. Table 1 shows the details of child participants for the different assessments.

Table 1 Number of participants with sex and mean age

Assessment	N	% male	Mean age (SD)	Age Range
T1	136	51	7.40 (1.37)	5.00–10.16
T2	97	56	8.03 (1.26)	5.67–10.75
T3	89	56	8.58 (1.22)	6.16–11.25

Measures

Conners Early Childhood (Conners EC™ MHS, North Tonawanda, NY)

The Conners EC™ scales assess a wide range of behavioral, emotional, social and developmental concerns in preschool-children aged two to six years. It is a multi-informant assessment with versions for parents and childcare providers. In both versions, the child's behavior is rated dimensionally in its frequency and intensity on a 4-point Likert scale from 0 (*not true at all/never, seldom*) to 3 (*very much true/very often, very frequently*), while the development over time is rated on a 3-point Likert scale from 0 (*no/never or rarely*) to 2 (*yes/always or almost always*).

The long form of the behavior scales consists of 110 items in the parent and 112 items in the childcare provider version assessing Inattention/Hyperactivity, Defiant/Aggressive Behaviors, Social Functioning/Atypical Behaviors, Anxiety, Mood and Affect, and Physical Symptoms. In the original version, the items of the Mood and Affect, Physical Symptoms and Atypical Behavior scale did not form independent factors during the EFA in the pilot data phase, and were regarded as “rational scales” which were “retained due to their theoretical and clinical significance” (Conners, 2009). For the German version, all Conners EC™ scales were translated into German according to the translation guidelines from MHS, back translated, and norms for a German-speaking sample were established (Harbarth et al., 2018; Türk et al., 2020). For this study, only the teacher-rated “inattention” scale was used. This study's internal consistency for the inattention scale ranged from .49 to .83 with a one year re-test reliability of .65.

Conners 3 Scales (Conners 3 MHS, North Tonawanda, NY)

The German version of the Conners 3 (C3D) assesses ADHD symptoms and related problematic behaviors in children and young adolescents between 6 and 18 years of age (Christiansen et al., 2016). The symptom-frequency assessment is based on the evaluations of parents (parent-rating), teachers (teacher-rating), and the children themselves (self-rating). Symptoms are rated on a Likert-type scale from 0 (*not at all/never*) to 3 (*very much/very frequently*).

The long form of the self-rating scales (C3D) consists of 94 items assessing not only ADHD core symptoms but also related problems in executive functions, learning problems, aggression, and peer/family relations. The C3D features screener items for anxiety and depression. Scales that relate directly to the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 2000) diagnostic criteria (symptom scales) are included for ADHD (inattention and hyperactivity/impulsivity) and the most commonly co-occurring group of disorders.

The parent (C3D-P) and teacher (C3D-T) ratings differ from the self-report primarily in how the questions are worded. Items in the self-report are formulated in the first person singular (e.g., “it is hard for me to pay attention ...”), whereas items in the parent and teacher ratings are formulated in the third-person singular (e.g., “the child being described doesn't pay attention ...”). The long form of the parent-rating scales (C3D-P) contains 105 items, with 44 symptom scale items, while the long form of the teacher-rating scales (C3D-T) contains 111 items with 42 symptom-scale items. For the current study, we only used the teacher-rated inattention symptom-scale. Its internal consistency in this study ranged between .92 and .93, and one-year re-test reliability reached .50.

Assessment of Emotional Competences in Children

The Emotional Competence Inventory for Children (Messverfahren für emotionale Kompetenz im Kindesalter; MeKKi, (In-Albon, 2015)) for preschool and elementary school children is based on Denham's concept of emotional competences (Denham, 1998) and assesses *emotion expression* (children have to mimic emotions), *emotion regulation* (emotional vignettes are presented and children asked what they would do to feel better), and *emotion knowledge* (Groß, 2014; Haaß, 2014; Huber et al., 2019; Uhrig, 2014). The latter comprises the *subscales emotion vocabulary* (children are asked to name all emotions they know), *emotion recognition (visually)*: e.g. pictures of people with different emotional expressions are presented; *auditory*: children hear a sentence with five different intonations; *situational*: twelve different situations are described that elicit different emotions and children have to report which emotion they would experience in that situation), and *emotion comprehension* (13 emotions are presented and the child is asked to describe a situation in which she/he has experienced such an emotion). All tasks are presented on a computer screen (laptop) and a small snail indicates each test's progress. Each assessment is performed individually and supported by a trained assessor. One year re-test reliability ranges from .30 to .48, and internal consistency rates for the different scales range from Cronbach's alpha of .62 to .80 (Huber et al., 2019). Inter-rater reliability is satisfactory with values between .62 and 1.00 (Huber et al., 2019). For the current study,

internal consistency ranged from .42 to .81 for the total score (sum of the subscales) applied in this study, as it captures EK as well as emotion expression and regulation, the other two facets of developmentally-relevant emotional competences (Christiansen et al., 2019; Kostyrka-Allchome et al., 2019). One-year re-test reliability for T1 to T2 was .60, for T1 to T3 .50 and for T2 to T3 .68 for the emotional competence (EC) total score.

Language Skills

Children’s kindergarten and elementary school teachers were asked to assess children’s language skills on a simple five-point Likert scale ranging from “significantly below average” (–2) to “definitely above average” (+2).

Procedure

All children willing to participate were assessed during individual appointments in their kindergarten or after-school care. All parents provided written informed consent to study participation, as did the kindergarten and elementary school teachers. Children gave their participation assent. The study was approved by the ethical review board of Philipps University Marburg, Department of Psychology and concurs with the Declaration of Helsinki 1964 and its later amendments. All children participated in three assessments over the course of one year (see Fig. 1). At each assessment, symptoms of inattention (measured with the C3D or ECTM for teachers) and emotional competences (measured with the MeKKi) were assessed. Teachers also rated children’s verbal competences ranging from low (–2) to above average (+2). Each child’s MeKKi assessment lasted about 45 min. Children received a small gift for participating, and all kindergartens/schools received compensation in form of toys/books for their institution as well as workshops on ADHD. Figure 1 illustrates the study procedure with the three different assessments over one year. However, as children

transferred from kindergarten to elementary school or moved homes over the course of the year, we were not able to assess all children at all three assessments which resulted in a drop-out of $n = 39$ children after T1 (see result section).

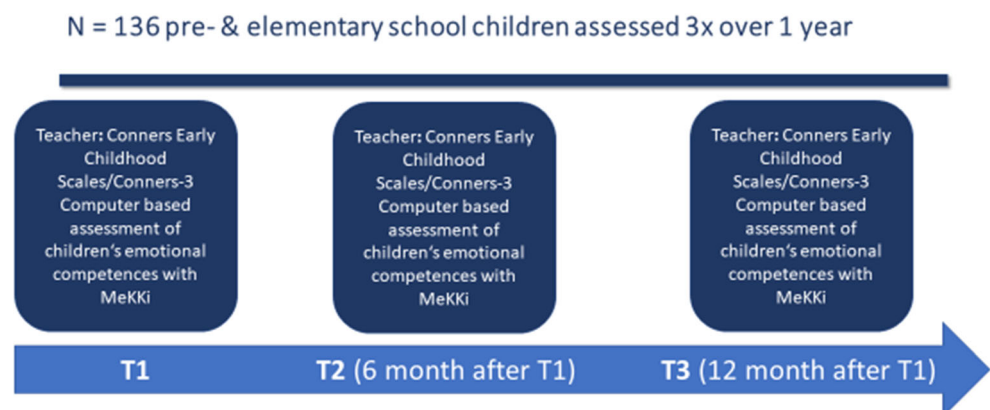
Statistical Analyses

Intra-class correlations (ICC) were calculated for emotional competences (EC) and inattention. The ICC signals the proportion of between-person variance and the converse shows the variance explained by fluctuations within persons. After standardizing the raw scores, the ICC can considerably differ in its value, as multilevel structural equation modeling demonstrates. When standardizing raw scores, the ICC is higher, as only the systematic variance is considered, excluding residual error variances from the computation. This does not seem to be realistic, as psychological constructs always have a measurement error (Hox, 2009), we thus based our ICC calculations on unstandardized scores.

Emotion scales were merged into a total emotion score (Cronbach’s α .81). Means and standard deviations (SD) were computed for all scales, as were bivariate Pearson correlations between inattention symptoms and emotional competences for the three assessments. Correlations with the variables age, sex, and verbal comprehension were also computed. For longitudinal data, a series of cross-lagged panel models (CLPM) were specified in Mplus (Finkel, 1995; Jöreskog et al., 1979; Little et al., 2016). The first model specified emotional competence and inattention. Following this primary analysis, four further models were specified to estimate the influence of the variables sex (model 2), age (model 3), verbal competences (model 4). Model 5 included all third variables (sex, age, verbal competences).

The CLPM can be applied if one measures two or more variables at two or more occasions and is interested in their influence on each other over time. If the stability of the constructs is trait-like and time-invariant to some extent, the CLPM is unable to account for that. Therefore, we also

Fig. 1 Study procedure over 3 assessments



calculated random intercept cross-lagged panel models (RI-CLPM) that decompose each observed score into a between-person and within-person part. That isolates the variance in repeated measurements of the outcomes that are stable (between-person and time-invariant) and those that are dynamic (within-person and time-varying) (Madigan et al., 2019). The deviation from an individual's expected score relies on the sample mean at each time point and the individual's stable trait factor. We calculated several model fit indices according to the recommended procedure in the literature to evaluate our analyses' results (Hu & Bentler, 1999; Schermelleh-Engel et al., 2003): Comparative Fit Index (CFI), Tucker Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), Akaike Information Criterion (AIC), and Standardized Root Mean Square Residual (SRMR). Hu and Bentler suggest that values $\geq .95$ for the TLI and CFI indicate good model fit, and that SRMR values $\leq .06$ are acceptable (Hu & Bentler, 1999). Regarding the RMSEA, values under .05 indicate good fit, values between .05 and .08 acceptable fit, and if the model's value exceeds .10, the fit is considered poor (Browne & Cudeck, 2016). The more parsimonious the model, the better the fit according to AIC, thus lower values indicate better model fit. The CLPM is nested under the RI-CLPM and therefore both models can be compared via a Satorra-Bentler chi-square difference test. If the intervals between occasions in an RI-CLPM are identical, one can test whether the effect variables have on each other are stable over time. This is done by constraining the lagged parameters over time and conducting a chi-square difference test (Hamaker et al., 2015).

We started our analyses with constrained models that test whether stability paths and cross-lagged associations can be constrained to be equal over time. The assumption is that the stability and cross-lagged effects from T1 to T2 are equal to those from T2 to T3. The constrained model is more parsimonious and should be preferred provided there are no significant differences to an unconstrained model (Kim et al., 2017). Standardized coefficients are presented in our results.

Model estimation was done using Full Information Maximum Likelihood Estimation (FIML) with robust standard errors (MLR) to account for missing data and non-normality (Hamaker et al., 2015; Lüdtke et al., 2007).

All variables were z-standardized prior to the analyses. Calculations were performed using IBM SPSS Statistics Version 24, MPlus 7 and Microsoft R Open 3.5.3 with package lavaan (Rosseel, 2012).

Results

A total of $n = 39$ children dropped out after T1. A potential reason for systematic drop-outs is that the older children moved from kindergarten to elementary school after the T1 assessments. We thus assessed differences between the group

that dropped out in comparison to those who participated in later assessments (age: $t(df = 60) = .18, p = .86$). We observed no systematic drop-out by older children, and thus assumed that participants were missing at random; missing data for structural equation modeling was estimated with full information maximum likelihood (FIML).

Inattention scores fell over the one-year course, whereas the emotional competence scores rose (see Table 2 for details).

The inattention-symptoms scores correlate substantially and significantly over time across the three assessments. Similarly, significant correlations appear for emotion competences (total score), with lower and partly non-significant correlations for the different subscales.

Language skills also correlate significantly in the moderate to large range with one another. Age and inattention scores are significantly associated at T1, but not at T2 and T3, whereas there are significantly moderate to large associations with age and emotional competence across the three assessments. At all three assessments, boys were given significantly higher inattention scores, and sex and emotion competences show a small correlation for T1 and T3 (see Table 3 for details).

The intraclass correlation for the inattention raw scores was .039 and .050 for the emotional competence raw scores. Thus 3.9% of the variance in the three inattention measures is attributable to differences between children (between-person variance) and 5.0% of the variance in the three measures of emotional competence is explained by differences between children (between-person variance). The main part of the variance in our outcome measures can therefore be attributed to fluctuations within individuals when taking measurement error into account.

Results from analyses in MPlus and R tended to be identical. Below we mainly refer to results from our analyses in R.

We started by comparing constrained and unconstrained cross-lagged panel models (CLPM). By including the potential moderators age, gender, and language skills, model fit indices were either unsatisfactory or the model could be more parsimonious; we thus focused on analyzing model 1, and analyses of models 2–5 were no longer followed. The constrained model 1 did not differ significantly from an unconstrained one (Satorra-Bentler χ^2 Test: $\chi^2(df = 4) = 4.26, p = .37$). The more parsimoniously constrained model 1 is therefore preferable [52], as depicted in Fig. 2.

The constrained CLPM in Fig. 2 has acceptable model fit indices: $\chi^2(df = 8) = 10.27, p = .25, RMSEA = .046, CFI = .989, TLI = .981, SRMR = .040$. The AIC was 1560.33. We noted highly positive and significant carry-over stability paths of inattention and emotional competence. The cross-paths in a CLPM represent a mixture of within-person and between-person variances. Deviations from the expected inattention and emotional competence scores predicted deviations from the expected scores at the next time point. There were significant negative cross-lagged effects from inattention

Table 2 Range, means and standard deviations (SD) for inattention symptoms, the Emotion Competence total score*, and different MeKKi subscales

		T1	T2	T3
Scale	Range	Mean (SD)	Mean (SD)	Mean (SD)
Inattention	0–3	.81 (.57)	> .73 (.59)	> .70 (.56)
Emotional Competence*	0–140	96.29 (19.37)	< 106.61 (14.39)	< 117.59 (11.51)
Emotion vocabulary	0–20	12.75 (5.84)	< 17.11 (4.15)	< 18.77 (2.35)
Situational knowledge	0–10	8.02 (1.58)	< 8.67 (1.06)	< 8.98 (1.10)
Visual knowledge	0–15	10.92 (1.63)	< 11.50 (1.71)	< 12.14 (1.46)
Auditory knowledge	0–20	13.76 (3.90)	< 16.04 (3.24)	< 16.81 (2.73)
Emotion expression	0–25	17.67 (5.21)	> 17.39 (5.43)	< 19.64 (4.40)
Emotion regulation	0–30	19.43 (6.56)	< 21.76 (5.12)	< 24.15 (4.86)
Emotion comprehension	0–20	13.73 (4.49)	< 14.14 (3.59)	< 17.10 (2.68)

T1 to emotional competence T2 and from inattention T2 to emotional competence T3, indicating that individuals’ deviations from expected emotional competence scores were predicted by their inattention scores at the previous time point. Individuals scoring higher than they were expected to on inattention are more likely to score lower on emotional competence than they would be expected to at the next time point after controlling for emotional competence on the previous time point. The reciprocal relationships were not significant. The amount of variance explained are generally very similar and ranged from 42% (inattention T3) to 50% (emotional competence T3).

Next, we compared a constrained and unconstrained random intercept cross-lagged panel model (RI-CLPM) and detected no significant difference between these two approaches (Satorra-Bentler χ^2 Test: χ^2 (df = 7) = 6.24, $p = .51$). Accordingly, we chose the more parsimoniously constrained RI-CLPM depicted in Fig. 3.

The constrained RI-CLPM in Fig. 3 reveals acceptable model fit indices: χ^2 (df = 5) = 6.56, $p = .26$, RMSEA = .048,

CFI = .993, TLI = .978, SRMR = .035. The AIC was 1562.21 and slightly higher than the CLPM. This signals a less adequate fit to the data than the CLPM. We identified highly positive and significant carry-over stability paths of emotional competence and moderately positive and significant carry-over stability paths of inattention. No other coefficients reached significance, although the negative within-person cross-lagged effects from inattention T1 to emotional competence T2 and from inattention T2 to emotional competence T3 exhibited similar effects as in the constrained CLPM. The between-person association between inattention and emotional competence was slightly negative, indicating that individuals possessing higher emotional competence across the measurement waves revealed less inattention across the measurement waves. The covariance between the between-person factors reflects the association that is constant across all study waves. The amount of variance explained varied considerably, ranging from 10% (inattention T3) to 43% (emotional competence T3).

We further compared the constrained CLPM and constrained RI-CLPM. This resulted in a non-significant

Table 3 Correlations of inattention symptoms, emotion, language, age and sex at the three assessments

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) IA T1	–									
(2) IA T2	.70**	–								
(3) IA T3	.57**	.66**	–							
(4) EK T1	.06	–.06	.08	–						
(5) EK T2	.04	–.09	.03	.69**	–					
(6) EK T3	–.03	–.23*	–.12	.51**	.68**	–				
(7) Lang. T1	–.22*	–.24*	–.14	.14	.08	.00	–			
(8) Lang. T2	–.31**	–.38**	–.36**	.18	.15	.11	.48**	–		
(9) Lang. T3	.26*	–.30*	–.32**	.08	.10	.13	.31**	.57**	–	
(10) Age T1	.25**	.11	.10	.60**	.55**	.43**	.04	.11	.00	–
(11) Sex	–.32**	–.36**	–.29**	.19*	.16	.23*	.11	.16	.00	.01

IA = inattention; EK = Emotion Knowledge; Lang. = Language skills; T1 = 1st assessment; T2 = 2nd assessment 6 months after T1; T3 = 3rd assessment 12 months after T1

Fig. 2 Constrained CLPM with standardized coefficients. EC = emotion competences; IA = inattention scores; T1 = 1st assessment; T2 = 2nd assessment; T3 = 3rd assessment

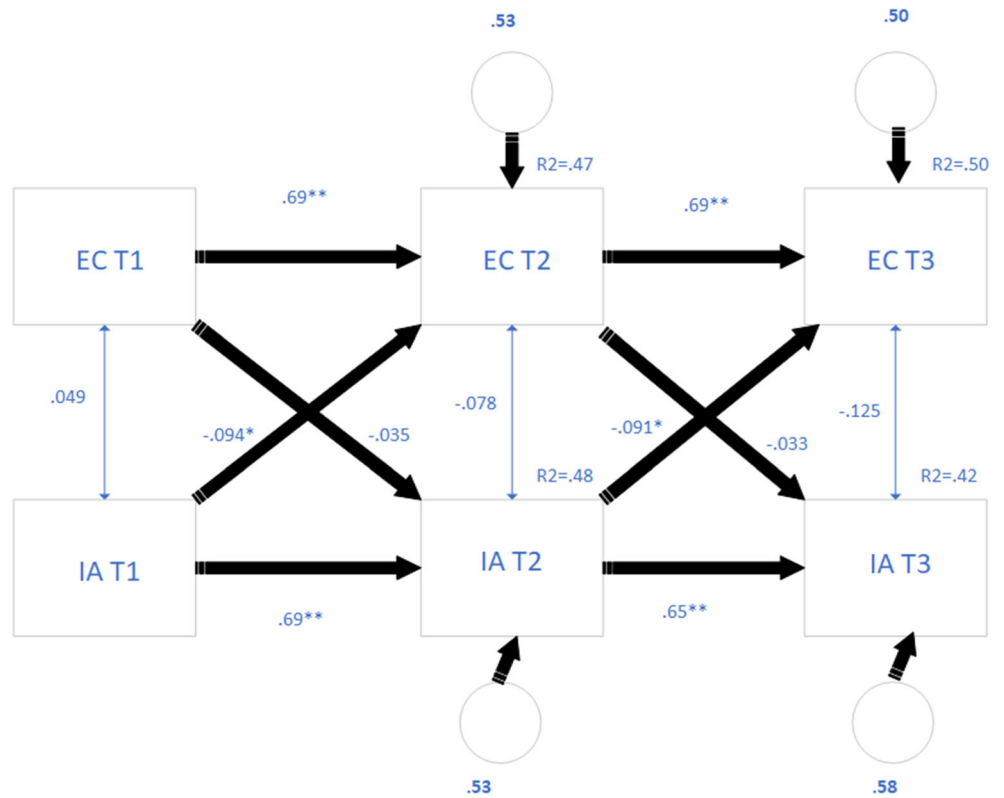
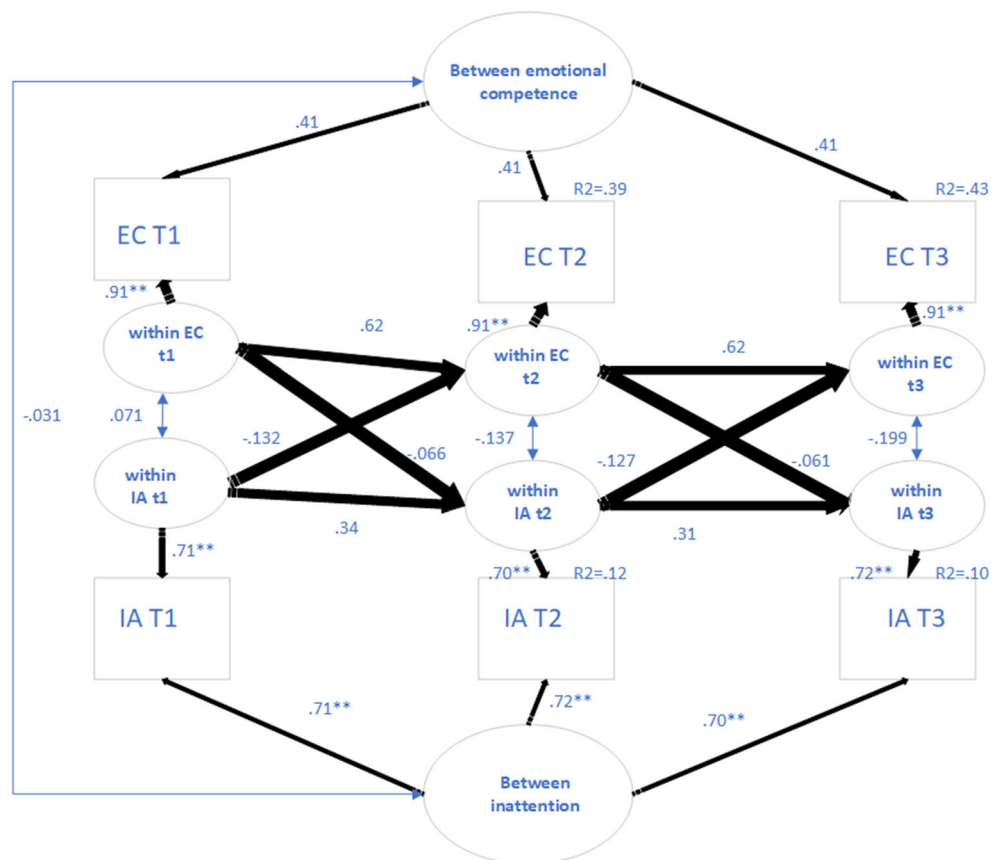


Fig. 3 Constrained RI-CLPM with standardized coefficients. EC = emotional competence; IA = inattention scores; T1 = 1st assessment; T2 = 2nd assessment; T3 = 3rd assessment



difference (Satorra-Bentler χ^2 Test: χ^2 (df = 3) = 3.74, $p = .59$). As a consequence, and as the constrained CLPM is more parsimonious according to AIC, this model should be chosen for our data.

Discussion

Inattention scores and emotional competences correlated significantly over time, as did language skills. Overall, inattention scores fell over the course of one year, while emotional competences and language skills rose, demonstrating maturation effects in pre- and elementary school children. This is important regarding early interventions, as although the constructs are somewhat stable, there is evidence of positive and significant carry-over stability paths of inattention and emotional competence in the constrained CLPM model, and a certain variability and thus a window for change. Regarding our study's findings, between-person variance is irrelevant both for inattention and emotional competences, emphasizing the importance of developmental dynamics in children.

We were unable to replicate the results of previous studies supporting the “Emotion Knowledge Hypothesis” (Rhoades et al., 2011; von Salisch et al., 2017; Trentacosta et al., 2006). Children revealing higher emotion competences did not exhibit greater attention skills over time in our study, that is, the cross-lagged path did not reach significance, even though paths between inattention and emotional competences were slightly negative in the RI-CLPM model, indicating that individuals with higher emotional competences across measurement waves demonstrated less inattention across measurements. In the restrained CLPM model, inattention at T1 and the stability of emotional competence between T1 and T2 significantly predicted emotional competences at T2 with overall 47% of the variance explained; and inattention at T2 and the stability of emotional competence between T2 and T3 significantly predicted emotional competences at T3 with overall 50% variance explained, whereas the reversed paths of emotional competences on inattention did not reach significance. That is, individual deviations from expected emotional competences were predicted by their inattention scores at the previous time points, with individuals scoring higher on inattention being more likely to score lower on emotional competences. However, the incremental variance explanation of inattention on emotional competences is .9% and .8%, respectively. The majority of the variance explained is based on the respective stability paths. Thus, the significant path between inattention at T1 and T2 on emotional competences at T2 and T3, does not really support the “Attention Effect Hypothesis” either (Izard et al., 2011; Kats-Gold & Priel, 2009; Schultz et al., 2001). With respect to earlier studies in this field, the amount of incremental variance this study explains is less than in others: The study by von Salisch et al. (2017) that supports

the “Emotion Knowledge Hypothesis” reports 4.75% of incremental variance explanation of emotion knowledge on inattention, though the largest amount of variance explained is due to inattention's stability path, just as in our study. In the longitudinal study by Schultz et al. (Schultz et al., 2001) that supports the “Attention Effect Hypothesis”, overall 11% of variance is explained for emotion-expression knowledge and 21% for emotion-situation knowledge, although attentional control only significantly contributed to the latter with 7% incremental variance explained, while verbal ability and behavioral control explained a total of 14%. That is, in comparison to the present study, the variance explanation for attention and emotional competences in aforementioned studies is ~3.5–6%. While this is certainly significant, one could argue that the practical implications potentially drawn from this rely on rather weak effects.

Regardless, both attention and emotional competences are crucial factors in child development (Izard et al., 2011). Of the three measurement waves, about 4% of variance of inattention and 5% of EK were accounted for by between-person variance, but the main part of the variance of outcome measures was explained by fluctuations within persons when taking measurement error into account. As within-person associations can help us identify targets for interventions, between-person associations can help us detect who may need an intervention (Masselink et al., 2018). Here, one could argue that inattention should be a focus for children identified as having poor attention abilities. Accordingly, the promotion of attention could improve their learning abilities and result in better emotional competences as more capacities would become available (“Attention Effect Hypothesis”). There are a few early intervention programs for pre-school children with severe ADHD symptoms, and one recent randomized controlled study revealed positive effects on the core symptomatology (Halperin et al., 2020; Masselink et al., 2018; Türk & Christiansen, 2018), although emotional competences so far have not been assessed as an outcome measure and would thus be an interesting target for future investigations in this field. On the other hand, emotional competences are central for social-emotional development, and poor emotional competences have been linked longitudinally to behavior problems in childhood (Kostyrka-Allchorne et al., 2019) and to severe mental disorders in adulthood (Trentacosta & Fine, 2010). In this regard, one could also argue that those children identified as having poor emotional competences require training and early interventions targeting such competences. Attention capacity should be assessed as an outcome in order to demonstrate the currently-hypothetical link to the “Emotion Knowledge Hypothesis”.

Models 2–5, which would have tested for the moderators age, sex, and language, were not further pursued analytically as they had not revealed satisfactory model fit indices or were insufficiently parsimonious. Still, boys were rated as being

more inattentive than girls at all three assessments, replicating results from other studies in the field (Schlack et al., 2007; Skounti et al., 2007; Xu et al., 2018). Concerning emotional competences, we found that associations with sex were more heterogeneous: girls exhibited higher emotional competences at T1 and T3, although correlations tended to be small and no significant associations resulted at T2 between emotional competences and sex, as meta-analysis might have led us to expect (Chaplin & Aldao, 2013) as well as previous findings outlined above (Hukkelberg & Ogden, 2020; Veiga et al., 2017).

The older the participating children, the greater their emotional competences, as reflected in highly significant and strong correlations between emotional competences and age and as we expected from the literature (Izard et al., 2011; von Salisch et al., 2017). We observed a significant correlation between age and inattention scores only at T1 in this study, with older children receiving higher ratings, although one might expect older children to receive lower inattention ratings (Elder, 2010; Evans et al., 2005; Morrow et al., 2012; Wuppermann et al., 2015). We were surprised to find no associations at the other two assessments between inattention and age.

Language skills as assessed by kindergarten and elementary school teachers showed significant and medium-to-large correlations between the different assessments. Stronger skills at T1 are also associated with better language competences at T2 and T3. Highly significant small-to-medium correlations also indicate that children possessing stronger language skills were given lower inattention scores at the three assessments. Contrary to our expectations, language skills in this study demonstrated no significant association with emotional competences (Izard et al., 2011; von Salisch et al., 2015), as associations between language skills and emotional competences remained non-significant across all assessments. Children in our study tended to be older and of a wider age range (5–12 years) than in the von Salisch et al. ((von Salisch et al., 2017); 3–6 years) study, however. It might therefore be simply that the children in our sample already possessed good overall language skills, which would explain this lack of association with emotional competences. Furthermore, as we only asked for a teacher-rating of language skills and applied no standardized, objective test for such an assessment, that might also explain this lack of association.

Conclusions

Our study provides information on a sample of pre- and elementary school children over the course of one year. Our data supports neither the “Attention Effect Hypothesis” nor the “Emotion Knowledge Hypothesis”, but it does indicate the need for targeted interventions for those children identified

as being either highly inattentive or having inadequate emotional competences. Tailored interventions for those children should assess both attention and emotional competences to shed light on potential etiologic psychopathological pathways. Thus, if either attentional or emotional delays are observable in children of pre-school and elementary school age and associated with clinical impairment, those should specifically be treated and treatment results should be followed up in order to understand etiological mechanisms of disorder development.

Limitations

Some limitations need to be considered. First of all, our sample is quite small and a convenience cohort, as we approached different kindergartens and not all opted to participate in the study – a factor that might have contributed to our study’s small effects. Second, some children changed during the year from kindergarten to elementary school, which meant a change in rating scales from the Conners-EC to Conners-3. However, as both are in the Conners family, we could use the inattention index in both studies. In light of these limiting factors, we could still count on all 136 children for analyses, as data was missing at random and could be imputed.

Third, some of the Cronbach’s α values, especially those of the Conners-EC scales, were not quite satisfactory. However, one-year re-test reliability proved to be quite good and the overall values we used fulfilled psychometric requirements.

Fourth, we included no children with an established ADHD diagnosis, which would have shed light on potential etiologic pathways to the disorder. However, diagnosing children with ADHD at the pre-school age is notoriously difficult, as problem behaviour is strongly linked to general development, i. e., children who have not reached significant developmental milestones will necessarily be more inattentive, hyperactive and impulsive, even though this might not be clinically impairing (Elder, 2010; Evans et al., 2005; Morrow et al., 2012; Wuppermann et al., 2015).

Fifth, we did not include parental ratings in our study. As we carried the study out in kindergartens, we only relied on child care-provider ratings that, however, are known to correlate significantly with parents’ ratings (Bergold et al., 2019). Considering the latter as well would have assessed cross-situational diagnostic criteria of ADHD and might have yielded ratings with less measurement error, as children transitioning from kindergarten to school were rated by different raters. Future studies should nevertheless aim to enrol children presenting a clinical diagnosis of ADHD as well as those without, and both parental and teacher/child care-provider ratings should be obtained to target the potential developmental pathways of disorder development linked to EK and ER.

Sixth, as we did not include parental ratings, information is not available regarding ethnicity, SES, and other parent that might contribute to a more comprehensive picture of the study sample, as well as potential factors that need to be controlled for in analyses. Future studies should provide this information.

Seventh, children's language abilities were only assessed as a best estimate rating by teachers. Even though teachers do see many children during their career and are trained in judging interindividual differences, a standardized assessment would have been advantageous.

Authors Contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Hanna Christiansen, Oliver Hirsch and Mira Chavanon. The first draft of the manuscript was written by Hanna Christiansen and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding Open Access funding enabled and organized by Projekt DEAL. The study did not receive external funding.

Data Availability The data can be made available upon request.

Declarations

Conflict of Interest The authors have no conflicts of interest to declare that are relevant to the content of this article.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Abdi, B. (2010). Gender differences in social skills, problem behaviours and academic competence of Iranian kindergarten children based on their parent and teacher ratings. *Procedia - Social and Behavioral Sciences*, 5, 1175–1179. <https://doi.org/10.1016/j.sbspro.2010.07.256>.
- American Psychiatric Association. (2000). DSM IV-TM: Diagnostic and statistical manual of mental disorders, 4th edition, text revision (DSM-IV-TR) (Fourth ed.). American Psychiatric Association.
- Barkley, R. A., Fischer, M., Smallish, L., & Fletcher, K. (2004). Young adult follow-up of hyperactive children: Antisocial activities and drug use. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, 45(2), 195–211. <https://doi.org/10.1111/j.1469-7610.2004.00214.x>.

- Beheshti, A., Chavanon, M.-L., & Christiansen, H. (2020). Emotion dysregulation in adults with attention deficit hyperactivity disorder: A meta-analysis. *BMC Psychiatry*, 20(1), 120. <https://doi.org/10.1186/s12888-020-2442-7>.
- Bergold, S., Christiansen, H., & Steinmayr, R. (2019). Interrater agreement and discrepancy when assessing problem behaviors, social-emotional skills, and developmental status of kindergarten children. *Journal of Clinical Psychology*, 75(12), 2210–2232. <https://doi.org/10.1002/jclp.22840>.
- Bornstein, M. H., Hahn, C.-S., & Haynes, O. M. (2010). Social competence, externalizing, and internalizing behavioral adjustment from early childhood through early adolescence: Developmental cascades. *Development and Psychopathology*, 22(4), 717–735. <https://doi.org/10.1017/S0954579410000416>.
- Browne, M. W., & Cudeck, R. (2016). Alternative ways of assessing model fit. *Sociological Methods & Research*, 21(2), 230–258. <https://doi.org/10.1177/0049124192021002005>.
- Chaplin, T. M., & Aldao, A. (2013). Gender differences in emotion expression in children: A meta-analytic review. *Psychological Bulletin*, 139(4), 735–765. <https://doi.org/10.1037/a0030737>.
- Christiansen, H., Hirsch, O., Albrecht, B., & Chavanon, M.-L. (2019). Attention-deficit/hyperactivity disorder (ADHD) and emotion regulation over the life span. *Current Psychiatry Reports*, 21(3), 17. <https://doi.org/10.1007/s11920-019-1003-6>.
- Christiansen, H., Hirsch, O., Drechsler, R., Wanderer, S., Knospe, E.-L., Günther, T., & Lidzba, K. (2016). German validation of the Conners 3® rating scales for parents, teachers, and children. *Zeitschrift Für Kinder- Und Jugendpsychiatrie Und Psychotherapie*, 44(2), 139–147. <https://doi.org/10.1024/1422-4917/a000408>.
- Conners, C. K. (2009). Conners early childhood: Manual. Pearson.
- Dalsgaard, S., Mortensen, P. B., Frydenberg, M., & Thomsen, P. H. (2013). Long-term criminal outcome of children with attention deficit hyperactivity disorder. *Criminal Behaviour and Mental Health : CBMH*, 23(2), 86–98. <https://doi.org/10.1002/cbm.1860>.
- Dalsgaard, S., Mortensen, P. B., Frydenberg, M., & Thomsen, P. H. (2014). Adhd, stimulant treatment in childhood and subsequent substance abuse in adulthood - a naturalistic long-term follow-up study. *Addictive Behaviors*, 39(1), 325–328. <https://doi.org/10.1016/j.addbeh.2013.09.002>.
- Denham, S. A. [Susanne A.]. (1998). Emotional development in young children. Guilford series on social and emotional development. Guilford Press.
- Elder, T. E. (2010). The importance of relative standards in ADHD diagnoses: Evidence based on exact birth dates. *Journal of Health Economics*, 29(5), 641–656. <https://doi.org/10.1016/j.jhealeco.2010.06.003>.
- Evans, S. W., Allen, J., Moore, S., & Strauss, V. (2005). Measuring symptoms and functioning of youth with ADHD in middle schools. *Journal of Abnormal Child Psychology*, 33(6), 695–706. <https://doi.org/10.1007/s10802-005-7648-0>.
- Finkel, S. (1995). Causal analysis with panel data. SAGE Publications, Inc.
- Garner, P. W., & Waajid, B. (2008). The associations of emotion knowledge and teacher-child relationships to preschool children's school-related developmental competence. *Journal of Applied Developmental Psychology*, 29(2), 89–100. <https://doi.org/10.1016/j.appdev.2007.12.001>.
- Groß, C. (2014). Messverfahren für emotionale Kompetenz bei Kindern im Vor- und Grundschulalter (MeKKi). *Entwicklung und Evaluation eines Messverfahrens - Die Meinung von Experten und Kindern [MSc Thesis]*. Koblenz-Landau.
- Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. *Review of General Psychology*, 2(3), 271–299. <https://doi.org/10.1037/1089-2680.2.3.271>.

- Gross, J. J., & Jazaieri, H. (2014). Emotion, emotion regulation, and psychopathology. *Clinical Psychological Science*, 2(4), 387–401. <https://doi.org/10.1177/2167702614536164>.
- Haaß, C. (2014). *Messverfahren für emotionale Kompetenz bei Kindern im Vor- und Grundschulalter (MeKKi) - Entwicklung und erste Validierungsbefunde* [MSc Thesis]. Koblenz-Landau.
- Halperin, J. M., Marks, D. J., Chacko, A., Bedard, A.-C., O'Neill, S., Curchack-Lichtin, J., Bourchtein, E., & Berwid, O. G. (2020). Training executive, attention, and motor skills (TEAMS): A preliminary randomized clinical trial of preschool youth with ADHD. *Journal of Abnormal Child Psychology*, 48(3), 375–389. <https://doi.org/10.1007/s10802-019-00610-w>.
- Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. P. (2015). A critique of the cross-lagged panel model. *Psychological Methods*, 20(1), 102–116. <https://doi.org/10.1037/a0038889>.
- Harbarth, S., Steinmayr, R., Neidhardt, E., & Christiansen, H. (2018). *Conners-EC: Deutsche Adaptation der Conners Early Childhood Scales*. Göttingen und Bern: Hogrefe-Verlag.
- Heinze, J. E., Miller, A. L., Seifer, R., & Locke, R. (2015). Emotion knowledge, loneliness, negative social experiences, and internalizing symptoms among low-income preschoolers. *Social Development (Oxford, England)*, 24(2), 240–265. <https://doi.org/10.1111/sode.12083>.
- Hirsch, O., Chavanon, M. L., & Christiansen, H. (2019). Emotional dysregulation subgroups in patients with adult attention-deficit/hyperactivity disorder (ADHD): A cluster analytic approach. *Scientific Reports*, 9(1), 5639. <https://doi.org/10.1038/s41598-019-42018-y>.
- Hirsch, O., Chavanon, M., Riechmann, E., & Christiansen, H. (2018). Emotional dysregulation is a primary symptom in adult attention-deficit/hyperactivity disorder (ADHD). *Journal of Affective Disorders*, 232, 41–47. <https://doi.org/10.1016/j.jad.2018.02.007>.
- Hoehl, S., Brauer, J., Brasse, G., Striano, T., & Friederici, A. D. (2010). Children's processing of emotions expressed by peers and adults: An fMRI study. *Social Neuroscience*, 5(5–6), 543–559. <https://doi.org/10.1080/17470911003708206>.
- Hox, J. (2009). *Multilevel analysis: Techniques and applications* (reprint). Quantitative methodology series. Psychology Press.
- Hoza, B. (2007). Peer functioning in children with ADHD. *Journal of Pediatric Psychology*, 32(6), 655–663. <https://doi.org/10.1093/jpepsy/jsm024>.
- Hoza, B., Mrug, S., Gerdes, A. C., Hinshaw, S. P., Bukowski, W. M., Gold, J. A., Kraemer, H. C., Pelham, W. E., Wigal, T., & Arnold, L. E. (2005). What aspects of peer relationships are impaired in children with attention-deficit/hyperactivity disorder? *Journal of Consulting and Clinical Psychology*, 73(3), 411–423. <https://doi.org/10.1037/0022-006X.73.3.411>.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>.
- Huang, Y., & Macek, P. (2020). The effect of gender differences and cognitive empathy on the encouragement of social competence for the next generation: Evidence from Chinese parents. *Journal of Clinical & Developmental Psychology, Online First Articles / Journal of Clinical & Developmental Psychology*. Advance online publication. <https://doi.org/10.6092/2612-4033/0110-2438>
- Huber, L., Plötner, M., In-Albon, T., Stadelmann, S., & Schmitz, J. (2019). The perspective Matters: A Multi-informant Study on the Relationship Between Social-Emotional Competence and Preschoolers' Externalizing and Internalizing Symptoms. *Child Psychiatry and Human Development*. Advance online publication. <https://doi.org/10.1007/s10578-019-00902-8>.
- Hukkelberg, S., & Ogdén, T. (2020). What is social competence? An investigation into the concept among children with antisocial behaviours. *Emotional and Behavioural Difficulties*, 25(1), 80–93. <https://doi.org/10.1080/13632752.2019.1687168>.
- In-Albon, T. (2015). *Messverfahren für emotionale Kompetenz bei Kindern im Vor- und Grundschulalter (MeKKi): unpublished measure*.
- Izard, C. E., Woodburn, E. M., Finlon, K. J., Krauthamer-Ewing, E. S., Grossman, S. R., & Seidenfeld, A. (2011). Emotion knowledge, emotion utilization, and emotion regulation. *Emotion Review*, 3(1), 44–52. <https://doi.org/10.1177/1754073910380972>.
- Jöreskog, K. G., Sörbom, D., Cooley, W. W., & Magidson, J. (1979). *Advances in factor analysis and structural equation models*. (2nd print). Abt books.
- Kats-Gold, I., & Priel, B. (2009). Emotion, understanding, and social skills among boys at risk of attention deficit hyperactivity disorder. *Psychology in the Schools*, 46(7), 658–678. <https://doi.org/10.1002/pits.20406>.
- Kim, J., Christy, A. G., Schlegel, R. J., Donnellan, M. B., & Hicks, J. A. (2017). Existential Ennui. *Social Psychological and Personality Science*, 9(7), 853–862. <https://doi.org/10.1177/1948550617727587>.
- Kostyrka-Allchorne, K., Wass, S. V., & Sonuga-Barke, E. J. S. (2019). Research review: Do parent ratings of infant negative emotionality and self-regulation predict psychopathology in childhood and adolescence? A systematic review and meta-analysis of prospective longitudinal studies. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*. Advance online publication. <https://doi.org/10.1111/jcpp.13144>, 61, 401, 416.
- Landau, S., & Milich, R. (1988). Social communication patterns of attention-deficit-disordered boys. *Journal of Abnormal Child Psychology*, 16(1), 69–81. <https://doi.org/10.1007/BF00910501>.
- Little, T. D., Preacher, K. J., Selig, J. P., & Card, N. A. (2016). New developments in latent variable panel analyses of longitudinal data. *International Journal of Behavioral Development*, 31(4), 357–365. <https://doi.org/10.1177/0165025407077757>.
- Lüdtke, O., Robitzsch, A., Trautwein, U., & Köller, O. (2007). Umgang mit fehlenden Werten in der psychologischen Forschung. *Psychologische Rundschau*, 58(2), 103–117. <https://doi.org/10.1026/0033-3042.58.2.103>.
- Madigan, S., Browne, D., Racine, N., Mori, C., & Tough, S. (2019). Association between screen time and Children's performance on a developmental screening test. *JAMA Pediatrics*, 173(3), 244–250. <https://doi.org/10.1001/jamapediatrics.2018.5056>.
- Masselink, M., van Roekel, E., Hankin, B. L., Keijsers, L., Lodder, G. M. A., Vanhalst, J., Verhagen, M., Young, J. F., & Oldehinkel, A. J. (2018). The longitudinal association between self-esteem and depressive symptoms in adolescents: Separating between-person effects from within-person effects. *European Journal of Personality*, 32(6), 653–671. <https://doi.org/10.1002/per.2179>.
- Mauss, I. B., Levenson, R. W., McCarter, L., Wilhelm, F. H., & Gross, J. J. (2005). The tie that binds? Coherence among emotion experience, behavior, and physiology. *Emotion (Washington, D.C.)*, 5(2), 175–190. <https://doi.org/10.1037/1528-3542.5.2.175>.
- Morrow, R. L., Garland, E. J., Wright, J. M., Maclure, M., Taylor, S., & Dormuth, C. R. (2012). Influence of relative age on diagnosis and treatment of attention-deficit/hyperactivity disorder in children. *CMAJ : Canadian Medical Association Journal = Journal De L'association Medicale Canadienne*, 184(7), 755–762. <https://doi.org/10.1503/cmaj.111619>.
- Mrug, S., Molina, B. S. G., Hoza, B., Gerdes, A. C., Hinshaw, S. P., Hechtman, L., & Arnold, L. E. (2012). Peer rejection and friendships in children with attention-deficit/hyperactivity disorder: Contributions to long-term outcomes. *Journal of Abnormal Child Psychology*, 40(6), 1013–1026. <https://doi.org/10.1007/s10802-012-9610-2>.
- Posner, J., Kass, E., & Hulvershom, L. (2014). Using stimulants to treat ADHD-related emotional lability. *Current Psychiatry Reports*, 16(10), 478. <https://doi.org/10.1007/s11920-014-0478-4>.

- Ren, Y., & Wyver, S. (2016). Social competence, cultural orientations and gender differences: A study of mandarin–English bilingual preschoolers. *International Journal of Early Years Education*, 24(2), 143–156. <https://doi.org/10.1080/09669760.2016.1138282>.
- Rhoades, B. L., Warren, H. K., Domitrovich, C. E., & Greenberg, M. T. (2011). Examining the link between preschool social–emotional competence and first grade academic achievement: The role of attention skills. *Early Childhood Research Quarterly*, 26(2), 182–191. <https://doi.org/10.1016/j.ecresq.2010.07.003>.
- Riechmann, E., Sattler, F. A., Christiansen, H., & Chavanon, M.-L. (2017). Emotionsregulation. Konzepte, Modellvorstellungen und aktuelle Befunde bei ADHS: [emotion regulation. Concepts, models and current reports for ADHD]. *Lernen Und Lernstörungen*, 6(3), 145–155.
- Rosseel, Y. (2012). Lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, 48(2). <https://doi.org/10.18637/jss.v048.i02>.
- Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research*, 8(2), 23–74.
- Schlack, R., Hölling, H., Kurth, B.-M., & Huss, M. (2007). Die Prävalenz der Aufmerksamkeitsdefizit-/Hyperaktivitätsstörung (ADHS) bei Kindern und Jugendlichen in Deutschland. Erste Ergebnisse aus dem Kinder- und Jugendgesundheitsurvey (KiGGS) [The prevalence of attention-deficit/hyperactivity disorder (ADHD) among children and adolescents in Germany. Initial results from the German Health Interview and Examination Survey for Children and Adolescents (KiGGS)]. *Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz*, 50(5–6), 827–835. <https://doi.org/10.1007/s00103-007-0246-2>.
- Schultz, D., Izard, C. E., Ackerman, B. P., & Youngstrom, E. A. (2001). Emotion knowledge in economically disadvantaged children: Self-regulatory antecedents and relations to social difficulties and withdrawal. *Development and Psychopathology*, 13(1), 53–67. <https://doi.org/10.1017/s0954579401001043>.
- Sheppes, G., Suri, G., & Gross, J. J. (2015). Emotion regulation and psychopathology. *Annual Review of Clinical Psychology*, 11, 379–405. <https://doi.org/10.1146/annurev-clinpsy-032814-112739>.
- Skounti, M., Philalithis, A., & Galanakis, E. (2007). Variations in prevalence of attention deficit hyperactivity disorder worldwide. *European Journal of Pediatrics*, 166(2), 117–123. <https://doi.org/10.1007/s00431-006-0299-5>.
- Stringaris, A., & Goodman, R. (2009). Mood lability and psychopathology in youth. *Psychological Medicine*, 39(8), 1237–1245. <https://doi.org/10.1017/S0033291708004662>.
- Trentacosta, C. J., & Fine, S. E. (2010). Emotion knowledge, social competence, and behavior problems in childhood and adolescence: A meta-analytic review. *Social Development (Oxford, England)*, 19(1), 1–29. <https://doi.org/10.1111/j.1467-9507.2009.00543.x>.
- Trentacosta, C. J., & Izard, C. E. (2007). Kindergarten children's emotion competence as a predictor of their academic competence in first grade. *Emotion (Washington, D.C.)*, 7(1), 77–88. <https://doi.org/10.1037/1528-3542.7.1.77>.
- Trentacosta, C. J., Izard, C. E., Mostow, A. J., & Fine, S. E. (2006). Children's emotional competence and attentional competence in early elementary school. *School Psychology Quarterly*, 21(2), 148–170. <https://doi.org/10.1521/scpq.2006.21.2.148>.
- Türk, S., Harbarth, S., Bergold, S., Steinmayr, R., Neidhardt, E., Kamp-Becker, I., Equit, M., Wunsch, K., & Christiansen, H. (2020). Do German children differ? A validation of Conners early childhood™. *Journal of Attention Disorders*, 1087054720907955, 1087054720907955. <https://doi.org/10.1177/1087054720907955>.
- Türk, S., & Christiansen, H. (2018). Prävention der ADHS. In H. Christiansen, D. Ebert, & B. Röhrle (Eds.), *Fortschritte der Gemeindepsychologie und Gesundheitsförderung (FGG): Band 24. Entwicklungen und Perspektiven* (pp. 393–422). dgvt-Verlag.
- Uhrig, K. (2014). *Messverfahren für emotionale Kompetenz bei Kindern im Vor- und Grundschulalter (MeKKi) - Zusammenhang zum elterlichen Erziehungsstil [MSc Thesis]*. Koblenz-Landau, Landau, Germany.
- Veiga, G., de Leng, W., Cachucho, R., Ketelaar, L., Kok, J. N., Knobbe, A., Neto, C., & Rieffe, C. (2017). Social competence at the playground: Preschoolers during recess. *Infant and Child Development*, 26(1), e1957. <https://doi.org/10.1002/icd.1957>.
- von Salisch, M., Denham, S. A., & Koch, T. (2017). Emotion knowledge and attention problems in Young children: A cross-lagged panel study on the direction of effects. *Journal of Abnormal Child Psychology*, 45(1), 45–56. <https://doi.org/10.1007/s10802-016-0157-5>.
- von Salisch, M., Haenel, M., & Denham, S. A. (2015). Self-regulation, language skills, and emotion knowledge in Young children from northern Germany. *Early Education and Development*, 26(5–6), 792–806. <https://doi.org/10.1080/10409289.2015.994465>.
- Walker, S. (2005). Gender differences in the relationship between young children's peer-related social competence and individual differences in theory of mind. *The Journal of Genetic Psychology*, 166(3), 297–312. <https://doi.org/10.3200/GNTP.166.3.297-312>.
- Wang, Q. (2008). Emotion knowledge and autobiographical memory across the preschool years: A cross-cultural longitudinal investigation. *Cognition*, 108(1), 117–135. <https://doi.org/10.1016/j.cognition.2008.02.002>.
- Whalen, C. K., Henker, B., Collins, B. E., McAuliffe, S., & Vaux, A. (1979). Peer interaction in a structured communication task: Comparisons of Normal and hyperactive boys and of methylphenidate (Ritalin) and placebo effects. *Child Development*, 50(2), 388. <https://doi.org/10.2307/1129414>.
- Wuppermann A, Schwandt H, Hering R, Schulz M, Bätzing-Feigenbaum J. (2015). Zusammenhang zwischen ADHS-Diagnose- und Medikationsprävalenzen und dem Einschulungsalter - Teil 2. Zentralinstitut für die kassenärztliche Versorgung in Deutschland (Zi). <https://www.versorgungsatlas.de/themen/alle-analysen-nach-datum-sortiert/?tab=6&uid=61>
- Xu, G., Strathearn, L., Liu, B., Yang, B., & Bao, W. (2018). Twenty-year trends in diagnosed attention-deficit/hyperactivity disorder among US children and adolescents, 1997–2016. *JAMA Network Open*, 1(4), e181471. <https://doi.org/10.1001/jamanetworkopen.2018.1471>.
- Young, S., Moss, D., Sedgwick, O., Fridman, M., & Hodgkins, P. (2015). A meta-analysis of the prevalence of attention deficit hyperactivity disorder in incarcerated populations. *Psychological Medicine*, 45(2), 247–258. <https://doi.org/10.1017/S0033291714000762>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.