Development Patterns of Intelligence, Emotional Intelligence, and Motor Skills across Socioeconomic Groups: A GAMLSS-Based Approach

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Abstract

This study investigated the developmental patterns of intelligence, emotional intelligence (EI), and motor skills in children and adolescents aged 4.4 to 21.6 years, with a focus on the influence of socioeconomic status (SES). Using data from 1,474 German-speaking participants across Germany, Austria, and Switzerland, and employing Generalized Additive Models for Location, Scale, and Shape (GAMLSS), the study modeled both linear and non-linear growth trajectories. Results indicated that intelligence followed a linear development pattern, while EI and motor skills showed significant non-linear trajectories. SES had a strong and stable influence on intelligence and gross motor skill development, but little to no effect on fine and visuomotor skills or EI. Notably, the correlation between intelligence and EI remained significant after controlling for age, particularly within the low SES group, suggesting stronger developmental interdependence. The findings highlight the complex, domain-specific nature of child and adolescent development and emphasize the role of SES in shaping developmental outcomes.

Keywords: intelligence, emotional intelligence, motor skills, socioeconomic status, child development, GAMLSS

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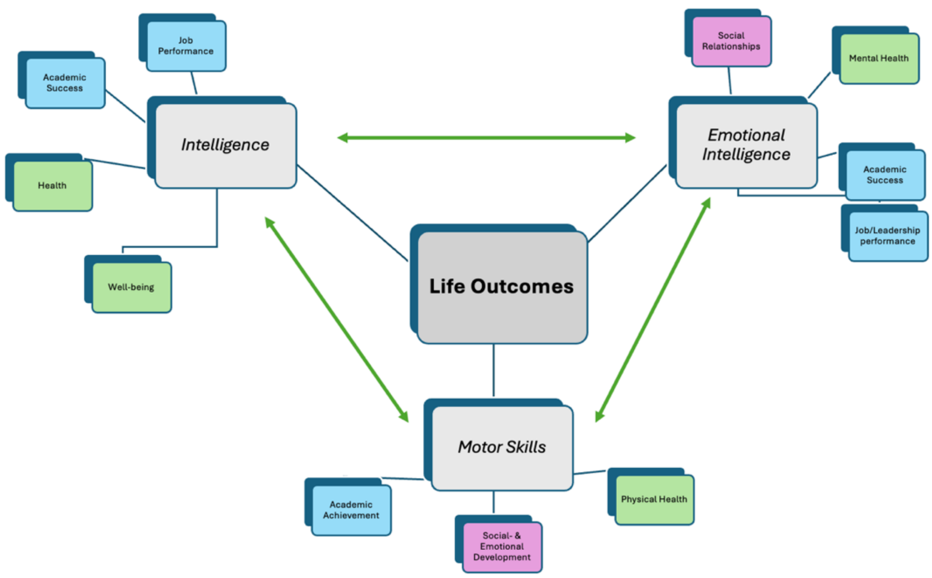
Introduction

Positive life outcomes are influenced by the interplay of intellectual abilities, emotional intelligence, and motor skill development (Esmaeelzadehazad et al., 2021; Li et al., 2022; Ubago-Jimenez et al., 2019).

For instance, intelligence test results, such as IQ tests, predict multiple relevant areas of everyday life in our society. This includes health (Wrulich et al., 2013), job performance (Strenze, 2007), and school success (Roth et al., 2015). Given this broad impact, understanding factors that impact intelligence has crucial societal relevance. One factor impacting Intelligence is socio-economic status (SES). A wide array of studies investigated intelligence tests and consistently found that people of lower socioeconomic status score lower on intelligence tests compared to people of high socioeconomic status (von Stumm and Plomin, 2015; Madhushanthi et al., 2018; Piccolo et al., 2016). A summary of the relationship of the key domains can be seen in Figure 1.

Figure 1

Relationships of Intelligence, Emotional Intelligence, and Motor Skills with Life Outcomes



Similar to intelligence, emotional intelligence (EI) is linked to many important areas of life. For example, EI is associated with better job performance, especially in leadership positions or other jobs that require social interactions as teamwork, communication, and adaptability (Cherniss, 2010). Leaders with high EI are better at conflict resolution, motivating others, and adapting to changes. All these qualities are essential factors for organizations and their success (Makkar and Basu, 2024; Cherniss, 2010). EI is also positively associated with psychological well-being and, in turn, negatively associated with stress and depression (Martins et al., 2010). This might be because of higher EI leading to better emotion regulation and coping strategies. Additionally, EI is related to academic success because students with high EI seem to benefit from managing anxiety better, maintaining their motivation, and navigating the social aspects of learning better (MacCann et al., 2020). Regarding social relationships, people with higher EI seem to have an advantage as well, as the results from Bracket et al. (2011) indicate that people with higher EI communicate better and have more satisfying relationships, because of heightened levels of empathy and ease of managing social situations.

Next to these cognitive elements, motor skills are also linked to various areas of everyday life. Academic achievement is strongly associated with gross and fine motor skill performance, especially for the subjects of maths and reading (Hudson and Willoughby, 2021). But also to academic and attentional performance at school entry (Cinar et al., 2023). Furthermore, motor skills performance was associated with social and emotional well-being development in pre-school children (Salaj and Masnjak, 2022). Additionally, motor skills were found to be a predictor of social-emotional adjustment and scholastic performance in children attending kindergarten (Holloway and Long, 2019). Regarding health, motor skills are a vital part for the participation in physical activity, which in turn is proven to be important to prevent as well as manage diseases such as heart disease, hypertension, stroke, diabetes, and several cancers (World Health Organization, 2025). Further support of the impact of weak motor skills was provided by Vandoni et al. (2024), who found a relationship between obesity and impaired motor skills and motor coordination.

In addition to the already described factors of positive life development, previous research findings established the link between the level of socioeconomic status (SES) and intelligence test performance (von Stumm and Plomin, 2015; Madhushanthi et al., 2018; Piccolo et al., 2016). These studies indicate that lower SES is related to reduced performance in intelligence tests compared to higher levels of SES. Because intelligence is also linked to future earnings (Strenze, 2007), success in school and university (Roth et al., 2015), as well as well-being and health (Wrulich et al., 2013). These findings have a huge societal impact, suggesting that potentially moving up the social hierarchy is limited for people in low SES environments.

While the link between intelligence and SES has been of considerable research attention, other cognitive domains are emerging as correlates as well. Similar patterns have been observed for motor skills (Ramos-Campo and Clémente-Suárez, 2024) and emotional intelligence (Maccan et al., 2019), but these fields are less extensively studied. This growing body of evidence highlights the broader impact SES has on multiple facets of human development and life outcomes.

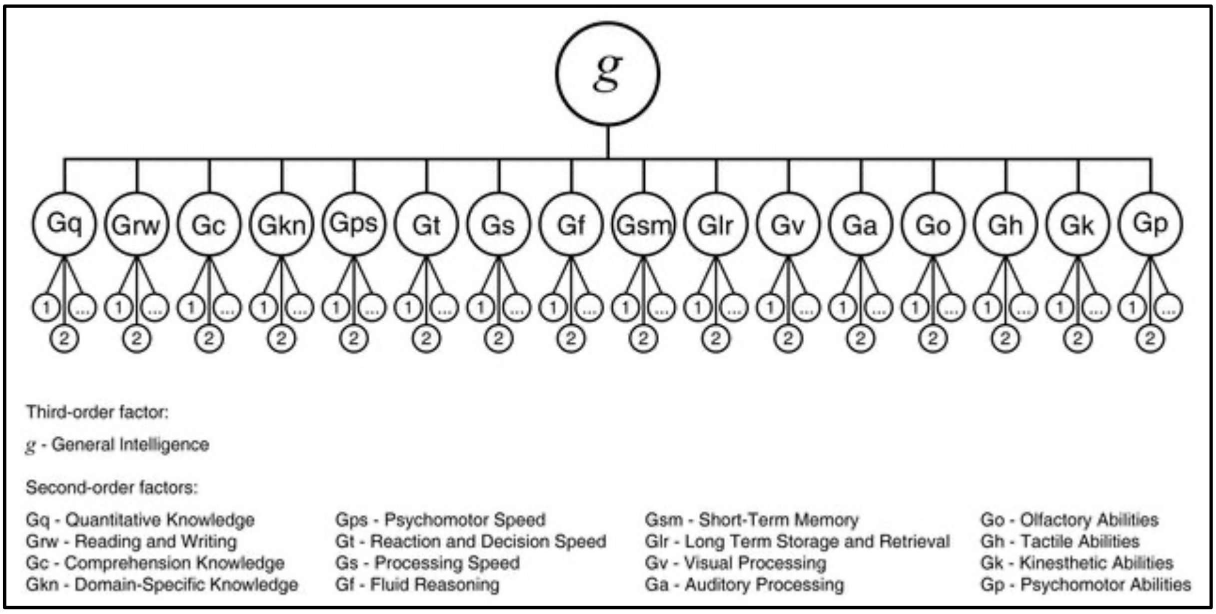
If there are also systematic differences based on SES for the variables motor skills and emotional intelligence, this would indicate that the impact of SES is even more severe, and interventions should also focus on these two variables. A separation of social classes will remain if these variables are not addressed.

Intelligence

According to the APA Dictionary of Psychology, intelligence is “the ability to derive information, learn from experience, adapt to the environment, understand, and correctly utilize thought and reason” (American Psychological Association, 2023). To explain the concept of the model of intelligence, this paper refers to the widely accepted *Cattel-Horn-Carroll (CHC) theory* (McGrew et al., 2009) as the concept frame.

Figure 2

Overview of the CHC Model



Note. From “CHC theory and the human cognitive abilities project: Standing on the shoulders of the giants of psychometric intelligence research,” by K. S. McGrew, 2009, *Intelligence*, *37(1),* Copyright 2009 by Elsevier.

The CHC theory is the most widely accepted intelligence theory to date (McGrew et al., 2009). It integrates with two different sub-theories. On the one hand, the Cattell-Horn theory of intelligence, which differentiates between fluid intelligence *gf* and crystallized intelligence *gc*. And on the other hand, the three-stratum approach from Carrol (1993). The *CHC* is hierarchically divided into three strata, which are based on the three-stratum approach from Carrol (1993). The highest stratum (*stratum III*) in the *CHC* is the *g* factor or *general intelligence*. The *g* factor describes the common variance across all cognitive tasks. In *stratum II*, also named broad abilities, crystallized intelligence *gc* and fluid intelligence *gf* from the *Cattell-Horn model* are integrated. While crystallized intelligence describes stored knowledge from experience and learning, fluid intelligence describes the ability to solve novel problems and the ability to reason independently from non-verbal abilities, and also independent of learning (McGrew, 2009). McGrew (2009) describes *stratum II* as having 10-16 abilities resulting from factor analyses. The most establishd ones in addition to *gc* and *gf* are visual-spatial processing *gv* as the ability to create mental images and process visual patterns, auditory processing *ga* as the discrimination of sounds, processing speed *gs* as the speed of perfroming simple tasks, short term memory processing *gsm* for holding and manipulating information, long term retrieval *glm* as the ability to store and retrieve information over longer periods, quantitative knowledge *gq* as the skills related to math and numeric reasoning, reading and writing *grw* for language based academic skills, and reaction and decision speed *gt* for timed or reaction based tasks. Tenatively identified in belonging to *stratum II* are also psycho motor abilities, *gp,* which describes the ability to precisely and effectively perform body motor movements, and psychomotor speed, *gps,* which describes performing fast and fluent physical motor movements mainly independent of cognitive control (McGrew, 2009). *Stratum I* consists, according to McGrew (2009), of more than 70 narrow abilities based on belonging to one or more of the broader abilities in stratum II, resulting from factor analyses.

Socioeconomic status is a theoretical division of social classes based on income and educational background, occupation, and the subjective interpretation of one’s social class (APA Dictionary of Psychology, 2023). SES is, according to Noble et al. (2007), one of the strongest predictors for intelligence or IQ measures and academic performance. SES is also related to brain development, more precisely, brain surface area, especially for areas regarding language and executive functions (Noble et al., 2015), and delayed and reduced development in brain regions regarding cognitive functions (Hair et al., 2015). A possible explanation for this phenomenon was provided by Bradley and Corwyn (2002), who state that the home environment acts as a mediator of the effects of SES on intellectual ability. The phenomenon of delayed brain development in low SES families was attributed to the factors of better comparitevly better nutrition, health care, more stimulating environments as well as lower exposure to hazards like physical and psychological stress, and exposure to and environmental toxins for children of High SES families (Bradley and Corwyn, 2002). Especially, chronic stress seems to be detrimental to cognitive function. Exposure to chronic stress hinders the development process of executive functions and, therefore, intelligence due to factors like more exposure to violence or instability (Blair and Raver, 2012). Additionally, the gene-environment interaction seems to be mediated by SES as well. As genetic influences on IQ are more expressed in enriched environments, which are often provided in high SES, and less expressed in deprived environments, which are linked to low SES (Tucker-Drob and Bates, 2016).

General cognitive abilities improve steadily over the ages 3-18 years old (Best and Miller, 2010). Additionally, different broad cognitive abilities from the CHC develop at different rates and follow unique trajectories over the lifespan (McGrew, 2009). Furthermore, research suggests that *g* stabilizes in structure and strength in late adolescence (McGrew, 2009).

Emotional Intelligence

Emotional intelligence (EI) can be regarded as a construct of abilities, like in Mayer and Salvoys' (1997) Ability Model. In Mayer and Salvoys' (1997) Ability Model, EI refers to a set of cognitive abilities. These abilities include perceiving emotions, emotions to aid thought, being able to understanding emotions, and being able to manage emotions. This approach allows for testing EI objectively. On the other hand, Bar-On (1997) introduced a trait-based model. This model includes the 5 traits: (1) self-regard, (2) interpersonal skills, (3) emotional awareness, (4) impulse control, and (5) stress tolerance. Taking both theories into account, an overarching theme about emotional intelligence can be deduced. Both models describe emotional intelligence as an entity of perceiving, recognizing, understanding, and managing one's own emotions and emotions displayed by others.

While some studies portray a negative relationship between SES and emotional intelligence, indicating that higher SES leads to more autonomy and focus on oneself, and therefore less care for others (Smalor and Heine, 2021), different study approaches have shown a positive relationship between SES and emotional intelligence. For example, a higher SES was related to better EI development because children from lower SES backgrounds have a higher chance of dealing with stressors that hinder emotional development, like stress, parental responsiveness, and a more limited access to higher-level education (Bradley and Corwyn, 2002). Lawson et al. (2013) added a biological component by claiming that these stressors in early life have negative effects on brain areas that are involved in emotional development, like the amygdala and the prefrontal cortex. Denham et al. (2012) further explain that higher SES children have advantages in developing EI due to higher levels of emotionally responsive parenting. Regarding adolescence and adults, people from low SES environments tend to display lower levels of EI, particularly in the areas of emotion regulation and social skills (Peliterri, 2002). But adolescence can significantly improve in EI by benefitting from school-based emotional learning interventions, even if they have a lower SES background (Brackett et al., 2011). Developing EI might be especially important for low SES groups because EI can serve as a protective factor for people in lower SES environments, as it buffers the negative impact of SES on mental health, school success, and job performance (Mavroveli et al., 2007).

Emotion recognition is one of the earlier aspects of EI that develops already in early childhood and becomes more nuanced in middle childhood, from 6-11 years old (Denham et al., 2012). Different aspects of EI develop mainly in adolescence. Such as emotion regulation because of growing cognitive control and prefrontal cortex maturation (Steinberg, 2005). On top of that, adolescents increasingly develop core skills of EI in adolescence as empathy, perspective taking, and social-awareness (Pfeifer and Blakemore, 2012).

Motor skills

Schmidt and Lee (2019) define motor skills as goal-directed activities that need voluntary body movements to achieve a desired outcome. Motor skills are often divided into gross motor skills and fine motor skills. Gross motor skills describe movements using large muscles or muscle groups, like walking or jumping. Additionally, gross motor skills are movements related to posture and locomotion (Haywood and Gatchell, 2020). Fine motor skills are much smaller movements using small muscles that are often performed with the fingers and hands. The tasks often require accuracy and dexterity (Gabbard, 2018). Magill and Anderson (2017) propose a further classification of motor skills, dividing it into a classification by environment and by movement type. The classification by environment contains the subcategories of open and closed skills. While closed skills are performed in a stable and predictable environment, open skills are performed in an unstable and unpredictable environment. Deficiencies in motor skills are linked to lower SES for fine and gross motor development (Piek et al., 2008) and overall motor proficiency compared to high SES (Goodway et al., 2010). The motor skill development seems also to be tied to cognitive development as fine motor skills in kindergarten predicted school success, particularly for children with low SES background (Grissmer et al., 2010). Similar are the findings of Cameron et al. (2012), who point out that an interrelation of motor and cognitive development exists, and differences in SES in early motor skill acquisition could represent a factor in ongoing educational discrepancy. Similar to previously mentioned for intelligence, the nutritional deficiencies associated with low SES also impact motor skills development, as in poor motor coordination or delays in physical development (Karasik et al., 2015).

The development of motor skills is dependent on neurological maturity, practice, and environmental support, and therefore influenced by both nurture and nature (Payne and Isaacs, 2017). Fine motor skills develop fast at ages 5-10 years old and tend to plateau at around 10-12 years old (Gabbard, 2018). Gross motor skills, on the other hand, improve in coordination and efficiency into adolescence (Haywood and Gatchell, 2020). Although, because of physical growth spurts, motor performance and coordination can be temporarily impaired before finally stabilizing in late adolescence (Payne and Isaacs, 2017). Furthermore, motor proficiency keeps improving and gets more refined through practice as well as neuromuscular maturity up until 20 years of age, especially in complex motor tasks or tasks related to sports (Payne and Isaacs, 2017). In summary, the interplay of the key domains can be suggested as provided in Figure 1.

The link between intelligence and SES is a robust and well-established finding, supported by decades of research (Bradley & Corwyn, 2002; von Stumm & Plomin, 2015; Tucker-Drob & Bates, 2016; Noble et al., 2005; Rakesh et al., 2024; Ritchie et al., 2022). In contrast, the relationships between SES and EI, as well as SES and motor skills, are less thoroughly explored and a more novel and emerging field of study. Furthermore, while links between SES and Intelligence, EI, and motor skills exist, how the development of these domains looks for different levels of SES is still relatively unknown.

Generalized Additive Models for Location, Scale, and Shape (GAMLSS)

This study, by leveraging the nuanced capabilities of Generalized Additive Models for Location, Scale, and Shape (GAMLSS), goes beyond confirming existing relations and enables comparisons of development trajectories. Linear regression models or ANCOVA only measure how the mean changes with a certain predictor, in our case, SES or age.

GAMLSS models display full distributions and not only means. Also, GAMLSS models make it possible to model non-linear distributions, which is especially important when investigating development over age for different levels of SES. Because of the GAMLSS-based modelling, potentially different distributions for different levels of SES over age can be visible, and age trends could be deduced. Furthermore, GAMLSS-based modeling is robust against skewed data, changing variance over age, and a non-constant error structure. Linear regression models would be insufficient in these cases. Which leads to the conclusion that GAMLSS-based models can give more nuanced insights for multiple domains while being overall more robust than traditional ANCOVA and linear-regression models typically used in development research.

This approach contributes valuable insights to the complex relationship between SES and human development and expands the existing body of knowledge.

Objectives

This study aims to investigate multiple questions. First, how do intelligence, EI, motor skills, and age relate to each other for different levels of SES? Second, how do the developed patterns for Intelligence, EI, and motor skills for different levels of SES compare to each other? More specifically, is the development pattern for intelligence and emotional intelligence the same concerning SES? And is the development pattern for intelligence and motor skills the same concerning SES?

This leads to multiple hypotheses:

$H0_a$: There are differences in Correlation between the levels of SES regarding Intelligence, EI, and motor skills.

$H1_a$: There are no differences in Correlation between the levels of SES regarding Intelligence, EI, and motor skills.

$H0_b$: There are differences in development patterns between the levels of SES, comparing Intelligence and EI

$H1_b$: There are no differences in development patterns between the levels of SES, comparing Intelligence and EI

$H0_c$: There are differences in development patterns between the levels of SES, comparing Intelligence and motor skills

$H1_c$: There are no differences in development patterns between the levels of SES, comparing Intelligence and motor skills

Method

Study Design

This study used a cross-sectional correlational design to investigate whether socioeconomic status moderates the age-related development of intelligence, emotional intelligence, and motor skills in children and adolescents.

Ethical considerations

The data is generated but based on real data and behaves as such. As this study is a secondary analysis of an existing anonymous data set, no ethical consent or approval is required.

Exclusion and Inclusion Criteria

The aim is to include all cases of the existing data set that have answered all relevant questions, and their performance for all relevant scales regarding SES, intelligence, EI, and motor skills is present. The data sets of children from ages 4 – 21 were included.

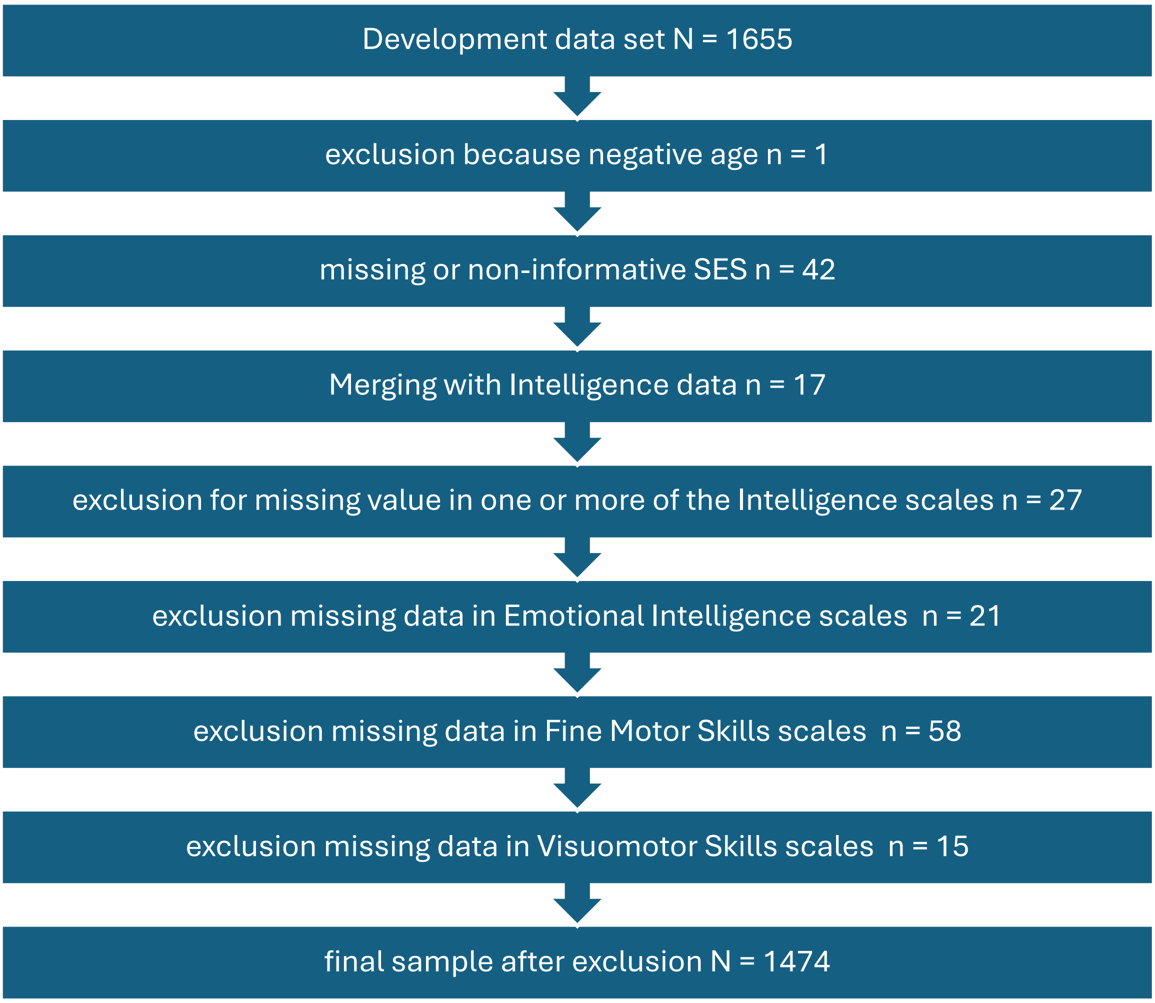
Participants

The total sample consists of two data sets from the same participants, who completed the IDS-2. First, the data set regarding the development variables of the IDS-2 consists of N = 1655, and second, the data set concerning the intelligence variables consists of N = 1652

German-speaking children and adolescents aged 4.4 to 21.6 years from Germany, Austria, and Switzerland. One participant (*n* = 1) was excluded due to having a negative value for the variable *age*. Further, n = 42 exclusions were made based on responses to the question regarding the mother's highest level of education that did not provide insights into the SES of the case, as information about SES is essential to the research question. After merging the two datasets, *n = 17* cases were removed because the ID numbers were not present in both sets. A total of *n = 27* were excluded for missing values in at least one of the intelligence scales. Another n = 21 were excluded for missing values in all EI-relevant scales. Additionally, *n* = 58 cases were excluded for having missing values for both fine motor skills scales. Lastly, n = 15 cases were excluded for having missing values in both visuomotor scales. After the exclusion process (Figure 3), a total of n = 181 cases were excluded, leaving the final data set reduced to *n = 1474*.

Figure 3

Participant Exclusion Overview as a Flow Chart



Sample size justification

A post hoc power analysis using the *pwr.f2.test* function from the *pwr* package in R indicated that the final sample for this study of n=1474, three predictor variables, and α = .05 was sufficient for detecting a medium effect size of f^2 = 0.15 (Cohen, 1988) in mutiple regression models, showing 100% power, which is way above the 80% threshhold.

Material and Measures

This study uses generated data from different questionnaires as part of an existing data set that behaves equally.

Three main domains from the Intelligence and Development Scales–2 (IDS-2; Grieder et al., 2023): general intelligence, social-emotional competence, and psychomotor skills. The IDS-2 is based on the Cattell-Horn-Carroll (CHC) theory of intelligence and is validated for individuals aged 5 to 20 years.

(1) Intelligence Assessment – IDS-2 General Intelligence Scales

The general intelligence component of the IDS-2 assesses broad and narrow cognitive abilities through 14 subtests. These subtests measure domains such as:

- Verbal comprehension
- Visual-spatial processing
- Working memory
- Logical reasoning
- Processing speed
- Mathematical reasoning
- General knowledge

In this study, an overall intelligence score was created by weighting each subtest score by its maximum possible value, then summing the results. The 14 subtests included were: *figure naming*, *general knowledge*, *sentence memory*, *digit span forward*, *visual memory*, *matrices*, *classification*, *planning*, *picture arrangement*, *coding*, *digit span backward*, *reading comprehension*, *analogies*, and *arithmetic*.

Grieder et al. (2023) report that the IDS-2 general intelligence scales demonstrate strong validity, though the subdomains may not always be psychometrically separable. Therefore, only a composite intelligence score was used in this study. The internal consistency of the composite scales typically ranges from α = 0.80 to 0.95, depending on age group and subscale (Grieder et al., 2023).

(2) Emotional Intelligence – IDS-2 Social-Emotional Competence Scales

Emotional intelligence (EI) was assessed using two IDS-2 subdomains of the Social-Emotional Competence Scales:

- *Emotion regulation*: the ability to monitor and adjust one’s emotional responses
- *Social-competent behavior*: the ability to act appropriately in social contexts

Although *emotion recognition* is part of the IDS-2 for ages 5–10, it was excluded from the composite EI score due to its restricted age range.

The overall emotional intelligence score was created by weighting ER and SKH scores by their maximum possible scores and summing them. The scales have demonstrated strong reliability and validity across age groups (Meyer et al., 2009), with internal consistency estimates between $\alpha = 0.75$ and 0.88, depending on scale and age.

(3) Motor Skills – IDS-2 Psychomotor Scales

Psychomotor skills in the IDS-2 are assessed by using three subscale categories:

- Fine motor skills (e.g., hand/finger coordination)
- Gross motor skills (e.g., balance, locomotion)
- Visuomotor integration (e.g., eye-hand coordination)

The motor skills composite score was based on the subscale categories fine motor quality and time, as well as visuomotor quality and time.

The time-based scores of the vioumotor subscale and the fine motor subscale were reversed so that longer durations are equal to lower performance, then weighted and combined with the quality scores to form a total motor skills score. Due to documentation inconsistencies, both visuomotor scales (time and quality) were weighted by the maximum observed score in the sample rather than a standard maximum.

Barnett et al. (2022) report that the IDS-2 motor scales are reliable and valid for both younger (5–10 years) and older (11–20 years) age groups, with internal consistency estimates ranging from $\alpha = 0.78$ to 0.89.

Additional Variables

An age variable was created by subtracting the date of birth from the date of the test administration. The resulting number of days was divided by 365.25 to account for gap years and create an age in years.

The SES was determined by the highest level of the mother's education following the classification of Damian et al. (2014). Resulting in obligatory schooling for low SES, vocational training and Matura as medium SES, and higher vocational training and university degree as high SES.

Procedure

The data is based on IDS-2 results. The IDS-2 underlies the CHC theory of intelligence. The intelligence section needs to be administered in a fixed order. All scales of a category need to be administered to achieve composite scores. The category IQ which our variables are based, takes approximately 50 minutes to administer. For social and emotional skills, 15 minutes, and psychomotor skills, 20 minutes. The tests have been done in person.

Data analysis

First, bivariate Pearson's correlations to establish the connections between the variables will be done. Afterwards, GAMLSS models for the three main categories vs age by SES will be administered. The statistical analysis of the correlations and partial correlations was done with IBM SPSS Statistics (Version 29.0.2.0 (20)). For the GAMLSS-based modelling as well as data management and variable recoding, R (Version 2024.12.1+563) was used. The significant threshold was determined to be p <0.05.

Forward selection was used to determine the GAMLSS models, and additionally, the distributions of scores for *Emotional Intelligence* (Figure A1), *Intelligence* (Figure A2), and Motor Skills (Figure A3) were investigated. Based on visual inspection and comparison of AIC scores (Table 1) to determine the model fit of different distributions, a model was selected.

Table 1

AIC Comparison by Model and Distribution Family

GAMLSS Model vs Age by SES	Distribution Family	AIC
Intelligence	Normal (NO)	3932.036
	Box-Cox-Cole-Green (BCCG)	3923.863

Emotional intelligence	Normal (NO)	214.233
	Sinh-Arcsinh (SHASHo)	-70.6524
Motor skills	Normal (NO)	-165.0493
	Sinh-Arcsinh (SHASHo)	-162.7983
Gross motor skills	Normal (NO)	3731.919
	Sinh-Arcsinh (SHASHo)	3714.91
Fine motor skills	Normal (NO)	8325.195
	Sinh-Arcsinh (SHASHo)	7854.616
Visuomotor skills	Normal (NO)	11224.47
	Box-Cox-Cole-Green (BCCG)	11237.66

The results showed that for every model, a non-normal distribution was superior in comparison to the normal distribution. Which led to choosing the *Box-Cox-Cole-Green* (BCCG) distribution for the models regarding the models for *Intelligence* and *Visuomotor Skills*, and the *Sinh-Arcsinh* (SHASHo) distribution for the models regarding *Emotional Intelligence*, *Motor Skills*, *Gross Motor Skills*, and *Fine Motor Skills*.

Results

Descriptive Statistics

The descriptive statistics of the final data set can be seen in Table 2.

Table 2

Descriptive statistics

	SES low (n = 143)	SES medium (n = 706)	SES high (n = 625)	Total (n = 1474)
Age (years)	M = 12.64; SD = 4.76	M = 12.13; SD = 4.36	M = 11.29; SD = 4.11	M = 11.82; SD = 4.32
age range (years, min-max)	4.41-21.11	4.43 – 21.64	4.42-21.50	4.41-21.64
Male	n = 70 49.0%	n = 353 50.0%	n = 304 48.6%	n = 727 49.7 %
Female	n = 73 51.0%	n = 353 50.0%	n = 321 51.4%	n = 747 50.3%

Correlations

The first research question addressed the link between motor skills, emotional intelligence, intelligence, and age with respect to the different SES levels. The results for the correlations can be seen below in Table x.

Table 3

Correlation

SES level		Motor skills	Emotional Intelligence	Intelligence	age
Low	Motor skills	r = 1	.	.	.
	Emotional Intelligence	*r* = .083; *p* = .323	r = 1	.	.
	Intelligence	*r* = -.040; *p* = .637	*r* =. 494** p < .001	r = 1	.
	age	*r* = .154; *p* = .066	*r* = .295**; *p* < .001	*r* = .863**; *p* < .001	*r* =1
Medium	Motor skills	*r* = 1	.	.	.
	Emotional Intelligence	*r* = -.099** *p* = .009	*r* = 1	.	.
	Intelligence	*r* = -.035; *p* = .357	*r* = .307**; *p* < .001	*r* =1	.
	age	*r* = -.075*; *p* = .045	*r* = .235**; *p* < .001	*r* =. 856**; *p* < .001	*r* =1
High	Motor skills	*r* = 1	.	.	.
	Emotional Intelligence	*r* = -.034; *p* = .391	*r* =1	.	.
	Intelligence	*r* = -.032; *p* = .422	*r* = .393**; *p* < .001	*r* =1	.
	age	*r* = -.019; *p* = .638	*r* = .358**; *p* < .001	*r* = .883**; *p* < .001	*r* = 1

Note. **. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Regarding the correlation between the three relevant test domains, while accounting for SES, multiple significant correlations were present in the data. First, the correlation among the subdomains with each other for the three different levels of SES was checked. EI and IQ had medium to high correlation in the low SES group (r = .494; p < .001), a medium correlation in the medium SES group (r = .307; p < .001), and a medium correlation for the high SES group (r = .393; p < .001). Motor skills and EI had a very small negative correlation for SES medium (r = -.099; p = .009). Motor skills and intelligence had no significant correlation for any level of SES, as shown in Table 3.

For low SES, Age has a medium positive correlation with EI (*r* = .295; *p* < .001) and a high positive correlation with intelligence (*r* = .863; *p* < .001).. For medium SES, age had a medium correlation with EI (*r* =.358; *p* < .001) and a high correlation with intelligence (*r* = .856; *p* < .001). Motor skills had a very small negative correlation with age (*r* = -.075; *p* = .045). For the high SES group, age had a medium correlation with EI (*r* = .358; *p* < .001) and a high correlation with intelligence (*r* = .883; *p* < .001).

Because age correlated with both intelligence and EI for all levels of SES, an additional correlation, partialling out age, was performed (Table 4).

Table 4

Partial Correlations accounting for age

SES level		Motor skills	Emotional Intelligence	Intelligence
Low	Motor skills	r = 1	.	.
	Emotional Intelligence	*r* = .136; *p* = .106	r = 1	.
	Intelligence	*r* = .187*; *p* = .026	*r* =. 497** p < .001	r = 1
Medium	Motor skills	*r* = 1	.	.
	Emotional Intelligence	*r* = -.084* *p* = .026	*r* = 1	.
	Intelligence	*r* = .058; *p* = .3124	*r* = .210**; *p* < .001	*r* =1
High	Motor skills	*r* = 1	.	.
	Emotional Intelligence	*r* = -.030; *p* = .460	*r* =1	.
	Intelligence	*r* = -.033; *p* = .409	*r* = .177**; *p* < .001	*r* =1

Note.**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

When accounted for by age, the correlation between EI and intelligence decreases the higher the level of SES increases. For low SES, the correlation was moderate to high (*r* = .497; *p* < .001), for medium SES, the correlation was small (*r* = 0.210; *p* < .001), and for the high SES also small (*r* = .177; *p* < .001). Furthermore, in the low SES group, after accounting for age, a low correlation between motor skills and intelligence (*r* = .187;*p* = .026) was present, and for the medium SES group, a small negative correlation (*r* = -.084; *p* = .026) was present (see Table 4).

GAMLSS Results

The second and third research questions obtained the development pattern of motor skills, EI, and intelligence for the different levels of SES, and whether the development patterns of motor skills and EI for different levels of SES are similar compared to the Intelligence development patterns for different levels of SES.

Intelligence

A GAMLSS model was fitted to investigate the relationship between age, SES, and Intelligence. The GAMLSS model allows variation in both parameters regarding location (μ) and scale (σ) on intelligence for the low SES, medium SES, and High SES groups, respectively, as well as skewness (ν).

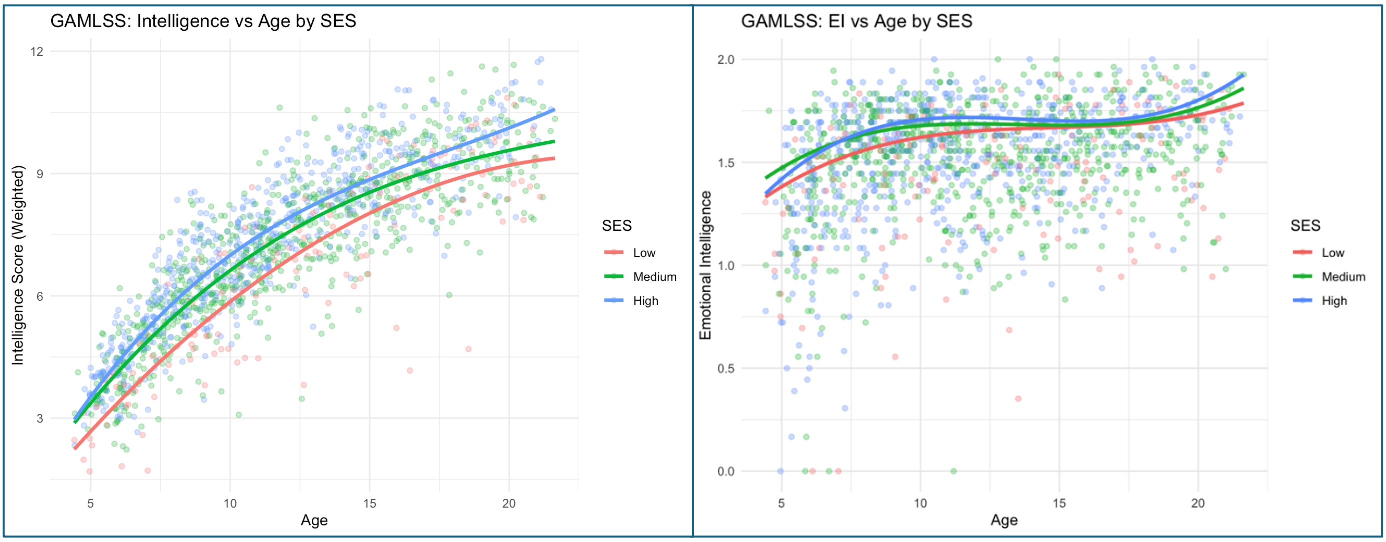
The results of the GAMLSS model for *Intelligence* (see Table B1) show that *Age* is a significant predictor for *Intelligence* in the linear model (β = 0.93, $p < 0.001$). Polynomials of *Age* as in Age^2 (β = -0.02, p = .475) andAge^3 (β = -0.00, p =.893) were not significant individually. Furthermore, neither *high SES* (β = -1.57, p = .183) nor *medium SES* (β = -0.09, p = .935) showed a significant main effect on their own. Indicating that *SES* alone does not explain differences in Intelligence when *Age* is held constant. Significant interaction for *Age ×SES high* (β = 0.73, p = .035), Age^2 *×SES high* (β = -0.06, p = .035), and Age^3 *×SES high* (β = 0.0017, p = .041) were pesent in the data (see Figure 4; Table B1).

The results regarding the scale (σ) show only a significant intercept (β = -1.56, $p <$ .001). Neither *Age* (β = -0.03, p = .789), Age^2 (β = -0.00, p = .806), nor Age^3 (β = 0.00, p = .704) was significant (see Table B2).

Significant skewness for the *Intelligence* scores was present in the data (β = 1.72, $p <$ .001), justifying the use of a non-normal distribution, like *BCCG* (see Table B3).

Figure 4

GAMLSS models for Intelligence (left) and EI (right) vs age by SES



Emotional Intelligence

The results regarding the *Emotional Intelligence* model (Table B4) showed significance for *Age* (β = 0.18, $p < .001$), *Age²* (β = -0.01, $p < .001$), and *Age³* (β = 0.00, $p < .001$). Neither *high SES* (β = -0.31, $p = .100$) nor *medium SES* (β = 0.04, $p = .867$) showed a significant main effect on their own. Indicating that *SES* alone does not explain differences in *Emotional Intelligence* when *Age* is held constant. Interaction effects were only present for the *high SES* group for *Age ×SES high* (β = 0.11, $p = .008$), *Age²×SES high* (β = -001, $p = .004$), and *Age³×SES high* (β = 0.00, $p = .005$).

The results regarding the scale (σ) show that the intercept (β = 0.64, $p = .040$) is significant. Also, *Age* (β = -0.61, $p < .001$), *Age²* (β = 0.05, $p < .001$), and *Age³* (β = -0.00, $p < .001$) were significant (see Table B5).

Significant skewness (ν) for the *Emotional Intelligence* scores was present in the data (β = -0.47, $p < .001$), and significant Kurtosis (τ) (β = -0.21, $p < .001$), justifying the use of a non-normal distribution, like SHASHo (see Tables B6 and Table B7).

The GAMLSS model regarding *EI* (Figure 4) displays an s-curve shape for all levels of *SES*. The *low SES* and *high SES* groups have a similar starting point, but the high SES group develops quickly compared to the *low SES* group up until age 10. The medium SES group has a higher starting point compared to *high* and *low SES*, but develops more slowly than the *high SES* group. All levels of *SES* seem to plateau beginning at roughly age 10 until age 17. After that, the development starts to increase again, with the *high SES* group having the steepest curve and the *low SES* the flattest curve (Figure 4).

Motor skills

The results regarding the *Motor Skills* model (Table B8) showed no significance for *Age* (β = 0.09, p = .225), Age^2 (β = -0.00, p = .404), nor Age^3 (β = 0.00, p = .699). Neither high SES (β = 0.45, p = .139) nor medium SES (β = 0.25, p = .437) showed a significant main effect on their own. Indicating that *SES* alone does not explain differences in *Emotional Intelligence* when age is held constant. Additionally, no interaction effect between *Age* and *SES medium,* as well as *Age* and *SES high,* was present for *Motor Skills*.

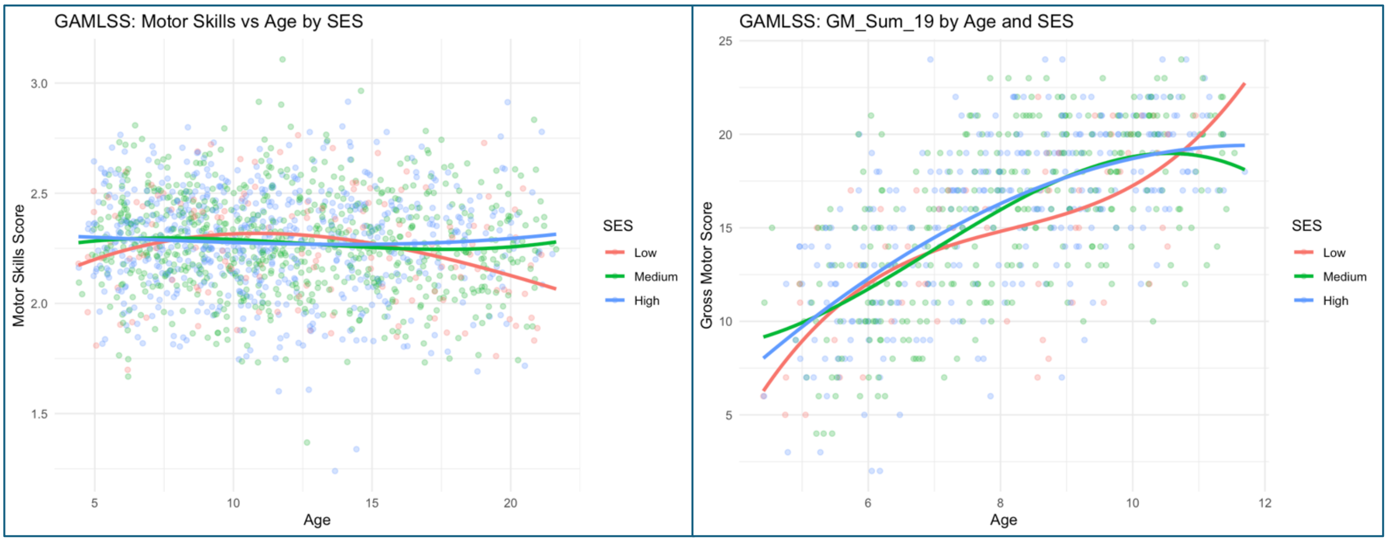
The results regarding the scale (σ) show that the intercept (β = -1.91, $p < .001$) is significant. Neither, *Age* (β = -0.00, p = .987), Age^2 (β = 0.00, p = .808), nor Age^3 (β = -0.00, p = .691) was significant (see Table B9).

Significant skewness (ν) for the *Motor skills* scores was present in the data (β = -0.20, $p < .001$), as well as significant Kurtosis (τ) (β = -0.14, $p < .001$), justifying the use of a non-normal distribution, like SHASHo (see Table B10 and Table B11).

The GAMLSS model for the motor skills is displayed in Figure 5. The lines for medium and high SES look identical, are linear, and do not rise the higher age. The curve for the low SES group starts the lowest over overtakes the medium and high SES groups in the age range 8-15 years old, and then drops off steeply and indicates the lowest performance with the highest age in this case, over 20 years old.

Figure 5

GAMLSS-models overall Motor Skills (left) and Gross Motor Skills (right) by Age vs SES



Because the findings for motor skills looked unexpected, further investigations into the individual scales were performed. First, we looked into the scale for gross motor skills, which was only assessed for ages 4-11. The results regarding the *Gross Motor Skills* model (Table B12) showed significance for *Age* (β = 15.35, p < .001), Age^2 (β = -.64, p < .001), and Age^3 (β = 0.06, p < .001). Both high SES (β = 27.73, p < .001) and medium SES (β = 51.09, p = .437) showed a significant main effect on their own. Indicating that *SES* alone does explain differences in *Gross Motor Skills* when *Age* is held constant. Additionally, interaction effects between *Age* × *SES high* (β = -11.44, p < .001), Age^2 × *SES high* (β = 1.57, p < .001), and Age^3 × *SES high* (β = -0.07, p < .001) as well as *Age* × *SES medium* (β = -20.71, p < .001), Age^2 × *SES medium* (β = 2.73, p < .001), and Age^3 × *SES medium* (β = -0.12, p < .001) were present.

The results regarding the scale (σ) show that only *Age* is significant (β = 0.56, p = .043). Neither Age^2 (β = 0.00, p = .808), Age^3 (β = -0.00, p = .691), nor the intercept (β = -0.40, p = .608) was significant (see Table B13).

Significant skewness (ν) for the *Gross Motor skills* scores was present in the data (β = -0.27, p < .001), but not significant Kurtosis (τ) (β = -0.07, p = .389), justifying the use of a non-normal distribution, like *SHASHo* (see Table B14 and Table B15).

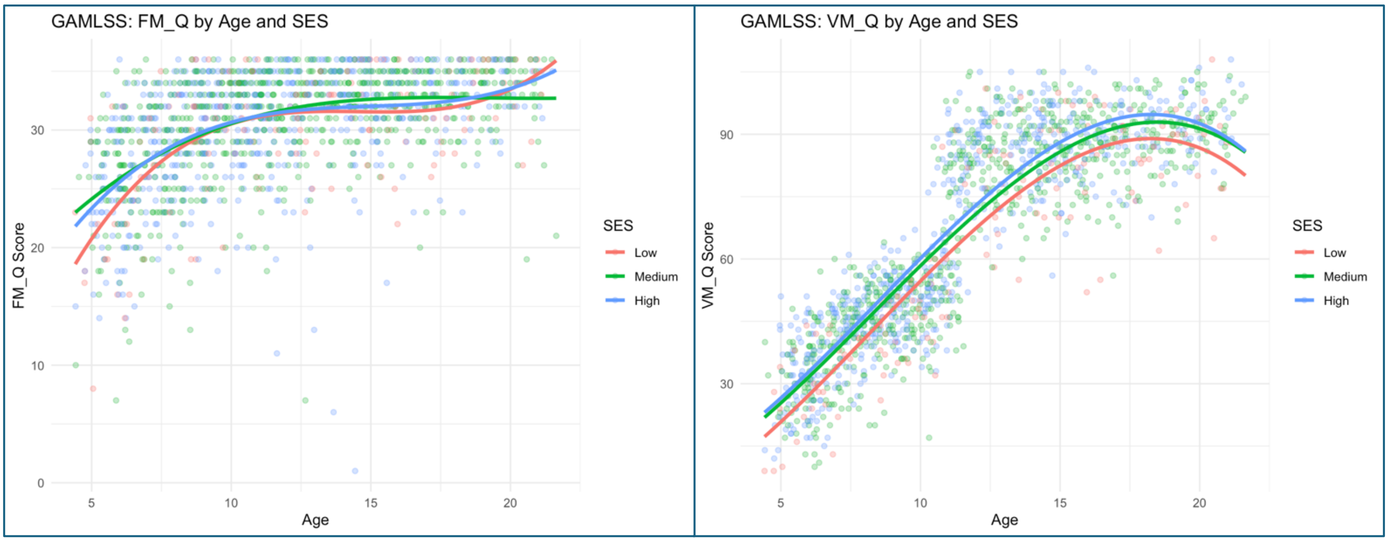
The results regarding the *Fine Motor Skills* model and the location (μ) (Table B16; Figure 6) showed significance for *Age* (β = 3.70, p = .005), Age^2 (β = -0.24, p = .021), and Age^3 (β = 0.01, p = .043). Neither *high SES* (β = -1.20, p = .843) nor *medium SES* (β = -0.06, p = .992) showed a significant main effect on their own. Indicating that *SES* alone does not explain differences in *Fine Motor Skills* when *Age* is held constant. No interaction effects were present for either the *high SES* group or the *medium SES* group.

The results regarding the scale (σ) showed that the intercept (β = 1.90, p = .040) is significant. But *Age* (β = -0.16, p = .254), Age^2 (β = 0.01, p = .619), and Age^3 (β = -0.00, p = .789) were not significant (see Table B17).

Significant skewness (ν) for the *Fine Motor Skills* scores was present in the data (β = -0.71, p < .001), and significant Kurtosis (τ) (β = -0.18, p < .001), justifying the use of a non-normal distribution, like *SHASHo* (see Table B18 and Table B19).

Figure 6

GAMLSS-models Fine Motor Skills (left) and Visuomotor Skills (right) by Age vs SES



The results of the GAMLSS model for *Visuomotor Skills* regarding the location (μ) (Table B20; Figure 6) showed that *Age*^{2} (β = 0.839, p < 0.001) and *Age*^{3} (β = -0.030, p < 0.001) are significant predictors. Furthermore, neither *SEShigh* (β = 0.855, p = .904) nor *SESmedium* (β = -6.051, p = .400) showed a significant main effect on their own. Indicating that *SES* alone does not explain differences in *Visuomotor Skills* when *Age* is held constant. No significant interaction for *medium SES* and *high SES* was present (Table B20).

The results regarding the scale (σ) showed only a significant intercept (β = -1.291, p < .001) (Table B21).

Significant skewness (ν) for the *Visuomotor Skills* scores was present in the data (β = 1.01, p < .001), justifying the use of a non-normal distribution, like *BCCG* (Table B22).

Discussion

This study aimed to investigate multiple questions. First, how *Intelligence*, *Emotional Intelligence*, *Motor Skills*, and *Age* relate to each other for different levels of *SES*. Second, how the development patterns for *Intelligence*, *Emotional Intelligence*, and *Motor Skills* for different levels of *SES* compare to each other. More specifically, if the development pattern for *intelligence* and *Emotional Intelligence* is the same concerning *SES*. And if the development pattern for Intelligence and *Motor Skills* is the same concerning *SES*.

Correlations

Concerning the first research question, the results show a relationship between *Intelligence* and *Emotional Intelligence* across all levels of *SES*. Additionally, this relationship of *Intelligence* and *Emotional Intelligence* was still present when accounted for by *Age*, indicating a co-dependency of *Intelligence* and *Emotional Intelligence* independent from *Age*. Because age was accounted for in the correlation of *Intelligence* and *Emotional Intelligence*, we can conclude that the relationship is not only because of an overall development process, but rather an inherent link between the domains of *Intelligence* and *Emotional Intelligence* exists, which was already shown in previous research (source). If the overall *Intelligence* score is considered as an approximation of *g,* this finding is in line with the *CHC* model of intelligence (Caroll, 1993; McGrew, 2009), which suggests a relationship of *g* with the broad abilities, like *Emotional Intelligence* (McGrew, 2009). The relationship between *Intelligence* and *Emotional Intelligence* was highest for the *low SES* group and barely changed even after accounting for *Age*. Indicating a potentially higher development dependency of *Intelligence* and *Emotional Intelligence* for the *low SES* group. This would mean that the development of both is more interconnected when compared to the *medium SES* and *high SES* groups. This could be explained by more individual development opportunities in the *medium SES* and *high SES groups* (Bradley and Corwin, 2002), which allow them to develop the domains of *Intelligence* and *Emotional Intelligence* more independently from each other. This independence might be related to more authoritative parenting in *high SES* families, fostering independent development (McLoyd, 1998).

Surprisingly, no correlation between *Age* and *Motor Skills* was present in our data regarding the three different SES. This goes against previous findings, which showed an age-dependent development of motor skills (Gabbard, 2018; Haywood and Gatchell, 2020; Payne and Isaacs, 2017)After inspecting the GAMLSS models for the scores regarding quality of perfroming a task of subdomains of *Motor Skills* individually, a dependency for *Age* was found for each of them. These findings suggest that the time scores for the domains, *Visuomotor Skill* and *Fine Motor Skills*, which were also included in the *Motor Skills* sum score, might not be sufficiently recoded to generate an overall sum score. Because of that, the interpretation of the overall *Motor Skills* score needs to be done with caution and should not be given much explanatory power.

Because the time to complete a motor skill task also gives valuable insights into the overall motor skill proficiency (Smith-Engelsman and Hill, 2012; Gabbard, 2018; Payne and Isaacs, 2017), future research should use a more comprehensive method, like classifying time intervals into norms scores, to integrate the time scores into the overall motor skills score.

Summarizing the results of the correlation, one might conclude that the $H1_a$ Hypothesis is only partially supported. While differences in the correlation of *Intelligence* and *Emotional Intelligence* for different levels of *SES* seem to exist, no conclusions can be drawn for overall *Motor Skills* scores.

GAMLSS: Intelligence vs Emotional Intelligence

The statistical results, as well as the visual inspection of the *Intelligence* model as well as the *Emotional Intelligence* model, suggest a different pattern in development for both concepts. While *Intelligence* development is best predicted in a linear fashion, for *Emotional Intelligence*, the location parameters (μ) for Ag^2, $Age,^{2,}$ and Age^3 were all significant. Indicating a non-linear and complex relation. In this case, visual inspection of the regression lines indicates a s-curve-shaped pattern (Figure 4). This s-shape pattern plateauing from roughly the ages 11-17 years old is somewhat contrary to the findings of Steinberg (2005) and Pfeifer and Blakemore (2012), who describe significant growth during adolescence. Potential reasons for this are the heightened self-focus and identity exploration during puberty, which can momentarily reduce empathy and emotion regulation (Elkind, 1967), which are key concepts in this research approximation of *Emotional Intelligence*. Furthermore, *SES* influences the development of intelligence, mainly showing that the *High SES* group always outperforms the low *SES group* in a stable fashion. This pattern is different for *Emotional Intelligence*, where differences in growth rate as shown by the significant interaction effects for *Age* × *SES high*, Age^2 × *SES high*, and Age^3 × *SES high*. For *Intelligence,* only an interaction effect for Age^3 × *SES high* was present, indicating only a conditional relation. Yet, both findings are in line with previous research indicating differences in performance based on SES for Intelligence (von Stumm and Plomin, 2015; Madshushanthi et al., 2018; Piccolo et al., 2016; Noble, 2015; Bradley and Corwyn, 2002) and Emotional Intelligence (Bradley and Corwyn, 2002; Lawson et al., 2013; Denham et al., 2012; Brackett et al., 201; Mavroelii et al., 2007). The findings are in contrast to the findings from Smalor and Heine (2021), who proposed the opposite effects for emotional intelligence, indicating that higher SES leads to more autonomy and focus on oneself, and therefore less care for others. This notion cannot be supported by the results of this research. This led to the conclusion to accept the $H1_b$ hypothesis, indicating different development patterns for *Intelligence* and *Emotional Intelligence*.

GAMLSS: Intelligence vs Motor skills

As mentioned already, the interpretation of the overall *Motor Skills* score should be done very cautiously. Therefore, only an indication based on the subscales can be deduced. And the regression coefficients for *Gross Motor Skills* regarding the location (μ) for *Age*, Age^2, and Age^3 were all significant, which indicates a non-linear and complex development compared to the proposed linear development for *Intelligence*. Both main effects for *SES medium* and *SES high* were significant, which indicates that *SES* impacts gross motor development for both development trajectory and development speed. This finding is in line with the results of Piek et al. (2008), who found differences in gross motor skills proficiency for SES groups, where high SES outperforms low SES. While there are some similarities, ultimately the curved pattern indicates a different trajectory for *Gross Motor Skills*, which is also more nuanced concerning *SES*, compared to *Intelligence*.

Fine Motor Skills seem to develop in a non-linear pattern because the regression coefficients for location (μ) for *Age*, Age^2, and Age^3 were all significant. Visual inspection suggests a steep development for all SES groups until age 10. These findings support the claims of Gabbard (2018). No main effects or interaction effects were present, indicating that *SES* does not seem to influence the development of *Fine Motor Skills*. This finding is contrary to the results of Piek et al. (2008), who found differences in fine motor skills proficiency for SES groups, where *high SES* outperforms *low SES*. This is also in contrast to the linear development seen for *Intelligence* and the interaction effect for the *high SES* group × Age^3 present in *Intelligence*.

For *Visuomotor Skills* as a subcategory of *Motor Skills,* only Age^2 and Age^3 were significant, indicating a non-linear development pattern. Because no interaction or main effects were present, *Visuomotor Skills* development seems to be only dependent on *Age* and independent from *SES*. This is also in contrast to the linear *Intelligence* development pattern and conditional interaction with *SES* for the *high SES* group.

All in all, based on the subpar overall *Motor Skills* score and different findings in the subdomains, whereas *Gross Motor Skills* is *SES* dependent and *Fine Motor Skills,* as well as Visuo*motor Skills,* are *SES* independent, it is difficult to come to conclusive evidence. Although all three subscales are significantly non-linear compared to the linear *Intelligence* development. Therefore, there are indications of different development patterns in *Intelligence* and *Motor Skills* that need to be further explored in future research.

Strengths and Limitations

This research strength lies in the multidimensional focus that allows for gathering a holistic view of child and adolescent development. Furthermore, it expands the body of research, especially for the less explored area of *Emotional Intelligence* and partially for *Motor Skills* development. The integration of *SES* as a core moderator allows for investigating how different development trajectories based on *SES* level behave, which is superior to the common claims that differences exist or do not exist. The use of GAMLSS also allows for potential nonlinear development trajectories and is therefore superior to standard regression models. Furthermore, the use of a large, diverse sample (N = 1474) from three countries (Germany, Austria, and Switzerland) enhances
the generalizability and statistical power of the findings.

Limitations of this research are that the cross-sectional design does not allow for causal claims and that the identification of SES is only based on the highest level of the mother's education. Some of the answer options could be evaluated as either medium or high, as well as either low or medium. Future research should confirm the results with adjusted coding of the SES variable. And, lastly, the Motor Skills coding was insufficient, which limits the explanatory power drastically. The time scores should be coded differently, like norming time intervals, to obtain better insights into overall motor skills development. Because of the coding issue, the low correlation between *Motor Skills* and *Intelligence* for the *low SES* group and the small negative correlation between *Motor Skills* and *Emotional Intelligence* in the medium SES group, both accounted for *Age,* should not be interpreted. The data set had a few cases of children and adolescents outside of the scope that the IDS-2 administers.

Conclusion

As a main outcome, this study showed that Intelligene and Emotional Intelligence are intercorrelated, especially in the low SES group. However, the development patterns of Intelligence and Emotional Intelligence behave differently over Age. Where Intelligence develops linearly, and Emotional Intelligence displays an S-shaped curve.

Also, SES influences each domain differently. Intelligence development shows stable SES differences, as the high SES group outperforms the low SES group. For Emotional Intelligence and for Gross Motor Skills, the SES differences are more nuanced by showing differences in both trajectory and level.

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Appendix A

Figure A1

Distribution of Emotional Intelligence Scores by SES

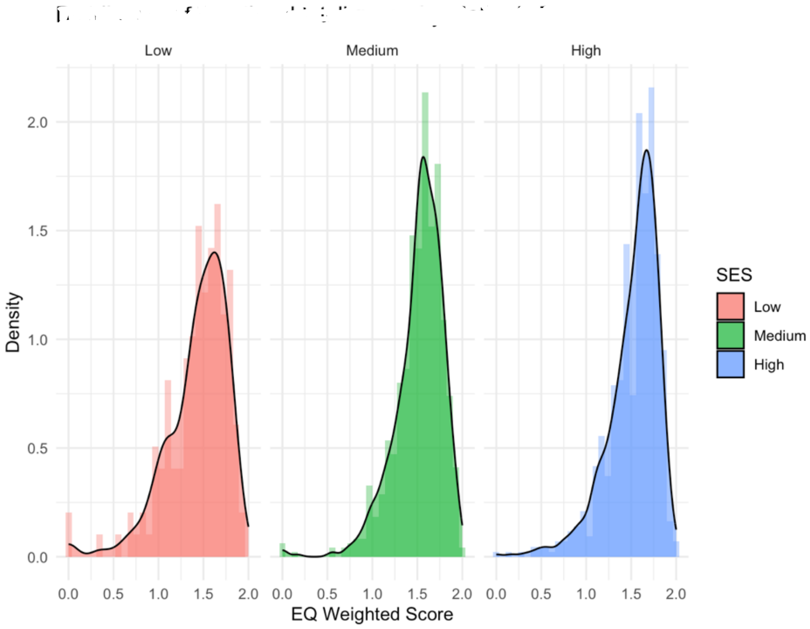


Figure A2

Distribution of Intelligence Scores by SES

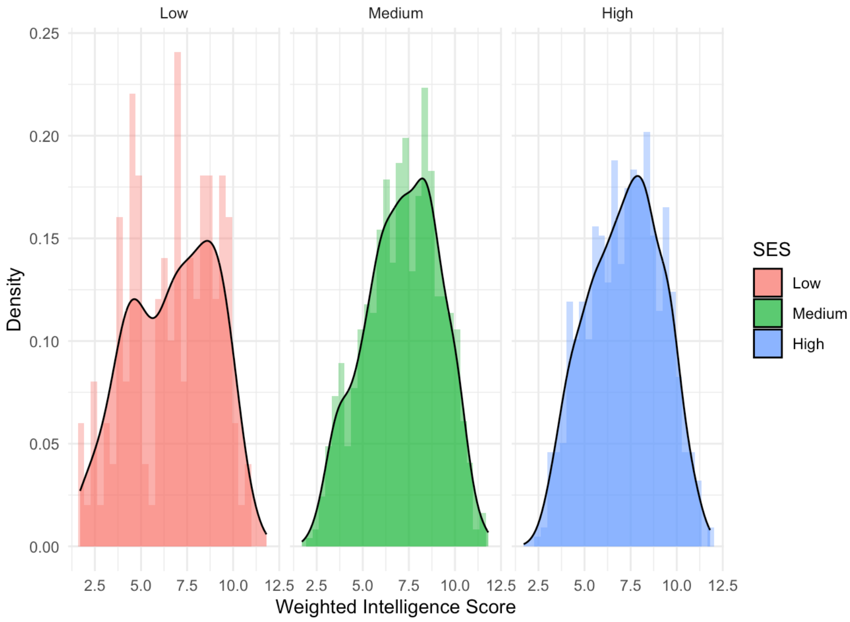


Figure A3

Distribution of Motor Skills Score by SES

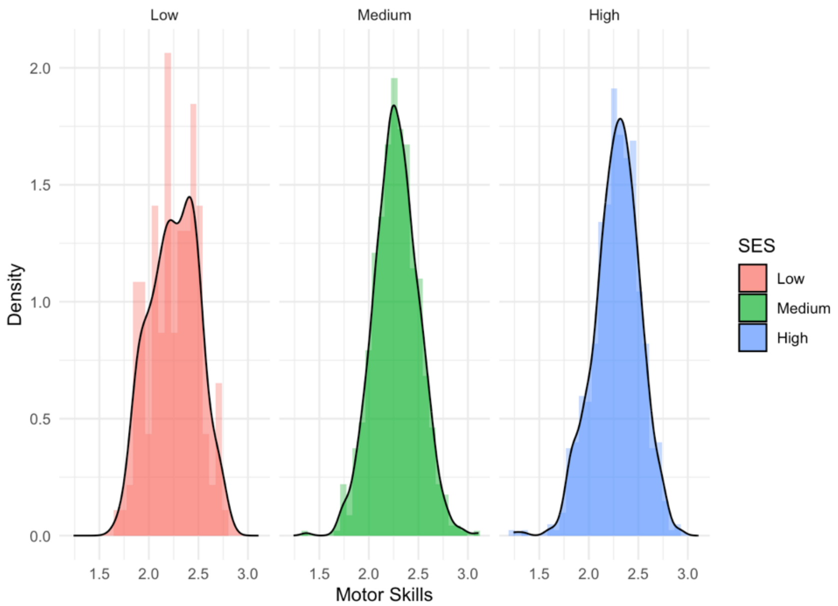
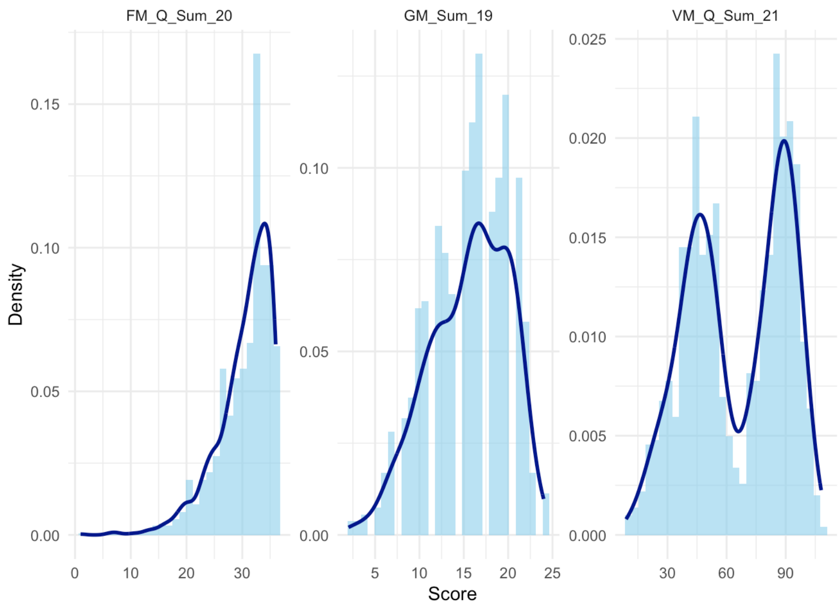


Figure A4

Distribution of Fne Motor Skills, Visuomotor Skills, and Gross Motor Skills Scores



Appendix B

Table B1

Regression Coefficients for the GAMLSS Model Predicting Intelligence Scores (Mu Parameter) as a Function of Age and Socioeconomic Status (SES)

Predictor	Estimate	SE	t	p
Intercept	-1.42	0.98	-1.45	.146
Age (Linear)	0.93	0.29	3.25	.001 **
Age (Quadratic)	-0.02	0.03	-0.71	.475
Age (Cubic)	-0.00	0.00	-0.14	.893
SES: Medium	-0.09	1.16	-0.08	.935
SES: High	-1.57	1.18	-1.33	.183
Age (Linear) × SES: Medium	0.27	0.34	0.79	.429
Age (Quadratic) × SES: Medium	-0.03	0.03	-0.88	.380
Age (Cubic) × SES: Medium	0.00	0.00	0.86	.390
Age (Linear) × SES: High	0.73	0.34	2.11	.035 *
Age (Quadratic) × SES: High	-0.06	0.03	-2.11	.035 *
Age (Cubic) × SES: High	0.00	0.00	2.04	.041 *

Note. $N = 1474$. The outcome variable is a weighted composite intelligence score derived from IDS-2 subtests. Age was modeled using a third-degree polynomial with raw scores, and SES was dummy coded (Low SES = reference group). The Mu parameter represents the expected value (mean) of the outcome distribution in the Box-Cox-Cole-Green (BCCG) family. $^*p < .05$, $^{**}p < .01$, $^{***}p < .001$

Table B2

Regression Coefficients for the GAMLSS Model Predicting the Sigma Parameter (Scale) of Intelligence Scores

Predictor	Estimate	SE	t	p
Intercept	-1.56	0.40	-3.88	.000 ***
Age (Linear)	-0.03	0.11	-0.27	.789
Age (Quadratic)	-0.00	0.01	-0.25	.806
Age (Cubic)	0.00	0.00	0.38	.704

Note. Sigma models the scale (variance) of the outcome. Age was modeled using a third-degree polynomial. $^*p < .05$, $^{**}p < .01$, $^{***}p < .001$

Table B3

Regression Coefficients for the GAMLSS Model Predicting the Nu Parameter (Skewness) of Intelligence Scores

Predictor	Estimate	SE	t	p
Intercept	1.73	0.15	11.71	< .001 ***

Note. Nu represents the skewness parameter of the distribution. Only the intercept was estimated in this model. *p < .05, **p < .01, ***p < .001

Table B4

Regression Coefficients for the GAMLSS Model Predicting Emotional Intelligence Scores (Mu Parameter) as a Function of Age and Socioeconomic Status (SES)

Predictor	Estimate	SE	t	p
Intercept	0.74	0.14	5.39	< .001 ***
Age (Linear)	0.18	0.03	6.62	< .001 ***
Age (Quadratic)	-0.01	0.00	-5.86	< .001 ***
Age (Cubic)	0.00	0.00	4.79	< .001 ***
SES: Medium	0.04	0.22	0.17	.867
SES: High	-0.31	0.19	-1.65	.100
Age (Linear) × SES: Medium	0.03	0.05	0.51	.607
Age (Quadratic) × SES: Medium	-0.00	0.00	-0.90	.368
Age (Cubic) × SES: Medium	0.00	0.00	1.10	.270
Age (Linear) × SES: High	0.11	0.04	2.64	.008 **
Age (Quadratic) × SES: High	-0.01	0.00	-2.92	.004 **
Age (Cubic) × SES: High	0.00	0.00	2.83	.005 **

Note. N = 1474. Emotional intelligence modeled as a function of age and SES using a third-degree polynomial. SES was dummy coded with low SES as the reference group. The Mu parameter represents location. *p < .05, **p < .01, ***p < .001

Table B5

Regression Coefficients for the GAMLSS Model Predicting the Sigma Parameter (Scale) of Emotional Intelligence Scores

Predictor	Estimate	SE	t	p
Intercept	0.64	0.31	2.06	.040 *
Age (Linear)	-0.61	0.08	-7.63	< .001 ***

Age (Quadratic)	0.05	0.01	6.90	< .001 ***
Age (Cubic)	-0.00	0.00	-6.27	< .001 ***

Note. The Sigma parameter represents the scale (spread) of the distribution. Age was modeled with a third-degree polynomial. *$p < .05$, **$p < .01$, ***$p < .001$

Table B6

Regression Coefficients for the GAMLSS Model Predicting the Nu Parameter (Skewness) of Emotional Intelligence Scores

Predictor	Estimate	SE	t	p
Intercept	-0.47	0.05	-10.39	< .001 ***

Note. The Nu parameter models skewness in the SHASHo distribution. Only the intercept was estimated. *$p < .05$, **$p < .01$, ***$p < .001$

Table B7

Regression Coefficients for the GAMLSS Model Predicting the Tau Parameter (Kurtosis) of Emotional Intelligence Scores

Predictor	Estimate	SE	t	p
Intercept	-0.21	0.04	-4.73	< .001 ***

Note. The Tau parameter models kurtosis (tail weight) in the SHASHo distribution. Only the intercept was estimated. *$p < .05$, **$p < .01$, ***$p < .001$

Table B8

Regression Coefficients for the GAMLSS Model Predicting Motor Skill Scores (Mu Parameter) as a Function of Age and Socioeconomic Status (SES)

Predictor	Estimate	SE	t	p
Intercept	1.91	0.26	7.34	< .001 ***
Age (Linear)	0.09	0.07	1.21	.225
Age (Quadratic)	-0.00	0.01	-0.83	.404
Age (Cubic)	0.00	0.00	0.39	.699
SES: Medium	0.25	0.32	0.78	.437
SES: High	0.45	0.31	1.48	.139
Age (Linear) × SES: Medium	-0.04	0.09	-0.47	.638
Age (Quadratic) × SES: Medium	0.00	0.01	0.10	.922
Age (Cubic) × SES: Medium	0.00	0.00	0.27	.785
Age (Linear) × SES: High	-0.10	0.08	-1.22	.224

Age (Quadratic) × SES: High	0.01	0.01	0.84	.399
Age (Cubic) × SES: High	-0.00	0.00	-0.43	.671

Note. *N* =1474. Motor skills modeled as a function of age and SES using a third-degree polynomial. SES was dummy coded with low SES as the reference group. The Mu parameter represents location. **p* < .05, ***p* < .01, ****p* < .001

Table B9

Regression Coefficients for the GAMLSS Model Predicting the Sigma Parameter (Scale) of Motor Skill Scores

Predictor	Estimate	SE	t	p
Intercept	-1.91	0.58	-3.29	.001 **
Age (Linear)	-0.00	0.16	-0.02	.987
Age (Quadratic)	0.00	0.01	0.24	.808
Age (Cubic)	-0.00	0.00	-0.40	.691

Note. The Sigma parameter represents the scale (spread) of the distribution. Age modeled with a third-degree polynomial. **p* < .05, ***p* < .01, ****p* < .001

Table B10

Regression Coefficients for the GAMLSS Model Predicting the Nu Parameter (Skewness) of Motor Skill Scores

Predictor	Estimate	SE	t	p
Intercept	-0.20	0.05	-4.08	< .001 ***

Note. The Nu parameter models skewness in the SHASHo distribution. Only the intercept was estimated. **p* < .05, ***p* < .01, ****p* < .001

Table B11

Regression Coefficients for the GAMLSS Model Predicting the Tau Parameter (Kurtosis) of Motor Skill Scores

Predictor	Estimate	SE	t	p
Intercept	-0.14	0.05	-2.69	.007 **

Note. The Tau parameter models kurtosis (tail weight) in the SHASHo distribution. Only the intercept was estimated. **p* < .05, ***p* < .01, ****p* < .001

Table B12

Regression Coefficients for the GAMLSS Model Predicting Fine Motor Skill Scores (Mu Parameter) as a Function of Age and Socioeconomic Status (SES)

Predictor	Estimate	SE	t	p

Intercept	15.69	5.33	2.95	.003 **
Age (Linear)	3.70	1.32	2.80	.005 **
Age (Quadratic)	-0.24	0.10	-2.32	.021 *
Age (Cubic)	0.01	0.00	2.03	.043 *
SES: Medium	-0.06	5.91	-0.01	.992
SES: High	-1.20	6.02	-0.20	.843
Age (Linear) × SES: Medium	-0.00	1.47	-0.00	.999
Age (Quadratic) × SES: Medium	-0.00	0.12	-0.00	.998
Age (Cubic) × SES: Medium	-0.00	0.00	-0.02	.988
Age (Linear) × SES: High	0.17	1.51	0.11	.911
Age (Quadratic) × SES: High	-0.01	0.12	-0.04	.966
Age (Cubic) × SES: High	-0.00	0.00	-0.02	.983

Note. N = 1474. Fine motor skills modeled as a function of age and SES using a third-degree polynomial. SES was dummy coded with low SES as the reference group. The Mu parameter represents location. *p < .05, **p < .01, ***p < .001

Table B13

Regression Coefficients for the GAMLSS Model Predicting the Sigma Parameter (Scale) of Fine Motor Skill Scores

Predictor	Estimate	SE	t	p
Intercept	1.90	0.53	3.59	< .001 ***
Age (Linear)	-0.16	0.14	-1.14	.254
Age (Quadratic)	0.01	0.01	0.50	.619
Age (Cubic)	-0.00	0.00	-0.27	.789

Note. The Sigma parameter represents the scale (spread) of the distribution. Age modeled with a third-degree polynomial. *p < .05, **p < .01, ***p < .001

Table B14

Regression Coefficients for the GAMLSS Model Predicting the Nu Parameter (Skewness) of Fine Motor Skill Scores

Predictor	Estimate	SE	t	p
Intercept	-0.71	0.02	-44.33	< .001 ***

Note. The Nu parameter models skewness in the SHASHo distribution. Only the intercept was estimated. *p < .05, **p < .01, ***p < .001

Table B15

Regression Coefficients for the GAMLSS Model Predicting the Tau Parameter (Kurtosis) of Fine Motor Skill Scores

Predictor	Estimate	SE	t	p
Intercept	-0.18	0.01	-24.89	< .001 ***

Note. The Tau parameter models kurtosis (tail weight) in the SHASHo distribution. Only the intercept was estimated. **p* < .05, ***p* < .01, ****p* < .001

Table B16

Regression Coefficients for the GAMLSS Model Predicting Gross Motor Skill Scores (Mu Parameter) as a Function of Age and Socioeconomic Status (SES)

Predictor	Estimate	SE	t	p
Intercept	-33.47	3.46	-9.68	< .001***
Age (Linear)	15.35	0.82	18.79	< .001***
Age (Quadratic)	-1.64	0.09	-18.15	< .001***
Age (Cubic)	0.06	0.01	10.99	< .001***
SES: Medium	51.09	4.12	12.41	< .001***
SES: High	27.73	4.58	6.06	< .001***
Age (Linear) × SES: Medium	-20.71	0.98	-21.03	< .001***
Age (Quadratic) × SES: Medium	2.73	0.10	26.22	< .001***
Age (Cubic) × SES: Medium	-0.12	0.01	-18.49	< .001***
Age (Linear) × SES: High	-11.44	1.23	-9.27	< .001***
Age (Quadratic) × SES: High	1.57	0.14	11.19	< .001***
Age (Cubic) × SES: High	-0.07	0.01	-9.22	< .001***

Note. *N* = 1474. Gross motor skills modeled as a function of age and SES using a third-degree polynomial. SES was dummy coded with low SES as the reference group. The Mu parameter represents location. **p* < .05, ***p* < .01, ****p* < .001

Table B17

Regression Coefficients for the GAMLSS Model Predicting the Sigma Parameter (Scale) of Gross Motor Skill Scores

Predictor	Estimate	SE	t	p
Intercept	-0.40	0.78	-0.51	.608
Age (Linear)	0.56	0.28	2.02	.043*
Age (Quadratic)	-0.06	0.03	-1.74	.083.
Age (Cubic)	0.00	0.00	1.15	.252

Note. The Sigma parameter represents the scale (spread) of the distribution. Age modeled with a third-degree polynomial. **p* < .05, ***p* < .01, ****p* < .001

Table B18

Regression Coefficients for the GAMLSS Model Predicting the Nu Parameter (Skewness) of Gross Motor Skill Scores

Predictor	Estimate	SE	t	p
(Intercept)	-0.27	0.06	-4.68	< .001***

Note. The Nu parameter models skewness in the SHASHo distribution. Only the intercept was estimated. **p* < .05, ***p* < .01, ****p* < .001

Table B19

Regression Coefficients for the GAMLSS Model Predicting the Tau Parameter (Kurtosis) of Gross Motor Skill Scores

Predictor	Estimate	SE	t	p
(Intercept)	-0.07	0.08	-0.86	.389

Note. The Tau parameter models kurtosis (tail weight) in the SHASHo distribution. Only the intercept was estimated. **p* < .05, ***p* < .01, ****p* < .001

Table B20

Regression Coefficients for the GAMLSS Model Predicting Visuomotor Skill Scores (Mu Parameter) as a Function of Age and Socioeconomic Status (SES)

Predictor	Estimate	Std. Error	t	p
Intercept	10.782	5.124	2.104	.0355*
Age (Linear)	-1.051	1.220	-0.862	.3888
Age (Quadratic)	0.839	0.098	8.576	<.001***
Age (Cubic)	-0.030	0.003	-11.059	<.001***
SES: Medium	-6.051	7.195	-0.841	.4004
SES: High	0.855	7.124	0.120	.9044
Age (Linear) × SES: Medium	2.909	1.853	1.569	.1168
Age (Quadratic) × SES: Medium	-0.261	0.153	-1.704	.0887
Age (Cubic) × SES: Medium	0.007	0.004	1.717	.0863
Age (Linear) × SES: High	1.103	1.979	0.557	.5773
Age (Quadratic) × SES: High	-0.091	0.174	-0.522	.6020
Age (Cubic) × SES: High	0.002	0.005	0.487	.6267

Note. *N* = 1474. Visuomotor skills modeled as a function of age and SES using a third-degree polynomial. SES was dummy coded with low SES as the reference group. The Mu parameter represents location. **p* < .05, ***p* < .01, ****p* < .001

Table B21

Regression Coefficients for the GAMLSS Model Predicting the Sigma Parameter (Scale) of Gross Motor Skill Scores

Predictor	Estimate	Std. Error	t	p
Intercept	-1.291	0.328	-3.937	<.001***
Age (Linear)	0.073	0.088	0.828	.408
Age (Quadratic)	-0.013	0.007	-1.801	.072
Age (Cubic)	0.000	0.000	1.778	.076

Note. The Sigma parameter represents the scale (spread) of the distribution. Age modeled with a third-degree polynomial. **p* < .05, ***p* < .01, ****p* < .001

Table B22

Regression Coefficients for the GAMLSS Model Predicting the Nu Parameter (Skewness) of Visuootor Skill Scores

Predictor	Estimate	Std. Error	t	p
(Intercept)	1.007	0.111	9.095	<.001***

Note. Nu represents the skewness parameter of the Box-Cox-Cole-Green distribution. Only the intercept was estimated in this model. **p* < .05, ***p* < .01, ****p* < .001