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Profiles of executive functions and social skills in the transition to school: A person-centred approach

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Abstract

Whether a child is ready for school is of interest for different parties involved. With a person-centred approach, the present study examined 123 kindergarteners (59 girls, 64 boys) regarding their early executive functions and social skills profiles. Children were 6–7 years of age at the first measurement point ($M = 6$; 6, $SD = 4.22$, range = 5; 8–7; 8). One year later, at the end of first grade, they were 7–8-years old ($M = 7$; 6, $SD = 4.11$, range = 6; 9–8; 8). Four different profiles were identified. The profiles did not differ on demographic dimensions or socioeconomic status but appeared to be related to academic achievement and school adjustment at the end of the first grade 1 year later. Profiles with high executive functions showed the greatest predictive validity, independent of their social skills. However, greater social skills seemed to serve as a compensator in the profile with lower executive functions. The resulting profiles have theoretical and practical relevance, when discussing the question what a child needs to be "ready" for school.

Highlights

- A person-centered approach to children's school readiness with 123 kindergarteners.

- Low executive functions can partially be compensated with high social skills. This compensation was stronger for school adjustment than for academic achievement.

- Cognitive and social aspects of a child's development should be considered by teachers and practitioners.

1 | INTRODUCTION

Increasingly, researchers and practitioners in the educational field recognize that a child's school readiness is the result of child-initiated and constructive interaction between the developing individual and her/his environment, which includes cognitive and social aspects (Fox & Riconscente, 2008; High, 2008). Given that children within relatively homogeneous age groups show large individual differences (Konold & Pianta, 2005), children's school readiness is broadly defined as a multidimensional construct (Blair & Raver, 2015). During the past decade, research has identified a number of cognitive and social aspects of a child's development that predict a smooth transition into formal learning and early academic achievement. The question, however, to what extent the different aspects interact with each other and differentially influence school readiness has only rarely been addressed. Indeed, the current literature is dominated by variable-centred approaches to school readiness. Hence, different dimensions of school readiness are addressed separately rather than simultaneously (Denham et al., 2012; Halle, Hair, Wandner, & Chien, 2012).

A variable-centred approach is a methodological tool that is useful when individual differences in certain outcomes such as school readiness are to be explained. This is done by estimating the relative contribution of different variables to school readiness. Typically, linear regression will help answer questions such as which variables have the strongest impact on school readiness compared with other possible variables. However, to address the multidimensionality of school readiness and to understand the interplay between cognitive and social factors as they dynamically operate for a particular child, a person-centred approach may serve as an additional insight (for an overview, see Laursen & Hoff, 2006). Cluster analysis is an exploratory multivariate method that tries to identify structure within the data by maximizing homogeneity within subgroups and heterogeneity between subgroups. Contrary to variable-centred approaches, cluster analysis will not identify structure to maximize a dependency relationship. Objectives are simplicity, description, and discovery (Hair, Black, Babin, & Anderson, 2010). Thus, cluster analysis will help answer questions like which variables are shared by children with different levels of school readiness. As factor analysis, cluster analysis reveals structure. However, in cluster analysis, it is the participants (here, children) that are classified (and not the variables), and the basis for the grouping is the distance among the participants themselves (and not the correlations among variables).

Cluster analysis has been used in several research areas, and school readiness is no exception. Important subgroup differences in social, emotional, and cognitive characteristics (Halle et al., 2012) have been identified and related to school readiness (e.g., Denham et al., 2012; Hair, Halle, Terry-Humen, Lavelle, & Calkins, 2006). The vast majority of recent research focuses on high-risk children (e.g., Abenavoli, Greenberg, & Bierman, 2017; Justice, Jiang, Khan, & Dynia, 2017). In the present study, a person-centred approach is presented for a sample of typically developing children in order to explore kindergarteners' profiles and to compare these distinct profiles in terms of school readiness.

Konold and Pianta (2005) examined children's profiles of early social and cognitive functioning as well as the corresponding relation to later achievement outcomes (e.g., the ability to identify words or to solve simple, practical mathematics problems).

The authors assessed social behaviour (i.e., social skills [SSs] and externalizing behaviour, as rated by parents) and cognitive abilities (i.e., working memory and attention, assessed through direct behavioural measurements, e.g., memory for sentences). Their results showed that there are different profiles of social and cognitive abilities in preschoolers that differentially impact later achievement. The highest achievements in first grade were found in profiles of children with the highest cognitive abilities. Interestingly, comparable performance was found in the profile of children with an average range of cognitive abilities and high social behaviour skills. Furthermore, when a comparison of profiles with children of roughly equivalent cognitive abilities was drawn, children with the highest rating of social behaviour showed higher achievement compared with those with poorer social behaviour. These findings suggest that cognitive functioning can be compensated by social behaviour, at least to some extent.

To directly link a person-centred approach to the evidence stemming from variable-centred approaches on children's school readiness, it would be necessary to include the same constructs that have been shown to play an important role in the transition to formal schooling. It is for this particular reason that the present study focuses on SSs and executive functions (EFs), two important indicators of school readiness (Blair & Raver, 2015).

EFs can be described as self-regulatory processes that are activated in complex or new situations to reach a certain goal (see Roebers, 2017, for an exhaustive review). Specifically, EFs are considered higher order cognitive processes, which act on the level of more elementary cognitive operations like memorizing or reading and thereby serving as fundamental processes for a wide range of academic skills, including school readiness (Blair, 2002; Diamond, 2013; Fernandez-Duque, Baird, & Posner, 2000). According to Miyake et al. (2000), the most prominent components of EFs are updating (e.g., short-term storage and manipulation of information), inhibition (e.g., ignore irrelevant stimuli), and shifting (e.g., shifting attention between different task demands). EFs emerge early in life become more differentiated in early childhood (Lee, Bull, & Ho, 2013; Wiebe et al., 2011), continuously improve throughout childhood, and stabilize during childhood and adolescence (Best & Miller, 2010). Moreover, numerous studies have shown that EFs play a crucial role in school readiness (Blair & Diamond, 2008; Blair & Raver, 2015; Welsh, Nix, Blair, Bierman, & Nelson, 2010). Specifically, EFs assessed in preschool predict later school success, and superior EFs lead to better academic achievement (e.g., Blair & Razza, 2007; Bull & Lee, 2014; Clark, Pritchard, & Woodward, 2009).

SSs are reflected in an individual's ability to express positive and negative feelings, to avoid unacceptable responses and to trigger, maintain, or even increase positive responses or evaluation from others (Elliott, Malecki, & Demaray, 2001). SSs have been shown to be important not only for social but also for academic functioning (e.g., literacy) in school (Bierman & Erath, 2006; Miles & Stipek, 2006). Moreover, earlier SSs (such as cooperation, empathy, or assertion) predict later elementary school grades and performance on standardized academic achievement tests (Caprara, Barbaranelli, Pastorelli, Bandura, & Zimbardo, 2000; Elias & Haynes, 2008; Malecki & Elliott, 2002).

The literature suggests that EFs and SSs are key predictors of school readiness for both preschoolers and kindergarteners (Denham, 2006). Applying a person-centred approach and including EFs and SSs thus have the potential to shed light on the interplay of these factors and to clarify how profiles of EFs and SSs differentially contribute to academic and social school adaptation.

The main aim of the present longitudinal study was to explore kindergarteners' profiles in terms of EFs and SSs as well as to compare distinct profiles in terms of their longitudinal impact on academic outcomes at the end of the first grade. More precisely, we were interested in establishing not only whether distinguishable subgroups of children with different profiles of EFs and SSs exist but also if there are any systematic differences in their academic achievement and school adjustment at the end of first grade. The premise of our approach is that a successful transition to school would involve satisfactory academic achievement and school adjustment (from the teacher's perspective), whereby school adjustment refers to children's behaviour in the classroom and attitudes associated with the transition to school (Herndon, Bailey, Shewark, Denham, & Bassett, 2013). On the basis of previous studies (e.g., Konold & Pianta, 2005), we expected identifiable subgroups of kindergarteners with different levels of EFs and SSs. In addition, following the suggestion that cognitive abilities may to some extent be compensable (Konold & Pianta, 2005), we hypothesized that higher levels of SSs will, to some degree, compensate for lower levels of EFs in predicting school readiness.

Although there is no direct empirical evidence that SSs can act as a compensator for EFs, there is a general evidence that SSs are central skills that support academic achievement in school. A recent study of Goble et al. (2017) found that positive

social interaction skills play a role in the relation between academic achievement and school readiness. One explanation for this finding is that positive social interactions foster children's school engagement. Indeed, it seems that socially skilled children appreciate learning and thus demonstrate greater commitment towards learning (Blair & Raver, 2015). Moreover, learning related behaviour in the classroom has been shown to have a direct impact on children's adaptation to the formal learning environment (Neuenschwander, Röthlisberger, Cimeli, & Roebers, 2012). Bulotsky-Shearer, Lopez, and Mendez (2016) revealed positive associations between positive social interaction skills and different academic achievement measures during the transition to school. Against this background, SSs may in fact compensate for poor EFs as SSs allow the child to optimally benefit from the teacher's input in class, rather than to be relying on self-regulatory skills. Concerning the present study, we therefore explored whether children with high EFs in kindergarten would show the best academic outcome and school adjustment in first grade. But we also sought to explore the possibility of at least partial compensation of lower EFs through higher SSs. This is, children with *lower* EFs yet *higher* SSs might show a positive school adaptation in the end of their first grade in terms of early academic performance and social adjustment to the classroom—possibly comparable with those of children with higher EFs.

2 | METHOD

2.1 | Participants

One hundred fifty-nine children were recruited from 12 kindergartens, balanced across urban and rural areas in Switzerland. After children whose data sets were not complete is excluded (four children were missing at time 2, nine children's EFs and 11 children's SSs data at time 1 were missing, six children's academic data at time 2 were missing, and six children were excluded due to statistical criteria in the cluster analytic strategies; see below), the final sample consisted of $N = 123$ participants (59 girls, 64 boys). Analyses showed that children for whom complete data were not available did not differ from the rest of the sample on EFs, SSs, academic achievement, school adjustment, socio-economic status (SES), gender, and age ($ps > 0.098$). At their first assessment, children were 6–7 years of age and at the end of their kindergarten year ($M = 6$; 6, $SD = 4.22$, range = 5; 8–7; 8). One year later, at the end of first grade, they were tested again (test interval between first measurement wave and second measurement wave is $M = 11.35$ months, $SD = 0.77$). At this measurement point, children were 7–8-years old ($M = 7$; 6, $SD = 4.11$, range = 6; 9–8; 8). Note the wide spread of ages (24 months at the first measurement wave). By including age as covariate in the profile group comparisons of time 2 measures (see results below), we take into account this dimension of differences. Fifty-eight percent of the children were native Swiss–German or German speakers, whereas the remaining children were non-native speakers but with sufficient German language competence to easily follow the instructions.

2.2 | General procedure

Ethical approval for the study was obtained from the local university's ethics committee, and written parental consent was obtained for each child. For both measurement points, children gave their verbal consent to participate. Kindergarten children were tested in a quiet room at their educational institution by a trained experimenter. In kindergarten, children were tested individually, and 1 year later, at first grade, children were tested as a classroom group.

2.3 | Measures

For the present investigation, we assessed EFs, SSs, academic achievement, school adjustment, as well as background variables such as language ability and SES. Although EFs, SSs, and background variables were assessed at the first measurement wave, academic achievement and school adjustment were measured at the second wave. EFs and academic achievement were assessed by specific tests performed with the children, whereas measures of SSs and school adjustment were obtained by questionnaires filled out by the children's kindergarten and school teacher, respectively. The order of the tasks performed by the children was counterbalanced across different groups of participants.

2.3.1 | Kindergarteners' profile measures (first measurement wave)

For EFs, we computed a composite score for all analyses, that is, the average based on z scores from the three EFs components updating, inhibition, and shifting, respectively, which were assessed as follows.

Updating was measured using the backward digit span task of the Working Memory Test Battery for children (Pickering & Gathercole, 2001). The experimenter reads a sequence of digits aloud, one per second, and the child was asked to recall them in reversed order. After practice, the task started with a sequence (or span) of two digits. Six trials were conducted in each span; span length was increased by one digit if the child remembered at least three trials correctly. The updating measure we used was the standardized score of the total number of trials correctly recalled backwards.

Inhibition was assessed with an adapted version of the flanker task by Eriksen and Eriksen (1974;e.g., Roebers, Schmid, & Roderer, 2010). The child was instructed to respond to a target stimulus (red fish) irrespective of the flanking stimuli (red fish). More precisely, children had to press a certain button on the keyboard when the central fish was right facing and another one when it was left facing. Additionally, the central fish was surrounded by a fish facing in either the same (congruent) or the opposite direction (incongruent). The task consisted of two blocks. In the first block, the central fish (target stimulus) always pointed in the same direction as the flanking fish (congruent) to establish a prepotent response (four practice and 20 experimental trials). In the second block, the central fish appeared either in a congruent way (as in the first block) or in an incongruent way (the central fish pointed into the opposite direction compared with the flanking fish). The second block consisted of six practice trials and 48 experimental trials (two-thirds congruent and one-third incongruent trials). In both blocks, stimulus duration was maximally 3,500 ms, followed by a randomized interstimulus interval ranging from 800 to 1,400 ms and by a fixation cross (100 ms).

Accounting for the high accuracy (ACC) in children's inhibition, the composite score for inhibition was computed based on the scoring algorithm introduced by Zelazo et al. (2013). This algorithm combines reaction time (RT) and ACC; as in young children, these two measures of performance are typically unrelated, suggesting the use of either a speed- or an accuracy-oriented strategy (that converges into a "speed–accuracy trading-off strategy" in the course of development, Roebers, 2017; Zelazo et al., 2013). The ACC was specified as the percent of correct responses to all incongruent trials and the RT as the inverted mean of the RTs in the correctly solved incongruent trials. For the dependent variable, the z-standardized values of ACC and RT were aggregated.

Cognitive flexibility was assessed with a computerized task, based on the graphical features of the flanker task and directly following the inhibition task to induce a rule switch (Jäger, Schmidt, Conzelmann, & Roebers, 2014). For this measure, children had to first learn a new rule. The child was instructed to respond to the flanking stimuli (yellow fish) irrespective of the orientation of the central stimulus (yellow fish). This learning phase included eight congruent and eight incongruent trials, with a stimulus duration of maximally 7,000 ms, followed by a randomized interstimulus interval from 800 to 1,400 ms and by a fixation cross (100 ms). After learning, yellow and red fishes were presented in randomized order, and children had to switch between the rules for red and yellow fishes. With yellow fish appearing, the child had to respond according to the orientation of the flanking stimuli; with red fish appearing, however, the orientation of the central stimulus was what the child had to respond to. The test phase included eight practice trials and 40 experimental trials (32 rule-switching trials out of 20 trials with red fish and 20 trials with yellow fish, half of the trials of each rule being congruent or incongruent) with the same stimulus duration and interstimulus interval as in the learning phase. Analogous to the flanker inhibition score, we calculated a standardized switching score consisting of RT and ACC of all rule-switching trials (Loher & Roebers, 2013; Zelazo et al., 2013). Again, the z-standardized values of ACC (now reflecting the percentage of correct responses to all rule-switch trials) and RT (specified as the inverted mean of RTs in correctly solved rule-switch trials) were summed up.

Because in the present study, the flanker task served as establishing a dominant rule that had to be overcome in the mixed block to quantify cognitive flexibility, the order of the tasks for inhibition and cognitive flexibility was not counterbalanced across participants. However, the order in which inhibition/cognitive flexibility and updating were assessed was alternated between participants.

SSs were assessed using the teacher form of the SSs Improvement System (SSIS; Gresham & Elliot, 2008). Kindergarten teachers had to evaluate how often the child showed a specific behaviour.

The questionnaire includes 46 items. For the purpose of analyses, a composite score was computed including all of the following subscales: communication (seven items,e.g., "the child says 'please'"), Cronbach's α = 0.82; cooperation (six items,e.g., "the child follows the teacher's directions"), α = 0.89; assertion (seven items,e.g., "the child says when there is a problem"), α = 0.78; responsibility (six items,e.g., "the child takes responsibility for her/his own actions") α = 0.87; empathy (six items,e.g., "the child tries to comfort others"), α = 0.81; self-control (seven items, e.g., "stays calm when teased"), α = 0.85; and engagement (seven items,e.g., "the child joins activities that have already started"), α = 0.81. The overall measure had an internal consistency of α = 0.93.

2.3.2 | First-grade outcome measures (second measurement wave)

For *academic achievement* at the end of first grade, children's mathematical, reading, and spelling skills were assessed using the well-established, curriculum-based, and standardized achievement tests.

Mathematical skills were assessed using the three subtests of the German Heidelberger Rechentest (HRT) 1–4 (Haffner, Baro, Parzer, & Resch, 2005), which measures basic numerical and mathematical skills, namely, the magnitude comparison, equation solving, and continuing sequence of numbers subtests (rs = 0.51–0.59, ps < 0.001). Children were instructed to solve as many items as possible in 2 min for magnitude comparison, 2 min and 30 s for equation solving, and 3 min for continuing sequences. The achieved number of correctly solved items in each task were z standardized to compute the achievement score. *Reading skills* were assessed with two tests, namely, the reading speed and reading comprehension tests (r = 0.86, p < 0.001). In the reading speed test, the children were asked to identify the picture that matched the written word, by choosing one out of four options within a given time limit of 5 min (Würzburger Leise Lese Probe; Küspert & Schneider, 1998). In the reading comprehension test (Salzburger Lese Screening für die Klassenstufen 1–4; Mayringer & Wimmer, 2005), the children had to judge the meaningfulness of different sentences, also within a given time limit of 3 min. For the achievement score, we used the z-standardized values of the total number of correctly solved items in each task. Children's *spelling skills* were assessed with a subtest of the Hamburger Schreib-Probe 1–9 (May, 2002). This subtest involved the examiner reading 22 words as well as one sentence out loud (six words), which the children were asked to write down. Points were given for each word that was correctly spelt. The z-standardized values of all the subtests mentioned above were used to compute a mean score for each skill. And those mean scores in turn were used to construct an academic achievement composite score. The academic achievement score included mathematical, reading, and spelling skills, which correlated substantially among each other (rs = 0.57–0.69, ps < 0.001).

The order of the task administration was counterbalanced across participants. Although one half of the children started with the tasks that assess mathematical achievement, the other half first completed the tasks measuring verbal achievement (reading and spelling). Within the mathematical and the verbal tasks, the order of the subtests was counterbalanced.

School adjustment was assessed with an aggregate z score of five items taken from Alsaker, Nägele, Valkanover, and Hauser (2008).

The items covered children's behaviour in the classroom and attitudes associated with transition to school (e.g., "the child mastered school enrollment well" and "the child often asks when school will end"). The first-grade teacher had to rate these items on a five-point Likert scale (1 = *not at all true* to 5 = *definitely true*) and complete the school adjustment scale. The scale showed good internal consistency with Cronbach's α = 0.79. The return rate of first-grade teachers' questionnaires was 81%; thus, we had missing data for 23 children that were otherwise included in the analyses. As our main focus was placed on academic achievement and not primarily on school adjustment, we did not exclude these children from the main analyses.

2.3.3 | Background variables

Because 42% of the children were non-native speakers and children's *language ability* is related to EFs (Zelazo, 2004), SSs (Mc Cabe & Meller, 2004), and academic achievement (Kastner, May, & Hildman, 2001), children were given the subtest receptive language of the Wechsler intelligence test (HAWIVA®, Ricken, Fritz, Schuck, & Preuß, 2007) at their first measurement point. Each trial was composed of four pictures, and the children were to point to the named

picture (e.g., "show me the telescope"). For every correct answer, children received one point, with a maximum of 31 possible points. To the extent that SES is also related to EFs (Sarsour et al., 2011), SSs (Ramsey, 1988), and academic achievement (Sirin, 2005), parental education and family income were additionally assessed (questions adapted from Schick et al., 2006) at the first measurement point (78% return rate of questionnaires, with an even distribution of missing SES data across the clusters). Parents were asked to give information about their actual graduation (e.g., high school and university), whereby higher education was rated with a higher score (if there was information about actual graduation of both children's parent, the mean of these two scores was used). Additionally, parents were asked to categorize their monthly family income into one of six categories: "below 3,000," "3,000–5,000," "5,000–7,000," '7,000–8,000," "8,000–10,000," or "over 10,000 Swiss francs." Corresponding z scores of parental education status and family income were summed up to a SES score (higher score mirrors higher SES).

3 | RESULTS

In the first step of the analyses, a cluster analytic approach was used to explore and create kindergarteners' profiles in regards to EFs and SSs based on the data of the first measurement point. Next, we determined whether there were demographic differences among the obtained profiles; finally, we examined whether and how these subgroups of children differed with respect to later academic achievement (standardized academic achievement tests) and school adjustment (teacher report) including the data of the second measurement point.

3.1 | Clustering strategies

A combination of hierarchical and non-hierarchical cluster analyses (Hair et al., 2010; Wiedenbeck & Züll, 2001) was used to explore a person-centred structure. More specifically, children with similar profile scores in EFs and SSs were arranged into homogenous groups or clusters. Because a cluster solution should make sense, thus, not merely be imposed by method or data (Aldenderfer & Blashfield, 1984), we ensured that the final cluster solution met both empirical as well as conceptual criteria.

In a first step, we carried out a hierarchical cluster analysis (Ward's method, squared Euclidean distance) to determine the number of clusters and the initial cluster centres. In a second step, we performed a non-hierarchical cluster analysis (k means) to produce more stable clusters and to optimize the cluster solution assuring maximal within-cluster homogeneity. The final cluster solution was needed to meet the statistical criteria of an adequate n in each cluster and the distance of each child to her/his cluster centre to be smaller than the distance between the cluster's centres.

The results of the hierarchical cluster analysis showed a large increase in the agglomeration coefficient (a measure of the reduction in within cluster similarity) between the three- and four-cluster solutions, suggesting a four-cluster solution. The four-cluster solution was also supported by the visual inspection of the dendrogram. Moreover, Lehmann (1989) recommended that the number of clusters should vary between n/30 and n/60, which was the case here. Taken together, this is a convincing evidence that the four-cluster solution is the best solution. With the number of clusters and initial cluster centres computed in the first step, we performed a non-hierarchical cluster analysis next.

The k-means analysis showed a cluster solution with an adequate n in each cluster and high significance on a conceptual level. The results of the ANOVAs with the four clusters as independent variable and the attributes EFs and SSs as dependent variables yielded significant results ($ps < 0.001$). However, within the clusters, there were six children, whose distance to their own cluster centre was larger than the distance between the four clusters' centres themselves. To meet our statistical criteria and assuring maximal within-cluster homogeneity, we excluded these six children and replicated Steps 1 (hierarchical cluster analysis) and 2 (non-hierarchical cluster analysis) again. The results did not change substantially, and we found an almost identical four-cluster solution. After non-hierarchical cluster analysis, again, there was an adequate n (see Table 1) in each cluster, and the same highly conceptual fit (see kindergarten profiles below) as in the first analysis was found. The four clusters still showed significant

TABLE 1 Overview of background variables in kindergarteners' profiles and full sample

Kindergarteners' profiles	Profile 1 EFs high, SSs high ($n = 39$)	Profile 2 EFs moderate, SSs very low ($n = 26$)	Profile 3 EFs high, SSs low ($n = 34$)	Profile 4 EFs low, SSs moderate ($n = 24$)	Full sample ($N = 123$)
Boys, %, n	46 (18)	62 (16)	62 (21)	38 (9)	52 (64)
Girls, %, n	54 (21)	38 (10)	38 (13)	62 (15)	48 (59)
Migration background, %, n	44 (17)	46 (12)	35 (12)	46 (11)	42 (52)
SES, mean (SD)	0.47 (1.52)	−0.05 (1.79)	0.18 (1.82)	−0.06 (2.07)	0.18 (1.76)
Language ability, mean (SD)	0.12 (.80)	−0.06 (1.09)	0.06 (.95)	−0.14 (1.19)	0.01 (.98)

Note. EFs: executive functions; SES: socioeconomic status; SSs: social skills; z scores for SES and language ability.

differences in their attributes, $F(3, 119) = 59.54$, $p < 0.001$, $\eta_p^2 = 0.600$ for EFs and $F(3, 119) = 189.58$, $p < 0.001$, $\eta_p^2 = 0.827$ for SSs. Furthermore, the distance of each child to her/his cluster center was now smaller than the distance between the cluster centers.

3.2 | Kindergarteners' profiles (first measurement wave)

Four different kindergarteners' profiles were identified (see Figure 1): Profile 1 was characterized by high EFs and high SSs, Profile 2 by moderate EFs and very low SSs, Profile 3 by high EFs and low SSs, and Profile 4 by low EFs and moderate SSs. Post hoc differences were tested following Gabriel's pairwise test procedure. All profile differences turned out to be significant ($ps < 0.001$) with the exception of EFs in Profiles 1 ($M = 0.37$, $SD = 0.42$) and 3 ($M = 0.43$, $SD = 0.38$). That is, in Profiles 1 and 3, children showed the highest EFs' scores and did not differ among each other. Children's EFs score in Profile 2 ($M = −0.22$, $SD = 0.43$) was significantly higher than for those in Profile 4 ($M = −0.87$, $SD = 0.47$). Regarding SSs, all differences turned out to be significant ($ps < 0.001$). Children in Profile 1 showed the highest SSs score ($M = 1.03$, $SD = 0.35$), followed by children in Profile 4 ($M = 0.32$, $SD = 0.37$). Children's SSs score in Profile 3 ($M = −0.14$, $SD = 0.34$) was higher than children's SSs score in Profile 2 ($M = −1.16$, $SD = 0.44$). Cohen's d effect sizes for all comparisons are reported in Table A1. Mean z scores for the EFs subcomponents (updating, inhibition, and switching) across the four profiles are reported in Table B1.
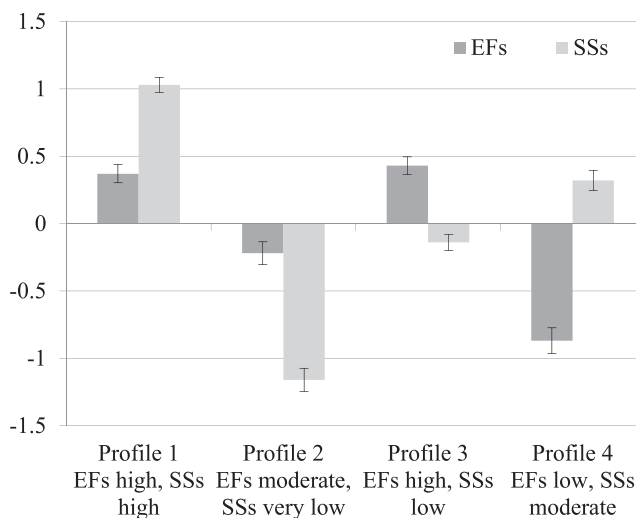

FIGURE 1 Overview of kindergarteners' profiles. Mean z scores and one standard error of the mean (*SEM*) for executive functions (EFs) and social skills (SSs) across the four profiles

3.2.1 | Controlling for background variables in kindergarteners' profiles

In order to control for confounding effects on the outcome measures, we checked profile differences in terms of gender, migration background, language ability as well as SES (see Table 1); there was no uneven distribution of boys or girls across the four clusters, $\chi^2(3) = 4.802$, $p = 0.187$, nor was there an imbalance of children with migration background, $\chi^2(3) = 0.991$, $p = 0.803$. Analysis also failed to reveal any differences in SES, $F < 1$, or in language ability indexed with the receptive language score, $F < 1$.

3.3 | First-grade outcome measure (second measurement wave) of the kindergarteners' profiles

3.3.1 | Academic achievement

The four groups differed in their academic achievement, $F(3, 119) = 8.588$, $p < 0.001$, $\eta_p^2 = 0.178$, see Figure 2. Gabriel post hoc tests (5% alpha level) failed to reveal differences between profiles characterized by high EFs (Profiles 1, $M = 0.24$, $SD = 0.79$, and 3, $M = 0.38$, $SD = 0.64$) but did indicate significantly higher academic achievement for the children in these profiles compared with those with moderate EFs (Profile 2, $M = -0.40$, $SD = 0.77$) and low EFs (Profile 4, $M = -0.30$, $SD = 0.65$). When comparing academic achievement between the profiles with low to moderate EFs, post hoc tests failed to reveal differences in academic achievement between children with low EFs but moderate SSs (Profile 4) and those with moderate EFs but very low SSs (Profile 2). Cohen's d effect sizes for all comparisons are reported in Table A2.

The effect of profiles with academic achievement remained statistically significant when controlling for differences in language ability and age in an analysis of covariance (ANCOVA), $F(3, 117) = 7.965$, $p < 0.001$, $\eta_p^2 = 0.170$. Pairwise comparisons showed similar results to the analysis without language ability and age as covariates (the same differences turned out to be significant). Mean differences and adjusted mean differences in academic achievement are reported in Table C1. Language ability was significant, $F(1, 117) = 8.749$, $p = 0.004$, $\eta_p^2 = 0.070$, whereas age was not statistically significant ($F < 1$).

To sum up, results showed that higher EFs was generally related to superior academic achievement. In addition, it seems that low EFs can be compensated through higher SSs, at least in children with low to moderate EFs.
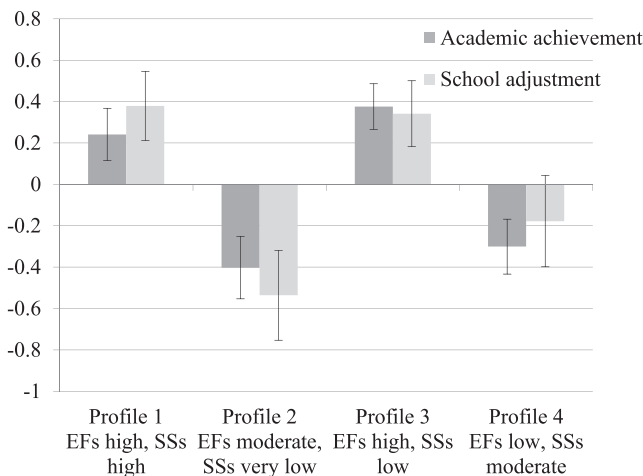

FIGURE 2 Kindergarteners' profiles in context of academic achievement and school adjustment in first grade. Mean z scores and one standard of the mean for academic achievement and school adjustment across the four profiles

3.3.2 | School adjustment

We found a similar pattern of results as we did for academic achievement, $F(3, 96) = 5.610$, $p = 0.001$, $\eta_p^2 = 0.149$, see Figure 2. Gabriel post hoc analyses (5% alpha level) revealed that regardless of their SSs level, children with high EFs (Profiles 1, $M = 0.38$, $SD = 0.93$ and 3, $M = 0.34$, $SD = 0.84$) showed the best school adjustment and did not differ from each other. However, children with Profile 4 (low EFs, moderate SSs, $M = -0.18$, $SD = 0.91$) also did not significantly differ from children with high EFs (Profiles 1 and 3), whereas children with Profile 2 (moderate EFs, very low SSs, $M = -0.54$, $SD = 0.97$) did. Yet children with low to moderate EFs (Profiles 2 and 4) did not show significant differences. Cohen's d effect sizes for all comparisons are reported in Table A2.

The effect of profiles with school adjustment remained statistically significant when controlling for differences in language ability and age in an ANCOVA, $F(3, 94) = 5.947$, $p = 0.001$, $\eta_p^2 = 0.160$. Pairwise comparisons showed similar results to the analysis without language ability and age as covariates (the same differences turned out to be significant). Mean differences and adjusted mean differences in academic achievement are reported in Table C2. Language ability, $F(1, 94) = 1.685$, $p = 0.197$, $\eta_p^2 = 0.018$, and age were not statistically significant ($F < 1$).

Overall, these results suggest that—similar to academic achievement—well-developed EFs is associated with better school adjustment independent of SSs. When it comes to the low to moderate range of EFs, however, relatively good SSs seemed to partially make up for low EFs. This compensation potential of EFs through SSs was even greater for school adjustment than it was for academic achievement, because a significant difference was missing again not only between the low and moderate EFs groups but also between the low and the two high EFs groups.

4 | DISCUSSION

In the present study, we used a person-centred approach for identifying and comparing different patterns of EFs and SSs, two important aspects of school readiness, in kindergarten children. The conducted cluster analyses identified four distinct profiles that classified our participants into distinguishable subgroups; these profiles were differentially related to later academic achievement and school adjustment. When comparing the two profiles with high EFs, one with also high SSs and one with relatively poor SSs, findings did not reveal significantly better outcomes for the profile with high EFs and high SSs. However, for *lower* EFs levels, our findings suggested that at least to some extent, there was a compensation potential through well-developed SSs.

4.1 | Kindergarteners' profiles

The largest subgroup (32%) showed a profile with high EFs and high SSs (above average in reference of SSIS norms). Almost the same percentage of children (28%) showed a profile with high EFs but low SSs (23% of them scored below average on SSIS norms). The latter scored highest on EFs tasks; however, the difference to the high EFs groups was not significant. Although approximately half of the remaining children (21%) showed a profile with moderate EFs yet very low SSs (below average in terms of SSIS norms), the other half (19%) showed a profile with low EFs but moderate SSs (33% of the children scored above average in reference to SSIS norms). Thus, the results from our cluster analysis approach support previous findings (e.g., Konold & Pianta, 2005) and can be interpreted indicating that identifiable and meaningful subgroups of kindergarteners within the normal range of development are easily overlooked in a variable-centred approach. Our study therefore substantially extends the existing literature, as it is the first to include both EFs and SSs. Thereby, two important aspects for the transition to school have been taken into account simultaneously. Evidence for the robustness of the profiles and their differential outcomes in terms of school readiness was provided by avoiding confounding with any of the background variables. This is particularly interesting for gender and SES. With regard to gender, this is because girls around this age have shown to be rated higher on SSs than boys (Denham et al., 2012). One would thus have expected more boys than girls to show a profile with low

SSs, which was not the case. Similarly, Konold and Pianta (2005) did not find any gender differences among their different profiles.

Concerning SES and based on previous findings, we expected differences between the profiles. Konold and Pianta (2005), for example, found that children with risk profiles (e.g., low social and low cognitive abilities) have a tendency to have lower SES family backgrounds. These findings are in line with the well-known relationships between SES and EFs as well as SES and SSs (Sarsour et al., 2011; Ramsey, 1988). Such differences would pose a methodological limitation, as firm conclusions on differences between clusters are then difficult to draw. In the present study, there was no such confounding. This may be due to the fact that the recruited sample varied somewhat less in terms of SES than samples in other studies (stemming from countries with more pronounced SES variations). Consequently, SES influence in our study may be underestimated.

4.2 | Kindergarteners' profiles and school readiness

As expected, children with high EFs also showed the highest scores on academic achievement and thus outperformed all others, regardless of their SSs. This result is consistent with Konold and Pianta's (2005) findings claiming that the profile with the highest cognitive abilities performed best. Just as had been hypothesized, cognitive ability is crucial for academic achievement. This finding as such is nothing new; however, our own as well as others' previous person-centred approaches reveal that high cognitive ability can serve as a compensator for lower SSs in terms of academic outcomes (Konold & Pianta, 2005).

SSs can—under certain circumstances—compensate for EFs. This seems to be the case when children show EFs in the below average to average range. In the current study, children with lower EFs but moderate SSs scored equally well in terms of academic achievement compared with children with moderate EFs and very low SSs. However, SSs did not appear to fully compensate for lower EFs, and results failed to show an overall association of higher SSs with better outcomes. Results are consistent with positive influences of SSs on successful and productive learning (Neuenschwander et al. 2012). Some authors assume that there are kinds of SSs that can be described as learning-related SSs (e.g., listening to instructions) and regarded as especially important for later social behaviour or academic performance (McClelland, Morrison, & Holmes, 2000). Results from Konold and Pianta's (2005) study also support the idea that EFs is being compensated through SSs. When comparing two groups of children showing equal cognitive abilities, the ones with higher SSs performed better on two out of three outcome measures. Furthermore, children with highest SSs were the only ones who were not significantly outperformed on the outcome measure by children with the highest cognitive abilities.

Results did not show an overall association of higher SSs with better outcomes. One potential explanation comes from EFs being a strong predictor for school-related outcomes, such as academic achievement and school adjustment (Blair, 2002; Diamond, 2013; Roebers, 2017). Besides such a strong predictor as EFs, SSs may not have a powerful additional predictive validity for later school-related outcomes. This assumption may be true at least for children as young as the participants that took part in the present study. Most of the studies demonstrating a significant relation between SSs and school achievement investigated children from the third grade upwards (Caprara et al., 2000; Elias & Haynes, 2008; Malecki & Elliott, 2002). Strong main effects from SSs to achievement may thus only emerge over the course of primary school. In contrast, EFs have been shown to be related to achievement also in very young children (Best, Miller, & Naglieri, 2011; Blair & Razza, 2007; Roebers, 2017) and thus may play a more important role for academic outcomes in this age group.

Interestingly and overlooked in previous studies, the greatest compensation was related to school adjustment (children's behaviour in the classroom and attitudes associated with transition to school). Children with the lowest EFs but second highest SSs did not differ from children with higher EFs profiles. This could be an indication that compensation through SSs is greater for school adjustment than for academic achievement, at least in the very beginning of a child's school career. School entry is the start of a multidimensional socialization process, possibly

emphasizing social adjustment even more strongly in the first grade than academic adjustment (Blair & Raver, 2015). Consequently, SSs may thus play a more crucial role in social-emotional aspects of school adjustment than in the case for academic performance.

4.3 | Limitations and further implications

There are limitations of the study that need to be considered. First, we want to highlight here the exploratory nature of cluster analyses. Indeed, cluster analysis is a descriptive tool with no statistical basis upon which to draw inferences from a sample to a population. The sample has to be large enough in order to provide sufficient representation of small groups in the population. Larger samples better allow to identify small groups (by avoiding confusion with outliers). Our study involved a relatively small sample; thus, we are not able to draw firm conclusions beyond the current sample. Moreover, given that there was no initial measure of academic skills, it was not possible to control for stability in this domain (by computing fixed effects models,e.g., Willoughby, Kupersmidt, & Voegler-Lee, 2012, see also Müller & Kerns, 2015). A future study should include prior measures of academic skills in the context of a longitudinal study. What is more, we found no differences between Profiles 1, 3, and 4 for school adjustment. It has to be noted, however, that a lack of difference may be due to a lack of power. Further research should investigate these aspects with a larger sample size.

However, the predictive validity of the profiles was meaningful and stronger for school adjustment than for academic achievement, motivating us towards an interpretation of compensation through productive learning. Along with other findings (Konold & Pianta, 2005), this is one of the first studies to reveal possible compensatory mechanisms for cognitive and social aspects in children's development. It should be kept in mind that EFs and SSs are not the only important aspects for school readiness and successful school careers. Domain-specific precursors of later school skills, like phonological awareness or number sense, also play a key role (Duncan et al., 2007). Additionally, factors such as family structure or parental educational attainment (Halle et al., 2012), teacher–student relationships, and/or children's temperament (Blair & Raver, 2015) should also be taken into account, as they may allow an individual to compensate for other aspects relevant for school readiness.

Strengths of our study include the person-centred approach in order to shed light on the interplay of social and cognitive aspects of school readiness. On the basis of our findings, cognitive and social aspects of a child's development should be considered by teachers, school psychologists, and other practitioners involved in children's transition to school, and individual adjustment should be made when developing prevention strategies and programmes. There may be different options to help children with low EFs and low SSs and thus increase the possibilities of successful transition to school and later academic achievement.

5 | CONCLUSION

To conclude, there are important interactions between social and cognitive aspects of school readiness, and these differentially affect early school adaptation. It is therefore necessary to consider multiple aspects as setting the stage for a child's school career. As Konold and Pianta (2005) have pointed out, "there is more than one route to successful or at least adequate, educational outcome among typically developing children" (p. 174). Uniquely, our study shows that average to below-average EFs may be compensated through well-developed SSs. Such compensation seems to be especially strong in teacher's ratings of school adjustment, possibly reflecting advantages of children with well-developed SSs in the domain of learning-related behaviour, social interactions, and social relationships. These aspects of social behaviour seem to be of major relevance for the transition to formal schooling.

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APPENDIX A

TABLE A1 Effect sizes (Cohen's *d*) for differences in executive functions (EFs) and social skills (SSs)

Kindergarteners' profiles	Profile 1 EFs high, SSs high (n = 39)	Profile 2 EFs moderate, SSs very low (n = 26)	Profile 3 EFs high, SSs low (n = 34)	Profile 4 EFs low, SSs moderate (n = 24)
EF, mean, SD	0.37 (0.42)	−0.22 (0.43)	0.43 (0.38)	−0.87 (0.47)
Profile 1	—	1.39	0.15	2.79
Profile 2	5.64	—	1.62	1.45
Profile 3	3.39	2.64	—	3.10
Profile 4	1.98	3.63	1.30	—
SS, mean, SD	1.03 (0.35)	−1.16 (0.44)	−0.14 (0.34)	0.32 (0.37)

Note. Effect sizes for EFs differences are presented above the diagonal, and effect sizes for SSs differences are presented below the diagonal. Means and standard deviations for EFs and SSs are presented in the first and last lines.

TABLE A2 Effect sizes (Cohen's *d*) for differences in academic achievement and school adjustment

Kindergarteners' profiles	Profile 1 EFs high, SSs high (n = 39)	Profile 2 EFs moderate, SSs very low (n = 26)	Profile 3 EFs high, SSs low (n = 34)	Profile 4 EFs low, SSs moderate (n = 24)
Academic achievement, mean, SD	0.24 (0.79)	−0.40 (0.77)	0.38 (0.64)	−0.30 (0.65)
Profile 1	—	0.82	0.19	0.72
Profile 2	0.97	—	1.12	0.14
Profile 3	0.04	0.98	—	1.06
Profile 4	0.61	0.38	0.60	—
School adjustment, mean, SD	0.38 (0.93)	−0.54 (0.97)	0.34 (0.84)	−0.18 (0.91)

Note. EFs: executive functions; SSs: social skills. Effect sizes for academic achievement differences are presented above the diagonal, and effect sizes for school adjustment differences are presented below the diagonal. Means and standard deviations for academic achievement and school adjustment are presented in the first and last lines.

APPENDIX B

TABLE B1 Overview of kindergarten and first grade measures (means and standard deviations in parentheses) in kindergarteners' profiles

Kindergarteners' profiles	Profile 1 EFs high, SSs high (n = 39)	Profile 2 EFs moderate, SSs very low (n = 26)	Profile 3 EFs high, SSs low (n = 34)	Profile 4 EFs low, SSs moderate (n = 24)
EFs	0.37 (0.42)	−0.22 (0.43)	0.43 (0.38)	−0.87 (0.32)
Updating	0.28 (1.11)	−0.21 (0.82)	0.37 (0.72)	−0.82 (0.71)
Inhibition	0.47 (0.73)	−0.23 (0.69)	0.46 (0.53)	−1.04 (1.02)
Switching	0.37 (0.66)	−0.23 (0.71)	0.46 (0.93)	−0.76 (0.58)
Academic achievement	0.24 (0.79)	−0.40 (0.77)	0.38 (0.64)	−0.30 (0.65)
School adjustment	0.38 (0.93)	−0.54 (0.97)	0.34 (0.84)	−0.18 (0.91)

Note. EFs: executive functions; SSs: social skills. Values are *z* scores.

APPENDIX C

TABLE C1 Mean differences and adjusted mean differences in academic achievement

Kindergarteners' profiles	Profile 1 EFs high, SSs high (n = 39)	Profile 2 EFs moderate, SSs very low (n = 26)	Profile 3 EFs high, SSs low (n = 34)	Profile 4 EFs low, SSs moderate (n = 24)
Profile 1	—	0.644*	−0.135	0.542*
Profile 2	0.603*	—	−0.779*	−0.102
Profile 3	−0.140	−0.743*	—	0.677*
Profile 4	0.499*	−0.104	0.639*	—

Note. EFs: executive functions; SSs: social skills. Mean differences are presented above the diagonal, and adjusted mean differences are presented below the diagonal. Covariates are language ability and age. Bonferroni adjusted post hoc tests.

*$p < 0.05$.

TABLE C2 Mean differences and adjusted mean differences in school adjustment

Kindergarteners' profiles	Profile 1 EFs high, SSs high (n = 39)	Profile 2 EFs moderate, SSs very low (n = 26)	Profile 3 EFs high, SSs low (n = 34)	Profile 4 EFs low, SSs moderate (n = 24)
Profile 1	—	0.915*	0.037	0.557
Profile 2	0.956*	—	−0.878*	−0.358
Profile 3	0.053	−0.903*	—	0.520
Profile 4	0.592	−0.364	0.539	—

Note. EFs: executive functions; SSs: social skills. Mean differences are presented above the diagonal, and adjusted mean differences are presented below the diagonal. Covariates are language ability and age. Bonferroni adjusted post hoc tests.

*$p < 0.05$.