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'Children at Risk' of Poor Educational Outcomes: Insights from a (Neuro-)Cognitive Perspective

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Abstract

Taking a (neuro-)cognitive perspective, this article deals with preconditions of successful learning and maladaptive developmental processes related to deficient learning processes and poor educational outcomes. Three strands of research are focused that have made significant contributions to the understanding of (neuro-)cognitive risks for poor educational outcomes: intelligence research, research on working memory, and research on attentional processes. Selected examples from these areas of research are provided with a summary of main conclusions. In addition, we highlight current research gaps by arguing that there is a specific need for (a) future research focusing on the interactions between the (neuro-)cognitive functions described, as well as for (b) integrating results from the (neuro-)cognitive perspective into a broader conceptual framework of risk factors. A claim is made that more research is needed linking insights from different scientific perspectives and methodological traditions to generate approaches that successfully contribute to a substantial reduction of the percentage of students with poor educational outcomes.

Keywords: Children at risk, Educational outcomes, Working memory, Attention, Intelligence

1 The (Neuro-)Cognitive Perspective on Risk Factors of Poor Educational Outcomes

The (neuro-)cognitive perspective deals with the question of which specific (neuro-)cognitive functions, interactions between these functions and which neurodevelopmental processes are related to deficient learning processes and educational outcomes in individual learners. During the last decades, three strands of research have made significant contributions to the understanding of possible risks for these kinds of undesired outcomes, namely intelligence research, research on working memory, and studies focusing on attentional processes. In the following, selected exemplary insights from these research areas will be presented.

2 Intelligence and its Relationship to Educational Outcomes

The concept of intelligence has a comparatively long history dating back to the first decade of the twentieth century. The first two models of intelligence that became very influential for all further research until today, were proposed by Charles Spearman (1927) and Louis Thurstone (1938). With these models, a controversy emerged whether intelligence should be conceptualized as one main component, the so-called general factor 'g' (Spearman 1927) or comprising several broad ability components like the socalled seven primary mental-abilities (Thurstone 1938). Current psychometric models such as the extended theory of fluid and crystallized intelligence (Gf-Gc-theory; Cattell 1943, 1963), the three-stratnum theory (Carroll 1993), or the Cattell-Horn-Carroll theory (McGrew 1997, 2005, 2009) integrate these two views and suggest one or more main factor(s) representing general mental abilities on a higher level and more specific factors, describing specialized and narrow abilities on lower levels (cf. Davidson and Kemp 2011). Despite various differences in contemporary models, intelligence researchers agree on intelligence being particularly important in unfamiliar situations: It describes an individual's general ability to learn as well as to reason and solve new problems. A milestone in the success story of intelligence as a powerful concept to explain individual's academic achievement and other features of educational outcomes was the development of psychometric intelligence tests. When Alfred Binet (Binet and Simon 1916) developed the first intelligence test, his central motive was to predict educational outcomes, and to identify those children who were at risk of not benefitting from common educational practice. Thus, the relationship between intelligence and educational outcomes has been studied ever since intelligence has been measured (Johnson et al. 2009). Current research on this topic reveals a moderate to strong relationship between general intelligence and educational outcomes (Mackintosh 1998). Hereby, the concrete level of the relationship depends on how educational outcomes are measured, with typically higher correlations for (standardized) achievement tests than for grades. In a recent meta-analysis, Strenze (2007) found an average overall correlation of 0.56 between intelligence and grade point average (GPA; obtained from school records and self-reports) whereas the relationship between general intelligence and standard achievement tests usually varies around 0.64 to 0.74 (Naglieri and Bornstein 2003), with studies focusing on the relationship on a latent level reporting even higher coefficients. For example, in a prospective study of 70,000 British children (Deary et al. 2007), the longitudinal correlation coefficient between a latent general intelligence factor taken at age 11 and a latent trait of scores on the General Certificate of Secondary Education (GCSE) examinations taken at age 16 was 0.81. A comparable mean correlation coefficient of 0.83 between a latent general intelligence factor and a latent academic achievement factor extracted from an achievement test battery was found in a cross-sectional sample of children aged between 5 and 19 years (Kaufman et al. 2012). A possible explanation for the heterogeneous results regarding the relationship between grades and test performance is that school grades are more closely related to students' effort, teachers' competences, the curriculum, and other confounding variables that are less important to performance on intelligence tests (Kaufman et al. 2012).

A further question that has been addressed by intelligence researchers during the last decades is whether the relationship between intelligence and educational outcomes is or is not comparable between different domains of achievement. From a perspective focusing on possible risk factors of poor educational outcomes, the question is whether children with low intelligence are at risk of poor educational outcomes in all or in specific educational domains. Results from recent cross-sectional as well as from longitudinal investigations shed light on this issue: Whereas general intelligence appears to be consistently related to and predictive of performance in mathematics and science (accounting for up to 58 % of variance; Deary et al. 2007), the amount of variance shared between general intelligence and language is lower (Deary et al. 2007; Lu et al. 2012) or even negligible (Krumm et al. 2008). Altogether, these correlational investigations reveal that despite its important role, a substantial amount of variance in educational outcomes is not accounted for by intelligence. Furthermore, the aforementioned studies leave open the question regarding the specific nature of the relationship between intelligence and educational outcomes (Rohde and Thompson 2007). In this context, several strands of research reveal results that are in line with a risk concept modeling the relationship between risk factors and outcomes as being probabilistic, suggesting an interplay of risk and protective factors in a way that the likelihood of undesired outcomes varies as a result of the presence of protective factors (Masten 2001; Perkins and Borden 2003; Werner and Smith 1992). For example, in a longitudinal study, Johnson and colleagues (2009) found that among participants with low intelligence (IQ<= 90) self-reported GPA was significantly more variable than among participants with average or high intelligence. As a possible explanation for this result, the authors suggest that those students with high IQ can achieve good grades easily and without much effort, whereas for students with low IQ, individual differences regarding the degree of effort are more important to their achievement. A similar conclusion regarding the interaction of intelligence with other factors in the educational process can be drawn from research focusing on children with average or below average intelligence who perform significantly above what would be expected from their general intelligence: In a study of German high-school students, rates of ambition at school were significantly higher for the overachievers than for students with comparable intelligence scores but achievement scores corresponding to what would be expected from their intelligence (Sparfeldt et al. 2010).

A further important issue regarding the educational trajectories of children with low intelligence as a (neuro-)cognitive risk in the context of other risk and protective factors is how genetic and environmental influences moderate the relationship between intelligence and educational outcomes. The current state of research suggests that both genetic and shared environmental influences on educational outcomes vary with the level of intelligence. For example, in a population-representative longitudinal twin study (Johnson et al. 2009), shared environmental influences on educational outcomes were significantly more important when intelligence was low and they decreased with an increasing level of intelligence. Shared environmental influences were of very little importance when intelligence was well (i.e. two standard deviations) above the mean. In contrast, genetic influences on educational outcomes were most important when intelligence was high, but less important when intelligence was low. Thus, for highly intelligent children, a lack of parental support and financial resources rarely curtails educational outcomes. For children with low intelligence, however, the results indicate that poor educational outcomes are not predetermined by genetic influences: Family environmental background (e.g. parental valuation of education; financial resources to obtain higher education) plays a major role for educational trajectories in this group of children at risk (Johnson et al. 2009).

However, not only the family environmental background but also aspects of the institutional learning environment may be of great importance for children with limited mental abilities (i.e. mental retardation). Especially learning environments that stimulate and support the social engagement of children with low intelligence in the classroom have proven to be of great value to promote their learning (Sheehy and Rix 2009).

In summary then, all the above mentioned studies focusing on the interaction of risk and protective factors on different levels show that an individual's low intelligence (i.e. a (neuro-)cognitive risk factor) might well be attenuated or increased by the co-occurrence of other risk or protective factors located in other areas of individual differences (i.e. motivational factors) or on other levels (e.g. the societal level). However, research on such interactions is far from completed and further studies are needed to derive educational approaches to support children in their educational pathways.

3 Working Memory and its Relationship to Educational Outcomes

Recently, in the field of psychology, more molecular (neuro-)cognitive resources of individuals have been addressed when investigating definitions for a child being at risk of poor educational outcomes. Working memory is one of the factors which seem to contribute to a deeper understanding of the interaction between intelligence and other factors in predicting educational outcomes.

The construct of working memory relates to "mechanisms or processes that are involved in the control, regulation, and active maintenance of task-relevant information in the service of complex cognition" (Miyake and Shah 1999, p.450). Working memory is a central component of the executive functions and implies a combination of both temporary storage and active manipulation of information, thereby referring to an individual's ability to process and remember information (e.g. Baddeley 2007, 2012). A variety of different working memory models have been proposed (for an overview see e.g., Michalczyk and Hasselhorn 2010). During the last decades, a multiple systems view of working memory developed by Baddeley (1986, 2007) has served as a particularly useful theoretical framework in studies investigating the relationship between working memory and educational outcomes (Schuchardt et al. 2008). According to this model at least three components of working memory can be distinguished. The central executive as a modality-free supervisory system coordinates and regulates cognitive processes in the two modality-specific subsystems, the phonological loop and the visual-spatial sketchpad. Additionally, the central executive is responsible for the retrieval of representations from long-term memory and comprises higher-order cognitive processes including attention focusing and attention switching. The phonological loop temporarily stores and processes verbal and auditory information and comprises two components, i.e. the phonological store and the subvocal rehearsal process. The functions of the visual-spatial sketchpad cover the temporary storage and processing of visual and spatial information. This part of the working memory system consists of a visual cache for static information and an inner scribe for dynamic spatial information.

Empirical research shows substantial degrees of interindividual variation in working memory functioning in children (e.g., Alloway and Gathercole 2006) and strong links between working memory performance and a variety of educational outcomes (e.g., Alloway and Alloway 2010; Geary et al. 2012; Lu et al. 2012; Swanson 2011). Regarding the mathematical domain, research has provided numerous indications that deficiencies in working memory functioning are linked to poor computational skills (e.g. Alloway and Alloway 2010; Bull and Scerif 2001), and poor skills in solving arithmetic word problems (Swanson 2011; Swanson and Sachse-Lee 2001) with specific evidence pointing out the importance of working memory capacity in predicting mathematical performance in primary school years. For example, in a longitudinal study with 98 children, Alloway and Alloway (2010) showed that working memory capacity assessed at the age of 5 years contributed 21 % of the variance in numeracy skills (i.e., a composite of numerical operations and math reasoning) 6 years later. A further longitudinal study investigating the relationship between working memory and mathematical problem-solving revealed that working memory capacity assessed in Grade 1 accounted for 26 % of variance in mathematical problem-solving accuracy with a direct association between growth in working memory capacity and increasing mathematical problem solving skills (Swanson 2011). However, a direct comparison of the relationship between working memory and performance in simple mathematical procedures (i.e. counting) versus more complex mathematical procedures (i.e. calculating) revealed that working memory capacity predicted only procedures that require higher cognitive processing demands but not simple mathematical procedures (Lan et al. 2011).

A further topic in this field of research is the question which components of working memory functioning are most important for mathematical performance. Regarding the central executive, there is substantial evidence that this component of working memory is strongly related to mathematical achievement and adoption of sophisticated strategy use in school aged children (e.g. Bull et al. 2008; Geary 2011; Geary et al. 2004, 2012; Swanson 2011; Swanson et al. 2008) with indications for an increasing contribution to individual differences in mathematical performance with successive grades and more complex tasks (Geary 2011). In contrast, research on the relationship between mathematical performance and the two subcomponents of working memory, namely the phonological loop and the visuo-spatial sketchpad, has provided mixed results (Geary 2011; DeStefano and LeFevre 2004).

Besides research on working memory in the mathematical domain, there are studies that indicate that working memory skills are also related to reading and spelling (e.g. Alloway and Alloway 2010; Gathercole et al. 2006; Lu et al. 2012). For example, in the aforementioned longitudinal study conducted by Alloway and Alloway (2010) the authors found that working memory capacity assessed in 5 year old children in the United Kingdom accounted for 16 % of the variance in literacy (reading and spelling) assessed 6 years later. However, a recent study revealed contradictory findings for younger children: In a sample of 119 Chinese and 139 American preschoolers, Lan and colleagues (2011) cross-sectionally found no significant relationship between working memory and early reading skills.

With regard to children showing specifically poor achievement in the domain of reading or in mathematics (i.e. children with specific learning disorders), particular attention has been paid during the last decades to the contribution of deficits in specific components of working memory in the development of these disorders (c.f. Schuchardt et al. 2008). Today, there is a substantial consensus that children with a specific reading disorder (i.e. dyslexia) show impairments in the phonological component of working memory (e.g. Schuchardt et al. 2008; Swanson 2006; Vellutino et al. 2004). There are also studies reporting impairments in the central executive for these children (e.g. Palmer 2000; Swanson 1993, 1999) but it has been claimed that these deficits might be due to phonological requirements of the tasks used to measure the central executive (Schuchardt et al. 2008). Furthermore, studies analyzing visual-spatial working memory capacity in children with reading disorders revealed an inconsistent pattern of results (Eden and Stein 1995; Howes et al. 2003; Kibby et al. 2004, Menghini et al. 2011; O'Shaughnessy and Swanson 1998; Pickering 2006). For mathematical learning disorders, a substantial body of research suggests particularly strong impairments in the central executive component of working memory (e.g. Geary et al. 1991, 2000; Hitch and McAuley 1991; McLean and Hitch 1999; Passolunghi and Siegel 2001; Swanson 1993; Swanson and Sachse-Lee 2001; Wilson and Swanson 2001). On the other hand, findings are contradictory for the phonological subsystem (e.g., Bull et al. 1999; Geary et al. 1991, 1999, 2000; Hitch and McAuley 1991; Landerl et al. 2004; McLean and Hitch 1999; Schuchardt et al. 2008; Swanson and Sachse-Lee 2001) and the visual-spatial subsystem of working memory (D'Amico and Guarnera 2005; McLean and Hitch 1999; Reuhkala 2001; van der Sluis et al. 2005; see also Passolunghi 2006). Possible explanations for these contradictory findings regarding the issue of which specific working memory components are impaired in different kinds of learning disorders have been proposed (Menghini et al. 2011): for example, differing inclusion criteria adopted in the studies (e.g. regarding demographic features, level of general intelligence, presence of comorbid disorders), and the specific kind of working memory tasks used (e.g. traditional span tasks or more complex tasks).

However, despite several unresolved issues, in sum, research findings show very strong links between working memory and educational outcomes, both for children with and without specific learning disorders. Thus, the question has been raised whether working memory is "simply a proxy for IQ with respect to academic attainment" (Alloway and Alloway 2010, p. 21). Research has begun to shed light on this issue, investigating working memory and intelligence concurrently in studies, in order to identify those components of variance that commonly or specifically contribute to educational outcomes. From a perspective focusing on risk factors, the question then is whether low intelligence, poor working memory or their interaction defines if a child is at risk of poor educational outcomes or not. With regard to this issue, so far both current cross-sectional and longitudinal studies provide compelling evidence that both constructs share a significant amount of variance in explaining educational outcomes (about 30–35 %; Lu et al. 2012) but that each of the constructs also has unique predictive power explaining educational outcomes when accounting for the respective other construct (e.g. Alloway and Alloway 2010; Geary 2011; Geary et al. 2012; Krumm et al. 2008; Lu et al. 2012). However, the question of whether one or the other construct might be a better predictor for one or the other specific educational outcome is far from resolved and results are rather heterogeneous. For example, while Alloway and Alloway (2010) found working memory skills to be a better predictor than intelligence for both literacy and numeracy skills, Lu and colleagues (2012) found that the relative importance of both constructs varied for different educational domains with a greater proportion of variance in math explained by working memory and a greater predictive power of intelligence for Chinese.

When considering the role of working memory in the prediction of (poor) educational outcomes it may be important (similar to intelligence) to take account of its possible interactions with risk factors on levels other than the cognitive level. So far, research addressing this issue is just emerging. Some studies have investigated the relationship between socio-economic status (SES) and working memory. For example, Engel and colleagues (2008) compared children from low-income families with those of high-income families in Brazil. Whereas on measures of expressive and receptive vocabulary, the group with higher SES showed significantly higher scores than the children from low-income families, no group differences appeared on measures of working memory. In a similar vein, Alloway and Alloway (2010) found (a) no significant association between working memory and maternal level of education, and (b) the relationship between working memory and educational outcomes to remain significant when statistically controlling for the influence of maternal education. This evidence suggests that working memory functioning might represent cognitive resources that are not influenced by acquired knowledge and skills (e.g. Alloway and Alloway 2010; Alloway et al. 2005; Conway et al. 2002; Engel et al. 2008). However, it should be mentioned that contradictory research findings also exist, for example a study revealing lower spatial and central executive working memory performance in African American girls with low versus middle SES according to parental education and years of parental tertiary education (Farah et al. 2006). One explanatory hypothesis for these results is that an inverse relationship between SES and stress (e.g., Lupien et al. 2009; McEwen 2000) might cause the SES-disparity in (working) memory: When young children are confronted with environmental burdens, their stress response system becomes overactive. This might lead to impairments and disruptions in the maturing brain, the metabolic regulatory system and thereby eventually increase the risk for problems in learning as well as physical and mental health (e.g. Shonkoff 2010, 2011). However, empirical studies specifically investigating the mechanisms underlying a possible association between SES and working memory are needed to clarify this particular interaction between (neuro-)cognitive and social risk factors.

4 Attention and its Relationship to Educational Outcomes

An individual's availability of attentional resources presents an even more molecular and more basic cognitive prerequisite of successful learning than working memory. Recent models describe attention as a conglomerate of distinguishable, though interrelated processes (e.g. alertness, orienting, selective and sustained attention). These processes are influenced both by endogenous ('top-down') factors such as knowledge and personal goals, as well as by exogenous ('bottom-up') factors referring to sensory stimulation (Corbetta and Shulman 2002). The constructs of attention and working memory are closely related as attention can be described as being responsible for the selection of those kinds of information that gain access to working memory (c.f. Knudsen 2007), and vice versa, the contents of working memory can be understood as activated representations that are currently within the focus of attention (Cowan 1995). Furthermore, the two constructs show an overlap regarding information processing goals as both provide the means of goal-driven processing by increasing the accessibility of relevant information (c.f. Awh et al. 2006). Nevertheless, for a long time both constructs have been investigated separately with regard to their predictive value in explaining educational outcomes.

In a coordinated analysis of 6 longitudinal data-sets from the research tradition focusing on attention and its possible explanatory value, Duncan and colleagues (2007) estimated the links between attention obtained at school entry and later educational outcomes (teacher ratings or direct skill assessment) in math and reading. The results show an average effect size of .10, thus revealing a modest association (but see, for example, Colom et al. 2007 for contradictory findings). Remarkably, attention skills were equally important for outcomes in math and reading (Duncan et al. 2007). This finding of attention uniformly predicting both achievement in reading and in mathematics has recently received further support from a cross-sectional study of 258 preschool-aged children from China and the United States, (Lan et al. 2011) as well as a longitudinal study tracking 693 children from age 6 through to age 17 (Breslau et al. 2009).

A possible explanation for this finding is that the predictive power of attention skills for educational outcomes might reflect the increase in time a child is engaged and participates in learning-related endeavors and activities due to his or her attention skills (Duncan et al. 2007). Accordingly, some researchers (e.g. Gordon et al. 1990) argue that the link between a child's potential and his/her actual (educational) performance largely depends on attention. However, it should be noted that the claim of domain-general effects of attention on educational outcomes is not beyond question and recently, particular importance of attentional competencies for math has been claimed (Steinmayr et al. 2010)—this requires further research.

Some studies reveal substantial correlations between attention and general intelligence (e.g. Buehner et al. 2006; Gordon et al. 1990; Steinmayr et al. 2010). Analogously to the question whether working memory predicts educational outcomes above and beyond intelligence, one may ask if attention has incremental validity in explaining educational outcomes above intelligence. So far, research on this issue has been scarce but indeed provides hints regarding the incremental predictive power of attention for performance on achievement test as well as for grades (i.e. GPA) both for clinical and non-clinical school-aged samples (Mayes and Calhoun 2007a,b; Steinmayr et al. 2010). In this vein, some researchers (e.g. Gordon et al. 1990) claimed that the link between a child's potential to learn (i.e. general intelligence) and his/her actual (educational) performance largely depends on attention. Until recently, empirical studies directly investigating this potential interplay between measures of attention and intelligence in predicting educational outcomes were lacking but a current study provides first empirical results: In a sample of 231 11th and 12th grade students Steinmayr and colleagues (2010) found the relationship between intelligence and GPA to be moderated by a measure of sustained attention. But as the sample in this study consisted of a rather homogeneous group of high-performing students, further studies are needed to investigate if the moderating effect of attention is recognizable across different levels of achievement.

Besides the incremental power of attention in predicting educational outcomes above and beyond intelligence, research provides further indications of its predictive power independent of working memory in non-clinical samples (Lan et al. 2011).

Further insights into the relationship between attention and educational trajectories come from research focusing on participants with attention-deficit/hyperactivity disorder (ADHD)—a developmental disorder that is characterized by fundamental attention deficits. There is a weight of evidence demonstrating that children with ADHD face a heightened risk for poor educational outcomes across a wide range of indicators (Daley and Birchwood 2010; Frazier et al. 2007), including lower performance on standardized achievement tests (e.g. Corkum et al. 2010; Hoza et al. 2002; Purvis and Tannock 1997, 2000), elevated amounts of grade retention and grade failing as well as children with ADHD leaving or dropping out of school earlier (Fergusson and Horwood 1995; Fergusson et al. 1997; Klein and Mannuzza 1991), and with fewer qualifications compared to their peers (Barkley et al. 1990; Biederman 1998; McGee et al. 2002). Furthermore, children with ADHD show increased rates of learning disabilities (e.g. Barkley 1997; Biederman et al. 1991; Pliszka 1998; Wood and Grigorenko 2001; Willcutt et al. 2003), and are more frequently placed in special education classes and programs (Biederman et al. 1996). Overall, meta-analytic results (Frazier et al. 2007) show moderate to large impairments in educational achievement among individuals with ADHD with standard achievement tests producing the largest effect sizes, possibly due to attention deficits that become significant in test situations. Despite a trend toward decreasing educational impairments with increasing age, the association between ADHD symptoms and poor educational outcomes continues to be significant up to tertiary education. Accordingly, current research focusing on college students with ADHD reveals that they have lower GPAs, and show higher rates of self-reported academic problems than college students without ADHD (Heiligenstein et al. 1999; for an overview see Weyandt and DuPaul 2006).

With regard to the differential explanatory value of the three core symptoms of ADHD, relatively little independent contributions of hyperactivity and impulsivity are found, whereas the largest amount of variance in educational outcomes—both cross-sectionally as well as longitudinally—can be explained by symptoms of inattentiveness (Frazier et al. 2007), stressing the importance of poor attention-related skills as potential risk factor for poor educational outcomes.

Nonetheless, not all individuals with an ADHD diagnosis show poor educational trajectories and outcomes. Rather, some studies show above-average achievements among individuals with ADHD (e.g. Forness et al. 1992; Goldstein 1987, Sandson et al. 2000). It has been suggested that the subset of individuals showing such positive educational trajectories despite an ADHD diagnosis might benefit from several protective factors on different levels and in different domains, including higher general cognitive abilities, superior coping skills, as well as positive academic experiences during primary school (Glutting et al. 2005). Regarding the interplay with working memory, path analytical results show that in a sample of adolescents referred for ADHD, the relationship between behavioral inattention, reading and math achievement was partially mediated by working memory variables (particularly auditory-verbal), indicating that adolescents with ADHD but good working memory skills might have a smaller risk of poor educational outcomes than adolescents with ADHD and poor working memory skills (Rogers et al. 2011). Furthermore, experimental research in college students with ADHD shows that specific response styles (i.e. slow but precise responding) might help them overcome some of the negative effects of their inattentiveness (Merkt et al. 2013). However, despite these promising recent studies, so far research on the relationship between ADHD as a risk factor and possible other (protective) factors and the mechanisms attenuating educational difficulties is very scarce and there is a clear need to address this topic in future studies.

5 Conclusions and Outlook

The research outlined in this article demonstrates that individual differences in intelligence, working memory and attention bear important consequences for learning, with children having poor resources being at heightened risk of poor educational outcomes. Furthermore, emerging evidence indicates that the joint consideration of these three areas of (neuro-)cognitive functioning leads to an integrated understanding that goes beyond what can be inferred from the sum of the three single strands of research. Overall, this extensive evidence provides us with a sound scientific basis that allows to identify children who are at heightened (neuro-)cognitive risk of academic failure at very early stages in their educational career. Building on related diagnostic insights, interventions addressing the individual (neuro-)cognitive weaknesses of the children can be put into action. However, insights from research that takes a broader perspective, focusing on interactions between (neuro-)cognitive and various other risk factors located both inside and outside the individual, clearly show that there is a limit to what we can expect from interventions that are confined to the (neuro-)cognitive prerequisites. In view of the complexity of possible relationships between multiple risk (and protective) factors on different levels reaching from the intra-individual to the sociocultural level, there is a clear necessity for a multidisciplinary approach (c.f. Luthar et al. 2000). Only research that aims at integrating insights from different scientific perspectives (e.g., psychology, sociology, etc.) and multiple methodological traditions has the potential to generate successful interventions and approaches located at the individual, familial, social and societal level to reduce the percentage of poorly performing students. In this way, children at risk may be given the opportunity to meet the challenges of their future lives and to find personal kinds of interest they can pursue as integrated members of society (OECD 2010).

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