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Identifying children at risk of autism spectrum disorder with the Child Behavior Checklist 1.5-5 and the influence of intellectual capability on the use of the CBCL

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1. Summary and *Zusammenfassung*

A long delay between the first registered symptoms of autism spectrum disorder and a final diagnosis has been reported. The reasons for this are the spare use of specialized autism instruments, missing clinical expertise, and the late referral to specialized centers in primary care. Previous studies recommending the Child Behavior Checklist 1.5–5 [(CBCL)] for screening have requested additional research. (Limberg, Gruber and Noterdaeme, 2017, p. 368)

Despite the strong association between autism spectrum disorder and intellectual disability, the potential effect of children`s intellectual capability on the CBCL 1.5–5 results have not been examined so far. The aims of the present research are "to examine whether the CBCL 1.5–5 can be used in Germany as a level 1 screening instrument to identify children with a risk of [autism spectrum disorder] . . . ." (Limberg et al., 2017, p. 369) and to analyze how children´s intellectual capabilities affect the CBCL 1.5–5 scales and their cut-off points. "A total of 183 children aged 25–71 months participated in this study. [In the first analysis] the Child Behavior Checklist scales of 80 children with autism spectrum disorder were compared with 103 children diagnosed with other psychiatric disorders" (Limberg et al., 2017, p. 368). Logistic regression analysis with Exp(B) was used to identify CBCL scales and receiver operating characteristics (ROC) analysis to detect optimal cutoff points. To analyze the influence of the intellectual capability, the CBCL 1.5–5 scales of an experimental group of 58 autism spectrum disorder children (31 IQ < 80, 27 IQ ≥ 80) was compared with a control group of 99 other psychiatric disorders children in the second (subsample) analysis. A comparison of means, a logistic regression analysis with Exp(B), receiver operating characteristics (ROC) analyses and Kendall`s tau (τ) correlations analyses, were performed.

> In the logistic regression analysis [of the first analysis], the Withdrawn and Pervasive Developmental Problems Child Behavior Checklist scales with a significant predictive value of risk for an autism spectrum disorder diagnosis were identified. The optimal cutoff points T = 64.5 on the Pervasive Developmental Problems scale (area under the curve = 0.781, sensitivity = 0.83, specificity = 0.60, positive predictive value = 0.62, negative predictive value = 0.82, odds ratio = 7) and T = 60.5 on the Withdrawn scale (area under the curve = 0.809, sensitivity = 0.88, specificity = 0.63, positive predictive value = 0.65, negative predictive value = 0.87, odds ratio = 12) were evaluated in the receiver operating characteristics analysis. [1] (Limberg et al., 2017, p. 368)

In the second analysis, to examine the influence of intellectual capability, the logistic regression analysis with Exp(B) and receiver operating characteristics (ROC) analysis confirm previous findings regarding the utility of the CBCL 1.5–5 scales Withdrawn (cutoff point T = 60.5, area under the curve = 0.794, sensitivity = 0.86, specificity = 0.64, positive predictive value = 0.58, negative predictive value = 0.89, odds ratio = 11) and Pervasive Developmental Problems (cutoff T = 64.5, area under the curve = 0.765, sensitivity = 0.79, specificity = 0.61, positive predictive value = 0.54, negative predictive value = 0.83, odds ratio = 6) for the differentiation between children with autism spectrum disorder and other psychiatric disorders. Kendall`s tau (τ) correlations analyses indicate weak or no relationship between intellectual skills and the CBCL 1.5–5 scales (IQ ≥ 80-Withdrawn: τ = 0.003, p = 0.983, IQ ≥ 80-Pervasive Developmental Problems: τ = -0.006, p = 0.966; IQ < 80-Withdrawn: τ = -0.239, p = 0.089, IQ < 80-Pervasive Developmental Problems: τ = -0.275, p < 0.05). A cutoff point T = 64.5 on the IQ < 80- Pervasive Developmental Problems scale (area under the curve = 0.826, sensitivity = 0.87, specificity = 0.61,

[1] From Gruber and Noterdaeme (2017). The German version of the Child Behavior Checklist 1.5-5 to identify children with a risk of autism spectrum disorder, *Autism, 21*(3), p. 368. DOI: 10.1177/1362361316645932. Copyright © [2016] (The Authors). Reprinted by permission of SAGE Publications.

positive predictive value = 0.41, negative predictive value = 0.94, odds ratio = 10) was evaluated in the readjusted receiver operating characteristics (ROC) analysis. “The present study confirms the utility of the German version of the Child Behavior Checklist 1.5–5 as a level 1 screening tool to identify children with a risk of autism spectrum disorder; however, a risk of overidentifying should be considered” (Limberg et al., 2017, p. 368). Different intellectual capabilities do not affect the CBCL 1.5–5 scales; a consideration of different cutoff points is not mandatory. “The Child Behavior Checklist 1.5–5 can complement the pediatric examination as a quick and cost-effective questionnaire” (Limberg et al., 2017, p. 368).

Keywords: autism spectrum disorder, Child Behavior Checklist 1.5–5, early detection, preschool children, screening**,** intellectual disability

Zwischen den ersten registrierten Symptomen und der endgültigen Diagnose einer Autismus-Spektrum-Störung entsteht eine lange Verzögerung. Die Gründe dafür liegen in der geringen Verwendung von autismusspezifischen Diagnostikinstrumenten, fehlender klinischer Expertise und einer späten Überweisung in Autismus-spezialisierte Zentren im Rahmen der Primärversorgung. Vorherige Studien empfehlen die Child Behavior Checklist 1.5-5 (CBCL) als Screeninginstrument und fordern ergänzende Forschungsarbeit (Limberg et al., 2017, S. 368). Trotz des deutlichen Zusammenhanges zwischen Autismus-Spektrum-Störungen und einer Intelligenzminderung ist bisher die mögliche Auswirkung der intellektuellen Fähigkeit auf die Ergebnisse des CBCL 1.5-5 nicht untersucht worden.

Die Ziele der vorliegenden Arbeit bestehen darin, zu untersuchen, ob die CBCL 1.5-5 auch in Deutschland als Level 1 Screeninginstrument zur Identifikation von Kindern mit einem Risiko für eine Autismus-Spektrum-Störungen eingesetzt werden kann (Limberg et al., 2017, p. 368) und zu analysieren, welche Auswirkungen die intellektuellen Fähigkeiten der Kinder auf die CBCL 1.5-5 Skalen und deren cut-off-Punkte haben.

Insgesamt haben 183 Kinder im Alter von 25-71 Monaten an dieser Studie teilgenommen. In der ersten Analyse wurden die CBCL Skalen von 80 Kindern mit einer Autismus-Spektrum-Störung mit 103 Kindern mit anderen psychiatrischen Störungen verglichen (Limberg et al., 2017, p. 368). Die logistische Regressionsanalyse mit Exp(B) wurde zur Identifizierung der CBCL Skalen und die Receiver operating characteristics (ROC) Analyse zur Ermittlung optimaler cutoff Punkte verwendet. Um den Einfluss von intellektuellen Fähigkeiten zu untersuchen, wurden in einer zweiten Analyse (Teilstichprobe) die CBCL 1.5-5 Skalen einer Experimentalgruppe von 58 Kindern mit einer Autismus-Spektrum-Störung (31 IQ $<$ 80, 27 IQ $\geq$ 80) mit einer Kontrollgruppe von 99 Kindern mit anderen psychiatrischen Störungen verglichen. Ein Mittelwertvergleich, eine logistische

Regressionsanalyse mit Exp (B), eine Receiver operating characteristics (ROC) Analyse und eine Kendall`s tau (τ) Korrelationsanalyse wurden durchgeführt.

In der logistischen Regressionsanalyse der ersten Analyse sind die Skalen Withdrawn (sozialer Rückzug) und Pervasive Developmental Problems (Tiefgreifende Entwicklungsstörung) als die Skalen mit einem signifikanten prädiktiven Wert für ein Risiko einer Autismus-Spektrum-Störung identifiziert worden. Der optimale cutoff Punkt T = 64.5 auf der Skala Pervasive Developmental Problems (area under the curve (AUC) = 0.781, Sensitivität = 0.83, Spezifität = 0.60, Positiver Vorhersagewert = 0.62, Negativer Vorhersagewert = 0.82, Odds Ratio = 7) und T = 60.5 auf der Skala Withdrawn (area under the curve (AUC) = 0.809, Sensitivität = 0.88, Spezifität = 0.63, Positiver Vorhersagewert = 0.65, Negativer Vorhersagewert = 0.87, Odds Ratio = 12) wurden in der Receiver operating characteristics (ROC) Analyse berechnet (Limberg et al., 2017, p. 368). In der zweiten Analyse, die den Einfluss von intellektuellen Fähigkeiten untersucht, bestätigen die logistische Regressionsanalyse mit Exp (B) und Receiver operating characteristics (ROC) Analyse die vorherigen Erkenntnisse: Die CBCL 1.5-5 Skalen Withdrawn (cutoff Punkt T = 60.5, area under the curve (AUC) = 0.794, Sensitivität = 0.86, Spezifität = 0.64 , Positiver Vorhersagewert = 0.58, Negativer Vorhersagewert = 0.89, Odds Ratio = 11) und Pervasive Developmental Problems (cutoff Punkt T = 64.5, area under the curve (AUC) = 0.765, Sensitivität = 0.79, Spezifität = 0.61, Positiver Vorhersagewert = 0.54, Negativer Vorhersagewert = 0.83, Odds Ratio = 6) können zur Unterscheidung zwischen Kindern mit Autismus-Spektrum-Störungen und anderen psychiatrischen Störungen verwendet werden. Die Korrelationsanalysen (Kendall`s tau (τ)) zeigen schwache oder keine Beziehungen zwischen den intellektuellen Fähigkeiten und den CBCL 1.5-5 Skalen (IQ ≥ 80-Withdrawn: $\tau = 0.003$, $p = 0.983$, IQ ≥ 80-Pervasive Developmental Problems: $\tau = -0.006$, $p = 0.966$; IQ < 80-Withdrawn: $\tau = -0.239$, $p = 0.089$, IQ < 80-Pervasive Developmental Problems:

τ = -0.275, p < 0.05). Der cutoff Punkt T = 64.5 auf der IQ < 80-Pervasive Developmental Problems Skala (area under the curve (AUC) = 0.826, Sensitivität = 0.87, Spezifität = 0.61, Positiver Vorhersagewert = 0.41, Negativer Vorhersagewert = 0.94, Odds Ratio = 10) wurde durch die angepasste Receiver operating characteristics (ROC) Analyse ermittelt.

Die vorliegende Studie bestätigt, dass die deutsche Version der Child Behavior Checklist 1.5–5 als Level 1 Screeninginstrument zur Identifizierung von Kindern mit einem Risiko für eine Autismus-Spektrum-Störung verwendet werden kann; allerdings sollte ein Risiko der Überidentifizierung berücksichtigt werden (Limberg et al., 2017, p. 368). Unterschiedliche intellektuelle Fähigkeiten beeinflussen die CBCL 1.5-5 Skalen nicht; eine Berücksichtigung verschiedener cutoff Punkte ist nicht zwingend notwendig. Die Child Behavior Checklist 1.5–5 kann als ein schneller und kostengünstiger Fragebogen die pädiatrische Untersuchung ergänzen (Limberg et al., 2017, p. 368).

Schlagwörter: Autismus-Spektrum-Störung, Child Behavior Checklist 1.5–5, Früherkennung, Vorschulkinder, Screening, Intelligenzminderung

2. Introduction

Persistent deficits in social communication and interaction associated with restricted, repetitive patterns of behavior, interests or activities are the key diagnostic characteristics of autism spectrum disorders (ASD), a varied group of neurodevelopmental disorders (American Psychiatric Association, 2013). It is stated that the symptoms must be manifest in the early developmental period, cause restriction in important areas of current functioning, and are not explained by an intellectual disorder or global developmental retardation. The fifth version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) enabled an individualization of the diagnosis by the use of several specifiers, such as intellectual and language impairment. A current prevalence rate of 1% is assumed, whereby the reason for the increase has remained unclear in recent years (American Psychiatric Association, 2013). "Modified diagnosis criteria and the growing awareness of [autism spectrum disorder] . . . are discussed, while a real increase of the prevalence rate is negated (Freitag and Petermann, 2014)" (Limberg et al., 2017, p. 368). There is an obvious growth in demand for diagnostic clarification of autism spectrum disorders in specialist clinics as well as in primary care. An accurate diagnosis requires significant experience in the field of autism spectrum disorders and specialized training in the correct use of assessment instruments (National Collaborating Centre for Women's and Children's Health (UK), 2011). The second edition of the Autism Diagnostic Observation Schedule (ADOS-2) (Lord, Rutter, DiLavore, Risi, Gotham and Bishop 2012) and the Autism Diagnostic Interview-Revised (ADI-R) (Rutter, LeConteur and Lord, 2003) are currently the gold standard instruments (National Collaborating Centre for Women's and Children's Health (UK), 2011).

Noterdaeme and Hutzelmeyer-Nickels (2010) note that children with autism spectrum disorders are identified late (in Germany at a mean age of 76 months), even though first symptoms are already registered during the second year of life by the majority of parents.

Even if the problems reported are typical core symptoms, such as language, communication, and social interaction issues, the authors emphasize that there is a long delay between first registered symptoms and the definitive diagnosis. Unfavorable consequences are late specific therapeutic interventions and a long period of anxiety and uncertainty for the family (Noterdaeme and Hutzelmeyer-Nickels, 2010).

> In a German study, Noterdaeme and Hutzelmeyer-Nickels (2010) could find that there was no significant reduction in the age at diagnosis between 1998 and 2007. One reason for the delay is the lack of clinical expertise with [autism spectrum disorder] . . . in primary care and the associated late referral to a specialized center. In addition, there are only a few specialized centers with experience and established expertise in [autism spectrum disorder] . . . (Noterdaeme and Hutzelmeyer-Nickels, 2010). (Limberg et al., 2017, p. 369)

Noterdaeme and Hutzelmeyer-Nickels (2010) indicate that the increasing prevalence and the difficult diagnostic analysis present a special challenge for pediatricians, who are usually contacted by concerned parents first. Furthermore, they see children regularly during obligatory medical check-ups. In this process, a pediatrician does the first evaluation if a child presents symptoms of a developmental disorder and a required referral is made for a specialist diagnosis (Noterdaeme and Hutzelmeyer-Nickels, 2010). Even though autism spectrum disorder screening procedures are discussed frequently in specialist publications and new knowledge is shared in international networks, such as the ESSEA COST Action (Enhancing the Scientific Study of Early Autism), future work should focus mainly on detecting early signs of autism spectrum disorder in primary care through adapting the screening procedure (García-Primo et al., 2014). Barbaro and Dissanayake (2010) demonstrate in their Social Attention and Communication Study that prospective identification of children with autism spectrum disorder is possible between 12-24 months of

age by developmental surveillance. By training primary health care professionals, social attention and communication behaviors can be evaluated, with this knowledge an improvement of early identification of autism spectrum disorder is possible (Barbaro and Dissanayake, 2010). There is a growing consensus that screening of autism spectrum disorder should integrate into the standard developmental monitoring to reduce the age of diagnosis (Zwaigenbaum, 2011). This point of view is also represented by the American Academy of Pediatrics (AAP). In their "Algorithm for Developmental Surveillance and Screening," they stipulate that all pediatricians are responsible for the early identification of developmental disorders. Any abnormality during consultation should be examined with standardized screening tests and, furthermore, screening tools are to be used regularly with children at the age of 9, 18 and 30 months (Council on Children With Disabilities, 2006). "The role of the pediatrician becomes increasingly important in reducing [the long diagnostic delay] . . . . For this reason, it is necessary to introduce a level 1 screening instrument for non-specialized professionals in primary care to identify children with a risk of [autism spectrum disorder] . . ." (Limberg et al., 2017, p. 369). García-Primo et al. (2014) mention that scientists and clinicians agree on the importance of early detection of autism spectrum disorder children but selecting the appropriate screening instrument is still difficult. They show more than 20 available screening instruments across Europe.

> Only in Spain is the Modified-Checklist for Autism in Toddlers (M-CHAT) used in routine screening procedures, while in most other countries the screening instruments are utilized only by [autism spectrum disorder] . . . specialists and are not part of routine practice. Because of the variety of health care and government policy in various countries, a standardization of the screening procedure in Europe is not possible (García-Primo et al., 2014). A solution could be a broadband behavior rating scale as a screener, a cost-effective and expeditious method that is already

> widespread in primary settings and requires less specialized knowledge of [autism spectrum disorder] . . . for evaluation. All these requirements meet the Child Behavior Checklist (CBCL), one of the most widely used parent report checklists (Achenbach and Rescorla, 2000). (Limberg et al., 2017, p. 369)

Regarding the manual (Achenbach and Rescorla, 2000), it provides the opportunity to quickly receive estimates of the children´s behavioral, social and emotional functioning. Autism spectrum disorder-specific items are recorded in the DSM-oriented scale Pervasive Developmental Problems (PDP). The CBCL 1.5-5 is standardized and demonstrates adequate reliability and validity (Achenbach and Rescorla, 2000).

In 1988, Rescorla tested the utility of the CBCL for the identification of autistic preschoolers. Several previous studies (Havdahl, Tetzchner, Huerta, Lord and Bishop, 2015; Myers, Gross and McReynolds, 2014; Muratori et al., 2011; Narzisi, Calderoni, Maestro, Calugi, Mottes and Muratori, 2013; Rescorla, Kim and Oh, 2014; Sikora, Hall, Hartley, Gerrard-Morris and Cagle, 2008) recommend the CBCL 1.5-5 as a screening instrument for children with autism spectrum disorder. All studies describe a higher rate of sensitivity than specificity, with the effect of incorrectly identifying children.

Unfortunately, most previous studies excluded examining the potential effect of children`s intellectual capability on the CBCL results. It is important to note that autism spectrum disorders are highly associated with intellectual disabilities and a range of genetic syndromes that include intellectual impairments (e.g., tuberous sclerosis, Fragile X syndrome, Prader-Willi syndrome, and Angelman syndrome) (Dykens and Lense, 2011). By analyzing international epidemiological studies, Dykens and Lense (2011) found that the prevalence rate of co-occurring intellectual disabilities in autism spectrum disorder vary widely and range from 34% to 84%, with a median of 65%. The American Psychiatric Association (2013) emphasizes that an associated intellectual disability is one of the

important prognostic factors for the outcome. The autism spectrum disorder diagnosis should specify accompanying intellectual impairment (American Psychiatric Association, 2013).

Because of the strong association between autism spectrum disorder and intellectual disability, it is essential to investigate the influence of the intellectual capability on autism assessment instruments.

> Following the CBCL 1.5–5 could be able to support non-specialized professionals (e.g. pediatricians) in deciding whether a recommendation for a more in-depth and specialized [autism spectrum disorder] . . . assessment is needed. Therefore, it is possible to accelerate a precise [autism spectrum disorder] . . . diagnosis and early intervention . . . (Dawson et al., 2012). (Limberg et al., 2017, p. 369)

Dawson et al. (2012) show that early initiation of treatment can result in a normalization of brain activity and consequently in an improvement of social behavior of children with autism spectrum disorders. Furthermore, the long-term outcome increases (Dawson et al., 2012).

3. Aims and research questions of the study

> . . . Current research is rare, and all of the above-mentioned studies require additional research to analyze the applicability of the CBCL 1.5–5. The [first] aim of this study is to examine whether the CBCL 1.5–5 can be used in Germany as a level 1 screening instrument to identify children with a risk of [autism spectrum disorder] . . . . In the process, significant CBCL scales should be detected and cutoff points calculated, which indicate an actual risk of [autism spectrum disorder] . . . . Previous studies (as mentioned above) describe a good ability of the CBCL 1.5–5 to distinguish between children with [autism spectrum disorder] . . . from typically developing children. We expect the same result from our research. Contrary to this, it is especially hard to differentiate between [autism spectrum disorder] . . . and other clinically referred children in primary settings. For this reason, the main focus of this study is the identification of CBCL scales to discriminate children with [autism spectrum disorder] . . . from children with other psychiatric disorders (OPDs). [2]
>
> (Limberg et al., 2017, p. 369)

There is a strong association between autism spectrum disorder and intellectual disability. To our knowledge, no data currently exist on how various intellectual skills affect the utility of the CBCL 1.5-5 for autism spectrum disorder children. The second aim of the present research is to examine how children´s intellectual capability affects the CBCL 1.5-5 scales and their cutoff points. A crucial issue in the process is whether the cutoff points of the possible suggested autism spectrum disorder screening scales have to be adjusted depending on higher or lower intellectual skills of the children.

[2] From Gruber and Noterdaeme (2017). The German version of the Child Behavior Checklist 1.5-5 to identify children with a risk of autism spectrum disorder, *Autism, 21*(3), p. 369. DOI: 10.1177/1362361316645932. Copyright © [2016] (The Authors). Reprinted by permission of SAGE Publications.

The following research questions arise for the present study:

1. "[Can the] CBCL 1.5–5 … be used in Germany as a level 1 screening instrument to identify children with a risk of [autism spectrum disorder] … and discriminate them . . . from children with other psychiatric disorders …" ? (Limberg et al., 2017, p. 369)
2. How does children´s intellectual capability affect the CBCL 1.5-5 scales to identify children with autism spectrum disorders and their cutoff points?

   Do the cutoff points of the CBCL 1.5-5 screening scales have to be adjusted depending on higher or lower intellectual skills of the children?

4. Theoretical background

4.1 Autism spectrum disorder

4.1.1 Classification and symptoms

The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013) classified autism spectrum disorder (299.00) in the section *Neurodevelopmental Disorders* with the following diagnostic criteria:

> A. Persistent deficits in social communication and social interaction across multiple contexts, as manifested by following, currently or by history . . . :
>
> 1. Deficits in social-emotional reciprocity . . .
>
> 2. Deficits in nonverbal communicative behaviors used for social interaction . . .
>
> 3. Deficits in developing, maintaining, and understanding relationships . . .
>
> B. Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history . . .
>
> 1. Stereotyped or repetitive motor movements, use of objects, or speech . . .
>
> 2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior . . .
>
> 3. Highly restricted, fixated interests that are abnormal in intensity or focus . . .
>
> 4. Hyper- or hyporeactivity to sensory input or unusual interest in sensory aspects of the environment . . .
>
> C. Symptoms must be present in the early developmental period . . .
>
> D. Symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning.
>
> E. These disturbances are not better explained by intellectual disability . . . or global developmental delay. (American Psychiatric Association, 2013, p. 50-51)

Specifiers are used to consider individual characteristics, as:

- With or without accompanying intellectual impairment
- With or without accompanying language impairment
- Associated with a known medical or genetic condition or environmental factor. . .
- Associated with another neurodevelopmental, mental, or behavioral disorder . . .
- With catatonia . . . (American Psychiatric Association, 2013, p. 51)

The current symptomatology is noted by severity levels based on social communication impairments and restricted, repetitive patterns of behavior (Level 1 = Requiring support; Level 2 = Requiring substantial support; Level 3 = Requiring very substantial support) (American Psychiatric Association, 2013).

The term *autism spectrum disorder* was introduced in the DSM-5. The American Psychiatric Association (2013) notes that current support and intervention can hide difficulties. Even the manifestation of an autism spectrum disorder differs widely according to severity, developmental level and chronological age (American Psychiatric Association, 2013). In the 10th issue of the International Statistical Classification of Diseases and Related Health Problems (ICD) (Dilling and Freyberger, 2016), different diagnoses such as infantile autism (F 84.0), atypical autism (F 84.1) and Asperger´s syndrome (F 84.5) are still classified under the section *Pervasive Developmental Disorders* (F84). According to Amorosa (2017), the 11th revision of the same work (ICD-11) is in preparation. In the preliminary form of the ICD-11, autism spectrum disorders are classified, as in the DSM-5, as neurodevelopmental disorders with disorders of intelligence development, language development disorders, disintegrative disorder of the childhood, development disorders of learning, development disorders of motor coordination, chronic tic disorders, attention deficit and stereotypical movement disorders (Amorosa, 2017).

4.1.2 Prevalence and gender relation

A current prevalence rate of 1% is reported by the American Psychiatric Association (2013) and shows an increase of autism spectrum disorders in the population. They continue that it is in discussion whether the reason is a real increase in the frequency of the disorder or rather a growth of the awareness of autism spectrum disorder. It could even be possible that the current DSM diagnostic criteria include children with mild expression who had not received a diagnosis before (American Psychiatric Association, 2013). An improvement of the diagnostic tools and reporting will further be argued (World Health Organization, 2017). The World Health Organization (2017) notes the current number: 1 in 160 children have an autism spectrum disorder, whereby the data of prevalence vary widely. There is no information about the prevalence rate in many low- and middle-income countries (World Health Organization, 2017).

According to the American Psychiatric Association (2013), males are diagnosed four times more often with autism spectrum disorder than females. An associated diagnosis of intellectual disability is diagnosed more often in females (American Psychiatric Association, 2013).

4.1.3 Differential diagnoses

Rett syndrome. The American Psychiatric Association (2013) records that during the regressive phase, the social interaction can be disrupted, and a diagnosis of an autism spectrum disorder seems possible. However, after a while, most of them improve their social communication skills (American Psychiatric Association, 2013).

Selective mutism. The American Psychiatric Association (2013) recognizes that early development is not impaired among children with selective mutism. Even if the child is

mute, they still show social reciprocity. Restricted or repetitive patterns of behavior do not exist (American Psychiatric Association, 2013). Noterdaeme (2017b) clarifies that the language development is usually not retarded and, furthermore, observation and anamnesis do not show autism-typical contact and communication behavior. So, a differentiation to autism spectrum disorders is usually easy (Noterdaeme, 2017b).

Language disorders and social (pragmatic) communication disorder. The American Psychiatric Association (2013) notes that some children with language disorders show communication and consequential social problems, but these are not the typical characteristics of language disorders. Even an association of language disorders with restricted or repetitive patterns of behavior, interests or activities is not common (American Psychiatric Association, 2013). Noterdaeme (2017b) describes that in early childhood, the differentiation between autism spectrum disorders and language disorders can be difficult. She illustrates that at primary-school age, the distinction causes fewer problems, because the social impairments in children with autism spectrum disorders, especially in the quality of social communication, are usually recognizable. In comparison to children with language disorders, autistic children typically show an extremely heterogeneous level of linguistic expression (non-speaking to fluent, complex sentence structure), logorrhea, echolalia and phrases (Noterdaeme, 2017b). According to Noterdaeme (2017b), the topics of conversation of people with autism spectrum disorders are often oriented to special interests, the eye contact is rigid and reduced, and their facial expression and gestures are decreased. Difficulties in social communication and interactions without restricted or repetitive patterns of behavior and interests are diagnostic criteria for a social communication disorder (American Psychiatric Association, 2013).

Intellectual disability. Intellectual disability (Intellectual Developmental Disorder) is classified by the American Psychiatric Association (2013) as a deficit in intellectual and

adaptive functioning in conceptual, social and practical areas beginning during the developmental period. A differentiation between an autism spectrum disorder and individuals with intellectual disabilities without language or symbolic skills may be difficult, because many of them also show a repetitive behaviour (American Psychiatric Association, 2013). The American Psychiatric Association (2013) emphasizes that it is even a challenge to make the right diagnosis for very young intellectually disabled children. The diagnosis of intellectual disabilities should be assigned if there is no deviation between intellectual skills and the level of social-communicative abilities (American Psychiatric Association, 2013). Noterdaeme (2017b), children with autism spectrum disorders, unlike children with intellectual disabilities, typically show echolalia, phrases, and special interests. Further, she notes that in people with autism spectrum disorders, empathic capacity and social perception are impaired. Additionally, the understanding of communication does not exist (Noterdaeme, 2017b). According to the American Psychiatric Association (2013), the intellectual functioning can be measured with IQ tests, where an average intelligence is set by a mean value of 100±15. With regard to the DSM-5, individuals with an intellectual disability are defined by IQ values of ≤70±5 (American Psychiatric Association, 2013).

Stereotypic movement disorder. As stated by the American Psychiatric Association (2013), stereotyped or repetitive motor movements are one of the core diagnostic criteria for autism spectrum disorder. An additional diagnosis of stereotypic movement disorder can be made if this is the focus of the therapy or if the child suffers self-injuries (American Psychiatric Association, 2013).

Attention-deficit/hyperactivity disorder. The American Psychiatric Association (2013) notes that attention deficits and hyperactivity are typical characteristics for children with autism spectrum disorders. If those characteristics exceed the typical behavior of children with the same mental age, a diagnosis of attention-deficit/hyperactivity disorder can be made

(American Psychiatric Association, 2013). According to Noterdaeme (2017b), in children with autism spectrum disorders, the attention is often overly selective and focused compared to children with attention-deficit/hyperactivity disorders. In addition, she notes that autistic children are less forgetful, talk excessively, and have sensomotoric peculiarities and special interests. Their empathic capacity is impaired, and their play is hardly creative (Noterdaeme, 2017b).

Schizophrenia. The American Psychiatric Association (2013) underlines that it must be considered that hallucinations and delusions are core diagnosis criteria of schizophrenia but not seen in children with autism spectrum disorder. It further states that even children with schizophrenia usually present a (nearly) normal development initially. Social problems and atypical beliefs and interests during the prodromal state can be misleading and confused with typical behavior of the autism spectrum disorder (American Psychiatric Association, 2013).

Tic disorder. According to Noterdaeme (2017b), the combination of tic symptoms and compulsive symptoms may seem like autism spectrum disorder. However, she points out that due to anamnesis and observation, the differentiation is usually obvious. The diagnosis of autism spectrum disorder can be excluded if an intact social communication exists (Noterdaeme, 2017b).

Sensory impairment. Children with hearing impairment may show symptoms of autism spectrum disorders, such as lack of response, uncertainty, and social withdrawal (Noterdaeme, 2017b). Consequently, Noterdaeme (2017b) notes that the language development may be disturbed. In case of additional mental or physical disability, stereotypical movement patterns and auto-aggressive behavior may occur (Noterdaeme, 2017b). As per Noterdaeme (2017b), children with visual impairment may attract attention by lack of eye contact, distanceless contact behavior, and special interests in acoustical or sensory stimuli and consequently may be confused with autistic children. In most cases,

through a precise examination of the senses, it is possible to differentiate between sensory impairment and autism spectrum disorders (Noterdaeme, 2017b).

Landau-Kleffner syndrome. According to Noterdaeme (2017b), children with the Landau-Kleffner syndrome lose both receptive and expressive language skills in previously normal language development while the general intelligence remains unchanged. Important distinguishing features of infantile autism are the reduction of already acquired language skills and the continued ability to have relationships (Noterdaeme, 2017b).

Attachment disorders. Attachment disorders are caused by deficient or traumatic relationships during the first years of life (Noterdaeme, 2017b). Therefore, Noterdaeme (2017b) stresses that in the diagnostic process, the third-party anamnesis is particularly important. The contact behavior of children with attachment disorders clearly differs from autism spectrum disorders: children with attachment disorders are socially responsive in their interaction with healthy adults and, unlike autism spectrum disorders, typical communication disorders and special interests are missing (Noterdaeme, 2017b).

Social phobia. Disturbances in social interaction are common in both social phobia and autism spectrum disorders (Noterdaeme, 2017b). According to Noterdaeme (2017b), children with social phobia are socially isolated but understand social signals or situations. Noterdaeme (2017b) indicates that even a disorder of empathy does not exist in children with social phobia and abnormalities of social communication and repetitive behavior are missing. In most cases a differentiation of social phobia and autism spectrum disorders is unproblematic (Noterdaeme, 2017b).

Compulsive disorders. As per Noterdaeme (2017b), a differentiation between compulsive disorders and autism spectrum disorders is usually easily made by anamnesis and observation of the typical characteristics of obsessive thoughts and compulsive acts.

Children with compulsive disorders show an intact social communication (Noterdaeme, 2017b).

4.1.4 Comorbidities

The intellectual functioning of people with autism spectrum disorders vary widely from high functioning intellectual abilities to intellectual disability (World Health Organization, 2017). According to the American Psychiatric Association (2013), individuals with average or high intellectual abilities present an uneven profile of their skills and therefore a large gap between intellectual and adaptive functional capabilities. Intellectual disability and autism spectrum disorder frequently co-occur (American Psychiatric Association, 2013). Dykens and Lense (2011) found a prevalence rate of 65% (range from 34% to 84%) of co-occurring intellectual disabilities in autism spectrum disorders. Autism spectrum disorders are also associated with various genetic syndromes with intellectual impairments, e.g., tuberous sclerosis, Fragile X syndrome, Prader-Willi syndrome, and Angelman syndrome (Dykens and Lense, 2011). Even a German study (Noterdaeme and Wriedt, 2010), where 96% of the participants present an autism spectrum disorder, confirmed the strong association between autism spectrum disorder and intellectual impairment: 45% of the participants presented a low intelligence or minor intellectual disability, and 30%, a moderate or severe intellectual disability. The frequent comorbid disorders intellectual impairment and structural language disorder should be documented as specifiers “with or without accompanying intellectual impairment or language impairment” (American Psychiatric Association, 2013).

The American Psychiatric Association (2013) notes that many individuals with autism spectrum disorder also have comorbid mental disorders, about 70% suffer from one and 40% have more than one. Autism spectrum disorder is associated with attention-deficit/hyperactivity disorder, developmental coordination disorder, anxiety disorders, and

depressive disorders (American Psychiatric Association, 2013). As stated by Noterdaeme (2017c), the typical core symptoms of an attention-deficit/hyperactivity disorder such as attention deficits, agitation and impulsivity are the most frequent attendant symptoms of autism spectrum disorders. She reminds that often, persons with Asperger´s syndrome or high-functional autism in early childhood are diagnosed first with attention-deficit/hyperactivity disorder. Anxiety disorders belong to the most common comorbidities of autism spectrum disorders (Noterdaeme, 2017c). Changes in sleeping and eating behavior can be a sign for anxiety or a depressive impairment and should be evaluated (American Psychiatric Association, 2013). In adolescent and early adulthood, depressive disorders are major comorbidities, especially in Asperger´s syndrome (Noterdaeme, 2017c). Thereby, clinical practice exhibits that depressive-anxious symptoms come to the foreground in people with autism spectrum disorder and average intellectual capabilities (Noterdaeme and Wriedt, 2010). Noterdaeme (2017c) describes, additionally, the occurrence of compulsive disorders and acute stress reactions with years of existing cognitive and social overload in adolescence and adulthood. Even specific learning difficulties (literacy and numeracy) and developmental coordination disorders are frequently comorbidities (American Psychiatric Association, 2013). Noterdaeme (2017c) notes that some preschool children with autism spectrum disorder present auto-aggressive or aggressive behavior. Aggressive behavior often correlates with low intellectual capabilities, low skills in expressive language, social impairment, and repetitive behavior (Noterdaeme, 2017c). She also states that children of school age may suffer from tic disorders. Some individuals with autism spectrum disorder show an avoidant-restrictive food intake disorder; narrow and extreme food preferences exist (American Psychiatric Association, 2013). The often extremely unilateral eating behavior is caused by sensory peculiarities in the tactile-kinesthetic area (Noterdaeme, 2017b). Noterdaeme (2017c) emphasizes that autism spectrum disorders are no longer considered a

form of schizophrenia; these are nosologically separable disorders. However, neuropsychological overlaps are found in the areas of executive functions, theory of mind, and social interaction (Noterdaeme, 2017c).

Epilepsy, sleep problems, and constipation are common comorbid medical conditions and should be registered as "associated with a known medical/genetic or environmental/acquired condition" (American Psychiatric Association, 2013). The association between autism spectrum disorders and epilepsy has been known for a long time (Ensslen and Enders, 2017). Remschmidt and Kamp-Becker (2011) refer to epilepsy as the most common comorbidity among individuals with infantile autism (20-30%). In accordance with Ensslen and Enders (2017), epilepsy occurs age-dependent in autism spectrum disorders with two frequency peaks: in early childhood (3-5 years) and adolescence. Risk factors for the development of epilepsy in people with autism spectrum disorder are an intellectual disability and the female gender (Ensslen and Enders, 2017). They describe that epilepsy in autism spectrum disorder does not present the characteristic types of seizures or epilepsy syndromes. Common epilepsy syndromes in autism spectrum disorders are the West syndrome, the Lennox-Gastaut syndrome, the CSWS syndromes and the Dravet syndrome (Ensslen and Enders, 2017).

According to Enders (2017c), people with autism spectrum disorder often display sensomotoric peculiarities. She notes that changes in sensory perception, such as altered responsiveness to sensory stimuli, excessive sensory sensitivity to touch, noise, texture, sense of taste, and sensory-seeking behavior may occur. Further, Enders (2017c) writes that numerous studies have examined the motor skills of people with autism spectrum disorder. Thereby, e.g., deficits in fine motor skills and difficulties in movement coordination and balance are determined (Enders, 2017c). Limitations in motor skills are found in children

with infantile autism as well as in adolescents and adults with high-functioning autism independent of the intellectual capabilities (Enders, 2017c).

4.1.5 Course and prognosis

People with autism spectrum disorder typically have the ability to learn and to compensate some of their impairments, and most individuals benefit at least in some fields from a developmental gain in the later childhood (American Psychiatric Association, 2013). According to the American Psychiatric Association (2013), just a minority shows deterioration in behavior during adolescence. They maintain, however, that only a small number of people with autism spectrum disorder can work and live independently. The basis for an independent life is possessing good intellectual abilities and language skills (American Psychiatric Association, 2013). The American Psychiatric Association (2013) marks that their special interests can be an advantage in particular work areas. Nevertheless, many may have problems to organize daily life activities and need help from outside (American Psychiatric Association, 2013).

Important prognostic factors are intellectual disability, language impairment, additional mental and physical problems: epilepsy, for example, is associated with greater impairment by intellectual disability and lower language skills (American Psychiatric Association, 2013).

As per the World Health Organization (2017), persons with autism spectrum disorder and their families mostly experience emotional and economic burdens. They emphasize that if the access to support is deficient, the care of severely impaired individuals can be challenging. Unfortunately, individuals with autism spectrum disorder suffer from stigmas, discrimination, and human rights violations and even the support in this matter is insufficient (World Health Organization, 2017).

4.1.6 Etiology

The precise etiology of autism spectrum disorders is still unexplained (Remschmidt and Kamp-Becker, 2011). The genesis is multifactorial and remains unclear in most cases, despite modern diagnostics (Rost, 2017). Numerous causes are discussed, e.g., genetic and environmental factors (World Health Organization, 2017).

A considerable influence of genetic factors is undisputed (Remschmidt and Kamp-Becker, 2011). According to Noterdaeme (2011), twin studies suggest a heritability above 90%. But, as expected, she stresses that an "autism gene" has not been found, because previous twin and family studies, as well as current molecular genetic and array-comparative genomic hybridization studies, point to a genetic heterogeneity. De novo mutations and syndromes cause 10-20% of autism spectrum disorders and, therefore, the reasons for 80-90% are still unknown (Noterdaeme, 2011). Noterdaeme (2011) notes that the probability of reoccurrence decreases strongly for second- and third-degree relatives and that speaks against a defect in only one gene. Currently, a significant involvement of 3-4 genes is assumed (Noterdaeme, 2011). In some genetic syndromes, which are often associated with intellectual disability, autistic symptoms may occur as part of the behavioral phenotype (Enders and Rost, 2017). Enders and Rost (2017) find that the frequency of autism spectrum disorders due to a specific medical cause ranges from 6% to 24%. The best known monogenic inherited syndromes associated with autistic symptoms are tuberous sclerosis, Fragile X syndrome, Rett syndrome, and Smith-Lemli-Opitz syndrome (Enders and Rost, 2017). Syndromes such as microdeletion 22q11.2, Phelan-McDermid syndrome (del 22q13), Angelman syndrome, Prader-Willi syndrome (del 15q11-13), Smith-Magenis syndrome (del 17p11.2), and Potocki-Lupski syndrome (dup 17p11.2) are caused by microdeletion or microduplication and should be considered as differential diagnoses (Enders and Rost, 2017).

Various biological and psychosocial risk factors of autism spectrum disorders can be mentioned. Prenatal biological risk factors such as an advanced age of the parents (> 35 years), primipara, an infection with rubella and cytomegalovirus during pregnancy, a fetal exposure to valproate, maternal diabetes and obesity, an increased concentration of adrenocortical hormones in the amniotic fluid, and inflammatory and autoimmune diseases of the mother are discussed (Enders, 2017b). Perinatal and postpartum risk factors are premature birth, a low Apgar score (after 1 minute < 7), hyperbilirubinaemia, and low birth weight (Enders, 2017b). Often, it is suspected that birth complications are implicated in the genesis of autism spectrum disorders (Noterdaeme, 2011). Noterdaeme (2011) point out that in most of the occasions, however, a difficult birth is the result of a genetic mutation and not the cause of the disorder. In some cases, severe cerebral hemorrhages around the birth can cause an autism spectrum disorder (Noterdaeme, 2011). According to Ensenauer and Enders (2017), autistic behavior is described in a few congenital neurometabolic disorders: symptoms of autism spectrum disorders may occur in disorders of purine and pyrimidine metabolism, creatine deficiency syndromes, mitochondriopathies and individual enzyme defects. However, an autism spectrum disorder can only be explained in a few people by a congenital neurometabolic disorder (Ensenauer and Enders, 2017). The World Health Organization (2017) emphasizes that an initially assumed association between autism spectrum disorder and mumps, measles and rubella vaccine has been refuted. They note that due to methodological flaws made in previous research, these causal relations were expected erroneously. According to the World Health Organization (2017), no other childhood vaccine is known to increase the risk of autism spectrum disorders. There is also no evidence that the ingredients *thiomersal preservative* and *aluminum adjuvants of vaccines* increase the risk of an autism spectrum disorder (World Health Organization, 2017). Enders (2017a) describes an association of autism spectrum disorders with chronic inflammatory diseases or

autoimmune processes is also discussed. The cerebral folic acid deficiency syndrome should be considered as a differential diagnosis in autism spectrum disorders (Enders, 2017a).

Bormann-Kischkel and Ullrich (2017) indicate that many experiments looked for impaired cognitive functions as the cause of autism spectrum disorders. There are several psychological theories for the cause of autism spectrum disorders, such as deficits in theory of mind, affective-social disorder, executive dysfunction, lack of central coherence and impaired self-development (Bormann-Kischkel and Ullrich, 2017). Noterdaeme (2011) illustrates that extreme neglect in the first years of life as found in Romanian children's homes – like malnutrition, numerous infections, no permanent caregivers and no playing facilities may increase autism-specific behaviors. Because this kind of deprivations are extremely rare, emotional and physical neglect is mostly not a reason for autism spectrum disorder (Noterdaeme, 2011).

4.1.7 Diagnostical procedures

The first symptoms of an autism spectrum disorder are registered quite early. Noterdaeme and Hutzelmeyer-Nickels (2010) indicate in their German study that first symptoms are recognizable in children with autism with median age of 15 months and in children with Asperger's syndrome at a mean age of 26 months. Their research shows that the first symptoms are predominantly core symptoms such as language, communication, and social interaction difficulties. Nevertheless, Noterdaeme and Hutzelmeyer-Nickels (2010) emphasize that the diagnosis is made late: at an average age of 76 months in children with autism and at a mean age of 110 months on children with Asperger's syndrome, which results in a large delay between the first registered symptoms by the parents and the age at which a diagnosis is made. According to Noterdaeme and Hutzelmeyer-Nickels (2010), there are several reasons for the diagnostic delay. They recorded that the triad of core symptoms is

often overlooked, which could indicate a lack of knowledge and training in assessing children with autism spectrum disorders. Even symptoms can be more or less apparent because autism spectrum disorders have dimensional aspects (Noterdaeme and Hutzelmeyer-Nickels, 2010). For this reason, pediatricians may find it difficult to recognize children with autism spectrum disorder in primary care and refer them to specialized centers in good time (Noterdaeme and Hutzelmeyer-Nickels, 2010). Another reason, determined by Noterdaeme and Hutzelmeyer-Nickels (2010), for the late diagnosis is the scarcity of clinical expertise in primary care centers. Despite obligatory medical check-ups in the early childhood, no specific screening exists in Germany, and furthermore, it should be emphasized that only a few specialized centers with autism spectrum disorders expertise exist (Noterdaeme and Hutzelmeyer-Nickels, 2010).

According to Noterdaeme (2017a), the diagnosis of autism spectrum disorders is based on the description of behavior. There are no laboratory tests for infantile autism available (Noterdaeme, 2017a). The diagnostic process is time-consuming and requires several appointments, sometimes a longer observation period of several months, and consists of different elements, as listed below:

- information from parents or caregivers
  (e.g., early history of development, family history or medical history);
- observation and psychiatric evaluation
  (e.g., core symptoms – especially social problems or anxious-compulsive behavior –, additional psychiatric problems – attention problems, aggressiveness, depression, anxiety or self-injury –, regular follow-up);
- neuropsychological evaluation
  (level of intelligence, language and communication, theory of mind, executive functions, central coherence, adaptive behavior, functional level in everyday life);

- medical evaluation

  (genetic analysis, EEG/CCT/MRI, physical and neurodevelopmental examination, metabolic screening, exclusion of hearing and visual impairments)

(Noterdaeme, 2017a).

Noterdaeme (2017a) notes that in recent years, instruments have been developed with the aim of a standardized diagnostic process of autism spectrum disorders. For a reliable diagnostic assessment, a distinction must be made between screening instruments and diagnostic instruments (Noterdaeme, 2017a).

Screening instruments. There are some screening instruments available for children under 36 months to differentiate an autism spectrum disorder from typical development and other developmental delays (Zwaigenbaum, 2011).

The Checklist for Autism in Toddlers (CHAT) by Baron-Cohen and colleagues (Baron-Cohen, Allen and Gillberg, 1992) was the first screening instrument to identify very young children with autism spectrum disorder through a questionnaire (Zwaigenbaum, 2011). It was developed to screen children between18 months and 3 years old by the pediatrician in primary care and consists of nine yes/no questions and five characteristics in behavioral observation (Noterdaeme, 2017a). The Checklist for Autism in Toddlers (CHAT) is the only screening measure rated in a general population sample but shows a very low sensitivity (Zwaigenbaum, 2011).

According to Zwaigenbaum (2011), the questionnaires completed by the parents – the Modified Checklist for Autism in Toddlers (M-CHAT) (Robins, Fein, Barton and Green, 2001) and the Infant Toddlers Checklist (ITC) (Wetherby et al., 2004) – are newer screening possibilities and both have the capability to effectively identify very young children with autism spectrum disorders. In comparison to the Checklist for Autism in Toddlers (CHAT), the Modified Checklist for Autism in Toddlers (M-CHAT) does not include an observational

part and measures a broader range of developmental areas such response to name, imitation, and motor abnormalities (Zwaigenbaum, 2011). Noterdaeme (2017a) notes that the Modified Checklist for Autism in Toddlers (M-CHAT) is suitable for children aged 24 months and consists of 23 yes/no items. It has a higher sensitivity and specificity than the CHAT (Noterdaeme, 2017a). Zwaigenbaum (2011) writes that the Infant Toddlers Checklist (ITC) comprises 24 items and one open question in which caregivers should rate the development of the 6-24-month-old child on a 3-5-point scale. While the M-CHAT is a combination of first- and second-stage screening, the Infant Toddlers Checklist (ITC) is a broadband screening tool tending toward communication delays (Zwaigenbaum, 2011). Kleinman et al., 2008 argue that one shortcoming of the Modified Checklist for Autism in Toddlers (M-CHAT) is the low positive predictive value (PPV=0.11) when using the Modified Checklist for Autism in Toddlers (M-CHAT) without a subsequent interview (using M-CHAT alone), especially for the general population sample. Therefore, it is always necessary to review the response for low-risk samples, thus causing a rise of the positive predictive value to 0.65 (Kleinman et al., 2008). Wetherby, Brosnan-Maddox, Peace and Newton (2008) found in their research that the Infant Toddlers Checklist (ITC) demonstrates a good sensitivity or true positive ratio of 93.3% to detect children with autism spectrum disorders. However, the Infant Toddlers Checklist (ITC) is unable to distinguish between autism spectrum disorder children and children with other communication delays (Wetherby, Brosnan-Maddox, Peace and Newton, 2008).

The two-stage measure Early Screening of Autistic Traits Questionnaire (ESAT) assesses children at the age s of 14 and 15 months. It shows low sensitivity and reduced validity (Zwaigenbaum, 2011).

Zwaigenbaum (2011) indicates that the Screening Tool for Autism in Two-Year-Olds (STAT) presents an effective second-level screen in a clinical setting for children between

24 and 35 months. He describes that during a structured interactive assessment, the children's behavior is observed (motor imitation, play skills, directing attention, requesting). The high-risk category of the Screening Tool for Autism in Two-Year-Olds (STAT) has an excellent agreement with the Autism Diagnostic Observation Schedule (ADOS) classification (Zwaigenbaum, 2011). It requires expertise and more training by the examiner than a questionnaire (Zwaigenbaum, 2011).

Zwaigenbaum (2011) marks that the Pervasive Developmental Disorders Screening Test - II (PDDST-II) consists of a first-stage component (children from 12 to 24 months in primary care settings) and a second-stage component (second-level screener in developmental clinics). Data on sensitivity and specificity are not available (Zwaigenbaum, 2011).

The following questionnaires are available for older children:

The Social Communication Questionnaire (SCQ) is a parent-completed questionnaire with 40 yes/no items and was designed as a screening instrument for the Autism Diagnostic Interview-Revised (ADI-R) suitable for children with a chronological age above 4 years or a mental age of at least 2 years (Rutter, Bailey and Lord, 2003). The Social Communication Questionnaire (SCQ) can be completed in less than 10 minutes (Rutter, Bailey and Lord, 2003). Noterdaeme (2017a) notes that the German version of the SCQ, the *Fragebogen zur sozialen Kommunikation* (FSK), is one of the most utilized questionnaires. There are two versions of the FSK, a lifetime version and a current version (Noterdaeme, 2017a). Noterdaeme (2017a) reports that with the questionnaire, it is possible to measure the severity of the symptoms and to evaluate whether or not an autism spectrum disorder exists. However, Zwaigenbaum (2011) does not recommend the Social Communication Questionnaire (SCQ) as an early screening measure because of insufficient data.

The parent rating scale Social Responsiveness Scale (SRS) determines the severity of an autism spectrum disorder among children between 4 and 18 years (Constantino, 2005). It

consists of 65 items and can be completed in 15 to 20 minutes (Constantino, 2005). According to Noterdaeme (2017a), the scale measures social, communicative and rigid behavior, and represents autism as a dimensional, normally distributed characteristic in the general population. She stresses that the Social Responsiveness Scale (SRS) is particularly important in identifying individuals with a mild expression of an autism spectrum disorder who require treatment. In studies to differentiate autism spectrum disorders from social phobias and externalized behavior, the questionnaire shows good results (Noterdaeme, 2017a).

The Marburg Rating Scale for Asperger's Syndrome (MBAS) is a screening instrument for children and adults aged between 6 and 24 years to identify Asperger´s syndrome, and consists of 57 questions with a five-point rating scale (Kamp-Becker and Remschmidt, 2005). The questions can be summarized in four scales: theory of mind, contact and play behavior; divided attention, joy, facial expression and, gestures; stereotypic and situation-adapted behavior; conspicuous language style, special interests and, motor skills (Noterdaeme, 2017a). Noterdaeme (2017a) recommends that the suspected diagnosis of Asperger`s syndrome is made if the total score is above the threshold and no delay in language development exist; the suspected diagnosis of high-functioning autism is made when the total score is above the threshold, and a significant delay in language development exists.

In reference to the German Society for Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy (DGKJP, 2016), in Germany, up to now, there is no systematic screening for autism spectrum disorders, and due to insufficient study quality, none of the existing instruments are recommended to be mandatory for screening. In the current German S3-guidelines (DGKJP, 2016), only a few are suggested as screening instruments:

- the M-CHAT (Modified Checklist for Autism in Toddlers) can be used for infants from the age of two years, even if the results have to be interpreted carefully, because of low specificity
- the FSK (*Fragebogen zur sozialen Kommunikation*) is suitable with a cutoff point of 11 for preschool and primary school children, especially in the differential diagnosis ADHS, and with a cutoff point of 15 for school children and adolescents
- the SRS (Social Responsiveness Scale) can be used from preschool children to adolescents. At a cutoff point of 75, it is possible to differentiate a high-functioning autism spectrum disorder from ADHS, conduct disorder, selective mutism and social phobia
- a high-functioning autism spectrum disorder in primary school children to adolescents can be screened by the MBAS (The Marburg Rating Scale for Asperger's Syndrome)
- the SEAS-M (*Skala zur Erfassung von Autismus-Spektrum-Störungen bei Minderbegabten*) is suitable for children, adolescents and adults with low intellectual abilities

(DGKJP, 2016)

The DGKJP (2016) suggests the following procedure depending on the screening results: In case of clinical suspicion and positive screening result, the person should be referred to a specialized center with expertise in autism spectrum disorders. If there is a negative screening result, clinically an autism spectrum disorder is unlikely, and no specific symptoms are reported, an autism spectrum disorder can be excluded. In this case, the differential diagnoses should be clarified. But, if there is a negative screening result, clinically an autism spectrum disorder is likely, and specific symptoms are reported, a timely follow-up or a referral to a specialized center should be made (DGKJP, 2016).

Diagnostic instruments. The Autism Diagnostic Interview-Revised (ADI-R) (Rutter, LeConteur and Lord, 2003) and the second edition of the Autism Diagnostic Observation Schedule (ADOS-2) (Lord, Rutter, DiLavore, Risi, Gotham and Bishop 2012) are currently the gold standard instruments to diagnose an autism spectrum disorder (National Collaborating Centre for Women's and Children's Health [UK], 2011). Bölte, Rühl, Schmötzer and Poustka (2006) note that the the Autism Diagnostic Interview-Revised (ADI-R) is suitable for children from 2 years on and comprises 93 items on early childhood development, verbal and non-verbal communication skills, language acquisition, loss of language abilities, stereotyped interests and activities, play and social interactional behavior, and comorbid symptoms (aggression, self-injury, epilepsy). The interview is conducted with parents or caregivers and takes 1.5 to 3 hours (Bölte, Rühl, Schmötzer and Poustka, 2006). Noterdaeme (2017a) indicates that the ADI-R includes five algorithms: two diagnostic algorithms for diagnosis and three current algorithms for the planning of intervention and support measures. In general, the ADI-R often tends to classify children with intellectual disabilities as autistic, and children with Asperger´s syndrome or atypical autism and average intellectual capabilities are underdiagnosed (Noterdaeme, 2017a). The Autism Diagnostic Observation Schedule (ADOS-2) is a structured method for measuring the social interaction, communication and playing behavior or imaginative play with objects for individuals assumed of having an autism spectrum disorder and consists of four modules for children of different ages according to their language abilities and an additional module for toddlers (12-30 months) (Poustka et al., 2015). Poustka et al. (2015) describe that it records the communication, language abilities, attention, expression abilities (language, gestures, facial expression), social interaction, social perception, anticipation of consequences of actions, creativity/imagination, and emotional experience. The implementation of one module takes 30-45 minutes, whereby only one module is used for one patient at a time

(Poustka et al., 2015). According to Noterdaeme (2017a), the ADOS-2 distinguishes between infantile autism and autism spectrum disorder, depending on the level of the threshold value. Both the Autism Diagnostic Interview-Revised (ADI-R) and the Autism Diagnostic Observation Schedule (ADOS-2) require expertise with autism spectrum disorders and knowledge on the use of the instruments (Noterdaeme, 2017a).

The Asperger Syndrome Diagnostic Interview (ASDI) (Gillberg, Gillberg, Rastam and Wentz, 2001) is used to diagnose Asperger´s syndrome and consists of 20 questions, which are summarized under six areas: social interaction, narrow interest patterns, routines/rituals, speech and language peculiarities, non-verbal communication problems, and motor clumsiness (Noterdaeme 2017a).

The Childhood Autism Rating Scale (CARS) (Schopler, Reichler, DeVellis and Daly, 1980) is the oldest instrument for diagnosing an autism spectrum disorder by behavioral observation and is appropriate for children from the age of 2 years to adulthood (DGKJP, 2016). The DGKJP (2016) point out that the new revised version CARS-2 was published with new items specifically for persons with high-functioning autism spectrum disorder, but validation data for CARS-2 do not exist so far

The German version of the PEP-R, the *Entwicklungs- und Verhaltensprofil für Kinder*, and of the AAPEP, the *Entwicklungs- und Verhaltensprofil für Jugendliche und Erwachsene*, are developed for educational diagnostics and follow-up in autism spectrum disorders (Noterdaeme, 2017a). Noterdaeme (2017a) states that the PEP-R is used for children with a developmental age up to 7 years. She adds that the developmental scale of the PEP-R consists of 131 items and includes cognitive and motor parts, and the behavior scale contains 43 items. The AAPEP comprises six areas (occupational skills, autonomy, leisure activities, work behavior, functional communication, interpersonal behavior) in three areas of life (clinic, life, work) (Noterdaeme, 2017a).

The *Skala zur Erfassung von Autismus-Spektrum-Störungen bei Minderbegabten* (SEAS-M) (Kraijer and Melchers, 2003) is suitable for persons between 2 and 70 years and comprises 12 items (Noterdaeme, 2017a). It serves for diagnosis and planning interventions of less gifted persons. The assessment is based on everyday situations (Noterdaeme, 2017a).

The current German S3-guidelines (DGKJP, 2016) recommend the use of the standardized instruments ADI-R, ADOS and CARS to diagnose autism spectrum disorders with clinically complex questions. The recommendations differ according to age, and clinical questions apply as follows: The ADI-R is suitable for preschool children (question infantile autism), primary school children and adolescents regardless of intellectual capabilities (question infantile autism), and primary school children and adolescents without an intellectual disability (question autism, Asperger`s syndrome or atypical autism). For preschool children (question Asperger`s syndrome or atypical autism), there is currently no valid German-speaking instrument available (DGKJP, 2016). A behavioral observation by the ADOS-2 and CARS should be conducted according to age and questions:

- infants 12-30 months, question autism or autism spectrum disorder: ADOS-2 (module for toddlers)
- preschool children 30-60 months, question autism: ADOS-2 (module 1/2), ADOS (module 1/2), CARS
- preschool children 30-60 months, question autism spectrum disorder: ADOS-2 (module 1/2), CARS
- preschool children and primary school children from 5 years on, question autism: ADOS-2 (module 2/3), CARS
- preschool children and primary school children from 5 years on, question autism spectrum disorder: ADOS-2 (module 2/3), CARS
- adolescents, question autism and autism spectrum disorder: ADOS (module 3/4)

- adults, question autism and autism spectrum disorder: currently no instrument recommended

(DGKJP, 2016)

4.1.8 Intervention

According to Noterdaeme (2011), there is no universally applicable and promising therapy for autism spectrum disorders. Every person with autism spectrum disorder requires an individually tailored therapy plan that needs to be adapted repeatedly during childhood development (Noterdaeme, 2011). There is no cure for autism spectrum disorders (World Health Organization, 2017). Remschmidt and Kamp-Becker (2011) suggest that in a holistic treatment approach, various methods are combined into a multimodal therapy plan. The therapy of autism spectrum disorders is always a long-term therapy and the interventions should be highly structured, direct and concrete (Remschmidt and Kamp-Becker, 2011).

Noterdaeme (2011) emphasizes that elements of behavioral therapy and curative education are the focus of the therapies. The following therapeutic measures are applied:

- Behavior-therapeutic early intervention programs (ABA)
- Treatment and education of autistic and communication handicapped children (TEACCH)
- Educational early intervention
- Social competence training
- Ergotherapy
- Speech therapy
- Pet therapy
- Play therapy

- Music therapy

(Noterdaeme, 2011)

The indication for psychodynamic psychotherapy is rarely provided and therapies such as diets, vitamin and mineral therapy, auditory integration training (AIT), attachment therapy and facilitated communication (FC) are usually not able to meet the high expectations (Noterdaeme, 2011).

According to Noterdaeme (2011), therapy aims are: support for social and communicative development, reduction of stereotypic behavior and rigidity, support for general learning and problem-solving skills, and assistance for families.

The treatment of autism spectrum disorders mainly focused on parental and family work, whereby, help can be given for everyday life and dealing with incomprehensible behaviors (Noterdaeme, 2011). Noterdaeme (2011) indicates that the families are also involved in the development support and behavioral stabilization. Relieving feelings of guilt can play a further role in family work (Noterdaeme, 2011). The families can find relief and support in dealing with autism spectrum disorders in self-help groups (Noterdaeme, 2011).

Noterdaeme (2011) notes that some individuals with autism spectrum disorders need temporary psychopharmacological treatment and emphasizes that in each individual case, a medication must be carefully considered, benefits and risks must be weighed. Usually, pharmacological treatment is part of a crisis intervention – and thus temporary – and does not have the function of a basic therapy, even pharmacological interventions are not curative (Noterdaeme, 2011). According to Blankenship, Erickson, Stigler, Posey and McDougle (2011), it is important to treat one target symptom at a time. They analyze that Methylphenidate (MPH) and alpha$_2$ adrenergic agonists are partially effective for hyperactive and inattentive symptoms, aggressive behavior and irritability can be treated more effectively by the antipsychotics aripiprazole, haloperidol and risperidone and selective

serotonin reuptake inhibitors (SSRIs) show efficacy for stereotypical and repetitive behaviors, which demonstrate greater improvements and fewer adverse events in adults than in children (Blankenship, Erickson, Stigler, Posey and McDougle, 2011). Nevertheless, it has to be said that still much work needs to be done to develop and test new pharmacotherapies to treat associated and core symptoms of autism spectrum disorders (McCracken, 2011).

Treatment during early childhood supports the optimal development and well-being of persons with autism spectrum disorders (World Health Organization, 2017).

4.2 Child Behavior Checklist 1.5-5

4.2.1 Use

The Child Behavior Checklist 1.5-5 has been developed to measure behavior problems of children between 1.5 and 5 years of age, in exceptional cases, it is possible to use the CBCL for children a few months younger or older than the given range of 1.5 to 5 (Achenbach and Rescorla, 2000). However, Achenbach and Rescorla (2000) note that for larger deviations the norms are less appropriate. They indicate that it is a standardized assessment form completed by parents or reference persons who see the children in family settings (for example, relatives, adoptive or foster parents, and childcare workers for children in institutional settings). The CBCL 1.5-5 is filled out in 10-15 minutes and easily assessed by computerized or manual scoring (Achenbach and Rescorla, 2000).

4.2.2 Structure

At the beginning of the form, the respondent gives information about names, relationship to the child (mother, father, other), parent's occupation and demographic information about the child, these data are the basis for scoring the socioeconomic status (Achenbach and Rescorla, 2000). As written in the manual of Achenbach and Rescorla (2000), the questionnaire contains 99 specific problem items that reflect concrete issues of behavioral/emotional function and asks the respondent to rate the behavior over the previous two months on a three-point scale (0 for not true, 1 for somewhat or sometimes true, 2 for very true or often true). Several items can be described with own words and at the open-question item 100, any additional problems that had not asked previously should be reported (Achenbach and Rescorla, 2000). At the end of the CBCL 1.5-5, the respondent is asked to write about any illnesses or disabilities (physical or mental) of the child, about what raises

the most concerns about the child, as well as about the best things about him/her (Achenbach and Rescorla, 2000). This descriptive information completes the picture of the child and can be used for discussion with the respondent (Achenbach and Rescorla, 2000).

4.2.3 Analysis

The item analysis results in seven syndrome scales (Emotionally Reactive, Anxious/Depressed, Somatic Complaints, Withdrawn, Sleep Problems, Attention Problems, Aggressive Behavior), five DSM-oriented scales (Affective Problems, Anxiety Problems, Pervasive Developmental Problems, Attention Deficit/Hyperactivity Problems, Oppositional Defiant Problems) and three summary scales (Internalizing Problems, Externalizing Problems, Total Problems) and an additional scale: Stress Problems (Achenbach and Rescorla, 2000). Achenbach and Rescorla (2000) stress that the DSM-oriented scales are consistent with the Diagnostic and Statistical Manual (DSM-IV) of the American Psychiatric Association and are inspected for consistency with the DSM categories by experienced psychiatrists and psychologists.

The distinction Internalizing/Externalizing constitutes a more global grouping of problems compared to the syndrome scales: the Internalizing Problems scale consists of four syndrome scales (Emotionally Reactive, Anxious/Depressed, Somatic Complaints, Withdrawn), which represent problems themselves without medical cause and the Externalizing Problems scale comprises two syndrome scales (Attention Problems and Aggressive Behavior) and reflects conflicts with other persons (Achenbach and Rescorla, 2000). Interestingly, the relation between these two summary scales (Internalizing and Externalizing) is analogous to the ratio between Performance IQ and Verbal IQ on the Wechsler intelligence tests (Achenbach and Rescorla, 2000). Achenbach and Rescorla (2000) note that the Sleep

Problems scale is not allocated to either of the groups because of its low loading on second-order factor analyses.

As the manual (Achenbach and Rescorla, 2000) says the sum of all 99 items (1 and 2 scores) plus the highest score (1 or 2) at item 100 (any problems) includes the Total Problems scale and represents the highest ranking level. The "Other Problems" are not combined into an own scale on the profile, because those are included in the Total Problem scale and do not belong to any syndrome (Achenbach and Rescorla, 2000).

4.2.4 Evaluation

The profiles show the scores for each syndrome of the child related to scores for normative samples of peers (Achenbach and Rescorla, 2000). As per Achenbach and Rescorla (2000), scores are transformed to T-scores with a similar meaning for each scale: Clinical range is indicated by a T-score of ≥70 on the syndrome and DSM-oriented scales, and by a T of ≥64 on the summary scales. T-scores between 65 and 69 on the syndrome and DSM-oriented scales, or between 60 and 63 on the summary scales, indicate the borderline range. These scores are reported to be of clinical concern. Scores below these figures indicate the normal range. Achenbach and Rescorla (2000) assess that because the summary scales (Internalizing, Externalizing, and Total Problems) include more numerous and diverse problems than the syndrome scales, lower cut points were defined, the syndrome scales contain smaller, homogeneous problems, so higher scores on these scales are required. The minimum of a scale represents a T-score of 50 in the profile; it is assumed that most children have at the least some problems (Achenbach and Rescorla, 2000).

4.2.5 Interpretation

The profile represents a description of a child's behaviour and should always be supplemented with data from multiple sources to provide a comprehensive picture of the child (Achenbach and Rescorla, 2000). Therefore, Achenbach and Rescorla (2000) warn that the form should not be used as a sole source for clinical evaluation. They explain that the Total Problems scale indicates a global index of the child´s problems and can be the basis for comparing different groups and evaluating changes in the function or outcome of interventions. If the evaluation results in extremely low scores on a scale, it can be assumed that problems were not reported or other reasons for these low scores could be that the respondent is poorly informed about the child, did not understand the form or is not being honest in his/her answers (Achenbach and Rescorla, 2000). Achenbach and Rescorla (2000) stress that, in addition, social desirability also affects the outcome. Extremely high or low scores on the Total Problem scale must be followed up at all times (Achenbach and Rescorla, 2000).

4.2.6 Features

If the child has different caregivers, each of them can complete a questionnaire; separate norms do not have to be considered (Achenbach and Rescorla, 2000). Achenbach and Rescorla (2000) note that different profiles can be used to identify differences and similarities in problems from various perspectives and to arrange appropriate interventions. The CBCL 1.5-5 has been translated into 58 languages (Achenbach and Rescorla, 2000). Respondents with low reading ability can still complete the questionnaire orally with the help of an interviewer (Achenbach and Rescorla, 2000). Furthermore, adequate reliability and validity are reported (Achenbach and Rescorla, 2000; Ivanova et al., 2010; Pandolfi, Magyar and Dill, 2009).

5. Identifying children at risk of autism spectrum disorder with the Child Behavior Checklist 1.5-5

5.1 Method

5.1.1 Participants

> A total number of 183 children aged 25–71 months (126 males, 57 females, mean age 53.8 months, standard deviation . . . = 11.7) participated in the study.
>
> The experimental group included 80 children diagnosed with [autism spectrum disorder] . . . (infantile autism (F 84.0) and asperger syndrome (F 84.5); 60 males, 20 females, mean age 53.2 months, [standard deviation] . . . = 10.7, range 25–71 months). The control group consisted of 103 children (66 males, 37 females, mean age 54.4 months, [standard deviation] . . . = 12.5, range 25–71 months), all with a diagnosis of [other psychiatric disorder] . . . . The diagnoses of the sample are adjustment disorders, developmental disabilities (except pervasive developmental disorders), behavioural and emotional disorders, and intellectual disabilities. Many of the children have more than one diagnosis (for details see Table 1). [3] (Limberg et al., 2017, p. 369-370)

[3] From Gruber and Noterdaeme (2017). The German version of the Child Behavior Checklist 1.5-5 to identify children with a risk of autism spectrum disorder, *Autism, 21*(3), p. 369-370. DOI: 10.1177/1362361316645932. Copyright © [2016] (The Authors). Reprinted by permission of SAGE Publications.

Table 1

Identify children with a risk of autism spectrum disorder - Diagnoses of the control group (OPD)

	N
Reaction to severe stress and adjustment disorders (F4)	21
Adjustment disorders (F43)	21
Developmental disabilities (F8)	125
Speech and language (F80)	85
Motor functions (F82)	31
Combined (F83)	2
Unspecified (F89)	1
Behavioural and emotional disorders (F9)	37
Attention-deficit hyperactivity disorders (F90)	21
Conduct disorders (F91)	4
Combined (F92)	2
Emotional disorders (F93)	3
Disorder of social functioning (F94)	1
Other (F98)	6
Intellectual disabilities (F7)	1

Notation. OPD: other psychiatric disorder.

From Limberg, Gruber and Noterdaeme (2017). The German version of the Child Behavior Checklist 1.5-5 to identify children with a risk of autism spectrum disorder, *Autism, 21*(3), p. 370. DOI: 10.1177/1362361316645932. Copyright © [2016] (The Authors). Reprinted by permission of SAGE Publications.

"All children were recruited from and diagnosed at the Department of Child and Adolescent Psychiatry and Psychotherapy and the Interdisciplinary Early Intervention Centre at Josefinum Hospital in Augsburg, Germany, between February 2013 and February 2014" (Limberg et al., 2017, p. 370). The diagnostic analysis was based on ICD-10 criteria (Dilling, Mombour and Schmidt, 2011) confirmed by the Autism Diagnostic Observation Schedule-Generic (ADOS-G) (Lord, Rutter, DiLavore, Risi, Gotham and Bishop 2012) and Autism Diagnostic Interview-Revised (ADI-R) (Rutter, LeConteur and Lord, 2003). The diagnosis was confirmed by an experienced child psychiatrist with expertise in autism. "In the control groups [other psychiatric disorders] . . . , a diagnosis of [autism spectrum disorder] . . . or another pervasive developmental disorder was strictly excluded" (Limberg et al., 2017, p. 370).

5.1.2 Procedures

"Based on the manual (Achenbach and Rescorla, 2000), the CBCL 1.5–5 was filled out by parents and others who see children in family settings. The questionnaires were computer-scored by a software for Achenbach System of Empirically Based Assessment (ASEBA) forms" (Limberg et al., 2017, p. 370). Questionnaires with more than eight unanswered items (item 100 excluded) were eliminated from the study. If the respondent circled two scores (1 and 2) or marked unclearly, score 1 was transferred (Achenbach and Rescorla, 2000). In the present study most of the CBCL 1.5-5 were completed during the diagnosis process.

5.1.3 Data analyses

All scales of the CBCL 1.5–5 and the group characteristics, age and gender were tested for normal distribution using the Kolmogorov–Smirnov test. None of them showed normality. Comparing the experimental group with the control group on age, the Mann–Whitney U test was used. The chi-square test examined the difference in gender between the two groups.

The logistic regression analysis with Exp(B) was used to identify significant CBCL scales distinguishing [autism spectrum disorder] . . . from [other psychiatric disorders] . . . . For that, different logistic regression models were constructed. The dependent variable ([autism spectrum disorder] . . . , yes or no) was invariant. The independent variable consisted of different CBCL scales and differentiated between the models. In model 1, the independent variable was the Total Problems scale; in model 2, the independent variables were the Internalizing and Externalizing Problems scales; in model 3, the independent variables were all syndrome scales; in model 4, the independent variables were all DSM-oriented scales; and in model 5, the independent variable was the Stress Problems scale.

In the following receiver operating characteristics (ROC) analysis, the CBCL scales with a predictive value for an [autism spectrum disorder] . . . diagnosis, identified in the logistic regression analysis, were examined to detect their optimal cutoff points. The cutoff point describes the optimal compromise between sensitivity (true positive rate) and specificity (true negative rate), with the intention to discriminate between children with [autism spectrum disorder] . . . and [other psychiatric disorders] . . . . To evaluate the accuracy of the diagnostic instrument, the area under the curve (AUC) was used. Based on criteria of Swets (1988), the [area under the curve] . . .

value was interpreted as low diagnostic accuracy for AUC < 0.7, moderate diagnostic accuracy for AUC range 0.7-0.9 and high diagnostic accuracy for AUC > 0.9.

For each optimal cutoff point, the positive predictive value (PPV; proportion of a positive test result that is true positive), negative predictive value (NPV; proportion of a negative test result that is true negative), and odds ratio (OR) were calculated.

To adjust the level of significance related to the problem of multiple testing, the Bonferroni correction was used, with the result of $p < 0.007$. The data were analyzed with the assistance of SPSS version 20. [4] (Limberg et al., 2017, p. 370-371)

5.2 Results

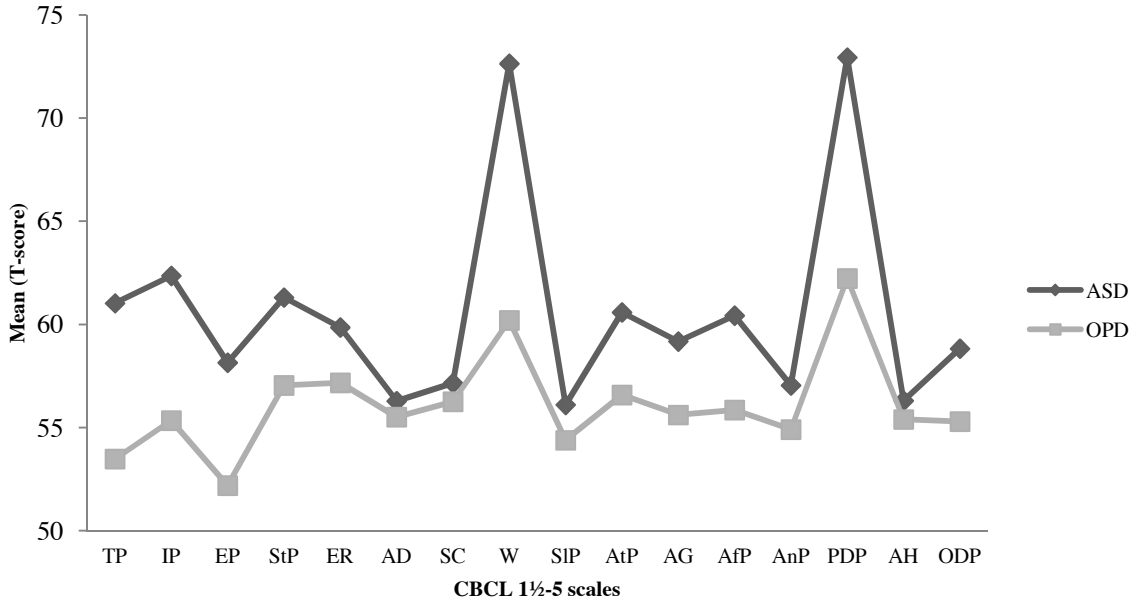
5.2.1 Preliminary analyses

A total of 183 children with the mean age of 53.8 months ([standard deviation] . . . = 11.7) participated in the study. The children with an [autism spectrum disorder] . . . diagnosis (mean age 53.2 months, [standard deviation] . . . = 10.7) were younger than the children with [another psychiatric disorders] . . . diagnosis (mean age 54.4 months, [standard deviation] . . . = 12.5). The Mann–Whitney U test was used to test the influence of age and showed no significant difference among the two groups ($p = 0.344$). Group differences on gender were calculated with the chi-square test. The percentage of males in the [autism spectrum disorder] . . . group (75% males, 25% females) were higher than in the [other psychiatric disorders] . . . group (64.1% males, 35.9% females), but the difference was statistically not significant (chi-square = 2.505, $p = 0.114$). [5] (Limberg et al., 2017, p. 371)

[4, 5] From Gruber and Noterdaeme (2017). The German version of the Child Behavior Checklist 1.5-5 to identify children with a risk of autism spectrum disorder, *Autism, 21*(3), p. 370-371. DOI: 10.1177/1362361316645932. Copyright © [2016] (The Authors). Reprinted by permission of SAGE Publications.

5.2.2 Clinical characteristics

"On first examination the comparison of means showed that the children with an [autism spectrum disorder] . . . diagnosis presented higher mean values with varying extent on all CBCL scales than the children with [other psychiatric disorders] . . . diagnosis (see Figure 1)" (Limberg et al., 2017, p. 371).



Notations. TP: Total Problems; IP: Internalizing Problems; EP: Externalizing Problems; StP: Stress Problems; ER: Emotionally Reactive; AD: Anxious/Depressed; SC: Somatic Complaints; W: Withdrawn; SlP: Sleep Problems; AtP: Attention Problems; AG: Aggressive Behavior; AfP: Affective Problems; AnP: Anxiety Problems; PDP: Pervasive Developmental Problems; AH: Attention Deficit/Hyperactivity Problems; ODP: Oppositional Defiant Problems; CBCL: Child Behavior Checklist; ASD: autism spectrum disorder ; OPD: other psychiatric disorder

From Limberg, Gruber and Noterdaeme (2017). The German version of the Child Behavior Checklist 1.5-5 to identify children with a risk of autism spectrum disorder, *Autism, 21*(3), p. 371. DOI: 10.1177/1362361316645932. Copyright © [2016] (The Authors). Reprinted by permission of SAGE Publications.

Figure 1. Identify children with a risk of autism spectrum disorder - Mean values of CBCL T-scores

In the logistic regression analysis with Exp(B), comparing the two groups, the CBCL scales Withdrawn (Exp(B) = 1.14, 95% confidence interval (…) 1.10–1.19), [Pervasive Developmental Problems] . . . (Exp(B) = 1.14; 95% [confidence interval] . . . 1.09–1.20), and Total Problems (Exp(B) = 1.06; 95% [confidence interval] . . . 1.03–1.09) were detected as scales with a significant predictive value of a risk for an [autism spectrum disorder] . . . diagnosis ($p < 0.001$). The results of the logistic regression analysis are represented in Table 2. (Limberg et al., 2017, p. 371)

Table 2

Identify children with a risk of autism spectrum disorder - Mean values and logistic regression analysis with Exp(B) on CBCL 1.5-5 T-scores

CBCL scales	ASD (N=80)	OPD (N=103)	Logistic regression with Exp(B) and 95% CI		
			ASD versus OPD		
			p	Exp(B)	95% CI
Total Problems	61.03	53.48	<0.001	1.06	1.03–1.09
Internalizing Problems	62.36	55.35	0.010	1.06	1.01–1.10
Externalizing Problems	58.15	52.20	0.572	1.01	0.97–1.05
Stress Problems	61.31	57.05	0.080	1.06	0.99–1.13
Emotionally Reactive	59.86	57.18	0.194	0.95	0.88–1.03
Anxious / Depressed	56.29	55.52	0.347	0.97	0.90–1.04
Somatic Complaints	57.16	56.26	0.540	0.98	0.93–1.04
Withdrawn	72.64	60.20	<0.001	1.14	1.10–1.19
Sleep Problems	56.11	54.39	0.927	1.00	0.95–1.06
Attention Problems	60.59	56.59	0.227	1.04	0.98–1.09
Aggressive Behavior	59.18	55.62	0.662	1.01	0.96–1.08
Affective Problems	60,43	55,86	0,771	1,01	0,95–1.07
Anxiety Problems	57.05	54.91	0.054	0.95	0.89–1.00
Pervasive Developmental Problems	72.94	62.23	<0.001	1.14	1.09–1.20
Attention Deficit/Hyperactivity Problem	56.31	55.40	0.124	0.95	0.89–1.01
Oppositional Defiant Problems	58.83	55.30	0.429	1.02	0.97–1.08

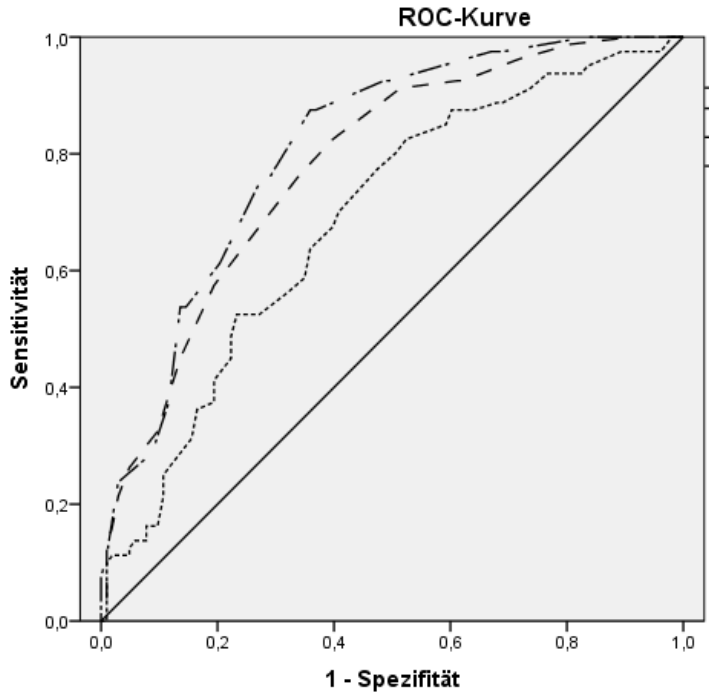
Notations. Exp(B): Odds; CBCL: Child Behavior Checklist; CI: confidence interval; ASD: autism spectrum disorder; OPD: other psychiatric disorder.

From Limberg, Gruber and Noterdaeme (2017). The German version of the Child Behavior Checklist 1.5-5 to identify children with a risk of autism spectrum disorder, *Autism, 21*(3), p. 372. DOI: 10.1177/1362361316645932.

5.2.3 Receiver operating characteristics (ROC) analyses

> In the [receiver operating characteristics] ROC analysis, the optimal cutoff points for the predictor CBCL scales Withdrawn, [Pervasive Developmental Problems] . . . , and Total Problems were identified. To discriminate children with [autism spectrum disorder] . . . from children with [other psychiatric disorders] . . . , the optimal cutoff point on the Withdrawn scale was determined at a score of T = 60.5 (sensitivity = 0.88, specificity = 0.63). The ROC curve shown in Figure 2 (a graphical plot of 1-specificity against sensitivity) represented for this cutoff point an [area under the curve] . . . of 0.809 and indicated in that way a moderate diagnostic accuracy. A . . . [positive predictive value] of 0.65, an . . . [negative predictive value] of 0.87, and an . . . [odds ratio] of 12 were calculated. For the CBCL scale [Pervasive Developmental Problems] . . . , the optimal compromise between sensitivity (0.83) and specificity (0.60) to discriminate the [autism spectrum disorder] . . . group from the [other psychiatric disorders] . . . group was made at a cutoff point of T = 64.5. Using this cutoff point, an [area under the curve] . . . with a moderate diagnostic accuracy of 0.781 was indicated. The calculation showed a . . . [positive predictive value] of 0.62, an . . . [negative predictive value] of 0.82, and an . . . [odds ratio] of 7. The best cutoff point for the Total Problems scale discriminating the two groups was at a score of T = 52.5 (sensitivity = 0.80, specificity = 0.50). An . . . [area under the curve] of 0.686 on this cutoff point showed only a low diagnostic accuracy. The examination of the values for . . . [positive predictive value] (0.55), . . . [negative predictive value] (0.76), and . . . [odds ratio] (4) resulted in much lower values than on the other scales (see Table 3). [6] (Limberg et al., 2017, p. 371-372)

[6] From Gruber and Noterdaeme (2017). The German version of the Child Behavior Checklist 1.5-5 to identify children with a risk of autism spectrum disorder, *Autism, 21*(3), p. 371-372. DOI: 10.1177/1362361316645932. Copyright © [2016] (The Authors). Reprinted by permission of SAGE Publications.



Notation. From Limberg, Gruber and Noterdaeme (2017). The German version of the Child Behavior Checklist 1.5-5 to identify children with a risk of autism spectrum disorder, *Autism, 21*(3), p. 372. DOI: 10.1177/1362361316645932. Copyright © [2016] (The Authors). Reprinted by permission of SAGE Publications.

Figure 2. Identify children with a risk of autism spectrum disorder - ROC curve for Pervasive Developmental Problems (PDP) (T=64.5), Withdrawn (T=60.5), and Total Problems (T=52.5).

– · – · – Withdrawn; - - - - PDP; ····· Total Problems; —— reference line.

Table 3

Identify children with a risk of autism spectrum disorder - Sensitivity, Specificity, PPV, NPV, AUC, diagnostic accuracy and OR at the optimal cutoff points on the Total Problems, Withdrawn, and PDP scales.

	Total Problems (Cutoff T=52.5)	Withdrawn (Cutoff T=60.5)	PDP (Cutoff T=64.5)
Sensitivity	80%	88%	83%
Specificity	50%	63%	60%
PPV	55%	65%	62%
NPV	76%	87%	82%
AUC	0.686	0.809	0.781
AUC interpretation for diagnostic accuracy	low	moderate	moderate
OR	4	12	7

Notations. PPV: positive predictive value; NPV: negative predictive value; AUC: area under the curve; OR: odds ratio; PDP: Pervasive Developmental Problems.

From Limberg, Gruber and Noterdaeme (2017). The German version of the Child Behavior Checklist 1.5-5 to identify children with a risk of autism spectrum disorder, *Autism, 21*(3), p. 373. DOI: 10.1177/1362361316645932. Copyright © [2016] (The Authors). Reprinted by permission of SAGE Publications.

6. The influence of intellectual capability on the use of the Child Behavior Checklist 1.5-5 to identify children with autism spectrum disorders

6.1 Method

6.1.1 Participants

The CBCL 1.5-5 scores of 157 children (sub-sample of the total 183 children) between 25 and 71 months of age (111 males; 46 females; mean age 55.2 months; standard deviation = 10.9) are examined.

The experimental group consisted of 58 children affected by an autism spectrum disorder (F84.0 and F84.5) (46 males; 12 females; mean age 55.3 months; standard deviation = 9.0; range 38-71 months). The sample was divided into two groups based on intellectual capability. The multiaxial system in ICD-10 (Dilling, Mombour and Schmidt, 2011) defines a below-average intelligence by an IQ value of ≤ 84. Considering measuring errors of testing, the group allocation was set to a value of 80. All children were examined by the Wechsler Preschool and Primary Scale of Intelligence (WPPSI-III) (Petermann and Lipsius, 2009) and Snijders-Oomen Nonverbal Intelligence Test (SON-R 2½-7) (Tellegen, Laros and Petermann, 2007). The first group included 31 children (26 males; 5 females) with an IQ < 80 (range 50-77; mean 57; standard deviation = 8.4) aged 40 to 70 months (mean 56.2 months; standard deviation = 9.0). Of these children, 30 had an intellectual disability (IQ ≤ 70) and 1 had low intelligence. The second group, characterized by an IQ ≥ 80 (range 80-127; mean 96; standard deviation = 12.8), consisted of 27 children (20 males; 7 females) between 38 and 71 months of age (mean 54.3 months; standard deviation = 9.0).

The control group comprised 99 children diagnosed with another psychiatric disorder (65 males; 34 females; mean age 55.2 months; standard deviation = 11.9; range 25-71 months).

The diagnoses are developmental disabilities (except pervasive developmental disorders), behavioral and emotional disorders, and adjustment disorders (for details see Table 4).

Table 4

The Influence of Intellectual Capability - ICD-10 diagnoses on axis 1 and 2 of the control group (OPD)

	N
Reaction to severe stress, and adjustment disorders (F4)	20
Adjustment disorders (F43)	20
Developmental disabilities (F8)	122
Speech and language (F80)	88
Motor functions (F82)	31
Combined (F83)	2
Unspecified (F89)	1
Behavioural and emotional disorders (F9)	37
Attention-deficit hyperactivity disorders (F90)	21
Conduct disorders (F91)	4
Combined (F92)	2
Emotional disorders (F93)	3
Disorder of social functioning (F94)	1
Other (F98)	6

Notation. OPD: other psychiatric disorder.

The intellectual capability of the OPD group is characterized by 86 children with an IQ mean value of 92 (range 50-138; standard deviation = 18.3) and 13 children with an average axis value of 3 or IQ 85-114 by the multiaxial classification scheme (Remschmidt, Schmidt and Poustka, 2009) (range 2-5; standard deviation = 1.04) based on ICD-10.

6.1.2 Data analyses

The analysis to identify children at risk for autism spectrum disorder determined the CBCL 1.5-5 scales Pervasive Developmental Problems and Withdrawn as predictor scales of risk for an autism spectrum disorder diagnosis. These scales are able to distinguish children with autism spectrum disorders from children with other psychiatric disorders.

A comparison of means and logistic regression analysis with Exp(B) was performed to confirm these findings in this sub-sample. The optimal cutoff points of the two scales were examined in the receiver operating characteristics (ROC) analysis. For this purpose, the optimal compromise between sensitivity and specificity were determined. The area under the curve (AUC) indicated the accuracy of the diagnostic instrument while the criteria of Swets (1988) were utilized: an AUC < 0.7 corresponds to a low diagnostic accuracy, an AUC 0.7-0.9 to a moderate diagnostic accuracy, and an AUC > 0.9 to a high diagnostic accuracy. Further, the positive and negative predictive values (PPV/NPV) and the odds ratios (ORs) for each optimal cutoff point were calculated.

To examine the influence of various intellectual capabilities on the CBCL 1.5-5 scales Pervasive Developmental Problems and Withdrawn, a correlation analysis was performed. For this purpose, a correlation analysis of the first experimental group (IQ < 80) and second experimental group (IQ ≥ 80) was run separately to test whether the different IQ ranges correlate with one of the CBCL 1.5-5 scales. According to Bühl (2012), the correlation coefficient determines the strength or weakness of a relationship between two variables and

depends on the variables` scale level. Because the variable IQ measures on an ordinal scale, the rank correlation coefficient Kendall`s tau (τ) was used in the present research (Bühl, 2012). Jackson (2015) explains that a correlation coefficient ranges between -1 and +1, whereby a value of 1 indicates a perfect/strong correlation, and 0 indicates no correlation between the variables. Therefore, a positive sign implies a direct connection between the variables which means that an increase (decrease) of one variable corresponds to an increase (decrease) of the other (Jackson, 2015). A negative correlation coefficient stands for an inverse relationship, whereby an increase (decrease) of one variable is related to a decrease (increase) of the other (Jackson, 2015). The strength of a relationship between two variables is assessed by the value of the correlation coefficient and interpreted as follows: 0.0-0.2 very weak, 0.2-0.5 weak, 0.5-0.7 moderate, 0.7-0.9 strong, 0.9-1.0 very strong correlation (Bühl, 2012). Jackson (2015) emphasizes that a correlation between two variables indicates only a relationship; they do not indicate causality. However, a prediction from one to the other variable is possible (Jackson, 2015).

According to the correlation analysis, a renewed receiver operating characteristics analysis of the identified CBCL 1.5-5 scales with an IQ correlation was carried out. In the process, the optimal cutoff points to distinguish between children with autism spectrum disorders from children with other psychiatric disorders , area under the curves, positive predictive values, negative predictive values, and odds ratios depending on the group allocation (IQ $<$ or $\geq$ 80) were calculated.

Finally, the results of the receiver operating characteristics analyses, with and without intellectual consideration, were compared.

Because of multiple testing, the level of significance was adjusted to $p < 0.006$ by the use of Bonferroni correction. Analyses were carried out with the support of SPSS version 20.

6.2 Results

6.2.1 Clinical characteristics

The comparison of means showed that the autism spectrum disorder children presented higher mean values on the CBCL scales compared to the other psychiatric disorder children.

In the logistic regression analysis with Exp(B), significant differences ($p < 0.001$) between the two groups on the CBCL scale Withdrawn (Exp(B) = 1.11, 95% confidence interval 1.07–1.16) and Pervasive Developmental Problems (Exp(B) = 1.11; 95% confidence interval 1.06–1.15) were examined (see Table 5) and confirmed the previous findings of the first analysis to identify children at risk of autism spectrum disorder.

Group differences on intellectual capability were calculated with the Mann-Whitney U test and indicated a significant difference among the two groups ($p < 0.001$).

Table 5

The influence of intellectual capability - Mean values and logistic regression analysis with Exp(B) on CBCL 1 ½-5 T-scores

CBCL scales	ASD (N=58)	OPD (N=99)	Logistic regression with Exp(B) and 95% CI		
			ASD versus OPD		
			p	Exp(B)	95% CI
Withdrawn	71.45	59.98	<0.001	1.11	1.07–1.16
Pervasive Developmental Problems	72.22	62.12	<0.001	1.11	1.06–1.15

Notations. Exp(B): Odds; CBCL: Child Behavior Checklist; ASD: autism spectrum disorder; OPD: other psychiatric disorder; CI: confidence interval.

6.2.2 Receiver operating characteristics (ROC) analyses

Aiming of differentiate between children with autism spectrum disorder and children with other psychiatric disorders, optimal cutoff points for the predictor CBCL 1.5-5 scales Withdrawn and Pervasive Developmental Problems were determined in the receiver operating characteristics (ROC) analysis. The results are presented in Table 6.

The best compromise between sensitivity (0.86) and specificity (0.64) is indicated by the cutoff point of T = 60.5 on the Withdrawn scale. The index of diagnostic accuracy is displayed by the area under the curve and indicates a value of 0.794 ($p < 0.001$), a moderate diagnostic accuracy at this point. A positive predictive value of 0.58, a negative predictive value of 0.89, and an odds ratio of 11 were identified.

On the Pervasive Developmental Problems scale, the receiver operating characteristics analysis resulted in an optimal cutoff point of T = 64.5 (sensitivity = 0.79; specificity = 0.61). The diagnostic accuracy, implied by an area under the curve of 0.765 ($p < 0.001$), is moderate. A positive predictive value of 0.54, a negative predictive value of 0.83, and an odds ratio of 6 were calculated.

The graphical plot of the ROC curves can be seen in Figure 3.

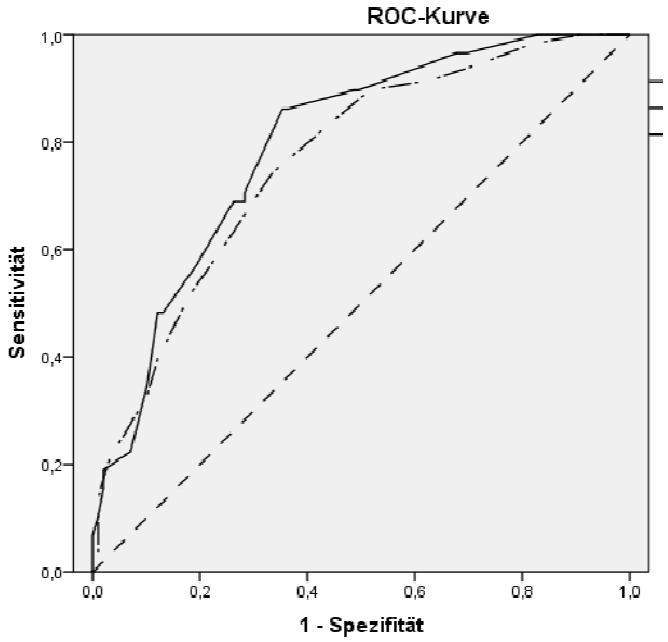


Figure 3. The influence of intellectual capability - ROC curve for Pervasive Developmental Problems (PDP) (T=64.5) and Withdrawn (T=60.5).

— Withdrawn; —··— PDP; - - - reference line.

6.2.3 Correlation analyses

Kendall`s tau (τ) correlation analyses were conducted to examine the influence of the intellectual capability on the two predictor CBCL 1.5-5 scales Withdrawn and Pervasive Developmental Problems and demonstrated a weak correlation between the intellectual level of children with autism spectrum disorder (without a group division) and these two scales (Withdrawn: $\tau = -0.265$, $p < 0.05$; Pervasive Developmental Problems: $\tau = -0.282$, $p < 0.05$).

The subdivided correlation analysis of the autism spectrum disorder group with average or above-average IQ values (≥ 80) showed that there is no correlation between these intellectual skills and the CBCL 1.5-5 scales (Withdrawn: $\tau = 0.003$, $p = 0.983$; Pervasive Developmental Problems: $\tau = -0.006$, $p = 0.966$). Also, the correlation coefficient indicated no relationship between autism spectrum disorder children with a below-average IQ (< 80)

and the scale Withdrawn ($\tau = -0.239$, $p = 0.089$). Only between autism spectrum disorder children with below-average intellectual skills or an intellectual disability (IQ < 80) and the Pervasive Developmental Problems scale, a significant correlation with a value of $\tau = -0.275$ ($p < 0.05$) was evaluated by Kendall`s tau (τ) correlation analysis. According to Bühl (2012), this amount resulted in a weak correlation (0.2-0.5). The negative correlation coefficient stands for an inverse relationship and indicates that an increase (decrease) of the IQ value is related to a decrease (increase) of the T-score on the Pervasive Developmental Problems scale.

6.2.4 Receiver operating characteristics (ROC) analysis – readjusted to IQ correlation

Regarding the weak correlation between the autism spectrum disorder group with below-average IQ (< 80) and the CBCL 1.5-5 scale Pervasive Developmental Problems, the renewed receiver operating characteristics (ROC) analysis selected the optimal cutoff point of T = 64.5. At this point, discrimination between children with autism spectrum disorder and co-occurring below-average intellectual skills and other psychiatric disorder children is possible. The sensitivity of 0.87 and specificity of 0.61 are presented in Figure 4. A moderate diagnostic accuracy was implied by an area under the curve value of 0.826 ($p < 0{,}001$).

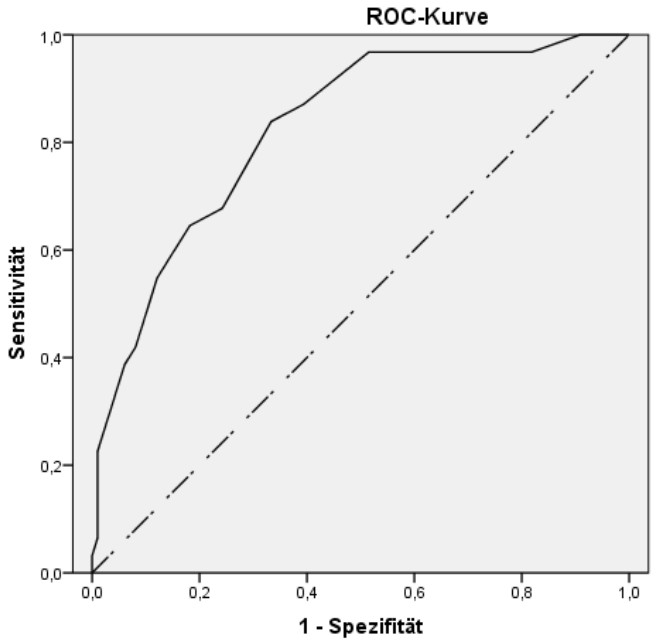


Figure 4. The influence of intellectual capability - ROC curve for Pervasive Developmental Problems (PDP) readjusted to IQ<80 (T=64.5)

—— PDP; —··— reference line

Further evaluation yielded a positive predictive value of 0.41, a negative predictive value of 0.94, and an odds ratio of 10. Table 6 lists the results.

6.2.5 Comparison between ROC analysis and readjusted ROC analysis to IQ correlation

When comparing the receiver operating characteristics analyses of the Pervasive Developmental Problems scale with and without intellectual consideration, no difference of the optimal cutoff point distinguishing autism spectrum disorder from other psychiatric disorder children was found. Both receiver operating characteristics analyses resulted in similar compromise between sensitivity and specificity at a cutoff point of T = 64.5 with a moderate diagnostic accuracy (Table 6).

Table 6

The influence of intellectual capability - Correlation Kendall-Tau-b, Sensitivity, Specificity, PPV, NPV, AUC, Diagnostic Accuracy and OR at the optimal cut-off points on the Withdrawn and PDP scales

			IQ correlation
	Withdrawn (cutoff T = 60.5)	PDP (cut-off T = 64.5)	PDP– IQ<80 (cutoff T = 64.5)
Correlation Kendall-Tau-b			-0.275 ($p < 0.05$)
Sensitivity	86%	79%	87%
Specificity	64%	61%	61%
PPV	58%	54%	41%
NPV	89%	83%	94%
AUC	0.794	0.765	0.826
AUC interpretation for diagnostic accuracy	moderate	moderate	moderate
OR	11	6	10

Notations. PDP: Pervasive Developmental Problems; PPV: positive predictive value; NPV: negative predictive value; AUC: area under the curve; OR: odds ratio.

7. Discussion

"Screening tests must meet strict criteria to be effective. Among other things, they have to be brief, standardized, objectively scored, and inexpensive (Meisels, 1989). The CBCL 1.5–5 meets all these requirements" (Limberg et al., 2017, p. 372). The CBCL 1.5-5 is recommended by several previous studies for early detection for children with autism spectrum disorder (Muratori et al., 2011; Narzisi, Calderoni, Maestro, Calugi, Mottes and Muratori, 2013; Rescorla, Kim and Oh, 2014; Sikora, Hall, Hartley, Gerrard-Morris and Cagle, 2008).

The first analysis of the present study examined the Child Behavior Checklist 1.5-5 as a Level 1 screening instrument as to whether an identification of German children with at risk of autism spectrum disorder is possible and distinguish them from children with other psychiatric disorders:

> As expected, the results of the mean comparison show that children with an [autism spectrum disorder] . . . diagnosis presented higher mean values on all CBCL scales than the children with an [other psychiatric disorder] . . . diagnosis. However, only three scales—[Pervasive Developmental Problems] . . . , Withdrawn, and Total Problems—indicate a significant predictive value of a risk for an [autism spectrum disorder] . . . diagnosis.
>
> For the cutoff point determination, we looked for the optimal compromise between sensitivity and specificity. (Limberg et al., 2017, p. 372)

Meisels (1989) requests at least a sensitivity and specificity of 80% for screening tests.

> Specific attention was paid to a high sensitivity, which describes the true positive rate, at the expense of the specificity, the true negative rate. The reason for this decision is the requirement to identify children with a risk of [autism spectrum

> disorder] . . . by the CBCL 1.5–5 as a level 1 screening instrument, not to make an accurate [autism spectrum disorder] . . . diagnosis. The two scales [Pervasive Developmental Problems] . . . and Withdrawn showed a high sensitivity, which will result in few under-identifying or false negatives. At the cutoff point of T = 64.5 on the [Pervasive Developmental Problems] . . . scale, 83% of the children are correctly identified by the CBCL 1.5–5. On the Withdrawn scale, 88% of the children with a T = 60.5 are truly at risk for an [autism spectrum disorder] . . . diagnosis. (Limberg et al., 2017, p. 372-373)

The lower specificity than required in our example carries the risk of over-identifying an autism spectrum disorder in children with other psychiatric disorders, with the consequence of unnecessary testing and anxiety for the parents (Meisels, 1989). But even under-identifying can cause confusion and disappointment after a false negative screening (Meisels, 1989). “Disadvantages of under-identification are associated with more serious consequences than over-identification” (Limberg et al., 2017, p. 373). It is unacceptable to overlook children who are at risk (Meisels, 1989). So, the recent research focused mainly on a high sensitivity, with the aim of identifying as many at-risk children as possible with the screen CBCL 1.5-5.

> It is extremely worth emphasizing that children with high values on the CBCL 1.5–5 and consequently at risk for an [autism spectrum disorder] . . . diagnosis do not receive a final diagnosis. This is possible only through examination by an experienced child psychiatrist or psychologist with expertise in autism. The CBCL 1.5–5 should point the way and reduce the current time lag of the [autism spectrum disorder] . . . diagnostic. In addition, the false positive tested children show behavior problems that need further analysis, so they could benefit from a specialized

assessment followed by early intervention. This is why we can accept a low specificity. . . . .

It is important for both scales, [Pervasive Developmental Problems] . . . and Withdrawn, to show a high [area under the curve] . . . and indicate a moderate diagnostic accuracy as an essential measure.

By calculating the [odds ratio] . . ., we can interpret that the risk of having an [autism spectrum disorder] . . . at T = 64.5 on the [Pervasive Developmental Problems] . . . scale is 7 times higher; at T = 60.5 on the Withdrawn scale, the risk is 12 times more frequent. In the logistic regression analysis, the scale Total Problems also indicated a significant predictive value of a risk for an [autism spectrum disorder] . . . diagnosis. Nevertheless, we are not recommending the use of this scale for identification of children with a risk of an [autism spectrum disorder] . . . by the CBCL 1.5–5 for the following reasons: In the [receiver operating characteristics] ROC analysis, the Total Problems scale shows an unacceptably low diagnostic accuracy with a low [area under the curve] . . . . Moreover, the scale Total Problems is a very unspecific scale and includes all 100 problem items of the CBCL 1.5–5. It is the sum of all scores. We can merely conclude that children with an [autism spectrum disorder] . . . have in general more problems than [other psychiatric disorder] . . . children.

Findings from this study are consistent with previous research. In these studies, two scales—[Pervasive Developmental Problems] . . . and Withdrawn—are also indicated as useful screening tools, despite a higher sensitivity than specificity (Muratori et al., 2011; Narzisi et al., 2013; Rescorla et al., 2014; Sikora et al., 2008). Similar cutoff points are calculated (Muratori et al., 2011; Rescorla et al., 2014).

Compared to our results, Muratori et al. (2011) describe the scale attention problems in the logistic regression analysis as a good predictor of an [autism spectrum

> disorder] . . . presence. A reason for the research difference is most likely the lower mean age and age range of the [autism spectrum disorder] . . . children in Muratori et al.'s (2011) study (average 44 months, ranging 24–60 months, compared to average 53.8 months, ranging 25–71 months in this study).
>
> In contrast to our findings, Havdahl et al. (2015) and Myers et al. (2014) indicated limited usefulness of the CBCL 1.5–5 for screening purpose because of a low [area under the curve] . . . and a poor sensitivity and specificity compromise on the Withdrawn ([area under the curve] . . . = 0.69 or 0.752) and [Pervasive Developmental Problems] . . . scales ([area under the curve] . . . = 0.68 or 0.713). With our study, we could not confirm these findings for the German version of the CBCL 1.5–5. [7] (Limberg et al., 2017, p. 373)

The second analysis of the recent study determined the influence of intellectual capability on the use of the Child Behavior Checklist 1.5-5 to identify children with autism spectrum disorders:

> The analysis to identify children at risk for autism spectrum disorder using the Child Behavior Checklist 1.5-5 of the present study suggests the scales Pervasive Developmental Problems and Withdrawn for the differentiation between autism spectrum disorders and other psychiatric disorders.
>
> The receiver operating characteristics (ROC) analysis of the sub-sample examined a cutoff point of T = 64.5 on the Pervasive Developmental Problems scale and a cutoff point of T = 60.5 on the Withdrawn scale with a moderate diagnostic accuracy corresponding to the preceding results. These findings constitute for further analysis and confirmed the selection of the sample.

[7] From Gruber and Noterdaeme (2017). The German version of the Child Behavior Checklist 1.5-5 to identify children with a risk of autism spectrum disorder, *Autism, 21*(3), p. 373. DOI: 10.1177/1362361316645932. Copyright © [2016] (The Authors). Reprinted by permission of SAGE Publications.

The correlation analyses indicated no relationship between average or above-average intellectual skills (IQ > 80) and the CBCL 1.5-5 scales. Contrary to expectations, no correlation existed between a below-average intellectual capability (IQ < 80) or an intellectual disability and the Withdrawn scale; only a weak correlation was examined on the Pervasive Developmental Problems scale.

Despite this weak relationship, it was tested whether an IQ value of < 80 affects the T-score cutoff on the Pervasive Developmental Problems scale that was calculated before. The renewed ROC analysis showed the best compromise between sensitivity and specificity at a T = 64.5. At this cutoff point, it is possible to differentiate between children at risk for autism spectrum disorder and children with other psychiatric disorders. It is, surprisingly, the same cutoff point as was determined in the receiver operating characteristics analysis regardless of variable intellectual skills.

In comparison, the cutoff point calculations both showed a moderate diagnostic accuracy at a higher sensitivity than specificity. At the cutoff point of T = 64.5 on the Pervasive Developmental Problems scale, regardless of the IQ, 79% of the children are correctly identified as children at risk for an autism spectrum disorder diagnosis by the CBCL 1.5-5. On the Pervasive Developmental Problems scale, considering an IQ correlation, 87% of the children were correctly identified as children at risk for autism spectrum disorder diagnosis by the CBCL 1.5-5. This high sensitivity results in little under-identifying or few false negatives. As clarified above, low specificity can be accepted. The true negative rate amounts to 61% on both scales. The receiver operating characteristics analyses resulted in similar odd ratios. At a T = 64.5 on the Pervasive Developmental Problems scale, the risk of autism spectrum disorder is six times higher, looking at the calculation without considering an IQ correlation, and ten times more frequent considering an IQ < 80.

In summary: the present study indicates that variable intellectual capabilities have weak or no influence on the use of the CBCL 1.5-5 autism spectrum disorder predictor scales Withdrawn and Pervasive Developmental Problems. An especially important result is that no effect on the cutoff point could be found.

These findings support the use of the CBCL 1.5-5 in primary care, where a reliable examination of intellectual skills is often not possible because there is limited time for consultations and assessment expertise is lacking. The present research shows that the CBCL 1.5-5 is able to identify children at risk of autism spectrum disorder and is capable of complying with the requirements for early detection in primary settings by pediatricians. This widespread and standardized test can reduce the delay of an autism spectrum disorder diagnosis. In this way, a quick referral to a specialized autism spectrum disorder assessment center is feasible. It should be explicitly emphasized at this point that of course no broadband screening tool is able to replace the gold standard autism assessment instruments applied by experts in autism spectrum disorder diagnosis.

There are some limitations of the present study.

> The most significant limitation . . . similar to the research already mentioned, is the low number of participants, which probably does not reflect the huge heterogeneity of the [autism spectrum disorder] . . . and [other psychiatric disorder] . . . [children]. There are also fewer children in the [autism spectrum disorder] . . . group[s] than in the [other psychiatric disorder] . . . group[s]. But due to the fact that children with an [autism spectrum disorder] . . . were diagnosed in Germany at a mean age of 76 months (Noterdaeme and Hutzelmeyer-Nickels, 2010) and only a limited number of children before this age will be seen by a psychiatrist with expertise in autism, the number of participants is quite acceptable. [8] (Limberg et al., 2017, p. 373)

The autism spectrum disorder groups consist of a higher proportion of male than female participants. However, the gender difference of the present research corresponds to the autism spectrum disorder-specific gender-related phenomenon; an autism spectrum disorder diagnosis is four times more frequent in males than in females (American Psychiatric Association, 2013).

> Missing data—relating to the procedure of completion of the CBCL 1.5–5—limits the power of this study. The results may have been influenced by whether the respondent completed the items of the questionnaire before or after knowing the child's final diagnoses. Most of the CBCL's 1.5–5 in this study were completed during the diagnosis process. (Limberg et al., 2017, p. 373-374)

Furthermore, the mean age (53.2 months or 55.3 months) and the age range (25-71 months or 38-71 months) of the autism spectrum disorder groups, compared to the full age range for which the CBCL 1.5-5 is intended, limit the generalization of the findings.

An additional limitation is the estimation of the intellectual capabilities of disabled children by traditional intelligence tests. Although the use of German intelligence tests for children with disabilities is not excluded, this sample plays only a tangential role in the test design, validation and standardization (Mickley and Renner, 2015). According to Mickley and Renner (2015), access requirements and needed test adaptations are inadequate reflected. To test the intellectual skills of children with autism spectrum disorder, it should be considered that traditional intelligence tests often need to be partially modified (Bernard-Opitz, 2007). Bernard-Opitz (2007) emphasizes that they should be motivating and visual, rather than exclusively auditory, and contain short text passages. The Wechsler Preschool and Primary Scale of Intelligence (WPPSI-III) (Petermann and Lipsius, 2009) and the Snijders-Oomen Nonverbal Intelligence Test (SON-R 2½-7) (Tellegen et al., 2007) applied

[8] From Gruber and Noterdaeme (2017). The German version of the Child Behavior Checklist 1.5-5 to identify children with a risk of autism spectrum disorder, *Autism, 21*(3), p. 373. DOI: 10.1177/1362361316645932. Copyright © [2016] (The Authors). Reprinted by permission of SAGE Publications.

in the present study are widely used assessment tools (Döpfner and Petermann, 2012). The SON-R 2½-7 measures the fluid intelligence of children aged 2.6 to 7.11 years and is a nonverbal test especially suitable for the study of communicatively affected children (Tellegen et al., 2007). Based on the current manual (Tellegen et al., 2007), children with autistic behavior are one of its target groups. A critical note is that the standardization of the SON-R 2½-7 took place in 1993/1994 and a new standardization is requested because of the Flynn effect (Tellegen et al., 2007). Concerning this matter, an advantage of computerized evaluation is the notification of a corrected IQ value (IQ^{*}) (Tellegen et al., 2007). According to Döpfner and Petermann (2012), the WPPSI-III is one of the most frequently used tests and generates a total IQ as a measure of the child's intellectual level of development between 3.0 and 7.2 years of age and is a child-friendly and colorful tool. The IQ evaluation refers to a standardization to German children in 2009 (Döpfner and Petermann, 2012). Within the current possibilities of intelligence testing, the selected tests seem to be most suitable for the present study.

The present study shows group differences on intellectual capability among the autism spectrum disorder and other psychiatric disorder group. Future research with an IQ-matched comparison group is needed. Nevertheless, a generalization of the study findings should be taken with care. Even if previous research activities show the ability of the CBCL 1.5-5 to differentiate between children with autism spectrum disorders and typically developing children, an inclusion of this control group in the data analysis would strengthen the results of the study.

"A strength of [the first analysis, the identification of children with a risk of autism spectrum disorder with the CBCL,] . . . compared to previous research (Muratori et al., 2011; Myers et al., 2014; Sikora et al., 2008) is that there are no significant differences in either gender or age among the two groups" (Limberg et al., 2017, p. 374). An important strength

of the present study is the inclusion of children with autism spectrum disorders and low intellectual capabilities. Dykens and Lense (2011) indicate that generally, published studies mainly include children with relatively high intellectual skills, whereby comorbid intellectual disabilities are underrepresented in current autism spectrum disorder research. Only 23% of all published articles on children in one year in a peer-reviewed autism journal (Journal of Autism and Developmental Disorders, JADD) included persons with intellectual disabilities (Dykens and Lense, 2011). Therefore, because of the wide range of intellectual skills and a high prevalence rate of associated intellectual disabilities in autism spectrum disorder, it is crucial to question existing research findings on the influence of intellectual capability on the CBCL 1.5-5 as tool for early identification for children with autism spectrum disorders.

Further research is needed to examine the present results on a larger sample and consider autism spectrum disorder children with intellectual disabilities in future studies.

8. Conclusion

> This study confirms the utility of the German version of the CBCL 1.5–5 as screening tool to identify children with a risk of [autism spectrum disorder] . . . . The scales Withdrawn and [Pervasive Developmental Problems] . . . are especially suitable [for the differentiation between autism spectrum disorders and other psychiatric disorders], although a risk of over-identifying should be considered. (Limberg et al., 2017, p. 374)

This study does not need to heed different cutoff points for children with above or below-average IQ or intellectual disability. Study findings indicate that a consideration of different cutoff points for children with above- or below-average IQ or intellectual disability is not mandatory.

> In conclusion, the CBCL 1.5–5 can complement the pediatric examination as a quick and costeffective parent questionnaire. If the CBCL 1.5–5 shows increased values on the [Pervasive Developmental Problems] . . . and Withdrawn scale, the pediatrician should refer the child to a child psychiatrist with expertise in autism for a deeper evaluation. This could reduce the time lag between initial parental concern and an [autism spectrum disorder] . . . diagnosis. This offers children an important opportunity for early and specific therapeutic intervention and subsequently an improved prognosis. (Limberg et al., 2017, p. 374)

9. References

Achenbach, T. M. & Rescorla, L. A. (2000). *Manual for the ASEBA Preschool Forms & Profiles. Child Behavior Checklist for Ages 1 ½-5. Language Development Survey. Caregiver-Teacher Report Form. An Integrated System of Multi-informant Assessment*. Burlington, VT: University of Vermont.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders. DSM-5*. (5th ed.). Washington, D.C.: Author.

Amorosa, H. (2017). Klassifikation und Epidemiologie. In: M. Noterdaeme, K. Ullrich & A. Enders (Eds.), Autismus-Spektrum-Störungen (ASS). Ein integratives Lehrbuch für die Praxis. *2nd ed*. (pp. 26-50). Stuttgart: Kohlhammer.

Barbaro, J. & Dissanayake, C. (2010). Prospective identification of autism spectrum disorders in infancy and toddlerhood using developmental surveillance: the social attention and communication study. *Journal of developmental and behavioral pediatrics: JDBP,* 31 (5), 376–385. DOI: 10.1097/DBP.0b013e3181df7f3c.

Baron-Cohen, S., Allen, J. & Gillberg, C. (1992). Can autism be detected at 18 months? The needle, the haystack, and the CHAT. *British journal of psychiatry : the journal of mental science,* 161, 839–843.

Bernard-Opitz, V. (2007). *Kinder mit Autismus-Spektrum-Störungen (ASS). Ein Praxishandbuch für Therapeuten, Eltern und Lehrer*. (2nd ed.). Stuttgart: Kohlhammer.

Blankenship, K., Erickson, C. A., Stigler, K. A., Posey, D. J. & McDougle, C. J. (2011). Psychopharmacological treatment of autism. In: D. G. Amaral, G. Dawson & D. H. Geschwind (Eds.), *Autism spectrum disorders* (pp. 1196-1214). New York: Oxford University Press.

Bölte, S., Rühl, D., Schmötzer, G. & Poustka, F. (2006). *ADI-R. Diagnostisches Interview für Autismus - Revidiert. Deutsche Fassung des Autism Diagnostic Interview-Revised (ADI-R) von Michael Rutter, Ann Le Couteur und Catherine Lord*. Huber. Retrieved from https://www.testzentrale.de/shop/diagnostisches-interview-fuer-autismus-revidiert.html (accessed 28 February 2018).

Bormann-Kischkel, C. & Ullrich, K. (2017). Psychologische Theorien. In: M. Noterdaeme, K. Ullrich & A. Enders (Eds.), Autismus-Spektrum-Störungen (ASS). Ein integratives Lehrbuch für die Praxis. *2nd ed*. (pp. 129-145). Stuttgart: Kohlhammer.

Bühl, A. (2012). *SPSS 20. Einführung in die moderne Datenanalyse*. (13th ed.). München: Pearson.

Constantino, J. N. (2005). *Social Responsiveness Scale (SRS)*. Retrieved from https://www.wpspublish.com/store/p/2993/srs-social-responsiveness-scale# (accessed 28 February 2018).

Council on Children With Disabilities, Section on Developmental Behavioral Pediatrics, Bright Futures Steering Committee, Medical Home Initiatives for Children With Special Needs Project Advisory Committee (2006). Identifying infants and young children with developmental disorders in the medical home: An algorithm for developmental surveillance and screening. *Pediatrics,* 118 (1), 405– 420. DOI: 10.1542/peds.2006-1231.

Dawson, G., Jones, E. J. H., Merkle, K., Venema, K., Lowy, R., Faja, S. et al. (2012). Early behavioral intervention is associated with normalized brain activity in young children with autism. *Journal of the American Academy of Child and Adolescent Psychiatry,* 51 (11), 1150–1159. DOI: 10.1016/j.jaac.2012.08.018.

Deutsche Gesellschaft für Kinder- und Jugendpsychiatrie, Psychosomatik und Psychotherapie (DGKJP) (Eds.) (2016). *Autismus-Spektrum-Störungen im Kindes-, Jugend- und Erwachsenenalter. Teil 1: Diagnostik. Interdisziplinäre S3-Leitlinie der DGKJP und der DGPPN*. Retrieved from http://www.awmf.org/leitlinien/detail/ll/028-018.html (accessed 30 April 2018).

Dilling, H., Mombour, W. & Schmidt, M. H. (Eds.). (2011). *Internationale Klassifikation psychischer Störungen. ICD-10 Kapitel V (F). Klinisch-diagnostische Leitlinien*. (8th ed.). Bern: Huber.

Dilling, H. & Freyberger, H. J. (Eds.). (2016). *Taschenführer zur ICD-10-Klassifikation psychischer Störungen*. (8th ed.). Bern: Hogrefe.

Döpfner, M. & Petermann, F. (2012). Diagnostik psychischer Störungen im Kindes- und Jugendalter. (3rd ed.). Göttingen: Hogrefe.

Dykens, E. M. & Lense, M. (2011). Intellectual disabilities and autism spectrum disorder: A cautionary note. In: D. G. Amaral, G. Dawson & D. H. Geschwind (Eds.), *Autism spectrum disorders* (pp. 263-269). New York: Oxford University Press.

Enders, A. (2017a). Immunologische Erklärungsansätze. In: M. Noterdaeme, K. Ullrich & A. Enders (Eds.), Autismus-Spektrum-Störungen (ASS). Ein integratives Lehrbuch für die Praxis. *2nd ed*. (pp. 183-187). Stuttgart: Kohlhammer.

Enders, A. (2017b). Prä-, peri- und postnatale Risikofaktoren. In: M. Noterdaeme, K. Ullrich & A. Enders (Eds.), Autismus-Spektrum-Störungen (ASS). Ein integratives Lehrbuch für die Praxis. *2nd ed*. (pp. 173-175). Stuttgart: Kohlhammer.

Enders, A. (2017c). Sensorische Besonderheiten. In: M. Noterdaeme, K. Ullrich & A. Enders (Eds.), Autismus-Spektrum-Störungen (ASS). Ein integratives Lehrbuch für die Praxis. *2nd ed*. (pp. 91-94). Stuttgart: Kohlhammer.

Enders, A. & Rost, I. (2017). Genetische Syndrome. In: M. Noterdaeme, K. Ullrich & A. Enders (Eds.), Autismus-Spektrum-Störungen (ASS). Ein integratives Lehrbuch für die Praxis. *2nd ed*. (pp. 153-172). Stuttgart: Kohlhammer.

Enhancing the Scientific Study of Early Autism (ESSEA): Cost Action BM1004. Retrieved from http://www.cost-essea.com/wg3.html (accessed 2 March 2018).

Ensenauer, R. & Enders, A. (2017). Neurometabolische Störungen. In: M. Noterdaeme, K. Ullrich & A. Enders (Eds.), Autismus-Spektrum-Störungen (ASS). Ein integratives Lehrbuch für die Praxis. *2nd ed*. (pp. 176-183). Stuttgart: Kohlhammer.

Ensslen, M. & Enders, A. (2017). Epilepsie und deren medikamentöse Behandlung. In: M. Noterdaeme, K. Ullrich & A. Enders (Eds.), Autismus-Spektrum-Störungen (ASS). Ein integratives Lehrbuch für die Praxis. *2nd ed*. (pp. 82-90). Stuttgart: Kohlhammer.

García-Primo, P., Hellendoorn, A., Charman, T., Roeyers, H., Dereu, M., Roge, B. et al. (2014). Screening for autism spectrum disorders: state of the art in Europe. *European child & adolescent psychiatry,* 23 (11), 1005–1021. DOI: 10.1007/s00787-014-0555-6.

Gillbert, Christopher, Gillbert, Carina, Råstam, M., Wentz, E. (2001). The Asperger Syndrome (and high-functioning autism) Diagnostic Interview (ASDI): a preliminary study of a new structured clinical interview. *Autism,*5 (1), 57–66. DOI: 10.1177/1362361301005001006

Havdahl, K. A., Tetzchner, S. von, Huerta, M., Lord, C. & Bishop, S. L. (2015). Utility of the Child Behavior Checklist as a screener for autism spectrum disorder. *Autism research. DOI:* 10.1002/aur.1515.

Ivanova, M. Y., Achenbach, T. M., Rescorla, L. A., Harder, V. S., Ang, R. P., Bilenberg, N. et al. (2010). Preschool psychopathology reported by parents in 23 societies: testing the seven-syndrome model of the Child Behavior Checklist for ages 1.5-5. *Journal of the American Academy of Child and Adolescent Psychiatry,* 49 (12), 1215–1224. DOI: 10.1016/j.jaac.2010.08.019.

Jackson, S. L. (2015). *Research methods and statistics. A critical thinking approach*. (5th ed.). Boston: Cengage Learning.

Kamp-Becker, I. & Remschmidt, H. (2005). *MBAS. Marburger Beurteilungsskala zum Asperger Syndrom*. Retrieved from http://www.kinderohneangst.de/Mbas-Asperger/2-Fragebogen%5b2%5d.pdf (accessed 28 February 2018).

Kleinman, J. M., Robins, D. L, Ventola, P. E., Pandey, J., Boorstein, H. C., Esser, E. L. et al. (2008). The modified checklist for autism in toddlers: A follow-up study investigating the early detection of autism spectrum disorders. *Journal of autism and developmental disorders,* 38 (5), 827–839. DOI: 10.1007/s10803-007-0450-9.

Kraijer, D. W. & Melchers, P. (2003). *SEAS-M. Skala zur Erfassung von Autismusspektrumstörungen bei Minderbegabten*. (1st ed.). Pits.

Limberg, K., Gruber, K. & Noterdaeme, M. (2017). The German version of the Child Behavior Checklist 1.5-5 to identify children with a risk of autism spectrum disorder. *Autism,* 21 (3), 368–374. DOI: 10.1177/1362361316645932.

Lord, C., Rutter, M., DiLavore, P. C., Risi, S., Gotham, K. & Bishop, S. L. (2012). *Autism diagnostic observation schedule, second edition (ADOS-2)*. Torrance, CA: Western Psychological Services.

McCracken, J. T. (2011). Pharmacotherapy for autism spectrum disorders. In: D. G. Amaral, G. Dawson & D. H. Geschwind (Eds.), *Autism spectrum disorders* (pp. 1309-1321). New York: Oxford University Press.

Meisels, S. J. (1989). Can developmental screening tests identify children who are developmentally at risk?. *Pediatrics,* 83 (4), 578–585.

Mickley, M. & Renner, G. (2015): Berücksichtigen deutschsprachige Intelligenztests die besonderen Anforderungen von Kindern mit Behinderungen?. *Praxis der Kinderpsychologie und Kinderpsychiatrie,* 64 (2), 88–103. DOI:10.13109/prkk.2015.64.2.88.

Muratori, F., Narzisi, A., Tancredi, R., Cosenza, A., Calugi, S., Saviozzi, I. et al. (2011). The CBCL 1.5– 5 and the identification of preschoolers with autism in Italy. *Epidemiology and Psychiatric Sciences,* 20 (04), 329–338. DOI: 10.1017/S204579601100045X.

Myers, C. L., Gross, A. D. & McReynolds, B. M. (2014). Broadband behavior rating scales as screeners for autism?. *Journal of autism and developmental disorders,* 44 (6), 1403–1413. DOI: 10.1007/s10803-013-2004-7.

Narzisi, A., Calderoni, S., Maestro, S., Calugi, S., Mottes, E. & Muratori, F. (2013). Child Behavior Check List 1½-5 as a tool to identify toddlers with autism spectrum disorders: A case-control study. *Research in Develo*pmental *Disabilities,* 34 (4), 1179–1189. DOI: 10.1016/j.ridd.2012.12.020.

National Collaborating Centre for Women's and Children's Health (UK). (2011). *Autism: recognition, referral and diagnosis of children and young people on the autism spectrum*. Retrieved from https://www.nice.org.uk/guidance/cg128/documents (accessed 17 September 2015).

Noterdaeme, M. (2011). Autismus-Spektrum-Störungen - ein Überblick zum aktuellen Forschungsstand. *Klinische Padiatrie,* 223 Suppl 1, 1-15. DOI: 10.1055/s-0030-1256068.

Noterdaeme, M. (2017a). Autismusspezifische Instrummente. In: M. Noterdaeme, K. Ullrich & A. Enders (Eds.), *Autismus-Spektrum-Störungen (ASS). Ein integratives Lehrbuch für die Praxis. 2nd ed.* (pp. 191-203). Stuttgart: Kohlhammer.

Noterdaeme, M. (2017b). Differenzialdiagnostische Abgrenzung im Kindes- und Jugendalter. In: M. Noterdaeme, K. Ullrich & A. Enders (Eds.), Autismus-Spektrum-Störungen (ASS). Ein integratives Lehrbuch für die Praxis. *2nd ed.* (pp. 75-82). Stuttgart: Kohlhammer.

Noterdaeme, M. (2017c). Psychiatrische Komorbiditäten. In: M. Noterdaeme, K. Ullrich & A. Enders (Eds.), Autismus-Spektrum-Störungen (ASS). Ein integratives Lehrbuch für die Praxis. *2nd ed.* (pp. 75-82). Stuttgart: Kohlhammer.

Noterdaeme, M. & Hutzelmeyer-Nickels, A. (2010). Early symptoms and recognition of pervasive developmental disorders in Germany. *Autism,* 14 (6), 575–588. DOI: 10.1177/1362361310371951.

Noterdaeme, M. A. & Wriedt, E. (2010). Begleitsymptomatik bei tief greifenden Entwicklungsstörungen. *Zeitschrift für Kinder- und Jugendpsychiatrie und Psychotherapie,* 38 (4), 257–266. DOI: 10.1024/1422-4917/a000045.

Pandolfi, V., Magyar, C. I. & Dill, C. A. (2009). Confirmatory factor analysis of the Child Behavior Checklist 1.5-5 in a sample of children with autism spectrum disorders. *Journal of autism and developmental disorders,* 39 (7), 986–995. DOI: 10.1007/s10803-009-0716-5.

Petermann, F. & Lipsius, M. (2009). *Wechsler Preschool and Primary Scale of Intelligence-III - Deutsche Version (WPPSI-III)*. (3rd ed.). Frankfurt am Main: Pearson.

Poustka, L., Rühl, D., Feineis-Matthews, S., Poustka, F., Hartung, M. & Bölte, S. (2015). *ADOS-2. Diagnostische Beobachtungsskala für Autistische Störungen - 2. Deutschsprachige Fassung der Autism Diagnostic Observation Schedule - 2 von C. Lord, M. Rutter, P.C. DiLavore, S. Risi, K. Gotham und S.L. Bishop (Module 1-4) und C. Lord, R.J. Luyster, K. Gotham und W. Guthrie (Kleinkind-Modul)*. Retrieved from https://www.testzentrale.de/shop/diagnostische-beobachtungsskala-fuer-autistische-stoerungen-2.html (accessed 28 February 2018).

Remschmidt, H. & Kamp-Becker, I. (2011). Autistische Syndrome. In: Helmut Remschmidt (Ed.), *Kinder- und Jugendpsychiatrie* (6th ed.) (pp. 190–202). Stuttgart: Thieme.

Remschmidt, H., Schmidt, M. & Poustka, F. (Eds.) (2009). *Multiaxiales Klassifikationsschema für psychische Störungen des Kindes- und Jugendalters nach ICD-10 der WHO. Mit einem synoptischen Vergleich von ICD-10 und DSM-IV*. (5th ed.). Bern: Huber.

Rescorla, L. (1988). Cluster analytic identification of autistic preschoolers. *Journal of Autism and Developmental Disorders,*18 (4), 475–492. DOI: 10.1007/BF02211868.

Rescorla, L., Kim, Y. A. & Oh, K. J. (2014). Screening for ASD with the Korean CBCL/1½-5. *Journal of Autism and Developmental Disorders. DOI:* 10.1007/s10803-014-2255-y.

Robins, D. L., Fein, D. Barton, M. L. & Green, J. A. (2001). The Modified Checklist for Autism in Toddlers: An initial study investigating the early detection of autism and pervasive developmental disorders. *Journal of Autism and Developmental Disorders,* 31 (2), 131–144. DOI: 10.1023/A:1010738829569.

Rost, I. (2017). Genetik. In: M. Noterdaeme, K. Ullrich & A. Enders (Eds.), Autismus-Spektrum-Störungen (ASS). Ein integratives Lehrbuch für die Praxis. *2nd ed*. (pp. 146-152). Stuttgart: Kohlhammer.

Rutter, M., Bailey, A. & Lord, C. (2003). *SCQ. The social communication questionnaire*. Retrieved from https://www.wpspublish.com/store/p/2954/scq-social-communication-questionnaire (accessed 28 February 2018).

Rutter, M., Le Conteur, A. & Lord, C. (2003). *Autism diagnostic interview-revised (ADI-R)*. Los Angeles, CA: Western Psychological Services.

Schopler, E., Rochler, R. J., DeVellis, R. F., Daly, K. (1980). Toward Objective Classification of Childhood Autism: Childhood Autism Rating Scale (CARS). *Journal of Autism and Developmental Disorders,*10 (1), 91-103. DOI: 10.1007/BF02408436.

Sikora, D. M., Hall, T. A., Hartley, S. L.; Gerrard-Morris, A. E. & Cagle, S. (2008). Does parent report of behavior differ across ADOS-G classifications: Analysis of scores from the CBCL and GARS. *Journal of Autism and Developmental Disorders,* 38 (3), 440– 448. DOI: 10.1007/s10803-007-0407-z.

Swets, J. A. (1988). Measuring the accuracy of diagnostic systems. *Science,* 240 (4857), 1285–1293.

Tellegen, P. J., Laros, J. A. & Petermann, F. (2007). SON-R 2 1/2 - 7. *Non-verbaler Intelligenztest*. Göttingen: Hogrefe.

Wetherby, A. M., Brosnan-Maddox, S., Peace, V. & Newton, L. (2008). Validation of the Infant-Toddler Checklist as a broadband screener for autism spectrum disorders from 9 to 24 months of age. *Autism,* 12 (5), 487–511. DOI: 10.1177/1362361308094501.

Wetherby, A. M., Woods, J., Allen, L., Cleary, J., Dickinson, H., & Lord, C. (2004). Early indicators of autism spectrum disorders in the second year of life. *Journal of Autism and Developmental Disorders,* 34 (5), 473–493. DOI: 10.1007/s10803-004-2544-y.

World Health Organization (2017). *Autism spectrum disorders*. *Fact sheet*. Retrieved from http://www.who.int/mediacentre/factsheets/autism-spectrum-disorders/en/ (accessed 26 February 2018).

Zwaigenbaum, L. (2011). Screening, risk, and early identification of autism spectrum disorders. In: D. G. Amaral, G. Dawson & D. H. Geschwind (Eds.), *Autism spectrum disorders* (pp. 75-89). New York: Oxford University Press.

Eidesstattliche Versicherung

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Ich erkläre hiermit an Eides statt,

dass ich die vorliegende Dissertation mit dem Thema

Identifying children at risk of autism spectrum disorder with the Child Behavior Checklist 1.5-5 and the influence of intellectual capability on the use of the CBCL

selbständig verfasst, mich außer der angegebenen keiner weiteren Hilfsmittel bedient und alle Erkenntnisse, die aus dem Schrifttum ganz oder annähernd übernommen sind, als solche kenntlich gemacht und nach ihrer Herkunft unter Bezeichnung der Fundstelle einzeln nachgewiesen habe.

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