Attention in preschool children with and without signs of ADHD.
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Summary

The primary objective of this study was to increase our understanding of the normal and deviant development of attention in the age range of two to six years. Although many studies have been undertaken concerning the attentional processes in children older than 7 years and younger than 2 years, a gap in our knowledge exists for the age range 2 to 6 years. Mainly because of this gap in our knowledge, the early diagnosis of children with a less optimal attentional development (ADHD children) appears to be problematic. With this study, we attempted to make a contribution to the development of instruments for the early diagnosis of ADHD.

In chapter two we gave an overview of various leading theories on attention and its development. Two particular methods were discussed more thoroughly: the information processing approach and the ethological approach. The information processing approach was chosen because of its influential basis for knowledge about attentional processes. Methods, derived from the information processing approach, are intensively used to study attentional processes in adults, adolescents, children from 7 years and older, and ADHD children of the same age. But very few researchers used this method for the study of attentional processes in children younger than 7 years. Therefore, we had to adapt the method in order to make it applicable with younger children. Since it was unclear if these young children were willing to undergo the very strict task demands of the method, we adopted a second line of theorizing: the ethological approach. With this approach we tried to observe the behaviors of children during free play in order to gain insight into the dividing and focusing of attention. One of the main advantages of the ethological approach was that we could be sure that children, even those as young as 2 years old, would be willing to play and thus comply with the experimental task demands.

In chapter three we studied the attentional processes of young children from the information processing perspective. The chapter could be divided in two main parts: one studying the developmental aspects of attention in normal children from 4 to 6 years (we did not study younger children because pilot studies showed that the tasks we used were too difficult for children younger than 4 years), and the other part comparing children with signs of ADHD and
their normal peers. The main focus was on two so-called output-related processes: response preparation and response choice. The processes were measured with the aid of a reaction time task, adapted to the ages of the children. The children had to push a button on a response tableau at the appearance of a stimulus (a dog) on a computer screen. Response preparation was manipulated by varying the interstimulus intervals so that timing of the response became difficult. Response choice was manipulated by varying the type of response the child had to give: left-hand responses versus right-hand responses, depending on the location of the stimulus (left or right). In the second task we were mainly interested in the capacity of the children to inhibit false responses in favor of the correct responses. As a validation of the reaction time measures we used additional behavioral measures, especially looking away behavior. In the developmental study we found that although all age groups differed on mean reaction times on most tasks (the younger children being slower than the older children), the younger children did not have more problems with response preparation than the older children. 4-year-old children did have more problems with response inhibition than the older children, but the 5-year-olds and 6-year-olds did not differ significantly from each other on this skill. We found that the three age groups differed from each other on task orientation (the younger children looking away from the screen more often than the older children), but this had no effect on task performance during reaction time tasks. In the clinical study we did not find differences between the children with signs of ADHD and the children of the control groups on reaction times, response preparation, and response inhibition. The only significant differences we found concerned task orientation: children with signs of ADHD had more problems with task orientation than the control children. The main conclusions of this chapter were firstly that reaction time studies can be used to study attentional processes in young children, and that additional behavioral observations are important for a valid interpretation of the results. We found age differences on reaction times and task orientation, and a 'developmental shift' between 4 and 5 years on response inhibition. We only found differences between children with signs of ADHD and control children on task orientation. Although we were not able to find differences between children with signs of ADHD and control children with the aid of reaction time measures, we concluded that this method as such is suitable for the use with ADHD children, but that it needs further refinement. One question we tried to answer in this chapter was whether ADHD is merely a developmental delay or if it is a problem of a more structural nature. Although the answer to this question is premature because of the incompleteness of the reaction time tasks we used, we found indications that the children...
with signs of ADHD had significantly more problems with task orientation than the control children. This finding gave support to the suggestion that ADHD is not merely a developmental delay, but that children with these problems have a constitutional predisposition toward impaired ability to sustain attention and effort, poor inhibitory control and a tendency to seek stimulation and salience. Because of these predispositions, they will end up in a vicious cycle of increasing failure experiences, increasing impulsivity and concentration problems. But, as said before, the reaction time tasks need specific refinements to obtain a better understanding of the specific problems of young ADHD children.

In chapter four we studied task orientation in children two to six years with and without signs of ADHD during a free play situation. In the developmental study, the children of five and six years were treated as one group, so we were only able to compare four age groups: a 2-year-old group, a 3-year-old group, a 4-year-old group and a group with children five to six years. The children played for fifteen minutes in an observation room, in the presence of a parent or a familiar teacher, with age-appropriate toys (a Fisher Price 'Main Street'). The whole session was videotaped and scored afterwards on three behavioral categories: task orientation: exploration, high level play, low level play, and four 'nonplay' categories: interaction with adult, manipulation of objects in the room, visual scanning of objects in the room, doing nothing. Both the frequency and the duration of all behaviors were scored. In order to be able to analyze the effect of time on task, we divided the total playing time in three blocks of five minutes. In the developmental study we found no clear differences between the age groups on the duration and frequency of task orientation. But further analyses revealed that young children showed more low level play and less high level play than the older children. This was especially true for the 2-year-olds when compared with the older age groups. When time-on-task was considered, it appeared that the highest amount of exploration of the toys occurred during the first block of five minutes, after which this behavior clearly decreased in the second and third block of five minutes. The older age groups showed almost no low level play during the whole observation period, whereas the duration of low level play in the 3-year-old group increased from the first block towards the second block, then decreased during the third block of five minutes. The 2-year-old children showed a steady increase in low level play during the observation period. With high level play we saw that all age groups showed an increase of high level play from the first to the second five minute block. During the third block, the duration of high level play decreased in the 2-year-old group,
whereas in the other age groups the duration of high level play increased slightly towards the end of the observation period. Concerning the frequency of the behaviors, we did not find any differences between the age groups on task orientation and exploration. Older children showed fewer low level behaviors, and more high level behaviors than the younger children. We did not find many differences between the different age groups on nonplay behaviors. We only found age differences concerning manipulations of objects in the room (younger children manipulated more than older children) and frequency of total nonplay behaviors: 2-year-old children showed more nonplay behaviors than older children. In the clinical study we found that children with signs of ADHD showed less task orientation, more low level and less high level play than control children. All children started with exploration in the first block of five minutes, after which this behavior decreased during the second and third blocks. The children with signs of ADHD started the observation period with a little low level play in the first block, after which the duration of this behavior increased steadily during the second and third five minute blocks. The control children showed almost no low level play. The children with signs of ADHD showed an increase in high level play from the first block to the second block, after which the total duration of that behavior remained at almost the same level until the end of the observation period. The duration of high level play in the control group increased steadily from the beginning to the end of the observation period. We found no differences between the children with signs of ADHD and the control children concerning the frequency of task orientation. Children with signs of ADHD did show a higher frequency of low level play than the control children. The mean duration of episodes (the duration of an uninterrupted behavioral category) during play was lower in the former group than in the latter. The children with signs of ADHD showed more interactions with and adult, more visual scanning, and more manipulations of objects in the room than the control children. The conclusion of this chapter was that observation of free play behavior appears to be an excellent method for the study of the normal and deviant attentional development in children from 2 to 6 years of age. In the developmental study we concluded that the children of all age groups started with the same amount of exploration, the 2-year-old children were not capable of developing high level, imaginative, combinatory play and persisted in repetitive manipulation of the toys. We found that the older the children were, the more they were able to use more sophisticated cognitive capacities in their play. In the clinical study we found that the children with signs of ADHD differed in their quality of both play and nonplay behavior. The clinical study showed that children with signs of ADHD differed on certain vari-
ables in the nonplay period with the control children, a difference which was not found in the developmental study between the age groups. This finding provided additional support for the suggestion that ADHD is not merely a developmental delay, but that children with these problems suffer from a constitutional predisposition towards attentional problems, among others, which will eventually result in a less optimal development. However, because we were not able to observe enough children in the clinical study to compare children with signs of ADHD of different ages with each other, a definitive conclusion concerning the development of ADHD could not be given.

In chapter 5 we analyzed the attentional and behavioral characteristics of the preschool ADHD children. The rationale behind this chapter was to investigate to what extent the diverse methods and measures used in this study (reaction time variables and additional behavioral observations, behavioral categories in the free play observations, and additional behavioral questionnaires filled in by teachers and parents) relate to each other. Furthermore, we wanted to obtain more insight into the profile of the group of children with signs of ADHD selected for the study. Using factor analyses of 23 variables, we were able to identify five factors. Three factors concerned attention processes (concentration during free play; impulsivity/distractibility during reaction time tasks and response preparation) and two factors concerned the behavioral characteristics of the children (rigidity/negativism and extraversion/negativism as manifested in school). We did not find support for the assumption that variables from different measures load on a common factor. We used the factor scores of all individuals as input for the cluster analysis and were able to identify four groups within the total group of children with signs of ADHD. Of these four groups, one group of two children could be characterized as 'real' ADHD children: they showed poor concentration during free play, were characterized as rigid, impulsive and showed poor motor preparation in the reaction time tasks. One group of four children showed no clear signs of ADHD with the measures we used, and the other two groups showed intermediate signs of ADHD. The conclusion we drew from this chapter was that the analyses showed that the use of a combination of behavioral observations together with questionnaires, objective measures from reaction time tasks and free play observation appeared to be a promising method for the early diagnosis of ADHD. Because the problems of ADHD children are very diverse, only the combination of different measures provides a good impression of the attentional and behavioral problems of these children. But because our study must be seen as a starting point for a better understanding of the normal and deviant attentional development, we con-
cluded that valid external criteria are needed to answer the question concerning the (predictive) value of the approaches used.

In the concluding chapter we discussed the different methods we used in our study. First, we discussed the selection of the children with signs of ADHD. Two main problems were identified: The question arose whether the 'ADHD' group we selected was representative of the real ADHD population. Because of a lack of valid external criteria for the young ADHD-group, we were not able to answer this question, which of course had consequences for the generalizability of our findings. The second problem was that only a small number of children with signs of ADHD could be selected for our study. Therefore, we were not able to compare children with signs of ADHD in different age groups with each other. The second topic of this chapter was the use of information processing paradigms for the study of early attentional processes. Besides the conclusions presented before, we discussed the methods employed in more detail. With the response preparation task we were unable to find any effects in the developmental and the clinical study. For practical reasons we had to vary the intertrial intervals within blocks of trials, whereas in a real event rate task the intertrial intervals are varied between blocks of trial. We suggested studying response preparation with a real event rate task before drawing the conclusion that the method is not suitable for identifying differences in this skill in young children with and without ADHD. The fact that we were not able to identify problems in the output related processes in young children with signs of ADHD at all could, in our opinion, have been caused by several factors. The reason for not finding effects with the response preparation task has already been discussed. The fact that we did not find any effects with the response inhibition task in the group of children with signs of ADHD could be caused by the small number of children and/or by the small number of trials we used. We suggested increasing at least the number of children in the study, and eventually also the number of trials, before drawing definitive conclusions concerning the response inhibition of ADHD children. The main conclusion concerning the method of observing the behaviors during free play was that this is an excellent method for the study of the normal and deviant development of attentional processes. The developmental shift between two and three years could possibly be caused by a shift in the cognitive development of the children, but we suggested also another possibility, namely a so-called bottom-effect: although we tried to choose age-appropriate toys, it is possible that the toys were not interesting to the older age groups. Although the method seemed to be well-suited for the study of young children with and without ADHD, it has
the disadvantage that the scoring of the different behavioral categories is very time consuming and requires thorough training of observers. Therefore, the method is not suitable for the quick screening of large numbers of children. On the other hand, the advantage of the method is that the children can be observed in a semi-natural environment, with no pressure from an experimenter or a demanding task (as is the case in reaction time tasks).

The main conclusions we can draw from the study presented here is that it provides a starting point for a better understanding of the normal and deviant development of attention during the early years (about two to six). Most of the methods used, especially the reaction time tasks, need further refinement, and more children, especially children with signs of ADHD, need to be examined before a contribution can be made to the development of objective instruments for the early diagnosis of attentional problems. Furthermore we strongly advise developing a reliable instrument for the initial screening for ADHD at preschool age (for example the extrapolation of the Groninger Behavior Observation Scale to younger age groups). With such an instrument, it should be easier to select enough children with signs of ADHD for a study like ours, which would then make the generalization of the results more valid.