UNIVERSITEIT VAN AMSTERDAM

Autonomic Functioning in Autism: A Focus on Inhibition and Sensory Sensitivity

M.W.M. Kuiper

Autonomic Functioning in Autism: A focus on inhibition and sensory sensitivity

M.W.M. Kuiper

SUMMARY

The current doctoral thesis is the first to thoroughly examine the role of baseline arousal in multiple aspects of autism. There were two major aims, namely a) to examine the relationship between baseline autonomic arousal and inhibitory control as well as ASD symptomatology (Part I; chapter 2 and 3) and b) to examine possible (psychophysiological) factors (i.e., habituation and detection thresholds) that may underlie the individual differences in auditory sensitivity in ASD (Part II; chapter 4, 5 and 6). Based on the results of the studies in this doctoral thesis, the following main conclusions can be drawn: 1) As a group, autistic people have indeed more prepotent response inhibition difficulties than TD people; 2) There are large differences in results between inhibition studies and these cannot be explained by task-related factors such as ISI; 3) Baseline HRV seems to play a role in inhibitory control in autistic adults, but not in TD adults; 4) Baseline HRV levels do not seem to play a role in several ASD characteristics; 5) Auditory sensitivity in ASD cannot be explained by factors such as habituation or detection thresholds; 6) Autistic adults seem to find certain sounds more stressful than TD adults, and they might also react physically stronger to sounds; 7) The GSQ-NL is a valid and reliable questionnaire, usable for the clinical practice and scientific research. Below, we will first summarize the findings of each study separately, after which we will critically discuss our findings, discuss the clinical implications of our research and end with future research avenues.

Part I: Inhibition

In *chapter 2*, we examined by means of a meta-analysis (N = 41 studies) whether the large, unexplained, differences between prepotent response inhibition studies in autism (see meta-analysis Geurts et al., 2014) could be explained by differences in interstimulus interval (ISI) or the type of stimulus used. We performed a qualitative analysis on studies that actively manipulated ISI or "stimulus-type" to examine its effect on inhibitory control as well. Three main conclusions can be drawn from this study. First, in line with the meta-analysis of Geurts and colleagues (2014), we observed a medium sized difference in prepotent response inhibition between autistic and TD people. Second, contrary to our expectations, the meta-analysis showed that differences in ISI were not a relevant explanation for the heterogeneity between the studies. Unfortunately, there were too few studies that used arousing stimuli to include "stimulus-type" as a moderator in the meta-analysis. The large amount of heterogeneity between the studies on prepotent response inhibition in autism is still unexplained. Third, the qualitative analysis indicated that more prepotent response inhibition difficulties were found when ISI was fast. The effects of "stimulus-type" were not conclusive as it depended on the type of stimulus whether it had a positive or negative effect on prepotent response inhibition. Contrary to previous studies on this topic in ADHD (for meta-analysis see Metin et al., 2012), both manipulations had a similar effect on the ASD and TD group.

In *chapter 3*, we examined the actual influence of baseline physiological arousal (indexed by HRV) on prepotent response inhibition abilities of both autistic and TD male adults (N_{ASD} = 31; N_{TD} = 39). We

measured baseline HRV (RMSSD and RSA), after which a prepotent response inhibition computer task was administered (i.e., Stop Signal Task). We examined whether an effect of baseline HRV on prepotent response inhibition differed between autistic and TD adults as well. Finally, we examined whether negative emotional stimuli affected autistic adults differently than TD on both inhibition performance as well as on a physiological level. From this study, the following conclusions can be drawn (although replication is required). First, there are indications that there is a subgroup within the ASD population that is characterized by significantly lower baseline HRV levels. Second, as expected, baseline HRV seems to impact inhibitory control in autistic male adults as the low baseline HRV ASD subgroup had more inhibitory control difficulties than the high baseline HRV ASD subgroup. Surprisingly, baseline HRV does not seem to impact inhibitory control in TD male adults as both low and high baseline TD subgroups performed similarly. Third, even though there is an ASD subgroup with significantly low baseline HRV levels, this subgroup did not differ in inhibitory control compared to the TD group (both low and high baseline HRV TD subgroups). This indicates that autistic adults, independent from baseline HRV level, have similar inhibitory control abilities compared to TD adults. Fourth, both autistic and TD adults took longer to inhibit their response when confronted with a negative emotional picture compared to a neutral picture. Contrary to our expectations, the negative emotional picture did not influence autistic adults differently than TD adults.

Part II: Sensory Sensitivity

In *chapter 4*, we explored whether baseline HRV was related to other ASD related symptoms such as self-reported sensory sensitivity, social skills, and social anxiety. Several questionnaires were administered and baseline HRV was measured. We performed regression analyses to determine whether baseline HRV was a predictor of self-reported sensory sensitivity, social skills or social anxiety in autistic and TD adults. This study showed that baseline HRV was not a relevant predictor for the three selected ASD characteristics in male adults.

In *chapter 5*, we examined two possible underlying mechanisms of one of the most common sensory sensitivities in autism, namely auditory sensitivity. We examined whether physiological habituation and subjective detection thresholds to auditory stimuli differed between autistic (N = 33) and TD adults (N = 31) as well as whether both factors were related to self-reported auditory sensitivity. Five conclusions can be drawn from this study. First, autistic adults habituate as fast as TD adults to a simple tone and a siren. Second, autistic adults have similar auditory detection thresholds as TD adults. Third, both factors were not related to self-reported auditory sensitivity, which means that differences in habituation and detection thresholds cannot explain the differences that are observed in auditory sensitivity in ASD. Fourth, autistic adults seem to experience certain auditory stimuli (e.g., a simple tone and a siren) as more arousing than TD adults. Fifth, although replication is required, we found hints that autistic adults might have a stronger physiologically reaction to certain auditory stimuli compared to TD adults.

In *chapter 6*, we examined the psychometric properties and clinical value of the Dutch version of the Glasgow Sensory Questionnaire (GSQ-NL). We translated the original GSQ (original authors: Robertson & Simmons, 2013) into Dutch and examined (N = 147) the internal consistencies, the test-retest reliability, the convergent and divergent validity as well as some clinically relevant features (i.e.,

hypo-and hyper-responsivity co-existence and a 95th percentile cut-off). The findings showed that the GSQ-NL is a reliable (i.e., total score, modality scores and hypo- and hyper-responsiveness total scores) and valid questionnaire. The reliability was excellent for the total GSQ-NL score and the total hyper-responsiveness subscale. For the modality score, the reliability varied between reasonable and good. The GSQ-NL was strong and positively related to other sensory sensitivity questionnaires such as the Adolescent Adult Sensory Profile (Brown and Dunn, 2002) and the Sensory Sensitivity Questionnaire (Minshew & Hobson, 2008). It had a small relationship with a social skills questionnaire (IIS; Van Dam-Baggen & Kraaimaat, 1999) and no relationship with a general cognitive ability test (i.e., intelligence test). Over about a 15-week period, the GSQ-NL showed to be very stable over time. Besides these psychometric properties, we showed that about two third of the autistic adults score above the 95th percentile of the TD group, which means that these adults report to have heightened sensory sensitivities. Moreover, we observed that hypo- and hyper-responsiveness seems to co-exist in the visual, vestibular and proprioceptive modality in the autistic group and only in the proprioceptive modality in the TD group. However, we did not observe that the co-existence of hypo- and hyper-responsivity within the same modality occurred more often in the autistic than in the TD group (Sapey-Triomphe et al., 2017). Overall, we conclude that the GSQ-NL is a reliable and valid questionnaire that can be used for both clinical practice as well as scientific research.