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Common Ground in Children with ASD:
The Contribution of Theory of Mind and Pragmatic Capabilities

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Abstract

Background. Children with High Functioning Autism Spectrum Disorder (HFASD) have an IQ > 70 and are described as having social, communication, and emotional difficulties, mainly around the fields of language use (pragmatics) and Theory of Mind (ToM). ToM relates to the ability to attribute mental states to oneself and others. As a result of these difficulties, children with HFASD face challenges establishing and persevering social discourse. An important pragmatic skill for effective and synchronized mutual discourse is the ability to create a Common Ground (CG), i.e., the tendency of interlocutors to adapt the way they communicate based on shared knowledge, which is assembled during the discourse. This is a necessary communication ability, and it involves both ToM abilities and other pragmatic skills, such as preserving the topic of conversation, providing relevant information to the interlocutor, or responding to interlocutor hints. When typically developed (TD) adults generate common ground during discourses, they tend to shorten their utterances on the grounds of shared knowledge. Among people with HFASD, however, it is not yet established whether they have this ability to generate CG in states of shared knowledge. Supporting the concept that CG generation is limited in HFASD, often they do not shorten their expressions, and they use ineffective descriptions which are generally too detailed or vague. The challenges with developing CG among children with HFASD might be due to core characteristics of their disability, such as pragmatic or ToM difficulties. To date, CG was rarely examined during peer interactions. Developmental growth in CG is even less known in HFASD children and studying it is more challenging.

Objective. The present study is aimed to examine the characteristics of CG among children with HFASD through an investigation of CG development and the factors that contribute to CG generation, such as pragmatic characteristics, ToM, and background variables, including autism severity and cognitive ability. Understanding the progress of CG generation among HFASD can shed light on their pragmatic abilities. The contribution of ToM abilities, which are impaired among children with HFASD and related to the CG generation process, has not been sufficiently researched to this day, mainly while using various measures, such as rating child's ability to understand the other through a questionnaire, together with an "applied" measures, such as the production of mental language during the discourse.

Research Questions. In this study we sought to expand upon the previous works by examining CG ability differences between age groups: childhood, pre-adolescents, and adolescents. For this, variables such as duration, word amount, and conceptualization process were assessed. In addition, differences between age groups in ToM and pragmatic abilities were also evaluated. CG abilities were correlated with ToM measures, pragmatic measures, and background variables such as autism severity, age, and IQ. Lastly, the contribution of baseline capabilities (duration of first turns or number of words in first turns), background variables (autism severity, age, IQ), ToM abilities, pragmatic abilities, and their interactions, were combined to predict CG generation.

Research hypotheses. We expected developmental growth in the CG as well as in ToM abilities, with the older group (adolescents) would outperform pre-adolescents and childhood. Due to limited prior knowledge, we found it difficult to estimate the nature of the age group's differences in terms of

pragmatic abilities. As for the correlations between the variables, we hypnotized that IQ and age will be positively correlated with CG abilities. We found it hard to estimate the direction of the correlation between autism severity and CG, owing to inconsistent findings in the literature. As a result of limited research knowledge, it was challenging to estimate the direction of correlation between mental terms use and CG generation. We expected a positive correlation between pragmatic abilities and ToM abilities. We further hypothesized that higher pragmatic abilities would be linked to better CG performance. Last of all, we expected that the regression analysis would show a significant contribution of background variables, ToM, and pragmatics, to the prediction of CG ability, but it was difficult to predict the unique contribution of each variable.

Method. A total of 80 children with HFASD were recruited for this study. The participant's ages ranged between 6–16 years, of whom 66 were boys, and 14 were girls. Participants were divided into three groups according to their age. The first group (childhood) included 22 participants, at the age of 77-104 months (6-8.5 years). The second group (pre-adolescents) included 26 participants, at the age of 105-146 months (over the age of 8.5 years to 12 years). The third group (adolescents) included 32 participants, at the age of 147–203 months (over the age of 12 years to 16 years). ASD diagnosis was validated using the Autism Diagnosis Observational Schedule (ADOS) (Lord et al., 2012). The participants took part in a context-dependent communication task, where a speaker, who observes a matrix model made of "Tangram" game cards, is required to explain to a listener how to arrange images that are not visible to the listener. The process was repeated six times, with participants switching roles between speaker and listener. We measured the task's duration, the number of words, and the "conceptualization process" (the turn in which the common ground is established, i.e., when the partners reach an agreement on a particular concept). We coded the average duration and words amount for the first two turns (turns 1 and 2) and the two last turns (turns 5 and 6), and we created two variables for turn type - first turns (turns 1 and 2) and last turns (turns 5 and 6). Cognitive ability was assessed using the Wechsler Intelligence Scale for Children- 4th Edition (WISC-IV-HEB) (Wechsler, 2003). ToM abilities were measured using the parent questionnaire Theory of Mind Inventory (TOMI) (Hutchins, Prelock & Bonazinga, 2012), which examines ToM skills at three levels, and by mental terms observation, meaning, counting the number of mental terms (such as want, hope, think) that the children used during the first two turns of the CG task. Pragmatic ability was measured using the Pragmatic Rating Scale (PRS) (Bauminger-Zviely et al., 2014, Landa et al., 1992; Ruser et al., 2007; Paul et al., 2009), also coded during the CG task.

Results. Age differences in CG: We found main effect of the turn type for duration index so that the first turns (1-2) were longer than the last turns (5-6). No evidence was detected for main effect of age group, or interaction between turn type and age group. While examining the word amount index, we observed a main effect for turn type, so that the first turns included more words than the last turns. Additionally, a significant interaction between turn type to age group was revealed. Even though we did not find a significant difference between the first and last turns in the childhood group, we did find differences between the first and last turns in the pre-adolescent and adolescent groups. Besides, there was a significant difference between the childhood and adolescent groups in the first turns, and adolescents used more words compared to the childhood group, whereas there was no difference between the groups in the last turns. As for the conceptualization process, the analysis revealed a significant difference between the age groups, and further tests showed that the young participants created the conceptualization at a later turn than the other two groups (pre-adolescents and adolescents).

Age differences in ToM Abilities: Our results show a significant difference between the groups concerning the TOMI questionnaire. As far as basic abilities are concerned (like meta-representation, i.e., the mental representation of the knowledge and beliefs of the other), we noticed that the adolescent scored better than the pre-adolescent group. As for the advanced abilities (which test social judgment, complex recursive thinking, meta-linguistic and meta-pragmatic ability), the adolescents scored better than all other groups. ToM's early abilities (such as the ability to engage in shared attention or social attribution) did not differ between the groups. The overall TOMI score for adolescents was significantly better than the other groups. As for the index of mental terms, differences were found between the groups, with the youngest group using fewer mental terms than the oldest group.

Age differences in pragmatic ability: There were no significant differences between the groups in pragmatic ability, as measured by the PRS scale.

Correlations between the predictors (CG, background variables, ToM abilities, pragmatic ability): The overall IQ score increased as the duration of the first turns shortened, and the conceptualization process occurred earlier. Earlier conceptualization was also linked to a higher verbal IQ score. Older participants used fewer words and shortened their utterances, in the last turns. The more severe the disability was, the longer the last turns lengthened, whereas the number of words in the first turns decreased. Using more mental terms was linked to a higher number of words in the first and last turns, and a longer duration of first turns. The advanced ToM abilities (TOMI questionnaire) were better as the duration of the last turns was shortened, even though all other TOMI questionnaire measures were not correlated with the CG indices. More deficient pragmatic capabilities were linked with the more deficient CG performance, reflected by an increase in the number of words and longer duration in the first turns. The subscales of the PRS, which examined specific pragmatic behaviors (such as speech and prosody, pragmatic or para-linguistic behaviors) were also linked with impaired CG abilities (such as more words or longer duration, at the beginning or end of CG task). Poorer pragmatic capabilities were linked with using more mental terms during the task. Surprisingly, it was found that the more speech and prosody behaviors were impaired, the better were TOMIs advanced abilities.

Regression for predicting CG capabilities: The first regression analysis revealed that the predictors explained 50% of the variance of CG ability, as measured by the number of words in the last turns. The baseline level, e.g., the number of words in the first turns (entered as the first step), significantly contributed to the explanation of CG ability, as measured by the number of words in the last turns. For this variable, children who used more words in the first turns also used more words in the last turns. In the second step, age significantly contributed to the explanation of children's CG ability. Thus, younger age children used more words in the last turns. In the fifth step, the interaction of age and IQ significantly contributed to the prediction of CG ability. Similarly, the interaction of general PRS and TOMI scores also significantly contributed. The interaction of age and IQ indicated that when the IQ score was higher than 91.70, the participants used more words in the last turns at a younger age. The interaction of general PRS score and general TOMI score indicated that in a PRS score below .12, participants with a lower TOMI score used more words in the last turns.

The second regression analysis revealed that the predictors explained 30% of the variance of CG ability, as measured by the duration of last turns. In the first step, the baseline level, e.g., the duration of the first turns, significantly contributed to an understanding of CG ability, demonstrating that the longer was the

first turns, so does the duration of the last turns. In the second step, age significantly contributed to the understanding of CG ability, so the duration of the last turns shortened at an older age. There was also a significant contribution to the interaction of age and general PRS score (entered in the fifth step). The interaction indicated that for a general PRS score lower than .35, younger participants extended the duration of the last turns. The third regression analysis revealed that the predictors explained 24% of the variance in the conceptualization process. In the first step, both age and IQ significantly contributed so that younger participants and children with lower cognitive ability reached conceptualization later. In the fourth step, the interaction of age and IQ significantly contributed to the understanding and indicated that for children older than 126.70 months, participants with lower cognitive ability reached conceptualization later.

Conclusions. There is limited knowledge in the research literature regarding the ability to create CG, and this study provided important information on the subject, especially concerning two main topics - CG development and the variables that explain the ability to generate CG. Current study findings broaden our knowledge, and they make a theoretical contribution, as we found that children with HFASD were able to shorten the verbal message in a state of shared knowledge. It seems that spontaneous learning has occurred between the baseline to the end of the task, that is, children with HFASD can coordinate their shared knowledge during a conversation with peers. We found a difference between the first and last turns in the index of words amount in the pre-adolescent and adolescent groups and a significant negative correlation between age and both words amount in the last turns and conceptualization process. Furthermore, age contributed significantly to each regression equation that we investigated. These results have further strengthened our hypothesis that CG is a developmental ability that stabilizes in children with HFASD as they age. We also found a developmental sequence in the use of mental language during the CG task. Beyond that, the findings have applied implications, and intervention programs can address factors that contribute to more advanced CG capability, such as ToM abilities and adequate pragmatic and cognitive abilities.