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# Mental State Language Development in Children with Down Syndrome versus Typical Development

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# MENTAL STATE LANGUAGE DEVELOPMENT IN CHILDREN WITH DOWN SYNDROME VERSUS TYPICAL DEVELOPMENT

**Abstract**

This study compared mental state language (talk about emotions, thoughts, intentions, etc.) used by 6- to 11-year-old children with Down syndrome (DS) to a younger typically developing (TD) comparison group matched by nonverbal cognition. We aimed to determine (1) whether mental state language use is delayed in DS relative to developmental expectations, and (2) if there are differences between groups in the association of mental state language and developmental factors (emotion knowledge; expressive language). Rate of mental state language use was significantly lower in the group with DS, but the number of different mental state terms was not significantly different. Nuanced patterns of similarity and difference emerged between groups regarding the association between mental state language and other developmental factors.

**Key Words:** Down syndrome; language; social cognition; mental state language; perspective taking

## Mental State Language Development in Children with Down Syndrome versus Typical Development

Down syndrome (DS) is the leading genetic cause of intellectual disability and is associated with a distinct behavioral phenotype (Fidler et al., 2016; Grieco et al., 2015). Individuals with DS tend to have relative strengths in early social-emotional development, including basic emotion understanding (Cebula et al., 2010; Channell et al., 2014; Fidler, 2006; 2008), and relative difficulties in expressive language, especially in grammatical development (Abbeduto et al., 2007; McDuffie et al., 2017). Despite a robust literature characterizing individual aspects of the behavioral phenotype associated with DS, little is known about how the profile of strengths and difficulties impacts social communication and interaction (Channell & Loveall, 2021). Specifically, interpreting and talking about others' emotions and mental states, such as thoughts, plans, and goals, is foundational for successful social interaction (Carpendale & Lewis, 2004; Denham, 2003). Mental state understanding and language use involves "putting oneself in another's shoes" and allows the individual to interpret others' social cues and respond appropriately. Recently, (blinded for review) documented mental state language use during narrative storytelling in 6- to 11-year-olds with DS and found it was just starting to emerge in this age range, much later than would be expected in typical development. Although these findings suggest that mental state language is delayed in DS, they do not demonstrate the extent of delay or other differences in mental state language development in this population. The current study builds on (blinded)'s study by comparing her cohort to a typically developing (TD) comparison group matched by nonverbal cognitive developmental level. This study aims to characterize cross-sectional trajectories of mental state language use and associated skills in the sample with DS compared to younger TD children to determine patterns of similarity and difference across the samples.

### Development of Mental State Language

TD children as young as 2.5 years old use mental state words in their vocabulary, mostly to indicate their own desires (e.g., *I want*) or perceptions (e.g., *see; hear*) (Bretherton & Beeghly, 1982;

Moore et al., 1994). At around the age of 3, they start using basic emotion words (e.g., *happy*; *sad*) (Bretherton et al., 1986), first to reference self and soon thereafter to reference others (Bartsch & Wellman, 1995; Hughes & Dunn, 1998). As perspective-taking, or theory of mind, becomes more developed during the preschool years, children begin using a wider variety of words to describe others' mental states, including references to cognitions (e.g., *think*; *know*) and desires (e.g., *want*; *wish*) (Bretherton & Beeghly, 1982; Hughes & Dunn, 1998; Moore et al., 1994; Wellman, 2014). These developmental patterns are based on research observations of young children in the context of free play with their mothers or in conversations with their peers, and they demonstrate that preschool-aged children can use mental state language across different contexts.

In contrast to free play where much of talk is self-focused, narrative storytelling (e.g., telling a story from a book) is a context that elicits talk about other people's mental states, such as the emotions and goals that motivate character plans and actions. Thus, it is particularly informative for assessing the social cognitive aspect of mental state language. However, the TD literature on the preschool years has almost exclusively focused on narrative comprehension only (rather than expression) as it relates to early developing social cognitive abilities. To date, only one study has reported data on spontaneous mental state language used by preschoolers during narrative storytelling (Tompkins et al., 2020). With this limited literature base, expectations regarding the amount of mental state language used by TD children in narrative storytelling during this developmental period are largely unknown.

In DS, the use of mental state language appears delayed. Young children with DS show less spontaneous mental state language use during free play compared to TD children matched by mental age (Beeghly & Cicchetti, 1997), with a level of use similar to that of language-matched children with autism spectrum disorder (Tager-Flusberg, 1992). Only two studies have characterized mental state language used by children with DS during narrative storytelling. Reilly et al. (1990) found that adolescents with DS used less mental state language in their fictional narratives compared to younger

TD children matched by mental age, although there were only four participants with DS in the study. (Blinded) examined mental state language in a larger sample of 6- to 11-year-olds with DS who told a story from a wordless picture book. A range of mental state language was used across the sample (0-24% of utterances), with six of the 37 children not yet including any mental state references in their narratives. However, without a TD comparison group or clear reference data on typical development, interpretations regarding the extent of delay are limited. The current study takes this next step by providing a TD comparison group to (blinded)'s sample, matched by nonverbal cognition.

**Skills Supporting Mental State Language Development**

The literature on typical development supports strong associations among children's perspective-taking, emotion knowledge (recognizing and/or labeling others' emotional expressions and identifying emotion-eliciting situations), general language, and mental state language (Conte et al., 2019). These skills appear to develop synchronously and support subsequent development of one another. For example, both early emotion knowledge and perspective-taking predict later mental state language understanding (Conte et al., 2019); both general language (Milligan et al., 2007; Pons et al., 2003) and talk about mental states (Symons, 2004) stimulate the development of emotion knowledge and perspective-taking. Recently, Tompkins et al. (2020) provided evidence that perspective-taking and inferencing (i.e., talking about non-literal aspects of a story) during narrative storytelling develop simultaneously during the preschool age range. Thus, both social-emotional and language skills are inter-related and collectively play an important role in the development of mental state language use in TD preschoolers.

The behavioral phenotype associated with DS includes relative strengths and difficulties across the social-emotional, cognitive, and linguistic domains. Expressive language in general, especially morphosyntax, is considered an area of weakness relative to nonverbal cognition (Abbeduto et al., 2007; McDuffie et al., 2017). In the social-emotional domain, earlier developing skills are considered a relative strength overall (Cebula et al., 2010; Fidler et al., 2006; 2008). However, there is also variability in the DS phenotype *within* this domain. For example, some studies have found emotion knowledge (i.e., the ability to recognize, interpret, and label one's own and others' emotional expressions and emotional situations) to be on par for general developmental level (e.g., Carvajal et al., 2012; Cebula et al., 2017; Channell et al., 2014; Hippolyte et al., 2009; Pochon & Declercq, 2013). In other studies, emotion knowledge is described as a relative difficulty (e.g., Andrés-Roqueta et al., 2021; Barisnikov, Thomasson, et al., 2020; Williams et al., 2005). This discrepancy is thought to stem from the level of emotion knowledge measured (e.g., recognizing basic or more complex emotions from simple or complex stimuli) as well as the amount of language and memory demands placed on the individual when making judgments about another's emotional expressions (Barisnikov, Theurel, et al., 2020; Channell et al., 2014; Hippolyte et al., 2009; Pochon & Declerq, 2013).

This uneven profile of strengths and difficulties within and across domains in DS emerges early in development, leading to a cascade of effects over time that result in the unique behavioral phenotype observed in middle childhood and beyond (Fidler et al., 2011). Thus, the DS phenotype likely alters the developmental course of mental state language in this population. (Blinded) reported the first data on skills associated with mental state language use in school-age children with DS whose developmental levels fall roughly within the preschool age range. Age and nonverbal cognition were not significantly associated with mental state language use, meaning that mental state language use was not simply a product of general development or level of cognitive delay. Instead, both nonverbal emotion knowledge (recognition of others' basic emotions from facial expressions and/or the situation) and structural language (expressive vocabulary and morphosyntax, or grammatical ability) were significantly associated with mental state language use during narrative storytelling. This supports the idea that certain social-emotional or linguistic skills may uniquely contribute to mental state language development in children with DS. However, a TD comparison group using the same measures is needed to test this possibility.

**Current Study**

The existing theoretical models of mental state language in typical development (Bartsch & Wellman, 1995; Bretherton et al., 1986; Hughes & Dunn, 1998) are based on TD studies using observational or experimental methods to assess mental state language use in limited communication contexts (e.g., mother-child play). These methods are not age-appropriate for older school-age children with DS, by the time they reach a developmental level in which they are expected to use mental state language. The current study includes a TD comparison group of preschoolers matched by nonverbal cognitive ability level to (blinded)'s cohort of school-age children with DS. The addition of a TD comparison group provides a model of mental state language use in the context of narrative storytelling on which to directly compare the children with DS. These data will determine whether mental state language use and its underlying factors are delayed and/or develop differently in children with DS. The specific aims of this study are:

1. *Examine mental state language use by children with DS relative to TD children matched by nonverbal cognitive developmental level*. This will determine whether level of mental state language use is delayed in DS relative to developmental expectations.
2. *Compare the cross-sectional trajectories of mental state language use relative to other developmental markers (emotion knowledge; expressive language—vocabulary and grammar) in children with DS and TD children*. This will determine if there are differences between groups in the association of mental state language and related developmental factors.

## Method

**Participants**

The participants were drawn from (blinded)'s cohort of 40 children with DS, ages 6-11 years, and a novel cohort of 40 TD children, ages 3-5 years. Participants with DS were recruited through parent support groups, community service providers, and participant registries across the United States. TD participants were recruited from a university daycare/preschool center.

All participants were native English speakers who primarily used speech to communicate in phrases or sentences. An additional inclusion criterion was that children attended to the narrative task and included story-relevant speech on at least some of the book pages. Three participants from each group were excluded due to incomplete narratives.

The participant groups were matched on nonverbal cognitive ability level by Leiter-3 growth score values (GSVs). GSVs are raw scores corrected for varying item difficulty (Roid & Miller, 2013). First, participants were excluded if their GSVs fell outside the overlapping range of values between groups ($n$ = 8 TD; 3 DS). Then, participants were divided into bins (GSVs in the 470s, 460s, 450s, etc.). More of the TD participants scored in the highest bin (470s), resulting in insufficient group matching. Thus, an additional eight TD participants were randomly selected for exclusion.

The final matched sample included 27 TD participants and 34 participants with DS, $t(59) = 0.57$, $p = .57$, Cohen's $d = 0.14$, variance ratio = 1.20. Participant groups were considered matched according to the standards set by Mervis and Klein-Tasman (2004; $p$-value > .50) and Kover and Atwood (2013; small effect size [<.20] and variance ratio [< 1.25]). There was not a significant difference between groups in Expressive Vocabulary Test-2 (EVT-2; Williams, 2007) growth score values ($t[50] = 0.39$, $p = .70$, Cohen's $d = .11$, variance ratio = 2.17), but there was a significant group difference in expressive morphosyntax, measured by mean length of utterance (C-unit) in morphemes (MLU; $t[59] = 3.20$, $p = .002$, Cohen's $d = 1.67$, variance ratio = 1.73). See Table 1 for descriptive characteristics of participant groups.

## Measures

### ***Nonverbal IQ***

The Leiter International Performance Test, 3rd edition (Leiter-3; Roid & Miller, 2013) is a standardized, norm-referenced measure of nonverbal IQ (four core subtests) for ages 3-75+ years. It is nonverbal in administration and response method, and it was designed for use in populations with disabilities including DS. Leiter GSVs were used to match participant groups.

***Mental State Language***

Examiners administered a narrative sampling procedure developed by Abbeduto and colleagues (Abbeduto et al., 2020; Thurman et al., 2021) in which participants were instructed to tell a story from a wordless picture book (*Frog Goes to Dinner* [Mayer, 1973] or *Frog on His Own* [Mayer, 1974]). Examiners used neutral prompts as needed (e.g., "*What's happening in this part of the story*?"; see Channell et al., 2018 for script). These procedures have been validated with adequate psychometric properties reported in 6- to 23-year-olds with DS (Thurman et al., 2021). Participants' narrative language samples were audio and video recorded for transcription and coding.

**Transcription.** Five transcribers used Systematic Analysis of Language Transcripts (SALT; Miller & Iglesias, 2012) software to transcribe participants' narratives following modified conventions (Abbeduto et al., 2020). Utterances were segmented by communication units (C-units; independent clauses with dependent clauses and modifiers). All transcripts were double-checked and finalized by two transcribers. At least twenty percent of transcripts from each group were randomly selected for independent transcription to assess reliability. Inter-transcriber reliability in the group with DS averaged 90.12% (87-94) across transcription conventions (blinded). Reliability within the TD group averaged 93.84% (88-97).

**Coding.** Two coders marked transcripts for mental state language use. Off-task (e.g., "I want a sticker") or scripted (e.g., *happily ever after*) language was excluded. Codes were subcategorized according to (blinded)'s coding scheme which was based on the TD literature (Bartsch & Wellman, 1995; LaBounty et al., 2008). Subcategories included emotional state (e.g., *happy*), emotional behavior (e.g., *cry*), desire (e.g., *want*), cognitive (e.g., *think*), perception (e.g., *see*) and physiological state (e.g., *hungry*) references. Mental state language was not coded in abandoned utterances, repetitions, or mazed words.

Coders were trained to fidelity with practice transcripts until reaching at least 95% agreement for the presence/absence of mental state language at the C-unit level and 80% agreement for the individual subcategory codes on consecutive transcripts. During coding, inter-coder agreement was computed for at least 20% of transcripts from each participant group. Agreement at the C-unit level averaged 99.32% for the group with DS and 98.48% for the TD group. Agreement for individual subcategory codes averaged 79% (Median = 88) for the group with DS and 84.48% (Median = 84) for the TD group.

**Outcome Variables.** Mental state language *density* was computed as the proportion of C-units containing mental state language. Mental state language *diversity* was computed as the number of different mental state words used. Density measures rate of mental state language use, while diversity indicates the breadth of mental state vocabulary.

***Expressive Vocabulary***

The Expressive Vocabulary Test, 2$^{nd}$ edition (EVT-2; Williams, 2007) is a standardized, norm-referenced measure of expressive vocabulary for ages 2.5+ years. Participants were asked to label items in a series of pictures. The EVT-2 was not administered to six TD children due to time constraints and was not scored for three children with DS due to examiner error in establishing basal. Age-based standard scores were used to describe the samples; GSVs were used in statistical models.

***Expressive Morphosyntax (MLU)***

Expressive morphosyntax was computed from the narrative language samples as the mean length of C-unit in morphemes (MLU). Abandoned utterances (DS $M$ = 3.43%, $SD$ = 5.37%; TD $M$ = 4.72%, $SD$ = 4.44%), interrupted utterances (DS $M$ = 0.18%, $SD$ = 0.74%; TD $M$ = 0.24%, $SD$ = 0.52%), and utterances containing unintelligible speech (DS $M$ = 15.65%, $SD$ = 13.42%; TD $M$ = 13.29%, $SD$ = 11.56%) were excluded from the calculation of MLU.

***Emotion Knowledge***

The Emotion Judgment Test (EJT; Channell et al., 2014) is a nonverbal measure of emotion knowledge designed for populations with developmental disabilities and language impairments. Participants were shown 18 short videos of a child experiencing emotional events and/or expressing emotion through facial expressions (i.e., 6 videos of emotional events with child's facial expression digitally masked; 6 videos of child's facial expressions, and 6 videos of emotional events and facial expressions visible). Video presentation order was counterbalanced by emotion cue condition; each emotion was represented twice per video condition in a fixed random order. Children identified the emotions by pointing to schematic faces and verbally labeling from the choices of "happy, sad, or scared". Proportion scores out of 36 possible points represented accuracy for pointing (1 point each) and verbal labeling (1 point each) across all 18 videos. Three children did not pass a schematic faces screener and thus did not complete the EJT. The EJT has been validated in children with DS ages 6-18 and in TD preschoolers ages 3-5; good internal consistency was also reported in these samples (Channell et al., 2014).

**Analytic Plan**

To address Aim 1, we conducted independent samples *t*-tests comparing participant groups on their overall mental state language density and diversity. To address Aim 2, we used linear regression to estimate the association between each developmental factor (expressive vocabulary, expressive morphosyntax, and emotion knowledge) and mental state language in both participant groups and to assess whether the association differed by group. A series of regression models independently assessed the contribution of each predictor variable (developmental factor) to each outcome variable (mental state language density or diversity).

In each regression model, we considered three factors: Group, the predictor variable (EVT, MLU, or EJT), and the Group by predictor interaction term. The TD group served as the reference group, and each predictor variable was centered at the mean value of the TD group. Thus, the Group coefficient in a model with the interaction term represents the expected difference in the outcome variable between groups at the average TD score of the predictor variable. The interaction term indicates whether the association between the predictor variable and the outcome is different between participant groups. If the interaction term was not significant, the model was rerun without that term.

Underlying assumptions of the models were met. For any potential outliers, we ran sensitivity analyses by excluding those individuals and comparing results to the originally fit models. In all cases, the pattern of findings and interpretation of results did not change. Thus, the presented results include all participants. Cases with missing data were excluded list-wise (see Table 1).

## Results

### Aim 1 Group Comparisons: Mental State Language

There was a significant difference between groups in mental state language *density*; TD participants used a significantly greater proportion of C-units with mental state language than those with DS, $t(38.81) = 2.89$, $p = .01$, $d = .79$ (equal variances not assumed due to violation of Levene's Test). However, there was no significant group difference in mental state language *diversity*, $t(59) = 0.77$, $p = .45$, $d = .20$. See the Appendix for the mental state terms most frequently used by each participant group. See Figure 1 for the relative frequencies (i.e., percent of all mental state words used) across subcategories.

### Aim 2 Group Comparisons: Cross-Sectional Trajectories

#### *Expressive Vocabulary*

The model predicting mental state language *density* revealed no significant Group X EVT interaction, $B = -.003$ (SE = .002), $t(48) = -1.25$, $p = .22$. In the model without the interaction term, across all participants there was not a significant association between expressive vocabulary and mental state language density. However, the Group coefficient (reference = TD) was significant. See Table 2. After accounting for expressive vocabulary, mental state language density was approximately 9 percentage points higher, on average, in the TD group than in those with DS (Figure 2).

The model predicting mental state language *diversity* revealed a marginally significant Group X EVT interaction term, so this term was retained in the model (Table 2). The EVT coefficient was significant, indicating a positive association between expressive vocabulary and mental state language diversity in the TD participants (reference group). Specifically, for every 3-point increase in EVT growth value scores, on average, mental state language diversity is expected to increase by approximately 1 word ($B$ = 3 x .32 = .96) in the TD group and .42 words ($B$ = 3 x [.32 -.18]) in the group with DS. Thus, the association between expressive vocabulary and mental state language diversity was significantly less strong in participants with DS. The Group coefficient was not significant, indicating that at the TD group's mean EVT score, there was no significant difference between groups in mental state language diversity beyond the contribution of expressive vocabulary (Figure 2).

***Expressive Morphosyntax (MLU)***

The model predicting mental state language *density* indicated a significant Group X MLU interaction term (Table 2). The MLU coefficient was significant. For every 1-morpheme increase in MLU, on average, mental state language density is expected to increase by approximately 5% (proportion score = .05) in the TD group and 2% (.05-.03) in the group with DS. Thus, the association between expressive morphosyntax and mental state language density was significantly less strong in participants with DS. The Group coefficient also was significant. At the mean MLU of the TD group, on average, mental state language density was 5 percentage points lower in the group with DS compared to the TD group (Figure 3).

The model predicting mental state language *diversity* indicated no significant Group X MLU interaction term, $B$ = -.79 (SE = .53), $t(57)$ = -1.49, $p$ = .14. In the model without the interaction term, there was a positive association between MLU and mental state language diversity across all participants (Table 2). After accounting for MLU, the participants with DS had approximately 2 more different mental state words than the TD participants (Figure 3).

***Emotion Knowledge***

The model predicting mental state language *density* revealed no significant Group X EJT interaction, $B = -.05$ (SE = .13), $t(54) = -0.39$, $p = .70$. In a model without the interaction, across all participants there was a non-significant but trending positive association between emotion knowledge and mental state language density. The Group coefficient was significant. See Table 2. After accounting for emotion knowledge, mental state language density was higher in the TD group than in those with DS (Figure 4).

The model predicting mental state language *diversity* revealed no significant Group X EJT interaction, $B = .71$ (SE = 5.54), $t(54) = 0.13$, $p = .90$. In a model without the interaction, across all participants there was a positive association between emotion knowledge and mental state language diversity (Table 2). However, the Group coefficient was not significant; after accounting for emotion knowledge, there was no significant difference between groups in mental state language diversity scores (Figure 4).

## Discussion

The purpose of this study was (1) to compare the mental state language used by school-age children with DS to younger TD children matched by nonverbal cognition, and (2) to compare the association between mental state language use and developmental factors (i.e., emotion knowledge; expressive language [vocabulary and grammar]) across the two groups. As expected, fewer utterances spoken by the children with DS contained mental state language (density) compared to the TD children. However, the two groups did not significantly differ in the number of different mental state terms used (diversity). This was a surprising finding, suggesting that children with DS have acquired and can use a variety of mental state vocabulary, comparable to developmental expectations, but they do not spontaneously include as much mental state language in their narratives compared to TD children. Thus, mental state language use may be a relative difficulty for many school-age children with DS. Because mental state language is an important component of age-appropriate social interaction (Carpendale & Lewis, 2004), mental state language interventions for this population should focus particularly on increasing the use of mental state terms once acquired.

For intervention implementation, it is beneficial to know the typical developmental progression of related skills so that the clinician can assess and select appropriate targets for the child's current developmental level (Lieven, 2019; Rezzonico et al., 2015; Rowe & Snow, 2020). Accordingly, Aim 2 was designed to capture additional developmental differences, if present, across the two groups. These data reveal the extent to which typical developmental models are applicable to children with DS at the cross-section of ages represented in this sample with DS (6-11 years). Examination of the association between each developmental factor and mental state language density and diversity across participant groups revealed nuance of similarities and differences.

In both models predicting mental state language density and diversity, the two groups showed similar associations with emotion knowledge. For both groups, the strongest association was observed for mental state language diversity (i.e., mental state vocabulary). Many of the mental state words used by the children with DS were emotion labels to describe others' emotional states. Because some aspects of emotion knowledge are a relative strength for children with DS (i.e., on par for developmental expectations; Channell et al., 2014; Pochon & Declerq, 2013), this foundational skill set may be leveraged during intervention to promote mental state vocabulary development in children with DS. However, emotion knowledge involves different levels of skills, all of which may not be strong in children with DS (e.g., Andrés-Roqueta et al., 2021; Barisnikov et al., 2020). As with any intervention, an individualized and nuanced approach is needed. Nevertheless, in the current study, nonverbal emotion knowledge—measured here as recognizing others' basic emotions from facial expressions and/or situational context—appears to play a similar role in mental state language development in children with DS and TD children. Thus, we may be able to apply TD models of mental state language use to interventions for children with DS. For example, TD children develop emotion knowledge and learn to use mental state language through caregiver-child talk about others' mental states. Thus, caregiver-child interactions may be a fruitful avenue for increasing mental state language use in DS (see Channell & Bosley, 2021). Future work is needed to test this possibility.

Examining models of the association between mental state language and structural language variables, the picture is less clear. It appears that to some extent, TD models may apply to school-age children with DS, but that depends on which language variable (vocabulary or morphosyntax/MLU) and which mental state language outcome (density or diversity) is considered.

Regarding mental state language density (rate of use), MLU showed a significant association in both groups. However, this association was less strong in DS than in TD, resulting in a significant Group by MLU interaction. This suggests deviation from the typical developmental progression and thus limited application of the TD model to interventions targeting mental state language use in children with DS. In contrast, it appears that MLU may play a key role for the development of mental state language diversity in children with DS. There was no significant Group by MLU interaction, suggesting that here, the TD model can be applied to DS, at least across the MLU levels represented in our sample. Furthermore, once accounting for MLU, participants with DS had *higher* mental state diversity (i.e., 2 more mental state vocabulary words) than TD children. Thus, in addition to emotion knowledge, building grammatical skills in children with DS may result in more diverse mental state vocabulary use. However, the directionality of effects is unknown because this study was cross-sectional. It is equally possible that teaching children with DS different mental state terms may further develop emotion knowledge and result in the spontaneous production of longer, more complex utterances (i.e., increased MLU) during narrative storytelling. Regardless, MLU is a well-documented area of relative weakness in individuals with DS (Abbeduto et al., 2007; Grieco et al., 2015; McDuffie et al., 2017), and this study shows that MLU is closely tied to breadth of mental state vocabulary in school-age children with DS. Therefore, MLU should be addressed alongside mental state vocabulary during intervention.

Finally, the models examining expressive vocabulary showed the reverse pattern of the MLU models, albeit with less strong associations overall. Mental state language density was not significantly associated with expressive vocabulary in either group. Although expressive vocabulary was significantly associated with mental state language diversity, this association was less strong in the group with DS (i.e., a significant Group by Expressive Vocabulary interaction). This is noteworthy because it suggests that mental state vocabulary development is not simply driven by general vocabulary development for children with DS. Instead, mental state vocabulary is more closely tied to MLU and emotion knowledge. In addition to guiding interventions, these data contribute to our understanding of mechanisms underlying different aspects of language development in DS.

Upon inspection of the types of mental state words most frequently spoken by each group (Appendix), there is much overlap with some subtle but potentially important differences. No cognitive state words were on the list of words frequently spoken by children with DS, whereas two cognitive state words (*think*, *know*) were on the TD list. Thus, although children with DS showed levels of mental state language diversity comparable to the TD group, this diversity appears to reflect an expanded use of different emotional state words (with some references to perception) without the expected developmental progression toward referencing different cognitive states that is observed in typical development. Additionally, the relative frequencies of different subcategories of mental state language significantly differed between groups for references to desire (Figure 1), which may reflect less focus on others' intentions. It could be that the children with DS have mastered lower-level social reasoning but have not yet developed higher-level social reasoning that is required to interpret others' cognitions and intentions (e.g., theory of mind). This explanation fits with what is known about the DS social-cognitive phenotype (Cebula et al., 2010; Channell & Loveall, 2021); however, without a direct measure of theory of mind in the current study, this remains hypothetical. This represents an important avenue for future research in DS because in typical development, theory of mind is strongly linked to mental state language development (Tompkins et al., 2019). The challenge for future research is that measures of theory of mind tend to rely heavily on language processing, which can limit performance in populations with severe language delays like children with DS. A strength of the current study was the inclusion of a nonverbal measure of emotion knowledge, which is considered a lower-level social reasoning skill. Importantly, this nonverbal social reasoning skill was associated with both mental state language density and diversity in the sample with DS. This provides preliminary evidence that social cognition, in addition to expressive language, is important to mental state language development in DS. As for expressive language, the children with DS showed decreased diversity in cognitive words and decreased frequency of desire words compared to their TD counterparts. This may reflect more limited verb use by individuals with DS, particularly for verbs that are less actionable (e.g., *think*, *know*, *try* vs. *laugh*, *cry*; Loveall et al., 2019). Again, however, more research is needed.

**Limitations and Directions for Future Research**

Because this study was cross-sectional, directionality of effects cannot be confirmed. Future longitudinal research is needed to identify the natural progression of skills over time in children with DS to better inform intervention efforts. Additionally, the careful matching of participant groups by nonverbal cognitive developmental levels resulted in the exclusion of some participants, thus limiting the representativeness of samples and limiting statistical power. Although the advantages of participant matching arguably outweigh these limitations, they should be considered when interpreting the results. For example, conclusions about the associations between developmental factors and mental state language (or lack thereof) should only be applied to 6- to 11-year-olds with DS who have a developmental level advanced enough to be matched to TD preschoolers (3- to 5-year-olds) and who have the expressive language skills to tell complete narratives. Also, the current study's participants were matched by nonverbal cognition; future research should consider samples matched by aspects of expressive language (e.g., morphosyntax) to further understand the role of these skills in mental state language development. Further, the cross-sectional trajectory analyses in Aim 2 were limited to these same matched groups of relatively small sample sizes. Future research should consider the recommendation by Thomas et al. (2009) to include larger comparison groups for these analyses that do not require such participant matching. Additionally, because mental state language use was still emerging within this age range in DS, and some participants were not yet using any mental state language, the ability to detect significant associations may have been limited by the variability in mental state language use, particularly for the density measure. Finally, whenever matching participants and analyzing patterns at the group level, it is important to recognize the heterogeneity in skills observed across all participants but particularly those with DS. Future research should also consider individual differences analyses (Fidler et al., 2009) or even the possibility of subtypes within the DS phenotype (Channell et al., 2021).

**Study Implications and Conclusion**

This study has implications both in terms of theoretical research and clinical practice. First, by taking a nuanced approach to examining the development of mental state language and associated factors in children with DS, both similarities and differences between DS and typical development emerged. This exemplifies the importance of mapping trajectories, even in cross-sectional research studies, when comparing participant groups (Thomas et al., 2009). Additionally, the resulting data provide valuable information regarding the extent to which theoretical models of typical mental state language development can be applied to individuals with DS. This, in turn, can inform clinical research regarding which skills to target next during interventions for children with DS. From the current study's results, it appears that nonverbal emotion knowledge and to some extent MLU are important factors in mental state language development and thus should be assessed and considered when planning interventions. Although more research is needed, this study provides a critical next step in determining how to best promote mental state language and social communication in school-age children with DS.

**References**

Abbeduto, L., Berry-Kravis, E., Sterling, A., Sherman, S., Edgin, J. O., McDuffie, A., Hamilton, D., Nelson, J. A., & Thurman, A. J. (2020). Expressive language sampling as a source of outcome measures for treatment studies in fragile X syndrome: Feasibility, practice effects, test-retest reliability, and construct validity. *Journal of Neurodevelopmental Disorders, 12,* 10. https://doi.org/10.1186/s11689-020-09313-6

Abbeduto, L., Warren, S. F., & Conners, F. A. (2007). Language development in Down syndrome: From the prelinguistic period to the acquisition of literacy. *Mental Retardation and Developmental Disabilities Research Reviews, 13*(3), 247-261. https://doi.org/10.1002/mrdd.20158

Andrés-Roqueta, C., Soria-Izquierdo, E., & Górriz-Plumed, A. B. (2021). Exploring different aspects of emotion understanding in adults with Down syndrome. *Research in Developmental Disabilities, 114*, 103962. https://doi.org/10.1016/j.ridd.2021.103962

Barisnikov, K., Theurel, A., & Lejeune, F. (2020). Emotion knowledge in neurotypical children and in those with Down syndrome. *Applied Neuropsychology: Child,* 1-15. https://doi.org/10.1080/21622965.2020.1777131

Barisnikov, K., Thomasson, M., Stutzmann, J., & Lejeune, F. (2020). Relation between processing facial identity and emotional expression in typically developing school-age children and those with Down syndrome. *Applied Neuropsychology: Child, 9,* 179-192. https://doi.org/10.1080/21622965.2018.1552867

Bartsch, K., & Wellman, H. M. (1995). *Children talk about the mind.* Oxford University Press.

Beeghly, M., & Cicchetti, D. (1997). Talking about self and other: Emergence of an internal state lexicon in young children with Down syndrome. *Development and Psychopathology, 9*(4), 729-748. https://doi.org/10.1017/S0954579497001417

Bretherton, I., & Beeghly, M. (1982). Talking about internal states: The acquisition of an explicit theory of mind. *Developmental Psychology, 18*(6), 906-921. https://doi.org/10.1037/0012-1649.18.6.906

Bretherton, I., Fritz, J., Zahn-Waxler, C., & Ridgeway, D. (1986). Learning to talk about emotions: A functionalist perspective. *Child Development, 57(*3), 529-548. https://doi.org/10.2307/1130334

Carpendale, J. I. M., & Lewis, C. (2004). Constructing an understanding of mind: The development of children's social understanding within social interaction. *Behavioral and Brain Sciences, 27*(1), 79-96. https://doi.org/10.1017/s0140525x04000032

Carvajal, F., Fernández-Alcaraz, C., Rueda, M., & Sarrión, L. (2012). Processing of facial expressions of emotions by adults with Down syndrome and moderate intellectual disability. *Research in Developmental Disabilities, 33*, 783-790. https://doi.org/10.1016/j.ridd.2011.12.004

Cebula, K. R., Moore, D. G., & Wishart, J. G. (2010). Social cognition in children with Down's syndrome: Challenges to research and theory building. *Journal of Intellectual Disability Research, 54*(2), 113-134. https://doi.org/10.1111/j.1365-2788.2009.01215.x

Cebula, K. R., Wishart, J. G., Willis, D. S., & Pitcairn, T. (2017). Emotion recognition in children with Down syndrome: Influence of emotion label and expression intensity. *American Journal on Intellectual and Developmental Disabilities, 122*(2), 138-155. https://doi.org/10.1352/1944-7558-122.2.138

Channell, M. M. (2020). Cross-sectional trajectories of mental state language development in children with Down syndrome. *American Journal of Speech-Language Pathology, 29*(2), 760-775. https://doi.org/10.1044/2020_AJSLP-19-00035

Channell, M. M., & Bosley, R. (2021). Mental state language use in children with Down syndrome and the role of caregivers. *Seminars in Speech and Language, 42(04)*, 318-329. https://doi.org/10.1055/s-0041-1730990

Channell, M. M., Conners, F. A., & Barth, J. M. (2014). Emotion knowledge in children and adolescents with Down syndrome: A new methodological approach*. American Journal on Intellectual and*

*Developmental Disabilities, 119*(5), 405-421. https://doi.org/10.1352/1944-7558-119.5.405

Channell M. M., & Loveall, S. J. (2021). Assessment and intervention of cognitive and social functioning in adolescents, young adults, and older individuals with Down syndrome. In K. M. Wilkinson & L. H. Finestack (Eds.), *Multimodal AAC for individuals with Down syndrome* (pp.185-204). Paul H. Brookes Publishing Co.

Channell, M. M., Loveall, S. J., Conners, F. A., Harvey, D. J., & Abbeduto, L. (2018). Narrative language sampling in typical development: Implications for clinical trials. *American Journal of Speech-Language Pathology, 27*(1), 123-135. https://doi.org/10.1044/2017_AJSLP-17-0046

Channell, M. M., Mattie, L. J., Hamilton, D. R., Capone, G. T., Mahone, E. M., Sherman, S. L., Rosser, T. C., Reeves, R. H., Kalb, L. G., & The Down Syndrome Cognition Project. (2021). Capturing cognitive and behavioral variability among individuals with Down syndrome: A latent profile analysis. *Journal of Neurodevelopmental Disorders, 13*, 16. https://doi.org/10.1186/s11689-021-09365-2

Conte, E., Ornaghi, V., Grazzani, I., Pepe, A., & Cavioni, V. (2019). Emotion knowledge, theory of mind, and language in young children: Testing a comprehensive conceptual model. *Frontiers in Psychology, 10,* 2144. https://doi.org/10.3389/fpsyg.2019.02144

Denham, S. A., Blair, K. A., DeMulder, E., Levitas, J., Sawyer, K., Auerbach-Major, S., & Queenan, P. (2003). Preschool emotional competence: Pathway to social competence? *Child Development, 74*(1), 238-256. https://doi.org/10.1111/1467-8624.00533

Fidler, D. J. (2006). The emergence of a syndrome-specific personality profile in young children with Down syndrome. *Down Syndrome Research and Practice, 10(2)*, 53-60. https://doi.org/10.3104/reprints.305

Fidler, D. J., Most, D. E., Booth-LaForce, C., & Kelly, J. F. (2008). Emerging social strengths in young children with Down syndrome. *Infants and Young Children, 21(3)*, 207-220. https://doi.org/10.1097/01.IYC.0000324550.39446.1f

Fidler, D. J. Daunhauer, L. A., Will, E., Gerlach-McDonald, B., & Schworer, E. (2016). The central role of etiology in science and practice in intellectual disability. *International Review of Research in Developmental Disabilities, 50*, 33-69. https://doi.org/10.1016/bs.irrdd.2016.05.005

Fidler, D. J., Lunkenheimer, E., & Hahn, L. (2011). Emerging behavioral phenotypes and dynamic systems theory. *International Review of Research in Developmental Disabilities, 40*, 17-42. https://doi.org/10.1016/B978-0-12-374478-4.00002-2

Fidler, D. J., Most, D. E., & Philofsky, A. (2009). The Down syndrome behavioural phenotype: Taking a developmental approach. *Down Syndrome Research and Practice, 12*(3).

Grieco, J., Pulsifer, M., Seligsohn, K., Skotko, B., & Schwartz, A. (2015). Down syndrome: Cognitive and behavioral functioning across the lifespan. *American Journal of Medical Genetics Part C: Seminars in Medical Genetics, 169*(2), 135-149. https://doi.org/10.1002/ajmg.c.31439

Hippolyte, L., Barisnikov, K., Van der Linden, M., Detraux, J. (2009). From facial emotional recognition abilities to emotional attribution: A study in Down syndrome. *Research in Developmental Disabilities, 30*, 1007-1022. https://doi.org/10.1016/j.ridd.2009.02.004

Hughes, C., & Dunn, J. (1998). Understanding mind and emotion: Longitudinal associations with mental-state talk between young friends. *Developmental Psychology, 34(*5), 1026–1037. https://doi.org/10.1037/0012-1649.34.5.1026

Kover, S. T., & Atwood, A. K. (2013). Establishing equivalence: Methodological progress in group-matching design and analysis. *American Journal of Developmental Disabilities, 118*(1), 3-15. https://doi.org/10.1352/1944-7558-118.1.3

LaBounty, J., Wellman, H. M., Olson, S., Lagattuta, K., & Liu, D. (2008). Mothers' and fathers' use of internal state talk with their young children. *Social Development, 17*(4), 757-775. https://doi.org/10.1111/j.1467-9507.2007.00450.x

Lieven, E. (2019). Input, interaction, and learning in early language development. In V. Grøver, P. Uccelli,

M. L. Rowe, & E. Lieven (Eds.), *Learning through language: Towards an educationally informed theory of language learning* (pp. 19–30). Cambridge University Press. https://doi.org/10.1017/9781316718537.003

Loveall, S. J., Channell, M. M., Abbeduto, L., & Conners, F. A. (2019). Verb production by individuals with Down syndrome during narration. *Research in Developmental Disabilities, 85*, 82-91. https://doi.org/10.1016/j.ridd.2018.11.007

Mayer, M. (1973). *Frog on his own.* Dial Books.

Mayer, M. (1974). *Frog goes to dinner.* Dial Books.

McDuffie, A., Thurman, A. J., Channell, M. M., & Abbeduto, L. (2017). Language disorders in children with intellectual disability of genetic origin. In Schwartz R. (Ed.), *Handbook of child language disorders* (2nd ed., pp. 52-81). Taylor & Francis.

Mervis, C. B., & Klein-Tasman, B. P. (2004). Methodological issues in group-matching designs: α levels for control variable comparisons and measurement characteristics of control and target variables. *Journal of Autism and Developmental Disorders, 34*, 7–17. https://doi.org/10.1023/B:JADD.0000018069.69562.b8

Miller, J., & Iglesias, A. (2012). Systematic Analysis of Language Transcripts (SALT), Research Version 2012 [Computer software]. SALT Software.

Milligan, K., Astington, J. W., & Dack, L. A. (2007). Language and theory of mind: Meta-analysis of the relation between language ability and false-belief understanding. *Child Development, 78*(2), 622-648. http://doi.org/10.1111/j.1467-8624.2007.01018.x

Moore, C., Furrow, D., Chiasson, L., & Patriquin, M. (1994). Developmental relationships between production and comprehension of mental terms. *First Language, 14*(42-43), 1-17. https://doi.org/10.1177/014272379401404201

Pochon, R., & Declerq, C. (2013). Emotion recognition by children with Down syndrome: A longitudinal study. *Journal of Intellectual and Developmental Disability, 38*(4), 332-343. http://doi.org/10.3109/13668250.2013.826346

Pons, F., Lawson, J., Harris, P. L., & De Rosnay, M. (2003). Individual differences in children's emotion understanding: Effects of age and language. *Scandinavian Journal of Psychology, 44*(4), 347-353. https://doi.org/10.1111/1467-9450.00354

Reilly, J., Klima, E. S., & Bellugi, U. (1990). Once more with feeling: Affect and language in atypical populations. *Development and Psychopathology, 2*(4), 367–391. https://doi.org/10.1017/S0954579400005782

Rezzonico, S., Hipfner-Boucher, K., Milburn, T., Weitzman, E., Greenberg, J., Pelletier, J., & Girolametto, L. (2015). Improving preschool educators' interactive shared book reading: Effects of coaching in professional development. *American Journal of Speech-Language Pathology, 24*(4), 717–732.

Roid, G. H., Miller, L. J., Pomplun, M., & Koch, C. (2013). *Leiter International Performance Scale–Third Edition.* Stoelting.

Rowe, M. L., & Snow, C. E. (2020). Analyzing input quality along three dimensions: Interactive, linguistic, and conceptual. *Journal of Child Language, 47*(1), 5-21. https://doi.org/10.1017/S0305000919000655

Symons, D. K. (2004). Mental state discourse, theory of mind, and the internalization of self-other understanding. *Developmental Review, 24*(2), 159–188. https://doi.org/10.1016/j.dr.2004.03.001

Tager-Flusberg, H. (1992). Autistic children's talk about psychological states: Deficits in the early acquisition of a theory of mind. *Child Development, 63*(1), 161–172. https://doi.org/10.1111/j.1467-8624.1992.tb03604.x

Thomas, M. S. C., Annaz, D., Ansari, D., Scerfi, G., Jarrold, C., & Karmiloff-Smith, A. (2009). Using developmental trajectories to understand developmental disorders. *Journal of Speech,* *Language, and Hearing Research, 52*(2), 336-358. https://doi.org/10.1044/1092-4388(2009/07-0144)

Thurman, A. J., Edgin, J. O., Sherman, S. L., Sterling, A., McDuffie, A., Berry-Kravis, E., Hamilton, D., & Abbeduto, L. (2021). Spoken language outcome measures for treatment studies in Down syndrome: Feasibility, practice effects, test-retest reliability, and construct validity of variables generated from expressive language sampling. *Journal of Neurodevelopmental Disorders, 13.* https://doi.org/10.1186/s11689-021-09361-6

Tompkins, V., Blosser, M. K., & Downing, M. (2020). False belief understanding and narrative comprehension in the preschool years. *Cognitive Development, 56*, 100936. https://doi.org/10.1016/j.cogdev.2020.100936

Tompkins, V., Farrar, J., & Montgomery, D. E. (2019). Speaking your mind: Language and narrative in young children's theory of mind development. *Advances in Child Development and Behavior, 56,* 109-140. https://doi.org/10.1016/bs.acdb.2018.11.003

Wellman, H. M. (2014). *Making minds: How theory of mind develops.* Oxford University Press.

Williams, K. R., Wishart, J. G., Pitcairn, T. K., & Willis, D. S. (2005). Emotion recognition by children with Down syndrome: Investigation of specific impairments and error patterns. *American Journal on Mental Retardation, 110*, 378-392. https://doi.org/10.1352/0895-8017(2005)110[378:ERBCWD]2.0.CO;2

Williams, K. T. (2007). *Expressive Vocabulary Test–Second Edition (EVT-2).* Pearson.

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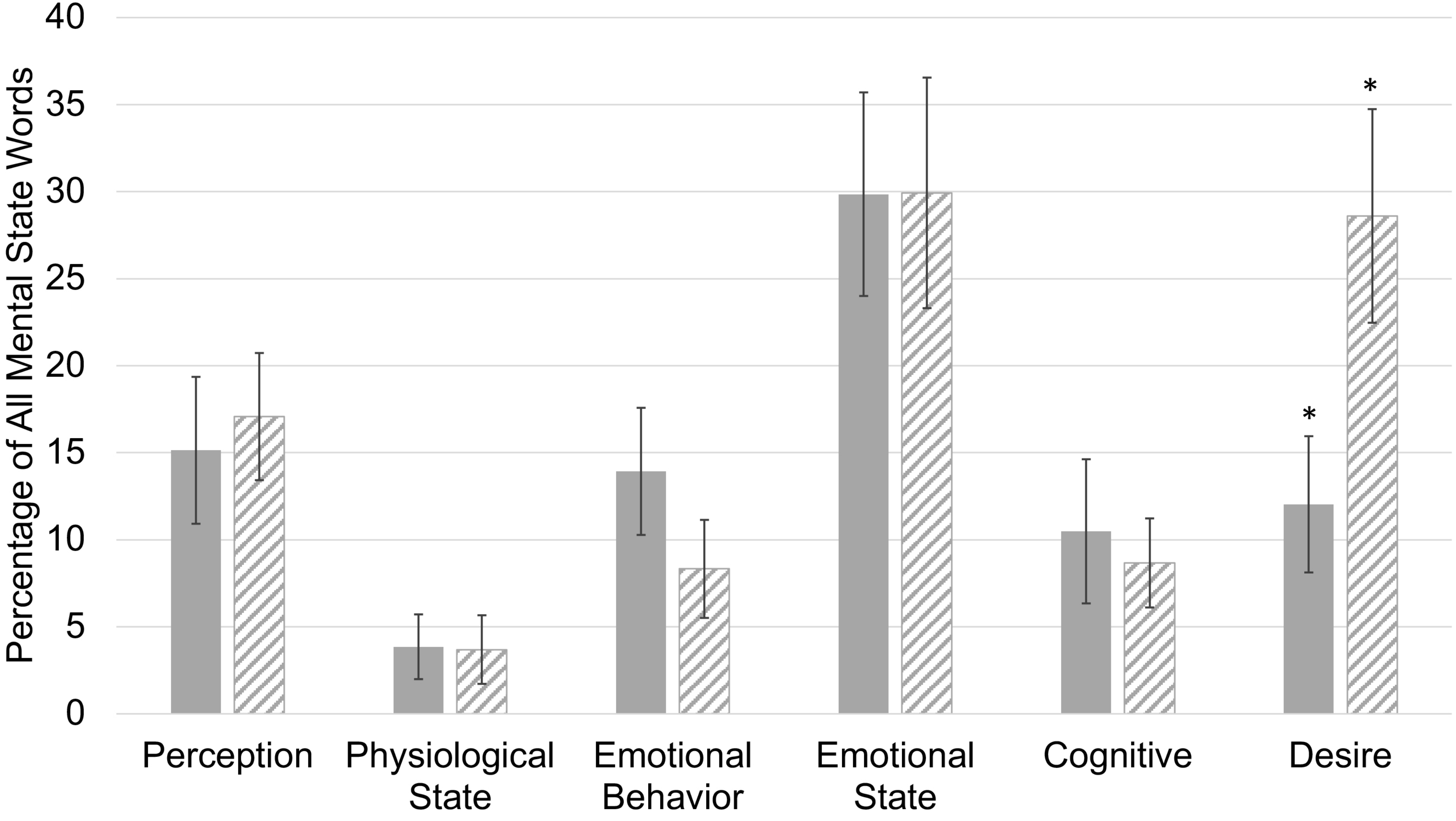
Figure 1

*Relative Frequencies of Mental State Word Categories Used by Each Group*

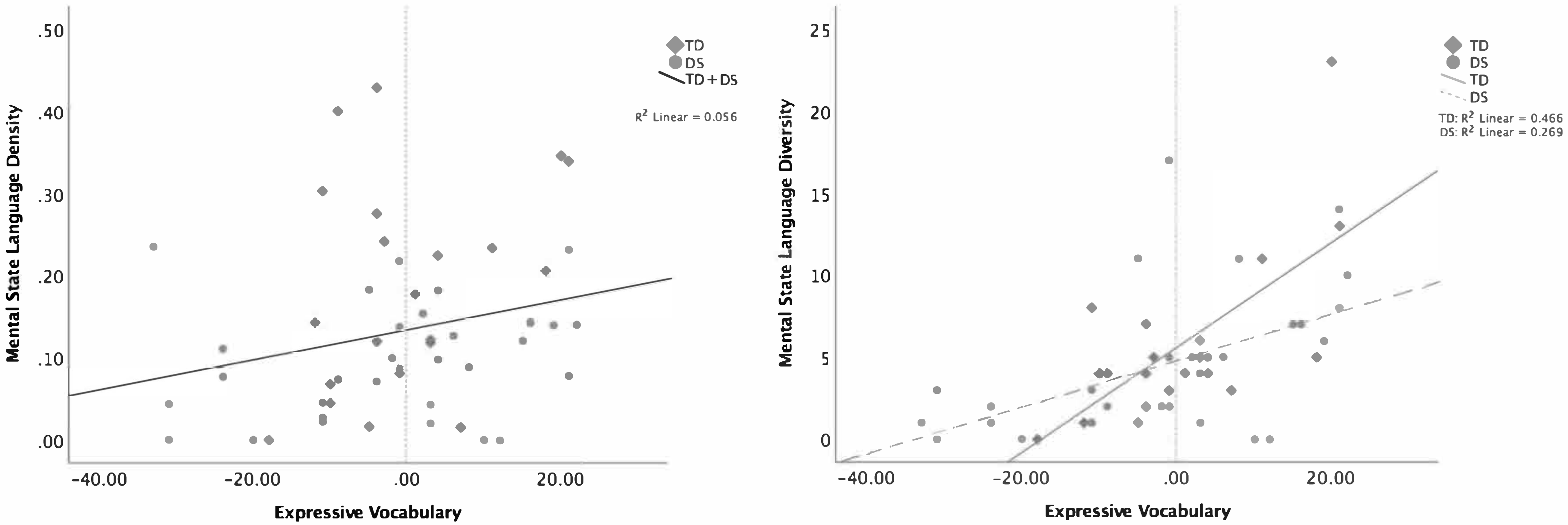



*$t(45.53) = -2.28$, $p = .03$, $d = -0.61$.

All other group comparisons not significant

Figure 2

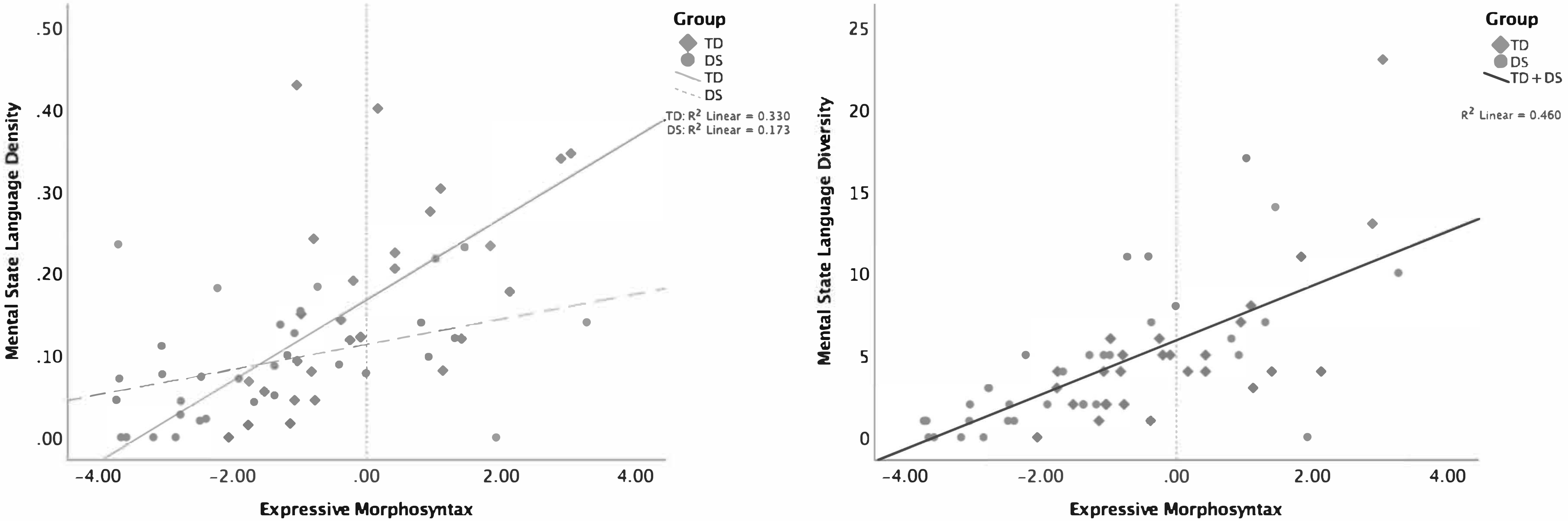
*Association Between Expressive Vocabulary and Mental State Language Density and Diversity by Participant Group*




*Notes.* Expressive Vocabulary is represented by EVT growth score values centered at the mean value for the TD group. The graph that includes only a single line indicates that the Group X Expressive Vocabulary interaction term was not significant and thus not retained in the final model. The graph on the left represents a simple regression in the entire sample that does not account for participant group, while the graph on the right illustrates the regression for each participant group, separately.

Figure 3

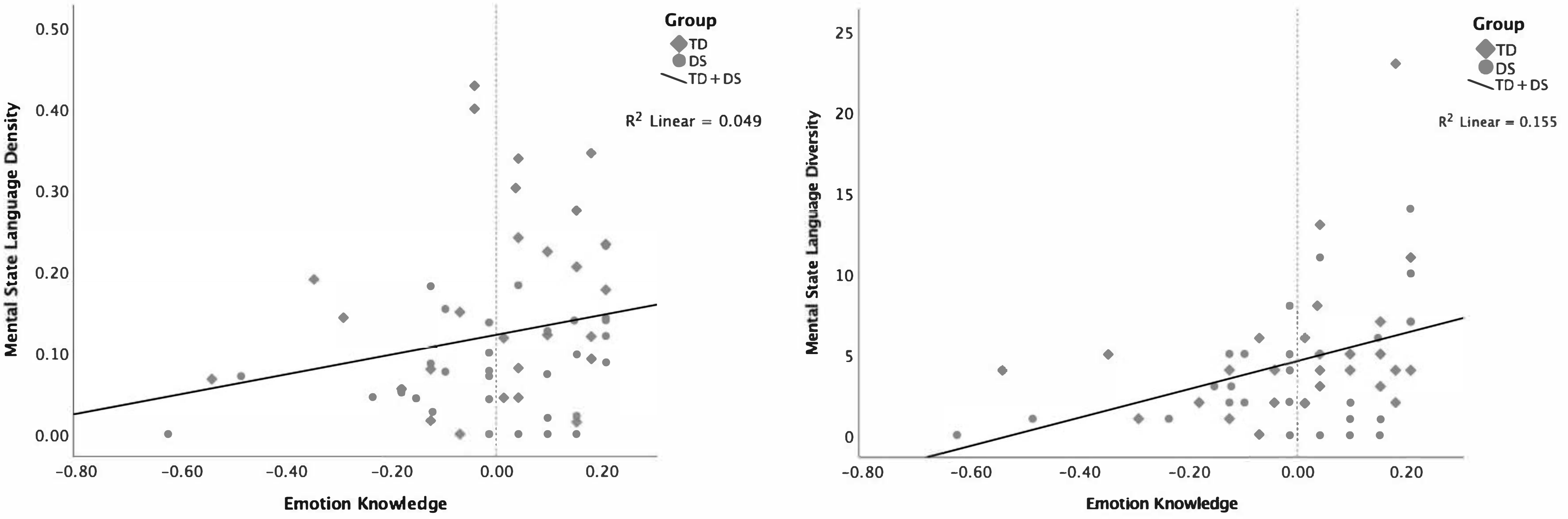
*Association Between Expressive Morphosyntax and Mental State Language Density and Diversity by Participant Group*




*Notes.* Expressive Morphosyntax is represented by MLU centered at the mean value for the TD group. The graph that includes only a single line indicates that the Group X Expressive Morphosyntax interaction term was not significant and thus not retained in the final model. The graph on the left represents the regression for each participant group, separately, while the graph on the right illustrates a simple regression in the entire sample that does not account for participant group.

Figure 4

*Association Between Emotion Knowledge and Mental State Language Density and Diversity by Participant Group*




*Notes.* Emotion Knowledge is represented by EJT proportion scores centered at the mean value for the TD group. Both graphs include only a single line because the Group X Emotion Knowledge interaction term was not significant and thus not retained in either model. These graphs represent simple regression that does not account for participant group.

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**Appendix**

*Mental State Words Most Commonly Used by Participants with DS (n = 34)*

| Word | Number of Participants (%) | Total Number of Occurrences (within and across participants) |
|---|---|---|
| *Cry* (emotional behavior) | 10 (29.41%) | 16 |
| *Happy* (emotional state) | 9 (26.47%) | 19 |
| *See* (perception) | 9 (26.47%) | 18 |
| *Sad* (emotional state) | 8 (23.53%) | 14 |
| *Saw* (perception) | 7 (20.59%) | 11 |
| *Scared* (emotional state) | 7 (20.59%) | 10 |
| *Mad* (emotional state) | 6 (17.65%) | 20 |
| *Like* (desire or emotional behavior) | 6 (17.65%) | 6 |
| *Wanna* (desire) | 5 (14.71%) | 6 |
| *Want* (desire) | 4 (11.76%) | 23 |
| *Try* (desire) | 4 (11.76%) | 13 |
| *Angry* (emotional state) | 4 (11.76%) | 4 |
| *Hurt* (emotional or physiological state) | 4 (11.76%) | 4 |
| All other words | (<10%) | |

*Mental State Words Most Commonly Used by TD Participants (n = 27)*

| Word | Number of Participants (%) | Total Number of Occurrences (within and across participants) |
|---|---|---|
| *Mad* (emotional state) | 13 (48.15%) | 45 |
| *See* (perception) | 12 (44.44%) | 18 |
| *Want* (desire) | 10 (37.04%) | 24 |
| *Trynta* (trying to; desire) | 9 (33.33%) | 19 |
| *Watch* (perception) | 9 (33.33%) | 16 |
| *Happy* (emotional state) | 7 (25.93%) | 22 |
| *Know* (cognition) | 7 (25.93%) | 10 |
| *Sad* (emotional state) | 7 (25.93%) | 22 |
| *Wanna* (desire) | 6 (22.22%) | 8 |
| *Saw* (perception) | 5 (18.52%) | 11 |
| *Cry* (emotional behavior) | 4 (14.81%) | 7 |
| *Laugh* (emotional behavior) | 4 (14.81%) | 9 |
| *Like* (desire or emotional behavior) | 4 (14.81%) | 7 |
| *Think* (cognition) | 4 (14.81%) | 9 |
| *Try* (desire) | 4 (14.81%) | 15 |
| *Angry* (emotional state) | 3 (11.11%) | 3 |
| *Feel* (emotional state) | 3 (11.11%) | 4 |
| *Hurt* (emotional or physiological state) | 3 (11.11%) | 5 |
| All other words | (<10%) | |

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Table 1 Descriptive Characteristics of Participants

| | TD (*n* = 27) | DS (*n* = 34) |
|---|---|---|
| Sex | | |
| Male | 66.67% | 61.76% |
| Female | 33.33% | 38.24% |
| Self-identified race[a] | | |
| African American | 0% | 14.71% |
| Asian/Pacific Islander | 12.50% | 0% |
| American Indian | 0% | 0% |
| Hispanic | 8.33% | 2.94% |
| White (Non-Hispanic) | 45.83% | 76.47% |
| More than one | 29.17% | 5.88% |
| Other | 4.17% | 0% |
| Maternal education[a] | | |
| Some college/technical work | 8.33% | 8.82% |
| Associate's/technical degree | 0% | 5.88% |
| B.A. or B.S. | 16.67% | 29.41% |
| Some graduate work | 0% | 8.82% |
| Graduate/professional degree | 75.00% | 47.06% |
| Household income in USD[b] | *Median*: \$110,000<br>*Range*: \$22,000-400,000 | *Median*: \$100,000<br>*Range*: \$32,000-500,000 |
| | *Mean (SD)*<br>Range | *Mean (SD)*<br>Range |
| Age[a] | *3.76 (0.71)*<br>3.00-5.75 | *8.65 (1.71)*<br>6.00-11.83 |
| Leiter-3 growth score value | *463.70 (6.99)*<br>451-477 | *462.74 (6.37)*<br>452-477 |
| Leiter-3 nonverbal IQ | *101.63 (6.42)*<br>90-113 | *60.88 (8.59)*<br>41-75 |
| EVT-2 growth score value[cd] | *133.86 (10.78)*<br>116-155 | *132.29 (15.89)*<br>101-156 |
| EVT-2 standard score[cd] | *112.81 (13.90)*<br>83-141 | *65.77 (13.51)*<br>41-94 |
| EJT proportion score[d] | *0.79 (0.18)*<br>0.25-1.00 | *0.78 (0.20)*<br>0.17-1.00 |
| MLUm | *4.90 (1.41)*<br>2.85-7.94 | *3.51 (1.86)*<br>1.18-8.17 |
| Total number of utterances (C-units) | *59.00 (26.05)*<br>7-136 | *65.15 (48.11)*<br>14-239 |
| Mental state language density | *0.17 (0.12)*<br>0.00-0.43 | *.09 (.07)*<br>0.00-0.24 |
| Mental state language diversity | *5.11 (4.59)*<br>0-23 | *4.24 (4.28)*<br>0-17 |

[a]TD *n* = 24 due to missing demographic forms; [b]TD *n* = 16 due to missing demographic forms or no response to item, DS *n* = 33 due to no response to item; [c]TD *n* = 21 due to time constraints; [d]DS *n* = 31 due to examiner error in establishing basal.

*Note.* EVT-2 = Expressive Vocabulary Test Second Edition, EJT = Emotion Judgment Test, MLUm = mean length of C-unit in morphemes.

Table 2 Regression Models Predicting Mental State Language Density and Diversity

| | Mental State Language Density | | | | Mental State Language Diversity | | | |
|---|---|---|---|---|---|---|---|---|
| Term | *B (SE)* | *t (df)* | *p* | $R^2$ | *B (SE)* | *t (df)* | *p* | $R^2$ |
| Group | -.09 (.03) | -3.19 (49) | .003 | | -.80 (1.07) | -0.75 (48) | .46 | |
| Expressive vocabulary | .002 (.001) | 1.69 (49) | .10 | | .32 (.08) | 4.08 (48) | <.001 | |
| Expressive vocabulary X Group | — | — | — | | -.18 (.09) | -1.98 (48) | .05 | |
| Model $R^2$ | | | | .22 | | | | .37 |
| Group | -.05 (.02) | -2.30 (57) | .03 | | 1.67 (.89) | 1.87 (58) | .07 | |
| Expressive morphosyntax (MLU) | .05 (.01) | 4.34 (57) | <.001 | | 1.84 (.25) | 7.40 (58) | <.001 | |
| Expressive morphosyntax (MLU) X Group | -.03 (.01) | -2.48 (57) | .02 | | — | — | — | |
| Model $R^2$ | | | | .38 | | | | .49 |
| Group | -.08 (.02) | 3.45 (55) | .001 | | -1.02 (1.01) | -1.00 (55) | .32 | |
| Emotion knowledge | .12 (.07) | 1.79 (55) | .08 | | 8.66 (2.71) | 3.19 (55) | .002 | |
| Emotion knowledge X Group | — | — | — | | — | — | — | |
| Model $R^2$ | | | | .22 | | | | .17 |

*Note*. Cells marked with a dash indicate that the interaction term was not significant and thus not included in the final model.