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Mental State Verb Production as a Measure of Perspective Taking in Narrations of Individuals With Down Syndrome

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Introduction: Perspective taking is an important ability to enrich narrations by empathizing with a real or fictional character. Mental state verbs (MSV) are a good indicator for this ability as they serve to reflect the mindset that the narrator attributes to a protagonist. Especially syntactic abilities have been argued to be relevant for MSV use. Investigating persons with Down Syndrome (DS) is likely to provide important insights into the relationship of MSV use and syntactic abilities: MSV are mostly used in complex sentence structures, which are a frequent difficulty for individuals with this syndrome. Indeed, previous investigations have found first evidence for impaired MSV production in individuals with DS, indicating a link to syntactic abilities and expressive vocabulary. Our aim was to provide evidence on MSV production and on the syntactic context of MSV production in individuals with DS and to target a possible connection to both cognitive and language abilities using specific language assessments. Typically-developing (pre-)school children were included as a comparison group to identify impaired respectively developmentally-adequate performance.

Method: 28 individuals with Down syndrome (aged 10; 0–20; 1 years) participated in a battery of cognitive, narrative and language measures. MSV-performance and syntactical context of MSV use were compared to data from 33 typically-developing children aged 3–9 years. We also analyzed the relationship between MSV production and language performance (vocabulary, syntax measures, mean length of utterance).

Results: The total number and types of MSV used were comparable for individuals with DS and TD. Moreover, a syntactic analysis indicated that individuals with DS and TD use MSV in the same syntactic contexts. Nevertheless, the syntactic difficulties of participants with DS are reflected in their frequent use of MSV in sentence-fragments. Correlations over the DS group yielded that syntactic abilities were not decisive for the richness and diversity of MSV in narrations.

Conclusion: Our findings suggest a comparable performance in MSV use in individuals with DS and school-aged TD children. The data indicate that MSV production is possible even with an impaired syntax suggesting unimpaired perspective taking abilities in individuals with DS.

Keywords: perspective taking, down syndrome, narration, mental state language, syntax, development of mental state verbs, syntactic impairment

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INTRODUCTION

Telling a story is an important part of social interaction in everyday life. A narration shows two main characteristics (Tompkins et al., 2013): the inclusion of (macrostructural) narrative elements such as actor, actions or scene and the perspective of the protagonist(s). Children need to understand the protagonist's intentions to comprehend a story as a whole (Kim, 2015). Furthermore, taking a protagonist's view is an important step of productive narrative development. Taking a protagonist's view requires the ability of perspective taking which allows to enrich narrations by empathizing with a (fictional) character. The ability of perspective taking requires both cognitive and linguistic abilities. Concerning cognitive functions, this especially involves Theory of Mind (ToM) development (see Symons, 2004 for an overview of perspective taking development and the connection between perspective taking and mentalizing). Theory of Mind (ToM) refers to an individual's ability of decoding other people's intentions and emotions. ToM enables a person to understand mental states within others to comprehend and predict their assumptions and behaviors. A critical achievement in ToM acquisition is false belief understanding (Tompkins et al., 2019, p. 111), which is used in most studies investigating ToM (Devine and Hughes, 2014; Beaudoin et al., 2020) and which reveals the connection between ToM and perspective taking. In the most common false belief task, the Sally-Anne-task by Baron-Cohen et al., (1985), the child witnesses that the puppet Anne hides the toy of the puppet Sally in a new place while Sally is away. To answer the target question correctly ("Where will Sally look for the marble?"), the child needs to take the perspective of Sally, who does not know the new place of the toy, and to suppress the own knowledge about the real hiding place in answering the question.

Linguistically, so-called mental state verbs (MSV) are important means for expressing the view of a protagonist or character in a narration (overview in Van Krieken et al., 2017). MSV are content verbs pointing towards mental states, beliefs or wants of a protagonist (Perner et al., 2003) or another character in a story. A common classification of MSV is semantic and differentiates three main categories (e.g. Jenkins et al., 2003): volition/desire (want, hope. . .), cognition (think, say. . .) and emotion/effect (like, hate. . .). Consider the following narration: "Yesterday, Susan walked along the neighbor's house when the little dog of the owner ran out and barked terribly behind the fence. After Susan returned home, she told her mother that she hated this frightening dog." In this example, the MSV "told" does not only show the mental state of the protagonist (hateful, frightened) but it also clearly points to a change in perspective of the narrator as it introduces the view of the fictional story character whereas the narrator might like dogs or does at least not know the (fictional) neighbor's dog. Van Krieken et al. (2017) point out that perspective taking in narratives can be expressed in different dimensions, e.g. an emotional and a cognitive dimension. The authors give a review of different linguistic elements to formulate a protagonist's view in these dimensions. One way to do this is to use MSV expressing the emotional or mental states of oneself or other persons.

In typical development, first MSV occur by the age of two and their occurrence strongly increases from the age of three onwards (see Channell, 2020, for an overview). During development, a connection between usage of MSV and the production of complex syntax seems plausible, as the description of other people's mental states often requires complex sentence structures, especially the mastery of syntactic complementation (De Villiers and Pyers, 2002) as in our narrative example before: "Susan told her mother that she hated this frightening dog." De Villiers & Pyers suggest that the mastery of this complex sentence construction enables children to represent other person's beliefs, a prerequisite for taking another individual's perspective. Thus, the acquisition of complex syntax involving sentence complements might constitute a prerequisite for using MSV expressing another person's perspective. While in English, only the verb *think* strongly encompasses the usage of a complement clause, Perner et al. (2003) point out that in German, substantially more verbs take a sentential complement in the form of a subordinate clause (e.g. want *that*, say *that*, think *that*. . .). Notably, all these verbs meet the definition of MSV, thus, bolstering the assumption that MSV use might be related to the mastery of complex syntactic structures, specifically involving sentence complementation and subordinate clauses.

A population which might be especially affected by the assumed connection between perspective taking (as expressed by MSV) and syntactic abilities are individuals with Down syndrome (DS). Individuals with DS display marked deficits in the production and comprehension of complex syntactic structures involving subordination (Abbeduto et al., 2007; Wimmer et al., 2020). Furthermore, individuals with this syndrome frequently show difficulties in narration (Neitzel & Penke, under review; overview in Segal and Pesco, 2015) and Theory of Mind (Neitzel and Penke, 2021). Thus, the investigation of MSV production in individuals with DS might provide important insights into the interrelation between MSV usage as a linguistic measure of perspective taking and the mastery of complex syntax production. Although investigations on this topic are sparse, the few existing studies addressing MSV production in individuals with DS have indeed pointed to an association of syntactic impairments and deficits in MSV usage.

Beeghly and Cicchetti (1997) compared the productive vocabulary of 2–5 year-old individuals with DS (n = 39) and typically-developing children (TD) (n = 38) with respect to internal state language. In contrast to MSV which specifically focus on people's feelings or intention, internal state language includes MSV but also verbs of perception or physiology. MSV were included but not coded as a separate category. The children were separated into two groups concerning their cognitive abilities: group 1 included individuals with a mental age of less than 30 months (individuals with DS: n = 18), whereas group 2 contained individuals with a mental age of above 30 months (DS: n = 21). Data were collected in a mother-child picture-book situation and during a period of semi-structured play. The authors describe that children with DS produced less internal state words than TD children in both mental-age groups. Although mental age was significantly associated to internal

state word production in individuals with DS, their level of internal state language stayed behind expectations for their mental age. Furthermore, the authors determined the mean length of utterances (MLU) as a measure for syntactic development and found children with DS to be significantly delayed in comparison to TD children. This study points to an impairment of mental state language and an association between mental state language and syntax in individuals with DS. However, the missing of a specific category for MSV and the use of an unspecific measure of syntactic development leave questions regarding the link between MSV production and syntactic abilities open.

In contrast to Beeghly and Cicchetti (1997) and Grela (2002) found the number of MSV to be comparable between individuals with DS and TD children. The author computed lexical verbs in language samples from a free play situation with the child's mother at home, containing 294 utterances per child, and found no significant group difference for MSV between the DS and TD group. However, this investigation only included seven individuals with DS (chronological age: 6;2–12;2) and seven TD participants, matched for MLU, limiting claims regarding MSV and their association to syntactic development in individuals with DS.

Larger groups of individuals with DS were investigated in three recent studies. The study of Ashby et al. (2017) included 23 children with DS (chronological age: 10–16 years) and a group of younger TD children matched for performance in an intelligence measure. All children were asked to tell a story based on a nonverbal picture book. The authors coded each utterance of the produced narrations for 15 inferential aspects. MSV were contained in one category measuring "internal states" but were not evaluated separately. According to the authors' analysis, children with DS showed significantly less inferential language than TD children. The authors employed MLU as a measure of syntactic complexity and suggested that the difficulties in inferential language might be due to a morpho-syntactic problem, rather than to a specific narrative or inferential deficit. While Ashby et al. (2017) suggest "a clear link between complexity of sentence structure and use of inferential language during narration in individuals with DS" (p. 105) they state that the direction a causal relationship might take remains unclear.

In 2020, Channell described difficulties in MSV production for a large group of individuals with DS (n = 40, chronological age 6–11 years) and found evidence for impaired MSV production in narrations obtained by a nonverbal picture book, both in terms of the total number of utterances including MSV and in terms of the diversity of MSV used. Furthermore, the author computed correlations between MSV use and measures for nonverbal cognition, an emotion knowledge task, an expressive vocabulary test and once again MLU as a syntactic measure. Significant correlations only held between MSV use and MLU as well as between MSV use and expressive vocabulary. Based on these findings, the author suggested a connection between MSV use and syntactic abilities and named expressive vocabulary as another key factor for MSV production. However, the investigation included no control participants with TD.

In a very recent study, Martzoukou et al. (2020) investigated narrative abilities of a group of 20 Greek adults with DS (chronological age 19–46 years). The participants were asked to retell two 6-picture-stories from the narrative instrument MAIN after auditory presentation. Macrostructural analyses of the re-narrations involved the enumeration of internal state words. Although MSV were not specifically coded, cognitive and emotional MSV were included in this category. In addition, to explore the participant's ability to recognize a character's internal state, all individuals were asked comprehension questions addressing the internal states of the characters after their re-narrations. MLU as well as a sentence-repetition test were adopted as measures of syntactic ability. Martzoukou et al. (2020) report that in comparison to two groups of typically-developing preschool children (each n = 20) - one matched by nonverbal cognition, one matched by expressive vocabulary abilities - individuals with DS produced less internal state terms in their re-narrations, although the comprehension questions revealed an adequate understanding of the character's beliefs, thoughts and emotions. In addition, Martzoukou et al. report poor morpho-syntactic abilities in their participants with DS reflected in significantly poorer performance in sentence-repetition compared to both groups of control children. Moreover, MLU was significantly lower compared to the control group matched for expressive vocabulary. Based on these findings, Martzoukou et al. (2020) conclude that individuals with DS might not be impaired in understanding the internal state of a (fictional) character but that their poor morpho-syntactic abilities might limit their expression of internal states.

Summarizing, the few existing studies provide some evidence for difficulties in MSV production in children, adolescents, and adults with DS, connecting these difficulties to impaired syntactic abilities and expressive vocabulary. However, none of the studies specifically focused on the relation between the production of MSV and the development of particular syntactic constructions that might be especially relevant to express perspective taking via MSV (i.e. sentence complementation, see De Villiers and Pyers, 2002).

A possible association between perspective taking, MSV and syntactic abilities is of special interest for clinicians working with atypically-developing individuals that show syntactic impairments. If these were associated to each other, one could assume that individuals who show syntactic disabilities might also show impairments in expressing another character's perspective. These difficulties might result in impaired narrative abilities and difficulties in story understanding (Kim, 2015). As narration is an important part of everyday interaction with others, narrative deficits might cause problems with respect to social relationships when children stay behind the narrative skills of their school peers. Furthermore, narrative abilities are a frequent aim in oral and written school exercises and research has proven a close connection between narrative abilities and later literacy (Griffin et al., 2004) or even mathematical skills (O'Neill et al., 2004). Thus, a limited expression of one's own and other person's perspectives might lead to limitations in every day social interaction or school life, suggesting MSV as a relevant topic for therapeutic intervention.

TABLE 1 | Chronological age (CA) and nonverbal mental age (MA) over participants with DS and TD groups. Nonverbal mental age was not available for TD participants.

	Group DS (n = 28)	Group TD: age groups		
		TD3 (n = 12)	TD5 (n = 11)	TD9 (n = 10)
CA (y; mm)				
Mean	14; 05	3; 08	5; 04	9; 06
SD	2; 06	0; 02	0; 04	0; 05
Range	10; 00–20; 01	3; 03–3; 11	5; 00–5; 11	9; 00–9; 11
MA (y; mm)		*n.a.*	*n.a.*	*n.a.*
Mean	5; 03			
SD	1; 02			
Range	3; 05-<7; 11			

Note: MA of one participant in the DS group exceeded the norming sample of the SON-R (<7; 11).

The aim of our study was to provide specific evidence on MSV production in narrations of individuals with DS and its implications for perspective taking abilities in individuals affected by this syndrome. We focused on the types of MSV produced and on the syntactic structures in which MSV appeared. By uncovering parallels and differences to typical development, we aimed to obtain deeper insight into the particular problems individuals with DS might display with respect to expressing perspective taking. If MSV usage was dependent on expressive vocabulary or on syntactic abilities, especially related to the mastery of complex syntax structures, individuals with DS that show impaired lexical/syntactic abilities should display difficulties in MSV usage, visible in the total number and the diversity of MSV. If, on the other hand, our analyses were to show that MSV production in individuals with DS was adequate despite impaired lexical or syntactic abilities, this would suggest that the expression of mental states in persons with DS via the use of MSV is independent from language and/or poor cognitive development.

We compared MSV production in narrations of 28 children and adolescents with DS to MSV production of 33 preschool and school children aged 3, 5 and 9 years. Furthermore, our participants with DS completed a battery of measures targeting nonverbal cognitive development as well as specific language measures. These included a measure for expressive vocabulary that was found to be related to MSV production by Channell (2020) and a measure targeting the development of complex syntactic structures.

MATERIALS AND METHODS

Participants

28 children and adolescents with Down syndrome participated in a comprehensive assessment battery including different cognitive and language measures. The data were obtained in two to three testing sessions per participant which lasted about 45–60 min and included sufficient breaks. All participants (n = 15 females, n = 13 males) were recruited by contacting special-need schools and parent organizations. Most participants displayed a free trisomy (n = 26); one participant was diagnosed with mosaic trisomy and the form of trisomy was unknown for one of the participants. All children and adolescents attended inclusive or special-need schools. Informed consent for participation in the study was obtained from participants as well as from their parents. The research project was approved by the Ethics Committee of the Medical Department of the University of Cologne (number of approval 18–121). Age characteristics of all groups are given in **Table 1**. Mean chronological age over the group was 14; 05 (given in y;mm, *SD* 2;06, range 10;00-20;01). Mean nonverbal mental age as measured with the SON-R 2 ½-7 (Tellegen et al., 2007; see 2.2) was 5;03 (*SD* 1;02, range 3;05–8;00). All participants were monolingual German speakers and had no other reported medical conditions or psychiatric diagnoses. Visual loss was corrected by glasses in all cases. For nine participants, parents reported a slight hearing loss (10–25 dB), however, hearing loss did not exceed 25 dB in any of these participants.

In addition, narrations of typically-developing (TD) children were taken from the Bamberg-corpus available on *Childes* (Berman and Slobin, 1994). Written transcripts of the so-called "Frog story" (see 2.2.1) were obtained from 3 year-olds (n = 12, range 3; 3–3; 11), 5 year-olds (n = 11, range 5;00-5;11) and 9 -year-olds (n = 10, range 9;00–9;11) (see **Table 1**). These age groups seemed especially suitable for a comparison concerning MSV production and syntactic context of MSV use as MSV vocabulary as well as complex syntax both develop at preschool age, more precisely between the age of three and five (see Channell, 2020 for an overview). Recall that the mean nonverbal mental age of the individuals with DS was 5; 03 years. Therefore, a comparison of the performance of the group with DS to these three groups of TD children allowed for a comparison to a younger group of TD children, to an older group of TD children, and a group of TD children matched in chronological age to the mental age of the individuals with DS. As neither sex nor mental age or performance in language measures were given for the participants from this corpus, these factors could not be included into statistical analyses comparing performance for participants with DS and TD children.

Instruments

Narrative Task

All participants' narratives were collected using a non-verbal picture-book ("Frog, where are you?"; Mayer, 2003). The so-called "Frog story" is a widely used instrument to obtain narrations in children. With its richness in protagonists and the black-white pictures, it is also suitable for older children and adolescents with DS. The story consists of 24 pictures illustrating the story of a young boy and his dog, who search for their pet frog which has escaped from his glass. On their way, they meet several animals and experience some adventures. For the participants with DS, we followed the procedure typically chosen when eliciting narratives of the Frog story. The book was first presented nonverbally by the experimenter so that the participant was able to learn about the protagonists and the storyline. Afterwards, the participant was asked to retell the story picture by picture. The images were presented while telling the story and the experimenter took care that every picture was

TABLE 2 | Categories for syntactic context of MSV and examples from the DS group.

Syntactic context of MSV	Example (participant)
[i] in a main clause	*Der Hirsch will trinken./*The deer wants to drink. (P02)
[ii] in a main clause followed by a subordinate clause	*Max möchte Timmy helfen, weil er hängt noch aufn Hirschkopf auf fest./*Max wants to help Timmy because he is still stuck on the deer's head on. (P17)
[iii] in a main clause followed by direct speech	*Dann sagte der Junge: Wo ist der Frosch denn hin?/*Then the boy said: Where did the frog go? (P09)
[iv] in a complex sentence (e.g. subordinate clause or question)	*Und der Hund ist enttäuscht, dass die Bienen sich geärgert haben./*And the dog is disappointed that the bees were annoyed. (P30)
[v] in sentence fragment	*Geflippt aus./*Freaked out. (P03)

included into the story. During the narration, only unspecific questions such as "What (else) happens here?" were asked by the experimenter. The narration was documented using video and audio recording. Afterwards, all stories were transcribed using ELAN 5.3 (Max Planck Institute, 2018). The written transcript was used for further analyses. For TD children, we used the written transcripts available on *Childes* (see 2.1) for further analyses.

Perspective Taking Measure

We analyzed usage of MSV in the frog-story narrations as a measure for perspective taking. MSV expressing volition (e.g. *want*), cognition (e.g. *think*) and emotion (e.g. *rejoice*) were included in this measure. MSV in the formulaic utterance '*(I) don't know*' were excluded from the analyses. For each Frog-story narration, we counted the total number of verbs produced and the total number of MSV (tokens) to determine the density of the verb inventory for each participant. We also determined the number of different verbs and different MSV (types) as an indication of the diversity of the verb lexicon. All categorizations to the three MSV types were coded by the same rater for both DS and TD participants and co-checked by a trained second rater. The categorizations used for the analyses were consistent in both ratings. A full table of all included MSV and their categorization is displayed in **Supplementary Table SA**. Subsequently, proportions of MSV in relation to verbs total were calculated for verb types and verb tokens for each narration and participant.

Furthermore, we determined the syntactic context in which each MSV appeared. Each utterance containing a MSV was coded for one of five syntactic contexts the MSV appeared in: [i] in a main clause, [ii] in a main clause followed by a subordinate clause, [iii] in a main clause followed by direct speech[1], [iv] in a complex sentence (e.g. a subordinate clause or question), [v] in a sentence fragment (see examples in **Table 2**). We also calculated the MLU (in words) for all participants since MLU had been used as a measure of syntactic development in all previous investigations.

[1]Direct speech is defined as the combination 'of two (or more) main clauses, representing the quoted utterance(s) on the one hand, and a framing clause on the other.' (Nordqvist, 2001, p. 58).

Non-verbal Cognition

Non-verbal cognition of children and adolescents with DS was assessed using the *Sniders-Omen Nonverbal Intelligence Test* (SON-R 2 ½-7; Tellegen et al., 2007). This measure includes a reasoning scale, which consists of three non-verbal subtests (categories, analogies, situations) and allows to compute the children's nonverbal mental age (see 2.1).

Specific Syntax Measure

To explore the relationship between MSV use and the mastery of complex syntactic structures, we used the *ESGRAF 4-8* (Motsch and Rietz, 2016), a standardized German instrument targeting the production of different complex syntactic structures in a circus setting. Specifically, the *ESGRAF 4-8* elicits subordinate clauses, *wh*-questions and main clauses with topicalized sentence constituents. *ESGRAF 4-8* offers norming data for 4–8 year-old children. The mental age of the children with DS was used to choose the norming scale for each participant.

The first subtest of *ESGRAF 4-8* assesses the production of *wh*-questions and topicalized sentences. In the first part of the subtest, the child is asked to produce 12 *wh*-questions to identify a toy animal hidden in a box (e.g. *Wo wohnst du?* "Where do you live?"). Subsequently, the child is asked to take the perspective of the animal and to formulate what she would like to eat and what she has eaten, resulting in a maximum of 24 utterances with a topicalized object (e.g. *Brot mag ich nicht*. "Bread, I don't like.") or a fronted adverbial (Adv VS) (e.g. *Heute esse ich Brot. Morgen esse ich den Apfel*. "Today, I eat bread. Tomorrow, I eat the apple."). In total, the subtest contains 36 items. A point is scored for each produced sentence that correctly contains the fronted element (*wh*-pronoun, object or adverb) before the finite verb in second structural position followed by the subject (max. 36 raw points). An imitation aid is possible for each item if the child is not able to produce one of the items by herself. The child scores one point for the production of the correct sentence after the imitation aid as well.

The production of subordinate clauses was assessed by the second subtest of the *ESGRAF 4-8*. In German, MSV are often accompanied by subordinate clauses that express the sentential complement of a MSV (e.g. *Susan told her mother that she hated this frightening dog.*). In contrast to English, German subordinate clauses display a different order of sentence constituents compared to main clauses. Whereas main clauses typically display SVO order, in subordinate clauses the finite verb is placed clause-finally, resulting in SOV (e.g. *Der Junge ist*

traurig, weil sein Frosch entwischt ist. "The boy is sad because his frog has escaped."). The subtest targets the acquisition of subordinate clauses by evaluating verb placement. It contains 20 items and is separated into three short tasks that require the child to produce subordinate clauses with different subordinating conjunctions while ordering items for the circus' magician, answering questions about magic tricks, or repeating magic rules. According to the manual, a point is scored if a subordinate clause with correct verb placement is produced independently or imitated after exemplification of the experimenter (=max. 20 raw points).

Vocabulary Measure

Expressive vocabulary was assessed using the *AWST-R* (Aktiver Wortschatztest für 3- bis 5-jährige Kinder – Revision; Kiese-Himmel, 2005), which is a standardized German vocabulary test. The instrument contains 75 items (51 nouns, 24 verbs). The verbs included in the measure are concrete verbs (e.g. *schneiden* "cut") and do not contain emotional or mental state verbs. All items are presented as colored photographs and the child is asked to name the pictures. According to the manual, the child scores one raw point (max. 75) for each item named correctly. Norming data is available for children aged 3; 00 to 5; 05 years.

Data Analysis

TD participants were separated into three age groups according to their chronological age: (i) three-year-olds (TD3, $n = 12$), (ii) five-year-olds (TD5, $n = 11$) and (iii) nine-year-olds (TD9, $n = 10$). Based on the written transcripts of the Frog-story, we counted occurrences of verbs (types and tokens) as well as MSV for each participant (DS and TD) and narration. Each utterance was coded for the type of MSV: volition, cognition or emotion verb. In a syntactic analysis, we coded the syntactic context for each MSV (see 2.2.2) per utterance and calculated the mean length of utterances (MLU) for words in each participant. Group means were computed for the three groups of TD children and the group with DS. Differences between the group with DS and the groups of TD children were computed using non-parametric statistical analyses to account for the fact that proportions were not normally distributed. Pairwise comparisons for each group combination (e.g. TD3 vs. DS) were computed by post hoc analyses using *SPSS 25* (IBM, 2017).

For participants with DS, raw scores were calculated for the vocabulary measure and the two syntax measures according to the manual. Based on these raw-scores, the norming data given in the respective tests and the nonverbal mental age of each participant as determined by the SON-R, we subsequently derived T-scores for each individual and each test. T-scores allow to address whether individual scores obtained by participants with DS are at the level expected for their nonverbal cognitive development. A T-score above 40 indicates performance that is appropriate for the participant's nonverbal mental age, whereas a T-score below 40 indicates substandard performance indicative of impairment in the respective test. Note that for 10 participants with DS norming data could not be obtained for the *AWST-R* as this measure only includes norming data for 3; 0 to 5; 05 year-old children. Pearson's correlations were computed using *SPSS* to analyze the relation between MSV use and language performance (vocabulary, MLU, complex syntax) as well as nonverbal mental age in participants with DS.

RESULTS

Density and Diversity of MSV in Narrations

In total, participants produced 420 utterances containing MSV in their narratives. Of these, 224 utterances were produced by TD participants ($n = 33$) und 196 utterances by the 28 participants with DS. **Table 3** gives an overview on the production of verbs and MSV. A total (cumulated number for all participants over the group), mean, *SD* and range are given for each measure and column. Key measures following Channell (2020) are the density of MSV (column 2), which means the number of utterances including MSV in total, and the diversity of MSV (column 5), which indicates the number of different MSV.

All participants with DS produced MSV. For TD children, only three of the 3 year-old participants did not produce any MSV. A high heterogeneity with respect to the number of MSV produced occurs in all groups, indicating that the observed variability in MSV production is not a specific problem of the group with DS but a typical pattern in MSV production. For TD children, the data indicate a vocabulary growth in verbs overall as well as in MSV that is particularly pronounced between the TD group aged 5 years and the group of 9 year-olds. The fact that three TD children at age three did not produce MSV underlines the start of MSV acquisition in this age range. Due to the increase of the overall number of verbs as well as of the number of MSV, the proportion of MSV in verbs shows only a slight increase over the three age groups of TD children. With respect to verb diversity, the data display a similar pattern with a pronounced increase in verb and MSV diversity between ages 5 to 9. The increase in verb diversity is supported by a Kruskal-Wallis analysis of variance that yields a significant difference between the TD3 and TD9 groups ($p = 0.020$). Due to comparable increases in verb diversity and MSV diversity, the proportion of different MSV in different verbs remains relatively stable over the three age groups.

Against this performance of the TD children, the group of participants with DS scores somewhat better in verb and MSV density and diversity measures than the group of 3 and 5 year old TD children, but scores below the group of nine-year-old TD children. Given a mean mental age of 5; 03 years in the tested participants with DS, their performance with respect to the density and diversity of MSV use thus seems adequate for their mental age. However, performance for the group of participants with DS is clearly below the expectations for their chronological age as the group performs below the group of TD9 children with respect to MSV density and diversity, despite a higher chronological age of the individuals with DS.

Types of MSV

MSV were assigned to three categories: volition, cognition and emotion. **Table 4** shows the numbers and proportions of MSV

TABLE 3 | Enumeration of verbs and MSV in narrations over group with DS and TD groups as well as group comparison (pairwise) for all groups using a Kruskal-Wallis variance analysis.

	1: *n* of verbs	2: *n* of MSV (Density)	3: Proportion of MSV in verbs	4: *n* of different verbs	5: *n* of different MSV (=Diversity)	6: Proportion of diff. MSV in diff. verbs
Group DS (*n* = 28)						
Total	1934	196		791	102	
Mean	69.07	7.00	0.11	28.25	3.64	0.13
SD	30.57	4.17	0.04	10.65	2.25	0.05
Range	5–122	1–20	0.06–0.25	4–48	1–10	0.06–0.25
Group TD3 (*n* = 12)						
Total	762	73		255	33	
Mean	63.50	6.08	0.08	21.25*	2.75	0.12
SD	34.05	6.80	0.08	7.72	2.49	0.10
Range	25–146	0–20	0.00–0.26	15–44	0–7	0.00–0.30
Group TD5 (*n* = 11)						
Total	681	69		252	27	
Mean	61.91	6.27	0.09	22.92	2.45	0.10
SD	23.97	6.47	0.06	5.32	2.34	0.08
Range	29–102	1–22	0.01–0.22	17–31	1–7	0.03–0.23
Group TD9 (*n* = 10)						
Total	769	82		324	45	
Mean	76.90	8.20	0.10	32.40*	4.50	0.13
SD	32.69	5.45	0.04	9.30	2.32	0.04
Range	51–156	3–19	0.04–0.14	23–56	2–10	0.09–0.19
Group comparison (Kruskal-Wallis)	n.s.	n.s.	n.s.	*p = 0.020 for TD3 vs. TD9	n.s.	n.s.

TABLE 4 | Enumeration and proportion of MSV types (volition, cognition and emotion) over age groups TD3, TD5 and TD9 and group DS.

Category (number / proportion)	Group			
	TD3 (*n* = 12)	**TD5 (*n* = 11)**	**TD9 (*n* = 10)**	**DS (*n* = 28)**
Volition	26 / 0.36	26 / 0.38	10 / 0.12	41 / 0.21
Cognition	43 / 0.59	38 / 0.55	53 / 0.65	130 / 0.66
Emotion	4 / 0.05	5 / 0.07	19 / 0.23	25 / 0.13
Total	73 / 1.0	69 / 1.0	82 / 1.0	196 / 1.0

for each category of MSV and participant group. All three types of MSV were produced in each group. Cognition verbs were the most frequently produced type of MSV in all groups (mean proportion between 0.55 and 0.66). Emotion verbs increase over age in the TD groups (0.05–0.23). Volition verbs are at a high level in the TD3 and TD5 groups (0.36/0.38), whereas the TD9 group and participants with DS produce less volition verbs (0.12/0.21). A group comparison using a Kruskal Wallis variance analysis was significant for emotion verbs (p = 0.032) over all four groups. However, none of the pairwise comparisons was significant, although a comparison between the TD5 and the TD9 group approached significance (p = 0.052). Over all groups, *want* was the most frequent volition verb (e.g. *Der Junge möchte auf den Fels klettern.* "The boy wants to climb on the hill."), *say/call* was the most frequent cognition verb (e.g. *Der Junge ruft: "Frosch, wo bist du?"* "The boy calls: Frog, where are you?") and *laugh* was the most frequent emotion verb (e.g. *Der Hirsch lacht über den Jungen.* "The deer laughs at the boy.").

Syntactic Context of MSV

The syntactic context of MSV use was analyzed for all TD groups and the DS group. For each participant group, **Figure 1** shows proportions of each syntactic context a MSV appeared in. All participant groups produced MSV verbs in each of the five categorized syntactic contexts, however proportions differed. In the TD children, we see that with increasing age fewer MSV are produced in main clauses while the proportion of MSV that are accompanied by a sentential complement in a subordinate clause increases substantially from 0.04 in the group of TD3 children to 0.21 in the TD9 group. A smaller increase can also be seen for MSV in main clauses + direct speech. MSV in sentence fragments have disappeared in the group of TD9 children. Likewise, MSV in *wh*-clauses or subordinate clauses decrease substantially from the TD3 group to TD9. While the former findings are well in line with a progredient development of syntactic abilities from age three to age nine, this latter observation (decrease of MSV in complex clauses) is unaccounted for by this explanation.

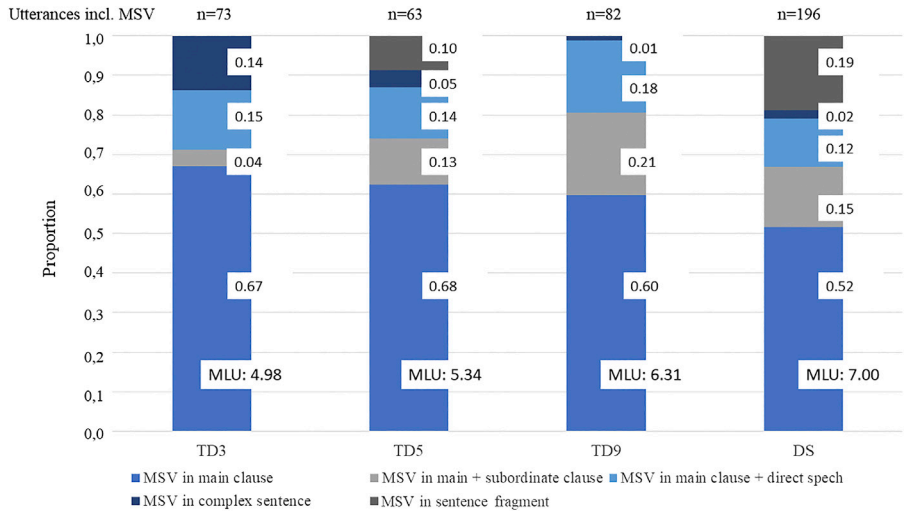

FIGURE 1 | Syntactic context of MSV over all groups: TD3 = 3 year-olds (n = 12), TD5 = 5 year-olds (n = 11), TD9 = 9 year-olds (n = 10), DS = participants with Down syndrome (n = 28).

As in the TD groups, participants with DS produce MSV in all five types of syntactic constructions. Note particularly the relatively high proportion of MSV that are accompanied by a sentential complement in a subordinate clause (0.15 for the group of participants with DS compared to 0.04 in TD3 and 0.13 in TD5). Comparable proportions of MSV use between TD children and the group of participants with DS can also be observed for MSV appearing in main clauses and for MSV accompanied by direct speech. A strong difference to the TD groups, however, holds with respect to MSV in sentence fragments. Here the proportion is particularly high in the group of participants with DS while MSV in sentence fragments do not occur in the data of TD3 and TD9 children. The high proportion of MSV in sentence fragments in participants with DS most likely reflects impairments in syntactic development which are frequently observed in individuals with DS.

The MLU in words shows a clear growth over the TD age groups, from a mean MLU of 4.98 in TD3 (*SD* 0.51) and 5.34 (*SD* 0.61) in TD5 to a mean MLU of 6.31 in the group of TD9 children (*SD* 0.51), reflecting progress in syntactic development. Although the MLU is even higher for the group of participants with DS (mean MLU 7.01, *SD* 2.94), this value has to be interpreted with caution as it is influenced by the frequent production of incomplete sentence fragments that are conjoined within one utterance (e.g. *Wir wissen noch nicht was sind die beiden was meint*. "We do not know yet what the two are what means."), leading to long but syntactically incoherent utterances.

Language Performance of Participants with DS

Table 5 shows the performance of the participants with DS in the standardized expressive vocabulary test (see 2.2.5) and the two syntax measures of the ESGRAF (see 2.2.4). Mean score in raw points was 49.71 (*SD* 13.44) for expressive vocabulary. Mean T-score was 52.06 (*SD* 15.09). Participants achieved a higher raw score in the syntax measure targeting the production of *wh*-clauses and topicalized main clauses than in the subtest targeting the production of subordinate clauses. This, however, does not reflect a better performance but is due to the fact that more points could be obtained in the first subtest of the ESGRAF compared to the second. Consequently, performance in T-scores was comparable over the two measures and suggests impaired syntax production (mean T-score below 40) in both measures.

Associations of Cognitive Development, Language Measures and MSV

To explore whether our measures of perspective taking are connected to age, cognitive development or language performance in individuals with DS, we computed Pearson's correlations (see **Table 6**). Diversity, which means the number of different MSV, correlated with density (number of utterances including MSV) at a very high level (r = 0.877, p < 0.01). The correlation between diversity and MLU showed a significance with a medium effect size (r = 0.301, p < 0.05). Correlations were not significant for diversity, density and the language measures targeting expressive vocabulary and the production of complex syntactic structures.

DISCUSSION

The main aim of our study was to describe perspective taking as reflected by MSV production in individuals with DS and to compare their performance to MSV use of TD children at (pre-)school age. Furthermore, we wanted to evaluate the influence of language abilities on MSV use, specifically of abilities related to complex syntax and expressive vocabulary which have been discussed as decisive factors in the literature. We

TABLE 5 | Raw scores and T-scores for standardized vocabulary (*AWST-R*) and syntax measures (*ESGRAF 4–8*) in participants with DS.

	Expressive vocabulary		Syntax *wh*-questions and topicalized main clauses		Syntax subordinate clauses	
	Raw points (max. 75)	T-scores	Raw points (max. 36)	T-scores	Raw points (max. 20)	T-scores
Mean	49.71	52.06	30.26	38.11	12.56	38.08
SD	13.44	15.09	12.37	7.06	5.48	10.60
Range	12–64	22–75	4–44	27–49	0–19	15–54

Note: Norming data (T-scores) are given for all participants in ESGRAF 4-8 *and for* n = *17 participants in* AWST-R.

TABLE 6 | Correlations for Density and Diversity with chronological age (CA) and nonverbal mental age (MA) (in months), MLU, and raw scores of syntax and vocabulary measures (*r*-values) for the DS group (*n* = 28).

	CA	MA	Density	Diversity	Raw score Main Clauses	Raw score Subord. clauses	Raw score expressive vocabulary	MLU
Density (*n* utterances incl. MSV)	0.296	0.346		0.877**	0.278	0.127	0.347	0.171
Diversity (*n* diff. MSV)	0.351	0.359	0.877**		0.324	0.246	0.370	0.301*

*p < *0.05*, **p < *0.01*.

analyzed number, types and syntactic context of MSV in frog-story narrations of 28 children and adolescents with DS as well as 33 children aged 3, 5 and 9 years. Our investigation is the first study to assess syntactic context of MSV production systematically in individuals with DS and to include specific measures of syntactic abilities that have been discussed as relevant for MSV production. Our investigation yielded four main results, which are discussed in the following: [i] Density and diversity of MSV were comparable for individuals with DS and TD. [ii] Types of MSV produced are similar for the TD groups and the DS group. [iii] A syntactic analysis shows similarities with respect to the syntactic contexts in which MSV are used between individuals with DS and children with TD. [iv] MSV production in individuals with DS seems independent from language measures related to vocabulary development and the acquisition of complex syntactic constructions.

Number and Proportion of MSV

Statistical comparisons yielded no significant differences between the groups of TD children and the group of participants with DS concerning number and proportion of verbs and MSV. Density and diversity of MSV were numerically comparable to the data of the TD3 and TD5 groups but lower than the values of the TD9 group. In particular, the similarity in the production of MSV in individuals with DS and children aged five (TD5) suggests that the performance in MSV production in individuals with DS is appropriate for their cognitive developmental level. The lower numeric values in density and diversity in the DS group in comparison to the TD9 group, however, indicate a performance that is not appropriate for their chronological age, given that the DS group shows a considerably higher chronological age (DS mean: 14; 05) and thus individuals had more time to expand their vocabulary, including MSV. The finding of mental-age adequate performance that is, however, not commensurate to chronological age is well in line with former investigations on expressive vocabulary in individuals with DS (see meta-analysis of Næss et al., 2011, and Witecy and Penke, 2019, for German individuals with DS) and gives no indication that MSV would pose a particular problem to individuals with DS.

Our findings are consistent with the findings of Grela (2002) who also described similarities of MSV production in a small group of seven children with DS and seven TD children matched by MLU. Our finding of mental-age appropriate production of MSV in individuals with DS is, however, in contrast to the studies of Channell (2020), who described impaired performance of MSV production in her participants with DS in a similar narration task, and Martzoukou et al. (2020), who found poorer use of internal state terms in individuals with DS than in cognition-matched TD children. While Channell did not include a control group of TD children against which performance of the DS group could be measured and evaluated as mental-age appropriate, the discrepancy to the findings of Martzoukou et al. (2020) awaits explanation. Note that Martzoukou et al. did not focus on MSV in their analysis but evaluated all sorts of internal state words including adjectives (such as *happy*, *sad* etc.) – a class of words that might be particularly vulnerable in individuals with DS (Beeghly and Cicchetti, 1997).

Types of MSV

We analyzed three different types of MSV: volition, cognition and emotion verbs. All types of verbs were produced by both populations (DS & TD) and in all TD age groups. Statistical comparisons yielded no significant differences in pairwise comparisons between the groups but suggested an age effect in emotion verbs. This finding underlines a comparable quality of MSV use between individuals with DS and TD children. The increase of emotion verbs in TD children suggests that emotion verbs might be acquired later than volition and cognition verbs.

This seems plausible as the description of another person's emotions requires a higher stage of sensitivity for others. This is a flaw of younger children who have been said to be relatively egocentric during development until the end of Piaget's preoperational phase at the age of seven (see Heo et al., 2011 for an overview). Hence, school children might be more sensible for a protagonist's emotions in storytelling, leading to a higher production of emotion verbs.

Syntactic Context of MSV

We furthermore explored five different syntactic contexts of MSV use: [i] in a main clause, [ii] in a main clause followed by a subordinate clause, [iii] in a main clause followed by direct speech, [iv] in a complex sentence (e.g. subordinate clause or question), [v] in a sentence fragment (see **Table 2**). Interestingly, MSV were produced in all five syntactic contexts by both populations (TD and DS) and over all TD age groups. This indicates that individuals with DS do not differ substantially in MSV use from TD children and are able to produce MSV in similar syntactic structures, including those where the MSV is accompanied by a sentential complement. Nevertheless, our participants with DS show a significantly higher number of MSV in sentence fragments than TD children, reflecting more pronounced difficulties of individuals with DS to use a MSV in a syntactically complex utterance. This observation conforms to the performance of the participants with DS in the two subtests of the *ESGRAF 4-8* which also indicate a performance with respect to the production of complex syntactic structures that is below mental-age expectations and, thus, indicative of a syntactic impairment. Against this background of an impaired syntactic development in individuals with DS, a striking finding of our investigation is that MSV production is possible despite developmental deficits in syntax and that it is not dependent on specific complex syntactic structures but that MSV can successfully be produced even in sentence fragments.

Our findings indicate that MSV are produced in various syntactic contexts already by young TD children and in individuals with DS who are impaired with respect to their syntactic development. This attenuates the assumption that use of MSV might be dependent on the acquisition of complex syntactic structures related to sentence complementation. De Villiers and Pyers (2002) have suggested that the understanding of another person's mind hinges on the acquisition of sentential complementation. The ability to produce complex sentence structures also allows complex cognitive inferences to the mental state of others. However, even the youngest age group of TD3 children and the syntactically impaired participants with DS produced MSV in a variety of syntactic structures, arguing against a direct association between MSV use and the acquisition of sentential complementation. Our findings are a first indication that syntactic abilities in individuals with DS are not decisive for their MSV production and perspective taking skills.

Relations Between MSV Production and Language Variables

To evaluate the relationship between language factors (complex syntax as well as expressive vocabulary) and MSV production in individuals with DS, we computed Pearson's correlations for density and diversity of MSV, age (chronological as well as mental), MLU in the narrations produced and performance in three standardized measures evaluating the production of complex syntactic structures as well as expressive vocabulary.

Previous investigations had identified syntactic development measured by MLU as well as expressive vocabulary as factors related to the production of MSV in individuals with DS (Ashby et al., 2017; Channell, 2020). With respect to expressive vocabulary, we could not confirm the finding of Channell (2020) that expressive vocabulary accounts for MSV production in individuals with DS. Note that while Channell evaluated expressive vocabulary against the chronological age of her participants we assessed it against the mental age of the participants with DS. While our participants display relatively good expressive vocabulary skills according to their mental age (mean T-score 52.06), Channell's participants displayed an impaired vocabulary performance. Given the substantial difference between chronological (mean 14; 05 years) and mental age (mean 5; 03 years) in our participants with DS, it seems likely that their expressive vocabulary – although adequate for their mental age – was limited for their chronological age. Due to the lack of a standardized test spanning the mental and chronological age range of our participants, this issue could not be determined. Nevertheless, the lack of a correlation between expressive vocabulary and MSV use is in contrast to Channell's findings and requires further research.

Similar to previous investigations by Channell (2020) and Ashby et al. (2017), we found a significant correlation between diversity of MSV and MLU ($r = 0.301$, $p < 0.05$). The exact nature of this relationship is, however, difficult to evaluate. Our data suggest that a high MLU does not indicate unimpaired syntactic abilities in individuals with DS but might also come about by concatenations of syntactic fragments within one utterance. Moreover, we included a specific measure of syntactic abilities but found no significant correlation between density and diversity of MSV and syntactic abilities in the group of participants with DS. This suggests that MSV use might be relatively independent at least from more advanced syntactic abilities, a finding that is supported by the frequent use of MSV in sentence fragments. Note also that MLU values cannot be directly compared between our investigation and previous studies because MLU is typically calculated on words in German but on morphemes in English (see Beeghly and Cicchetti, 1997; Ashby et al., 2017; Channell, 2020). Future studies should directly test specific syntactic abilities rather than relying on MLU as a measure for syntactic development in evaluating the developmental link between syntax and MSV use. The lack of a correlation between a measure of complex syntax and MSV use in our study suggests that MSV use seems to be more independent from syntactic development than was previously assumed. Specifically, it does not hinge on the acquisition of subordinate or complement clauses. Our finding that the ability to express perspective taking via MSV use is not dependent on syntactic abilities is also supported by Martzoukou et al. (2020) who found morpho-syntactic abilities as measured by a sentence-repetition not to be related to the use of internal state terms.

The findings of Martzoukou et al. and the results of our investigation suggest that the ability to understand a character's internal state and to take this character's perspective might be largely independent of language abilities and seems to be unaffected in individuals with DS. Participants in the Martzoukou et al. study were able to infer the internal state of story characters, participants in our study were able to produce MSV expressing a story character's view, beliefs and desires. The syntactic impairments that are typically observed in individuals with DS might, however, limit the ability to express another character's perspective verbally. In the study by Martzoukou et al., this was reflected by a lower number of complement clauses produced by the participants with DS. The use of MSV, that we adopted as a measure of perspective taking abilities, proved to be less affected by syntactic deficits. The amount and type of produced MSV were comparable to TD children, and MSV would also surface in ungrammatical sentence fragments. However, the relatively large proportion of MSV in sentence fragments produced by our participants with DS points to the limitations of these individuals when trying to express another character's perspective.

Limitations and Outlooks

It is important to consider some limitations of our study. While the overall number of participants in the TD groups ($n = 33$) and the DS group ($n = 28$) is sufficiently high and comparable in our study, the number in each TD age group is quite low, limiting type and power of the statistical analyses that could be conducted. Another limitation of our study is that for TD children no standardized measures on cognitive and syntactic development as well as size of expressive vocabulary were available, precluding direct comparisons between the TD children and the participants with DS with respect to these measures.

Our study targeted MSV production as a measure for perspective taking, disregarding other aspects of narrations that might also be indicative of the ability to take perspective in individuals with DS, such as character introduction or the consideration of the listener's knowledge. Also, perspective taking abilities might be associated to Theory of Mind as both abilities require sensitivity for other people's intentions and emotions. As individuals with DS often also show impairments in Theory of Mind abilities (Neitzel and Penke, 2021), the connection between perspective taking in form of MSV production and Theory of Mind may deserve closer examination.

A deeper investigation of this topic should also involve a qualitative assessment of MSV use in individuals with DS. Our study focused on the use and syntactic context of MSV whereas the semantically-adequate expression of mental states was not evaluated. It might, thus, be the case that while individuals with DS use a mental age-appropriate number of MSV, these provide a less adequate or incorrect identification of a character's mental states. Further research should target the difference between understanding a character's mental state and perspective and the verbal expression of another character's internal state and perspective to support the view that the former is unaffected in individuals with DS whereas the latter might be limited by impaired syntactic abilities.

Previous studies have mostly analyzed internal state language, including but not limited to MSV, as a measure of inferential language in individuals with DS. While Beeghly and Cicchetti (1997), Ashby et al. (2017) as well as Martzoukou et al. (2020) described impaired internal state language in individuals with DS, we focused on MSV and found the production of MSV to be mental-age adequate. However, this does not allow general conclusions concerning strengths and weaknesses in internal state language as a generic category of mental state language in individuals with DS.

As previous investigations have found impaired narrative ability in individuals with DS (overview by Segal and Pesco, 2015), future analyses should include not only MSV production as microstructural ability but also evaluate a connection to macrostructural and overall narrative abilities in this population. These aspects might be important as perspective taking and the understanding of other person's mental states are also reflected in a story's macrostructure, e.g. by attention to internal reactions of the characters or the communication of a moral in the end of a story.

Finally, longitudinal data of individuals with DS and TD would evidently be better suited to investigate and compare MSV development and other perspective taking abilities in typically- and atypically-developing children. Longitudinal data is however difficult to obtain as longitudinal studies including individuals with cognitive disabilities face multiple challenges (Witecy and Penke, 2017): First, participant recruitment, which is a difficulty in research on individuals with DS, might fail for long-term studies due to unpredictable health development and other factors. Second, drop-out of participants is more likely in less abled participants (Carr, 2005) which might distort the findings. This is especially problematic for individuals with DS since the slow progress in cognitive development demands observation over a long period. Finally, multiple testing is in danger to affect the outcome.

CONCLUSION

In our investigation, we focused on perspective taking in the form of MSV production in individuals with DS. Previous investigations have provided indications that MSV production might be impaired in this population and suggested that these difficulties might be related to expressive vocabulary or impaired syntactic abilities. We have compared MSV production in narrations of individuals with DS and three groups of TD children aged three, five and nine years. Our analyses indicate that MSV production is adequate for MA in our participants with DS regarding density and diversity of MSV as well as the syntactic context MSV appear in. Despite previous suggestions that MSV use might be dependent on syntactic development, specifically on the ability to construct sentential complements, we have not found interdependencies between MSV production and complex syntactic abilities. Rather, the production of MSV seemed to be quite independent of specific syntactic structures and MSV even occurred in sentence fragments in our participants with DS. Our investigation indicates that individuals with DS have mental age-

appropriate abilities of perspective taking in form of MSV production and that MSV can be produced even when syntactic abilities are impaired. These findings lead to a better understanding of the connection between MSV production and language performance in general. Our findings suggest that MSV production constitutes a measure of perspective taking abilities that is relatively unaffected by syntactic abilities and therefore even applicable for individuals with syntactic impairments such as individuals with DS. Further research on other measures of perspective taking is necessary to corroborate the assumption that perspective taking per se is unaffected in individuals with DS, while the ability to verbally express another character's perspective might be limited by syntactic impairments.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors on demand.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the Medical Department of the University of Cologne. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

IN collected the data and developed the concept for this paper. This concept work was supported by MP. IN computed all analyses which were controlled by and discussed with MP. This paper was written by IN and revised by MP.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2021.629757/full#supplementary-material

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