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Narrative production in autistic adults: A systematic analysis of the microstructure, macrostructure and internal state language

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ABSTRACT

While narrative competence has been well documented in autistic children and young adolescents, fairly little is known about narrative performance of autistic adults. However, narrative abilities continue to develop well into adulthood. Hence, the main objective of the present study is to provide a clearer linguistic and communicative profile of ASD in adulthood by performing a systematic description of narrative performance in autistic adults. A specific annotation scheme was developed to code narrative production, in order to be able to compare the production of autistic participants to pairwise matched neurotypical adults relative to microstructure (syntactic complexity), macrostructure (overall story structure and cohesive ties) and internal state language of the corpus' narratives. The results suggest that autistic adults performed worse than their neurotypical peers on all three dimensions of narrative production, resulting in less coherent narratives overall for autistic adults.

1. Introduction

Language in Autism Spectrum Disorder (ASD) is characterized by very heterogeneous linguistic profiles, ranging from individuals who will never develop functional speech and will remain non-verbal to individuals who will acquire average or even above average verbal skills (e.g., Eigsti et al., 2011; Tager-Flusberg, 2000). At the same time, these hugely variable linguistic profiles consistently share difficulties related to the domain of pragmatics which continue to be present even in individuals who have achieved average syntactic, lexical and phonological skills as well as average IQ (Volden et al., 2009). This suggests two different areas of difficulties in verbal autistic (ASD) individuals. On the one hand, the communication difficulties they experience are (mostly) associated with the use of language rather than with the structural linguistic properties. On the other hand, their communication difficulties are not restricted to the linguistic domain but also surface in the social and cognitive domains. Accordingly, discourse analysis proved a useful theoretical and methodological framework to study language use in ASD. The following section discusses in more detail narratives, a type of discourse that has been extensively studied in autism research as well as the main features that seem to characterize narrative discourse in autism in the existing literature.

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1.1. Narrative discourse as a measure of language use in autism

Narrative can be broadly defined as a discourse genre in which a series of events are presented as unfolding over time, and are related to each other (Stirling et al., 2014). The production of a coherent narrative discourse relies on various cognitive and linguistic skills. For example, stories typically have a reliable and consistent structure. Hence, storytelling will require the speaker to adhere to a story schema of the essential story components, such as setting, initiating event, consequences, resolution and ending (Hughes et al., 1997). Failing to include these essential story elements will usually affect the coherence of the overall organization.

Coherence can also be achieved through the use of linguistic devices, which create cohesive ties within the narrative structure. For instance, ties can be established between story events with temporal (e.g., *then*, *after*) or causal (e.g., *because*, *therefore*) connectives. Ties can also be established through references chains, viz. by using different referential expressions to reidentify a story protagonist across the narrative (e.g., definite expressions such as 'the boy' or a pronoun 'he'). Further contributing to the coherence of a narrative is the ability to express the point of view of the different story characters by verbalizing their internal states. This is reflected by the inclusion of linguistic devices to communicate about feelings (e.g., *happy, shocked*), desires (e.g., *want, wish*), beliefs (e.g., *assume*) and intentions (e.g., *try*; Stirling et al., 2014). Linguistic terms that refer to the internal and mental states of the story protagonists or narrator are usually referred to as 'internal state language' in the literature (Bretherton and Beeghly, 1982).

Producing a coherent narrative is therefore a complex task, which draws on multiple linguistic (e.g., grammar and lexicon), cognitive (e.g., deriving a story structure) and social skills (e.g., monitoring listeners' knowledge and interest) (De Marchena and Eigsti, 2016; Diehl et al., 2006; Volden et al., 2017). For this reason, narrative production is a particularly suitable measure of language use in ASD individuals who continue to experience communication difficulties, despite performing well on standardized tests of structural language skills (Manolitsi and Botting, 2011).

Narrative production also presents several methodological advantages. It is a particularly useful tool for the elicitation of sequences of utterances from a relatively naturalistic and fluent speech sample (Stirling et al., 2014). On the basis of audio recordings of the participant's performance, narratives can be transcribed verbatim, converting them into a format that can be used for subsequent assessment. Specifically, the transcripts can then be coded for different features of interest such as use of reference, inclusion of story grammar elements, etc. Another methodological advantage is that narrative elicitation tasks can be structured in a way that allows collection of comparable speech samples across participants (Stirling et al., 2014). For example, wordless picture books are often used to elicit narratives, with all participants seeing the same pictures and having to interpret them.

1.2. Characteristics of narrative discourse in autism

Considering the potential of narrative production to provide unique insight into communication in autism, a large number of studies have been published on narrative discourse in autism. Three major dimensions of narrative production have been investigated in these studies: (i) the microstructure, (ii) the macrostructure and (iii) internal state language (Baixauli et al., 2016). The most important discursive difficulties experienced by ASD individuals are situated at the level of the macrostructure; ASD participants seem less capable to maintain global coherence in their narratives relative to their NT peers. This difficulty surfaces especially as a reduced use of cohesive linguistic devices such as referential links (Norbury and Bishop, 2003) and causal conjunctions, as well as poor organization of the story around the gist events (Capps et al., 2000; Diehl et al., 2006; Losh and Capps, 2003; Tager-Flusberg, 1995).

Regarding the microstructure, results remain inconclusive with only some studies finding group differences. For example, some authors report that ASD children produced shorter and syntactically less complex narratives than comparison groups (Capps et al., 2000; Tager-Flusberg, 1995), while others find no such group difference (Losh and Capps, 2003; Norbury and Bishop, 2003). However, in their meta-analysis, Baixauli et al. (2016) suggest worse performance of ASD children and adolescents on productivity (number of words and utterances), lexical diversity (number of different words) and syntactic complexity (mean length of utterance). Hence, at least some ASD children and adolescents (viz. those represented in the meta-analysis) do seem to display delayed development in at least some features of morphosyntactic acquisition (Park et al., 2012).

Finally, regarding variables related to internal state language, ASD individuals include significantly fewer mental state terms than control groups (Baixauli et al., 2016). Baixauli et al. (2016) found that ASD participants with no IQ delay seem to have more difficulties in recognizing and expressing internal states than their NT peers. Although the opposite tendency might be expected, the authors suggest that cognitive and linguistic elements associated with socioemotional meaning such as mental state terms might follow a particular developmental path, resulting in an uneven development of these skills relative to the development of other cognitive and linguistic skills (such as syntactic skills).

1.3. Age and narrative performance

Most studies on narrative production in ASD have targeted children and young adolescents. In their meta-analysis, Baixauli et al. (2016) did not find chronological age to be a significant moderator of narrative competence. However, the age range of participants in all the studies these authors reviewed did not extend beyond fifteen, so it is not clear whether

older adolescents and adults continue to display difficulties in narrative production or whether they would perform similarly to their NT peers.

The few studies that did focus on storytelling in ASD adults report results that are quite similar to those found for children, suggesting that ASD adults continue to experience difficulties in narrative production. That said, results on narrative length and complexity in adults are as inconsistent as those in the literature on children. For example, when narrative production was supported by sequences of pictures (Beaumont and Newcombe, 2006) or a wordless picture book (Colle et al., 2008), no group differences surfaced in narrative length and syntactic complexity. However, using a more complex task (the Social Attribution Task designed by Heider and Simmel (1944) with dynamic stimuli, Klin (2000) did find that ASD adults produced shorter narratives than their typical peers.

Regarding the overall quality of their narratives, ASD adults do seem to display similar profiles of strength and weaknesses to ASD children. For example, while ASD adults have been found to produce internal state language in their narratives with the same frequency as their typical peers, they seemed to be less able than their typical peers to provide causal explanations for the mental states of the protagonist (Beaumont and Newcombe, 2006; Colle et al., 2008). Older ASD individuals also continue to show subtle difficulties with referential cohesion. For example, Colle et al. (2008) report that while the total number of referential expressions dedicated to the maintenance of reference does not differ per group, the type of expression does. The two groups also differed in their use of referential expressions to *maintain* reference. Specifically, NT participants used pronominal expressions more often than ASD participants to maintain reference to a character that was being talked about. This had the effect of a more cohesive and forward-moving story than if full NPs were used. In contrast, ASD participants used more full NPs and less pronominal expressions to maintain reference. In other words, it is not the case that adult ASD participants could not maintain reference across a narrative, but they did so in a less efficient way, suggesting subtle but persistent pragmatic difficulties.

1.4. Current study

Narrative production has been evaluated overwhelmingly in children and young adolescents. While narrative abilities appear early in development, they continue to develop well into adulthood (e.g., Stein et al., 1997). During adulthood, expressing oneself with clarity, precision and efficiency is crucial for success in various circumstances, from personal (e.g., building relationships) to educational (e.g., attending university) and employment (e.g., securing employment) settings (Nippold et al., 2017). Studies on NT adults have suggested that language samples, such as narrative production, can serve as a good measure of spoken language proficiency (Nippold et al., 2017). However, to this end one should systematically include measures of microstructure, macrostructure and internal state language, which was not the case in most of the existing studies on narrative production. Furthermore, adding analyses of narrative production from adults to the existing literature on children and young adolescents will provide a more comprehensive overview of narrative development, which could then be used to determine areas requiring language intervention.

The overarching aim of the present study is to contribute to a clearer linguistic and communicative profile of ASD in adulthood by providing a systematic description of narrative performance in ASD adults with linguistic and cognitive functioning in a typical range. A specific annotation scheme was developed to code narrative production, in order to answer the following research question: Do ASD adults perform differently than matched NT adults relative to the microstructure (syntactic complexity), macrostructure (overall story structure and cohesive ties) and internal state language of their narratives ? We hypothesized that older ASD adolescents and adults would perform worse than their NT peers on all three dimensions of narrative production, resulting in less coherent narratives overall for ASD individuals in comparison to NT individuals.

2. Methods

This study received ethical clearance from the Ethics Committee of the Faculty of Psychology and Education at Université libre de Bruxelles and the Behavioural Research Ethics Board of the University of British Columbia. Written consent was obtained from all participants or their parents.

2.1. Participants

Participants were 18 autistic and 18 neurotypical French-speaking adolescents and adults. Inclusion criteria for both groups included: 1) age between 15 and 60 years, 2) a Full-Scale IQ (FIQ) score above 70, 3) Verbal IQ (VIQ) score above 70 and 4) normal or corrected-to-normal vision and audition. For the control group, there was the extra inclusion criterion of no known psychiatric, developmental or neurological disorder. Participants were pairwise matched on age (plus or minus one year) and gender.

ASD participants had previously obtained a clinical diagnosis of autism from a multi-disciplinary team assessment external to our research group, based on criteria of the Autism Diagnostic Observation Schedule 2 (ADOS-2; Lord et al., 2012) and the Autism Diagnostic Interview-Revised (ADI-R; Rutter et al., 2003). For our study, clinical diagnosis of ASD was confirmed for all participants by a research-accredited ADOS assessor using Module 3 or 4 of the ADOS-2 (Lord et al., 2012). NT participants were also administered Module 3 or 4 of the ADOS-2 and all scored below the autism cut-off.

All participants received and signed an informed consent form, which included an authorization to be filmed during the ADOS-2. Furthermore, as advised by Baron-Cohen et al., the Empathy Quotient (EQ; Baron-Cohen and Wheelwright, 2004) was administered conjointly with the Autism Quotient (AQ; Baron-Cohen et al., 2001), which provides an estimate of autistic-like traits presented by an individual, and allows for them to be situated on the continuum from autism to neuro-typicality. As can be seen from Table 1, the ADOS-2 and AQ scores of participants in the autism group were significantly higher than those of the participants in the comparison group. Participants in the comparison group scored significantly higher on the EQ.

Table 1
Descriptive statistics of participants' characteristics per diagnostic group.

	ASD	NT	t	df	P
N (M:F)	18 (11:7)	18 (11:7)			
Age (SD)	28.90 (11.80)	28.79 (11.84)	0.028	34	0.98
Age-range	15.2–52.9	15.0–53.04			
ADOS Total Score (SD)	10.06 (2.86)	0.88 (1.32)	12.35	23.97	<0.0001
AQ (SD)	35.94 (7.67)	9.92 (4.54)	11.34	24.92	<0.0001
EQ (SD)	23.19 (10.75)	42.58 (10.19)	−4.87	24.506	<0.0001

Participants' Intellectual Quotient (IQ) was assessed using the full version of the Wechsler Adult Intelligence Scale (WAIS-IV; Wechsler, 2008). As can be seen from Table 2, ASD and NT participants did not differ in Full-scale IQ (FIQ), Verbal IQ (IQ) or Perceptual IQ (PIQ).

Table 2
Means and standard deviations (in brackets) of IQ scores per diagnostic group.

	ASD	NT	T	df	p
FIQ (SD)	110.67 (19.31)	108.17 (11.99)	0.467	28.41	0.64
VIQ (SD)	114.83 (21.11)	111.44 (12.41)	0.59	27.50	0.56
PIQ (SD)	108.72 (16.58)	103.50 (11.36)	1.10	30.08	0.28

2.2. Material

The material of this study comes from storybook narratives of the wordless picture book *Tuesday* (Wiesner, 1991). The current study is part of a wider research project and the full description of the data collection is given on Open Science Framework.

2.3. Procedures

The narrative task was administered during the standard ADOS-2 procedure. Based on the *word* tier of the TextGrids, narrative coding was performed by research and student assistants, all blind to participant diagnosis. Reliability of coding was measured by double-coding 10% of the transcripts. All disagreements were discussed and resolved.[1] See Table 3 for agreement scores.

Table 3
Percentage inter-coder agreement per coding category.

Category	Agreement (%)	Disagreement (%)
Story Grammar	72	28
Reference	71	29
Discourse-structuring devices	98	2
Internal State Language	82	18

2.4. Linguistic measures

2.4.1. Syntactic coding

Participants' narratives were segmented into syntactic units following the coding protocol of Tanguy et al. (2012). The full protocol is described on Open Science Framework.

[1] Discrepant coding were subsequently corrected in the narratives according to the discussed resolution.

2.4.2. Story structure

To examine the organization of the produced narratives, our coding scheme included a measure of story grammar. The story 'setting' was not included in the analysis, as it was always introduced by the experimenter (according to the instructions of the ADOS-2 and the protocol of this study). According to Kauschke et al. (2016) and Rumpf et al. (2012), there are two main events in the story: a triggering event, the frogs' sudden ability to fly, and a turning point, their loss of this ability. In between these two pivotal events, a series of main events happen. Table 4 summarizes the different story elements coded for this category.

Table 4
Main story elements in the wordless picture book *Tuesday*.

Story elements	Description
Sequence of events	
1	The turtle and the fish watch the frogs fly away.
2	The frogs discover the surrounding neighborhood.
3	They fly among crows.
4	They fly by a man who is having a midnight snack.
5	The frogs pursue their adventure in a garden and fly into some drying laundry.
6	They visit the house of an old lady
	Part 1: the old lady fell asleep watching television
	Part 2: she doesn't notice the frogs
	Part 3: One frog took control over the TV remote.
7	Meeting with a dog
	Part 1: One of the frogs runs into a dog.
	Part 2: The other frogs come to provide reinforcement to the frog.
Decisive event	The frogs lose their ability to fly and lose their lily pads.
Conclusion	They fall on the ground and find their way back to the pond
Coda 1	Police, detectives and the media are in the streets and are puzzled to find all the lily pads in the streets.
Coda 2	The pigs start to fly.

To capture whether and how participants added elements not pertaining to the traditional story schema, the following categories were also coded: *Additional story event*, *Image description*, *Additional elements* and *Extraneous comments.* Any event that was represented in the pictures but could not be coded as a main event was coded as *Additional story event*. The category *Image description* was applied when participants provided simple descriptions of elements present in the picture, without mentioning any actions or psychological states of the characters. Such descriptions often take the form of simple nominal expressions (e.g., *a cat*). *Additional element* was coded when participants mentioned events or elements that were not present in the picture. *Extraneous comments* was coded when participants produced comments that were related to the narrative task rather than the events depicted in the pictures. *Additional elements* and *Extraneous comments* were included in the coding to examine whether and how participants interrupted the structure of the narrative or the storytelling task itself. These two elements were hypothesized to hinder narrative coherence. See Table 5 for detailed examples of the four additional categories of story structure.

Table 5
Additional categories of story structure.

Category	Example
Additional story event	Le chat regard avec beaucoup de curiosité *The cat looks with a lot of curiosity* NT participant (male, 24 years old)
Image description	Il y a une ferme *There is a farm* ASD participant (female, 27 years old)
Additional elements	Les grenouilles c'est des aliens en fait *actually the frogs are aliens* ASD participant (male, 28 years old)
Extraneous comments	Le genre de truc qui me fait chier *The kind of stuff that pisses me off* ASD participant (female, 34 years old)

Coding of the story structure of entire narratives from the corpus are provided in Appendix 2.

2.4.3. Referential expressions

The coding category of reference concerns references to the story's characters. To measure how participants referred to these story entities, their syntactic form was coded. Story entities could be identified either in a definite or indefinite manner. Table 6 summarizes the coding categories of reference.

Table 6
Coding categories of reference.

Type of reference		Examples
Definite referential expressions	Definite nominal expression	les grenouilles (*the frogs*), le crapaud (*the toad*)
	Pronominal expression	ils, elles (*they*)
	Adjective demonstrative	cette grenouille (*this frog*), ces tortues (*these turtles*)
	Demonstrative pronoun	celle-là (*that one*)
Indefinite referential expressions	Indefinite nominal expression	une grenouille (*a frog*)
	Indefinite adjectival expression	certains (*some*)
	Indefinite pronominal expression	quelqu'un (*somebody*)

2.4.4. Discourse-structuring devices

Two specific types of discourse-structuring devices were coded: connectives and discourse markers. Connectives were coded into the following subcategories: additive, temporal, causal and contrastive connectives. The coding of discourse markers included lexemes serving a structuring or meta-discursive function (e.g., 'bah' (*well*), Tanguy et al., 2012). One important characteristics of discourse-structuring devices is that they are multifunctional (Crible, 2017). In the present corpus, connectives such as 'donc' (*so*) or 'alors' (*then*) were sometimes used as a discourse marker, viz. served a meta-discursive function, rather than relating two events together with the original meaning of the connective. In these cases, they were not coded as a connective but as a discourse marker. Table 7 summarizes the different types discourse-structuring devices.

Table 7
Coding categories of connectives and discourse markers.

Category	Example
Temporal	après (*after*), ensuite (*then*), puis (*then*), avant (*before*)
Additive	et (*and*), de plus (*moreover*)
Causal	parce que (*because*), car (*because*), puisque (*because*), donc (*so*)
Contrastive	mais (*but*), cependant (*however*), néanmoins (*nevertheless*), bien que (*although*)
Discourse marker	bah (*well*), tu vois (*you see*)

2.4.5. Internal state language

The coding category Internal State Language (ISL) consists of references made to the internal states of the story's characters. Table 8 below covers the ISL categories (adopted from Kauschke and Klann-Delius, 1997; Kauschke, van der Beek and Kamp-Becker, 2016) coded in the storybook narratives.

Table 8
Coding categories of internal state language.

Category	Definition	Example
Emotion	Terms referring to distinct emotions or expressive behaviors of emotions	Avoir peur (*to be afraid*), être content (*to be happy*)
Cognition	Terms referring to mental/cognitive states and expressions of knowledge/beliefs/memories	Croire (*believe*), dire (*say*), s'interroger (*to question oneself*)
Physiology	Terms referring to subjective biological and physical perception and sensations	Voir (*see*), entendre (*hear*)
Modality	Terms of volition, obligations and intentions	Vouloir (*want*), desirer (*desire*)
Evaluation	Terms expressing a moral judgment or an evaluation of people/events	Apparemment (*apparently*), évidemment (*obviously*)

Both individual words and phrases could be coded as internal state language. For a phrase to be coded as such, it should be clearly paraphrased into a mental state term. Words or phrases were not coded as internal state language if they involved personality traits (e.g., mischievous; see Bang et al., 2013). The annotation guidelines for the linguistic measures in participants' narrative productions are reproduced in Appendix 1.

2.5. Data preparation

All coding was performed in *Praat* (Boersma and Weenink, 2017). For each participant, a TextGrid was created containing all coding categories. Using the script 'tierextraction.praat' created by Oliver Ehmer (http://www.oliverehmer.de/transformer/), each tier was extracted into a Comma Separated Value (csv) file. The speech of the experimenter was manually removed to keep only the speech belonging to participants' narrative production.

2.6. Analysis

All statistical analyses were conducted in R (R Core Team, 2016). Log-linear models (Poisson regression) were performed on all coding categories using the **glm** function. For each category, viz. syntactic coding, story structure, reference, connective and internal state language, a model was created with feature type as dependent variable and group diagnostic entered as fixed effect. When necessary, the variability in the length of narratives — as measured by number of syntactic units — was controlled for by including the total number of syntactic units per narrative as a fixed effect in the models. The significance of the model was determined by comparing it to a model without the fixed effect of diagnostic group using the **anova** function from the 'stats' package. To examine which specific variables differed per group, Tukey post-hoc analyses were conducted using the **emmeans** function from the 'emmeans' package. All significant effects ($p < 0.05$) reported in this study remained so, when controlling for total number of syntactic units. Considering the variability in measurements (count data), percentage scores were also calculated for a more homogeneous representation of the data. To visualize the proportion of a given feature within the entire narrative, percentage scores were calculated as the total count of a given feature divided by the total number of syntactic units. These percentage scores are presented in the summary tables alongside the raw counts. Models and plots were created using the raw scores of the dependent variables.

Violin plots are used to illustrate the results. Violin plots represent the distribution and probability density of the data. The distribution shape of the data is represented by using a kernel density estimation. The wider parts of the shape shows a higher probability that the data of participants will take on a given value while the narrower parts of the shape show a lower probability that the data of participants will take on a given value. In comparison to boxplots which only provide summary statistics (e.g., mean, median and interquartile ranges), violin plots provide more information as they show the full distribution of the data.

3. Results

3.1. Narrative microstructure

3.1.1. Narrative productivity: total counts of words, syntactic sequences and syntactic units

Narrative productivity was measured by examining total counts of words,[2] syntactic sequences[3] and syntactic units.[4] NT participants produced more words, syntactic sequences and syntactic units than the ASD participants, $\chi^2(1) = 124.42$, $p < 0.0001$; $\chi^2(1) = 6.494$; $p = 0.01$ and $\chi^2(1) = 6.9519$, $p = 0.008$. See Tables 9 and 10.

Table 9
Regression coefficients of the generalized link model with the additive effect of diagnostic group (ASD diagnosis is the reference level, standard errors is in brackets).

	Total words	Total syntactic sequences	Total syntactic units
NT	0.165 (0.01)***	0.054 (0.02)*	0.085 (0.03)**

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

Table 10
Means and standard deviations (in brackets) of total words, total syntactic sequences and syntactic units per diagnostic group.

	ASD	NT
Total words	467.67 (276.66)	551.56 (205.35)
Total syntactic sequences	239.72 (146.78)	253.06 (79.92)
Total syntactic units	101.67 (61.52)	110.72 (36.36)

In the following figures, the median is indicated by the red dot and the mean is indicated by the diamond shape. Fig. 1 contains violin plots depicting the data distribution of the variables in the coding category 'narrative productivity' per diagnostic group, viz. total counts of words, syntactic sequences and syntactic units.

[2] The count of total words is the total of the words produced during the narrative, except the repletion of the same type in a row (e.g., 'he he he called me'), interrupted words (e.g., 'I play rug- I train or play rugby'), hesitation markers(e.g., 'uh', 'uhm'), paraverbal elements (e.g., 'pff', 'mhm') and non-words (e.g., 'ech').

[3] The total count of syntactic sequences includes the different subtypes of functional and categorical sequences, as proposed by Tanguy et al. (2012).

[4] The total count syntactic units includes the following coding categories of Tanguy et al.'s (2012) syntactic coding protocol: dependency clauses, adjuncts and discourse markers.

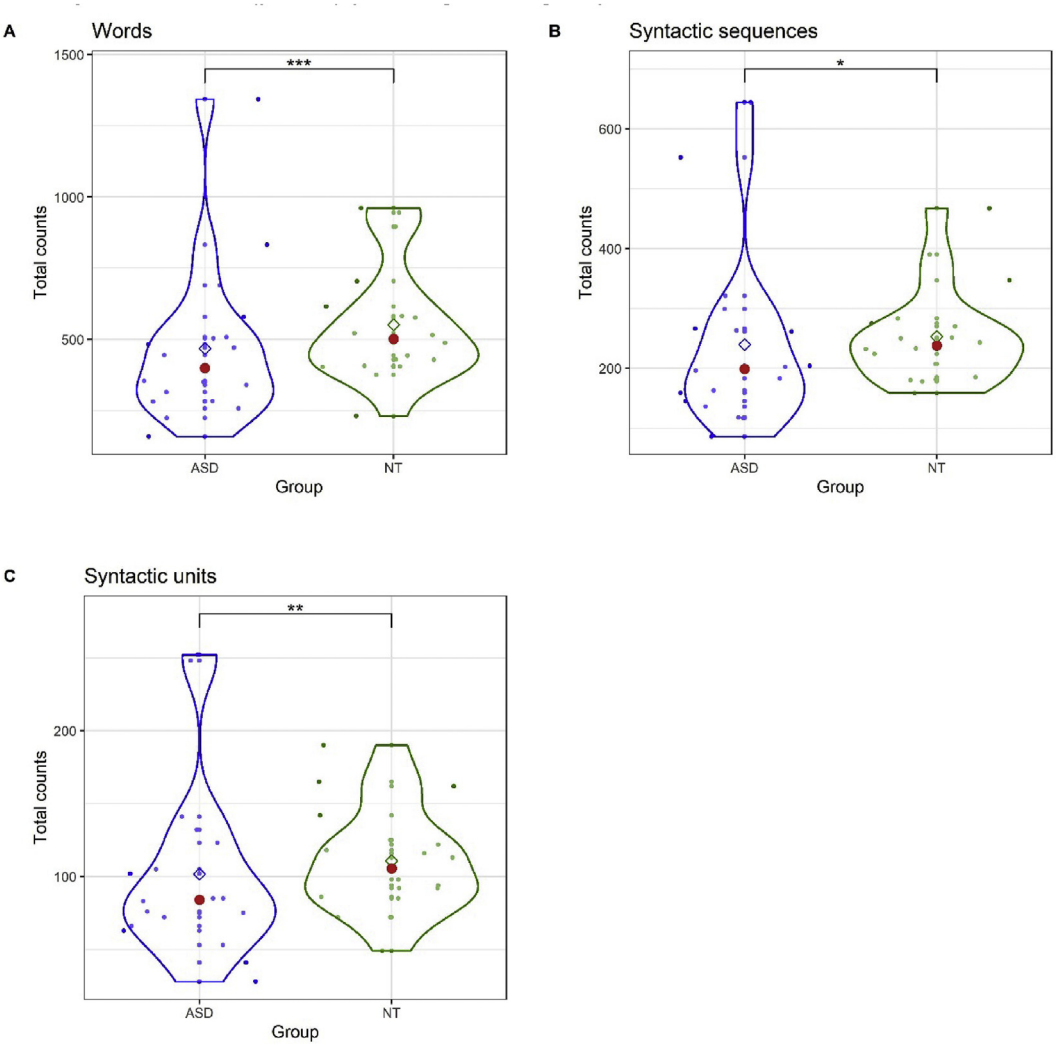


Fig. 1. Violin plots of total words (plot A), total syntactic sequences (plot B) and total syntactic units (plot C) per diagnostic group.

3.1.2. *Types of syntactic units*

3.1.2.1. Dependency clauses. When looking at the syntactic coding of dependency clauses, post-hoc analyses revealed that there were no significant group differences in total number of dependency clauses, $z = 1.224$, $p = 0.22$. However, when dependency clauses were divided into complete and incomplete ones, ASD participants produced less complete dependency clauses, $z = -1.965$, $p = 0.05$ but more incomplete dependency clauses, $z = 3.125$, $p = 0.002$. Table 11 contains summary statistics of total dependency clauses, complete dependency clauses and incomplete dependency clauses. Fig. 2 contains violin plots depicting the data distribution of the variables in the coding category 'dependency clauses' per diagnostic group, viz. total dependency clauses, complete dependency clauses and incomplete dependency clauses.

Table 11
Means and standard deviations (in brackets) of counts and percentage of total dependency clauses, complete dependency clauses and incomplete dependency clauses per diagnostic group.

	ASD		NT	
	Counts	Percentage	Counts	Percentage
Total dependency clauses	58.22 (34.66)	58.74 (9.07)	60.11 (20.67)	54.64 (6.67)
Complete dependency clauses	53.39 (30.18)	93.14 (5.08)	57.39 (20.25)	95.31 (3.72)
Incomplete dependency clauses	4.83 (5.22)	6.86 (5.08)	2.72 (1.96)	4.69 (3.72)

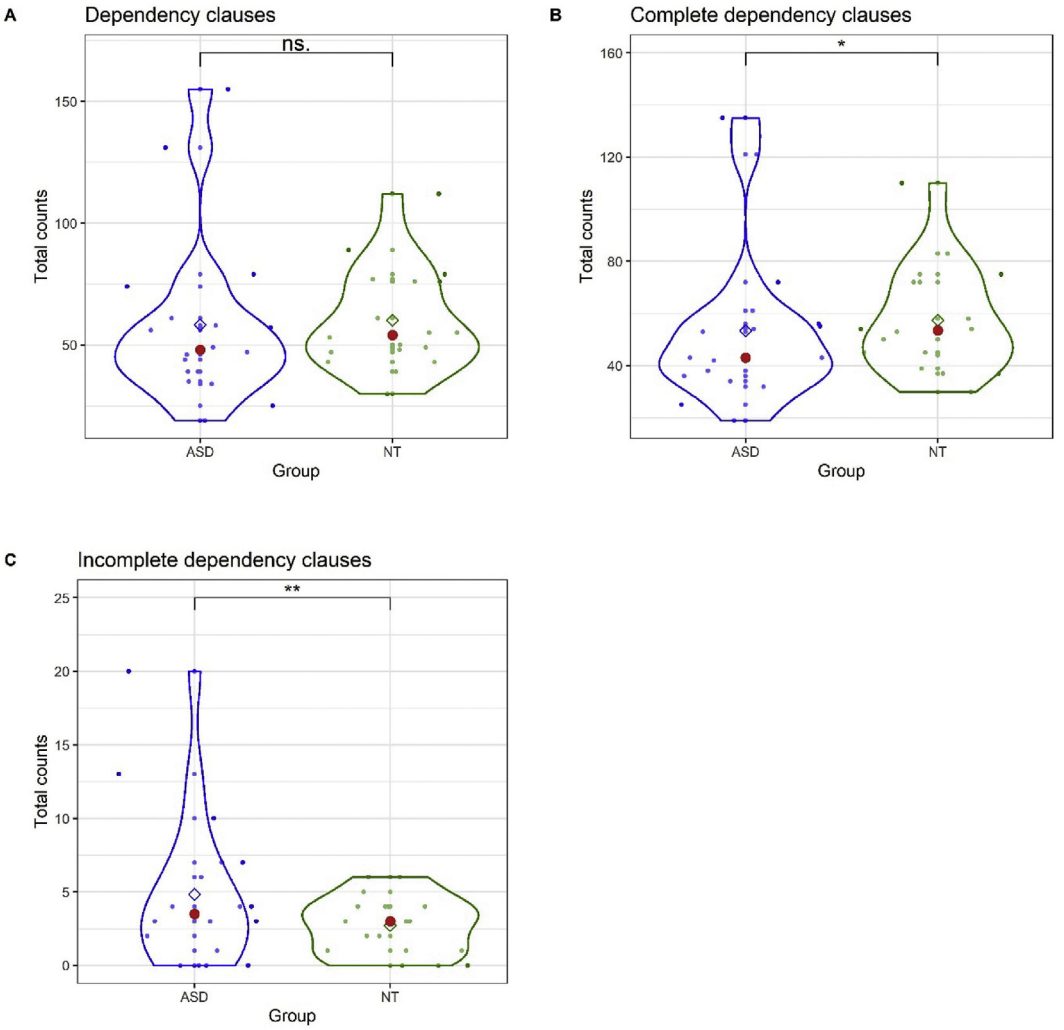


Fig. 2. Violin plots of dependency clauses (plot A), complete (plot B) and incomplete dependency clauses (plot C) per diagnostic group.

3.1.2.2. Dependency clause subtypes. When looking at subtypes of complete dependency clauses, ASD participants produced less complete verbal dependency clauses, $z = -3.632$, $p = 0.0003$ and more complete averbal dependency clauses, $z = 3.279$, $p = 0.001$. There was no group difference in the number of complete elliptic dependency clauses, $z = 1.224$, $p = 0.22$. Table 12 displays summary statistics of dependency clauses subtypes.

Table 12
Means and standard deviations (in brackets) of counts and percentage of dependency clause subtypes per diagnostic group.

	ASD		NT	
	Counts	Percentage	Counts	Percentage
Verbal	43.06 (20.97)	77.97 (11.36)	50.61 (16.94)	85.12 (9.74)
Averbal	8.39 (9.98)	12.24 (6.69)	5.39 (6.85)	8.08 (8.42)
Elliptic	1.94 (1.73)	2.93 (2.31)	1.39 (1.24)	2.11 (1.51)

Fig. 3 contains violin plots depicting the data distribution of the variables in the coding categories 'dependency clause subtypes' per diagnostic group, viz. verbal, averbal and elliptic dependency clauses.

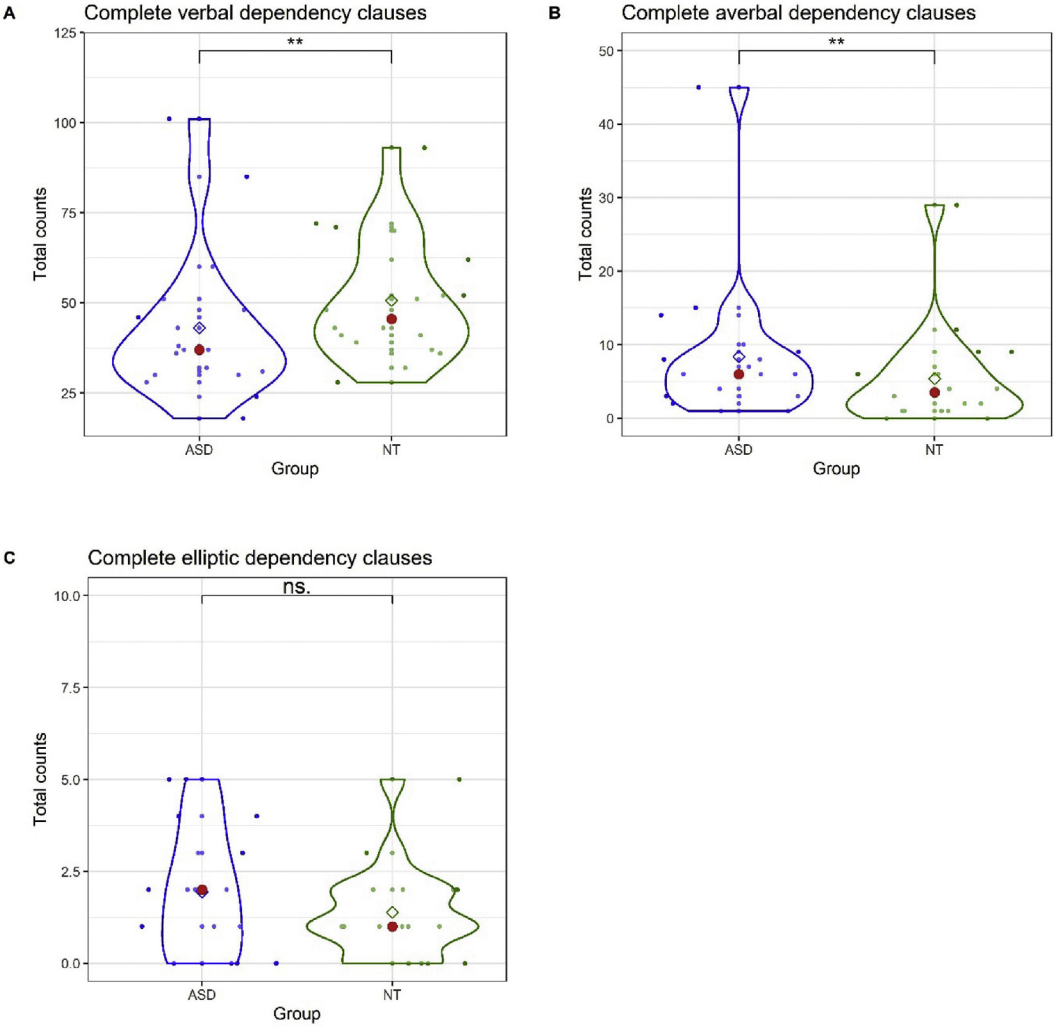


Fig. 3. Violin plots of complete verbal (plot A), averbal (plot B) and elliptic dependency clauses (plot C) per diagnostic group.

3.1.2.3. Additional syntactic units: adjuncts, discourse-structuring devices and hesitation markers. When examining the production of additional syntactic units, ASD participants produced less discourse-structuring devices, $z = -3.017$, $p = 0.003$ but more hesitation markers, $z = 2.565$, $p = 0.01$. than NT participants. Group differences in the production of adjuncts failed to reach significance, $z = -1.820$, $p = 0.07$. Table 13 contains summary statistics of the different types of additional syntactic units.

Table 13
Means and standard deviations (in brackets) of counts and percentage of additional syntactic units per diagnostic group.

	ASD		NT	
	Counts	Percentage	Counts	Percentage
Discourse-structuring devices	38.67 (26.49)	36.54 (9.70)	44.50 (16.64)	39.96 (8.19)
Adjuncts	4.78 (3.96)	4.72 (3.35)	6.11 (4.07)	5.41 (3.45)
Hesitation markers	11.17 (9.86)	11.41 (7.17)	8.33 (4.75)	8.43 (6.49)

Fig. 4 contains violin plots depicting the data distribution of the variables in the coding category 'additional syntactic units' per diagnostic group, viz. discourse-structuring devices, adjuncts and hesitation markers.

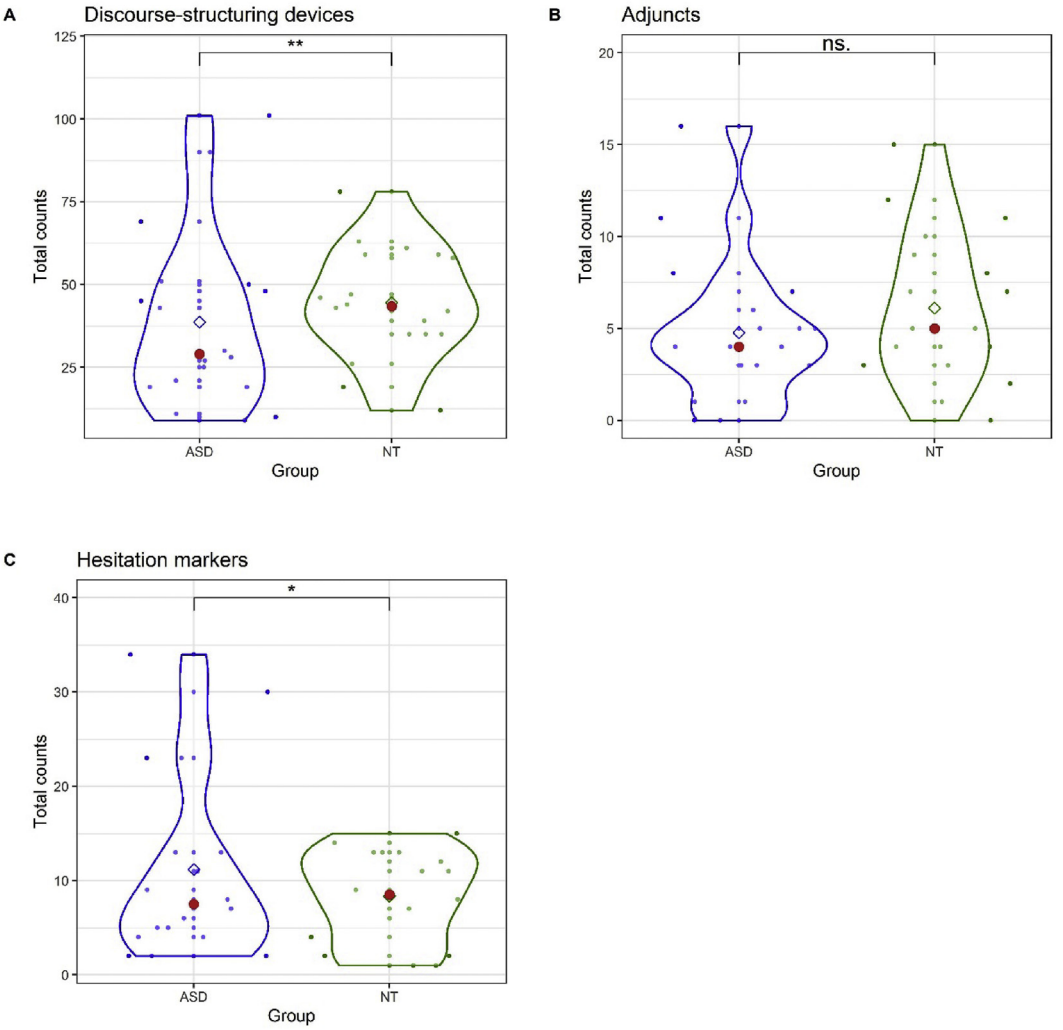


Fig. 4. Violin plots of discourse-structuring devices (plot A), adjuncts (plot B) and hesitation markers (plot C) per diagnostic group.

3.2. Narrative macrostructure

3.2.1. Story structure

There were no group differences in the total number of main story elements, $z = -0.601$, $p = 0.55$. ASD and NT participants produced comparable number of main events, conclusion and codas. There were also no group differences in the production of additional story events, $z = 1.290$, $p = 0.2$. However, there was a significant group difference in the production of extraneous comments related to the task and/or the story itself. ASD participants produced significantly more comments than NT

participants, $z = 2.612$, $p = 0.009$. The additional story categories *Image description* and *Additional element* were not analyzed, as there were not enough instances produced. See Table 14 for summary statistics of the elements of the story structure.

Table 14
Means and standard deviations (in brackets) of total counts of main story elements, additional story events and extraneous comments per diagnostic group.

	Main story elements	Additional story events	Extraneous comments
ASD	12.61 (1.61)	3.17 (3.29)	2.72 (2.80)
NT	13.33 (0.77)	2.44 (1.65)	1.44 (1.50)

Fig. 5 contains violin plots depicting the distribution of the data from the variables in the coding category 'story structure' per diagnostic group, viz. main story elements, additional story events and extraneous comments.

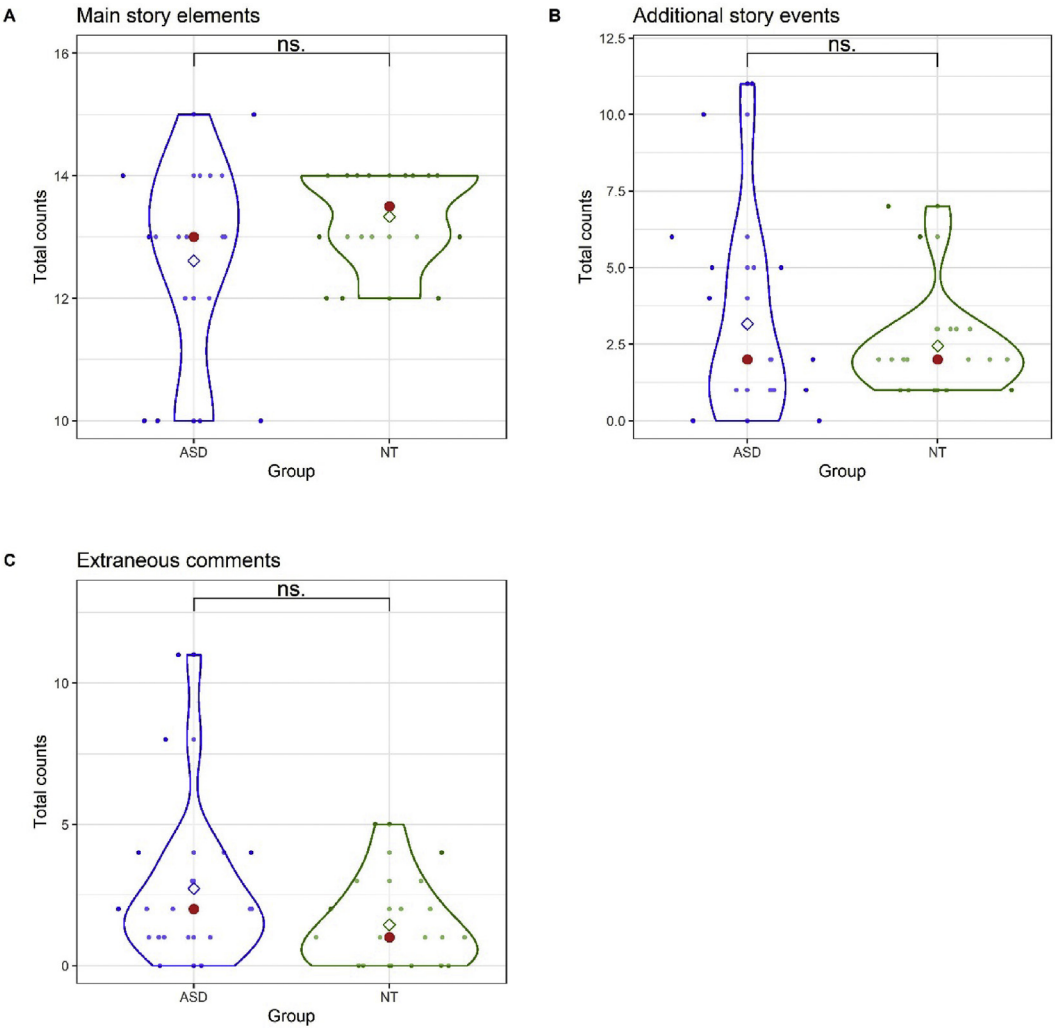


Fig. 5. Violin plot for main story elements (plot C), additional story events (plot B) and extraneous comments (plot C) per diagnostic group.

3.2.2. Discourse-structuring devices

When looking at both types of discourse-structuring devices combined (connectives and discourse markers), ASD participants produced less discourse-structuring devices than NT participants, $z = -3.443$, $p = 0.0006$. When breaking down by connective subtypes, ASD participants produced less additive, $z = -3.517$, $p = 0.0004$, causal, $z = -5.774$, $p < 0.0001$ and contrastive connectives, $z = -3.264$, $p = 0.001$ than NT participants. There were no significant group differences in the production of temporal connectives, $z = 1.548$, $p = 0.1217$. ASD participants produced more discourse markers than NT participants, $z = 2.349$, $p = 0.02$. Table 15 provides summary statistics of discourse structuring devices per group.

Table 15
Means and standard deviations (in brackets) of counts and percentage of discourse-structuring devices per diagnostic group.

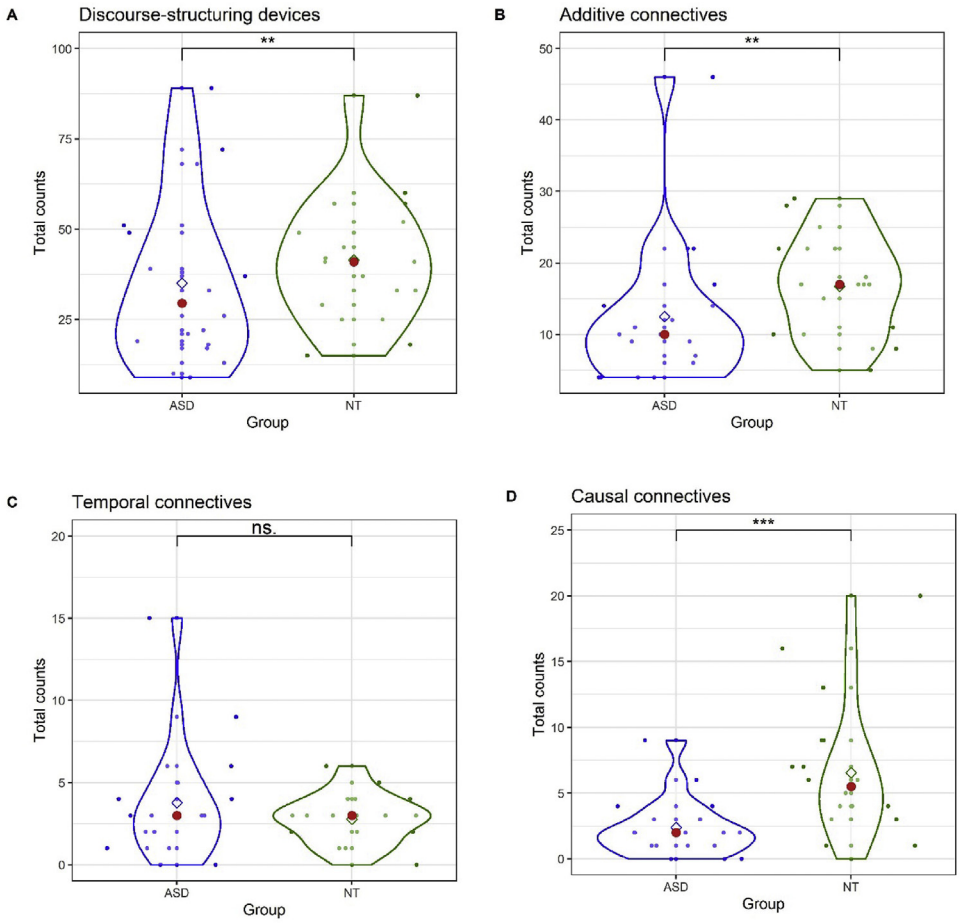
	ASD		NT	
	Counts	Percentage	Counts	Percentage
Additive connective	12.50 (10.08)	12.67 (7.53)	16.72 (7.06)	15.35 (5.17)
Temporal connective	3.78 (3.64)	3.98 (3.59)	2.78 (1.52)	2.90 (2.11)
Causal connective	2.39 (2.28)	2.49 (2.01)	6.56 (5.29)	5.55 (3.63)
Contrastive connective	2.50 (1.69)	2.53 (1.13)	4.50 (3.65)	3.69 (2.32)
Discourse maker	13.89 (13.25)	12.03 (7.53)	10.89 (5.11)	9.72 (3.61)
Total	35.06 (22.96)	33.71 (8.67)	41.44 (17.48)	37.21 (8.88)

In addition to comparisons across groups, frequency statistics were also calculated within group to give a better representation of how different subcategories of linguistic measures were distributed within each group. Table 16 provides frequency statistics of the distribution of each connective subtype and discourse markers within diagnostic group.

Table 16
Distribution of the different discourse-structuring devices within diagnostic group.

	ASD		NT	
	Counts	Percentage	Counts	Percentage
Additive connective	225	36%	301	40%
Temporal connective	68	11%	50	7%
Causal connective	43	7%	118	16%
Contrastive connective	45	7%	81	11%
Discourse markers	250	40%	196	26%
Total	631		746	

Fig. 6 contains violin plots depicting the data distribution of the variables in the coding category 'discourse-structuring devices' per diagnostic group, viz. total count, connective subtypes (additive, causal, contrastive, temporal) and discourse markers.



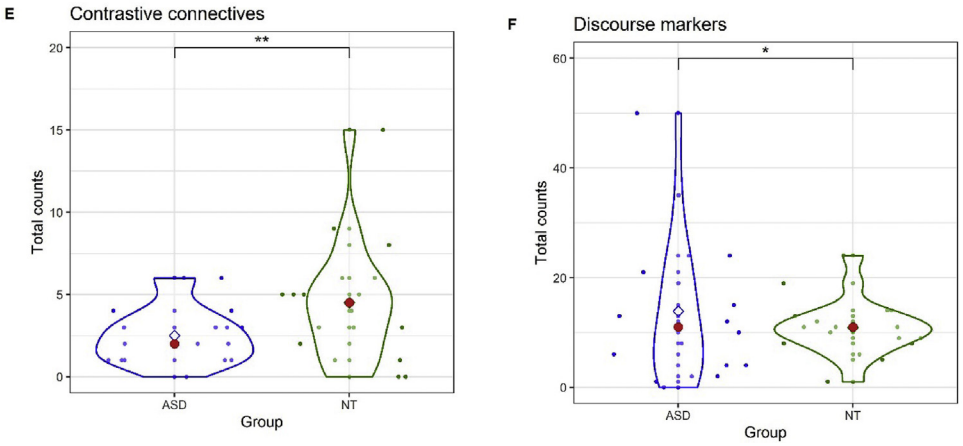


Fig. 6. (continued).

3.2.3. *Referential expressions*

ASD participants produced significantly less referential expressions overall than NT participants, $z = -4.037$, $p < 0.0001$. Breaking down by type of referential expressions, ASD participants produced less definite and pronominal expressions than NT participants, $z = -2.765$, $p = 0.006$ and $z = -3.719$, $p = 0.0002$. There were no group differences in the production of indefinite nominal expressions, $z = 0.455$, $p = 0.65$. See Table 17 for summary statistics of the different types of referential expressions.

Table 17
Means and standard deviations (in brackets) of counts and percent of referential expressions per diagnostic group.

	ASD		NT	
	Counts	Percentage	Counts	Percentage
Definite	12.28 (10.59)	13.23 (7.63)	15.67 (5.72)	14.44 (4.76)
Indefinite	7.50 (3.26)	8.55 (3.71)	7.06 (3.70)	7.54 (6.65)
Pronominal	19.06 (11.50)	19.98 (8.87)	24.78 (13.03)	22.31 (7.86)
Total reference	38.83 (22.30)	44.28 (11.16)	47.50 (15.95)	41.75 (16.03)

Table 18 provides frequency statistics of the distribution of the referential expression subtypes within diagnostic group.

Table 18
Distribution of the referential expression subtypes within diagnostic group.

	ASD		NT	
	Counts	Percentage	Counts	Percentage
Definite	221	31,62%	282	32,98%
Indefinite	135	19,31%	127	14,85%
Pronominal	343	49,07%	446	52,16%
Total	699		855	

Fig. 7 contains violin plots depicting the data distribution of the variables in the coding category ‘referential expressions’ per diagnostic group, viz. total referential expressions, definite nominal expressions, indefinite nominal expression and pronominal expressions.

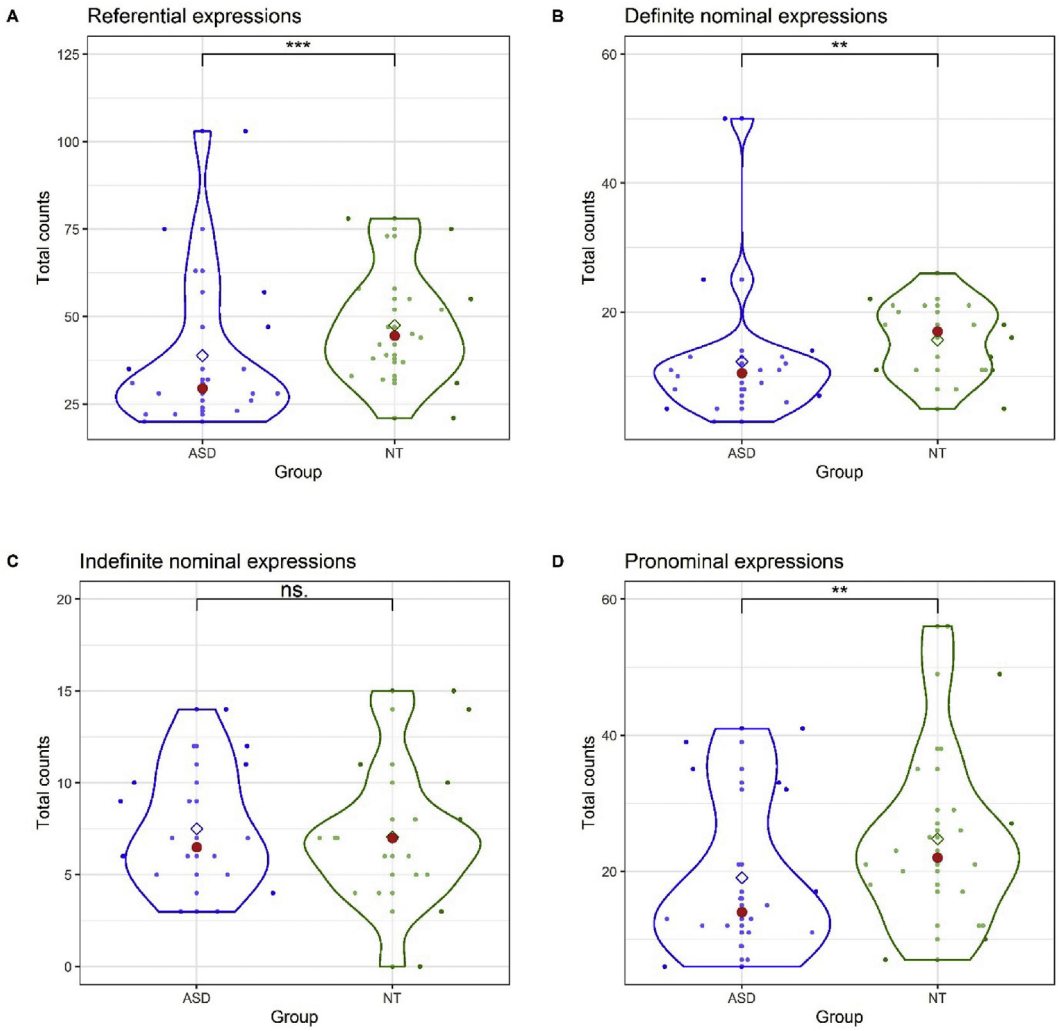


Fig. 7. Violin plots for total referential expressions (plot A), definite nominal expressions (plot B), indefinite nominal expressions (plot C) and pronominal expressions (plot D) per diagnostic group.

When looking at the story characters, ASD participants referred less often to the story's main protagonists, viz. frogs and toads ($z = -2.536$, $p = 0.0112$), the man ($z = -2.311$, $p = 0.02$), the old lady ($z = -2.193$, $p = 0.03$) and the frog being chased by the dog ($z = -3.412$, $p = 0.0006$) than NT participants. There were no significant differences for the remaining characters, namely the dog ($z = -1.293$, $p = 0.19$), turtle ($z = -0.357$, $p = 0.72$), fish ($z = -1.088$, $p = 0.28$), birds ($z = -1.342$, $p = 0.18$), cat ($z = 0.928$, $p = 0.35$), media ($z = -0.152$, $p = 0.89$) and pigs ($z = -0.013$, $p = 0.99$). Fig. 8 contains violin plots depicting the data distribution of the different story protagonists per diagnostic group.

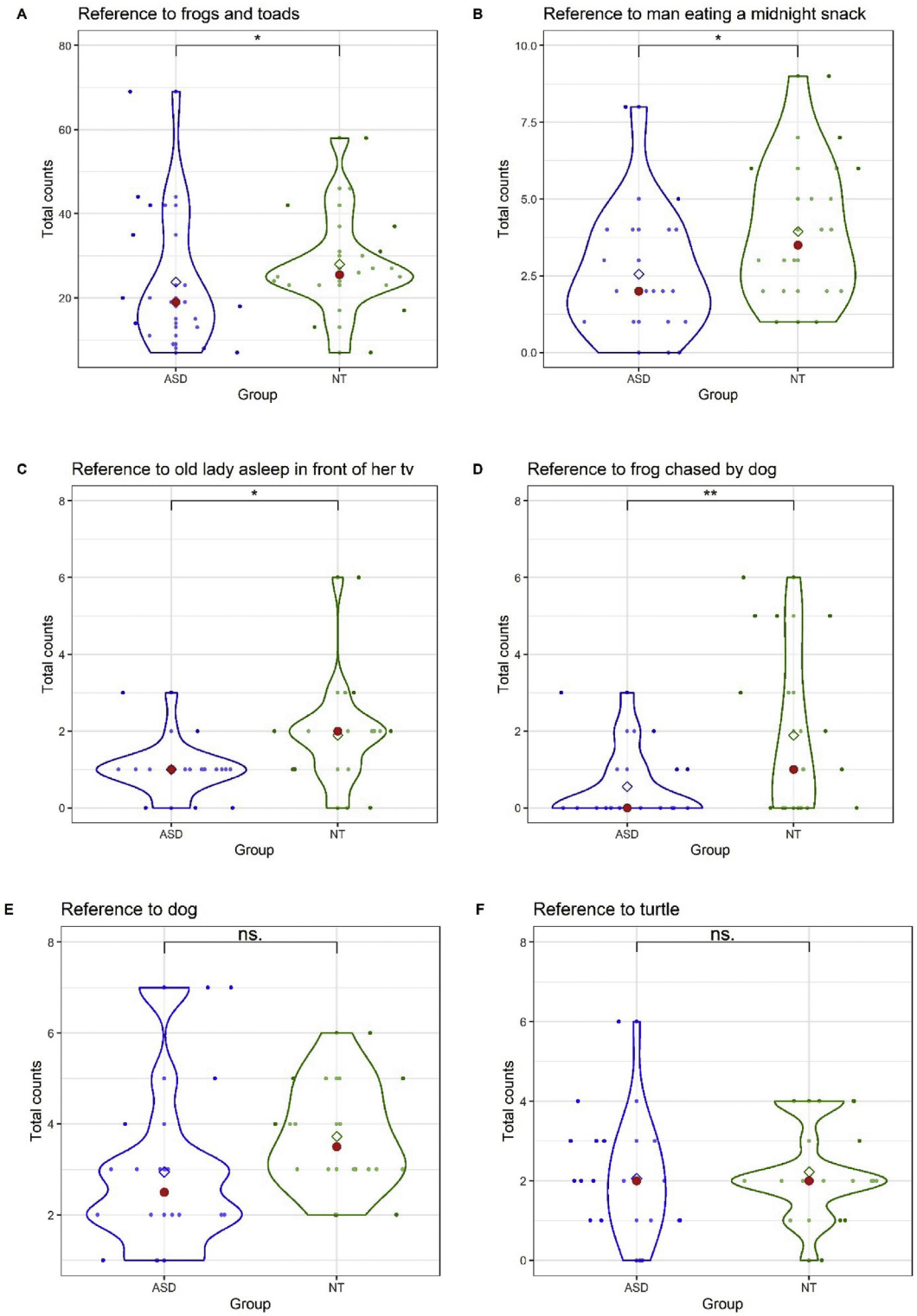


Fig. 8. Violin plots for total counts of references to toads and frogs (plot A), man eating a midnight snack (plot B), lady asleep in front of her television (plot C), frog chased by the dog (plot D), dog (plot E), turtle (plot F), fish (plot G), birds (plot H), cat (plot I), media (plot J) and pigs (plot K) per diagnostic group.

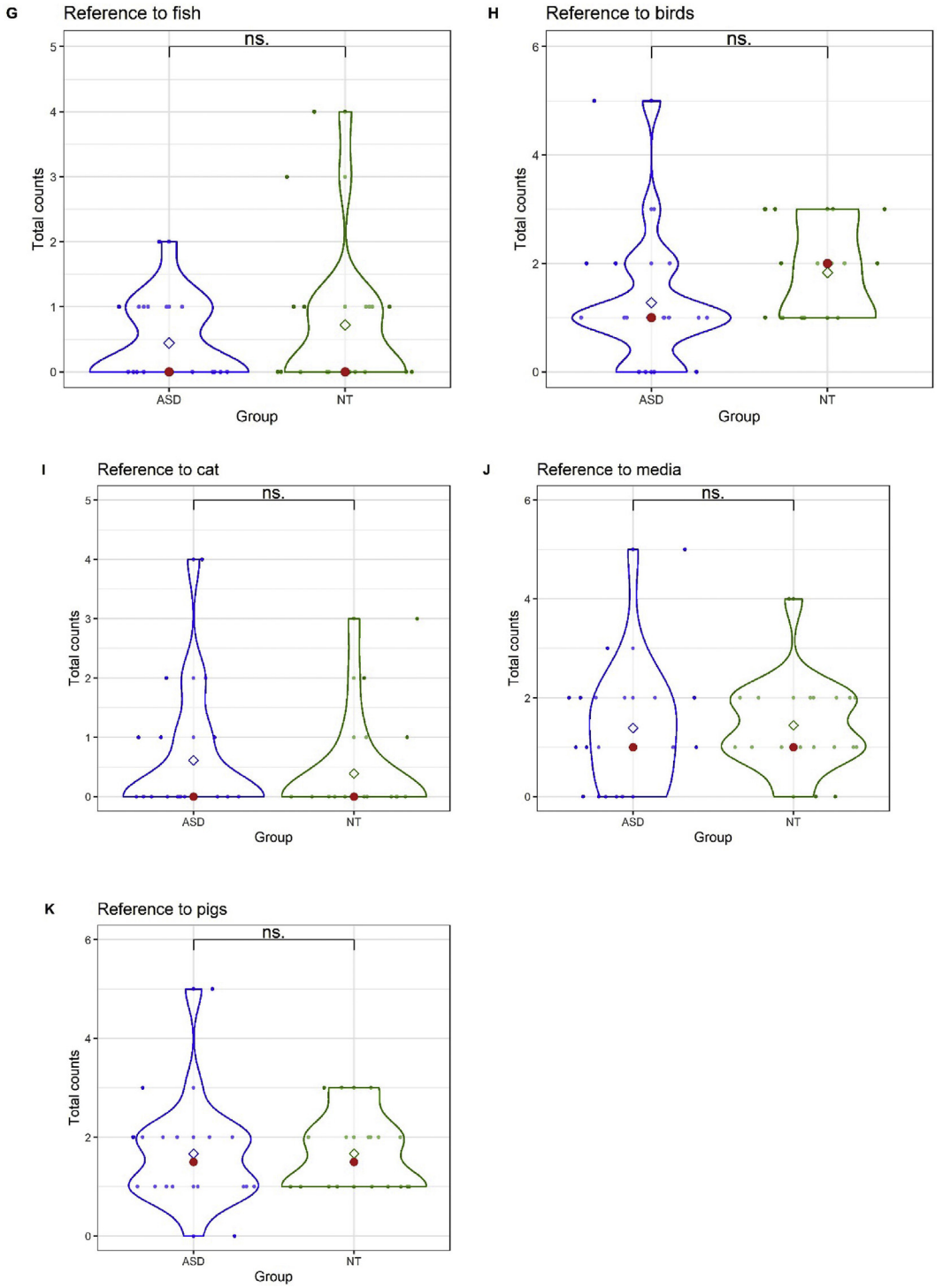


Fig. 8. (continued).

3.3. Internal state language

ASD participants produced less internal state language overall than NT participants, $z = -5.182$, $p < 0.0001$. When looking at specific subtypes of internal state language, ASD participants produced less cognitive mental state terms, emotional mental state and physiological terms than NT participants, $z = -3.934$, $p = 0.0001$; $z = -2.906$ $p = 0.0037$ and $z = -3.495$, $p = 0.0005$, respectively. There were no group differences in the production of modal terms and evaluative markers, $z = -1.471$, $p = 0.1412$ and $z = -0.158$, $p = 0.8748$, respectively. See Tables 19 and 20 for summary statistics and frequency distribution, respectively, of the different types of internal state terms.

Table 19
Means and standard deviations (in brackets) of counts and percentage of internal state language per diagnostic group.

	ASD		NT	
	Counts	Percentage	Counts	Percentage
Total	16.56 (12.39)	16.59 (7.84)	23.72 (12.04)	20.87 (6.29)
Cognition	2.94 (3.39)	2.67 (1.54)	5.56 (5.17)	4.66 (3.07)
Emotional	3.39 (4.09)	3.08 (2.92)	5.28 (2.93)	4.99 (2.65)
Physiological	2.67 (2.11)	3.38 (2.85)	4.83 (2.48)	4.37 (1.78)
Modal	2.39 (2.52)	2.50 (2.57)	3.11 (3.22)	2.63 (2.37)
Evaluative	5.06 (4.68)	4.78 (2.99)	5.00 (3.27)	4.25 (2.47)
Total	16.56 (12.39)	16.59 (7.84)	23.72 (12.04)	20.87 (6.29)

Table 20
Distribution of the different internal state language subtypes within diagnostic group.

	ASD		NT	
	Counts	Percentage	Counts	Percentage
Emotion	61	20%	95	22%
Cognition	53	18%	100	23%
Physiological	48	16%	87	20%
Modal	43	14%	56	13%
Evaluative	91	31%	90	21%
Total	298		427	

Fig. 9 contains violin plots displaying the data distribution of the variables in the coding category 'internal state language' per diagnostic group, viz. total internal state language, cognition terms, emotion terms, physiology terms, modal terms and evaluative terms.

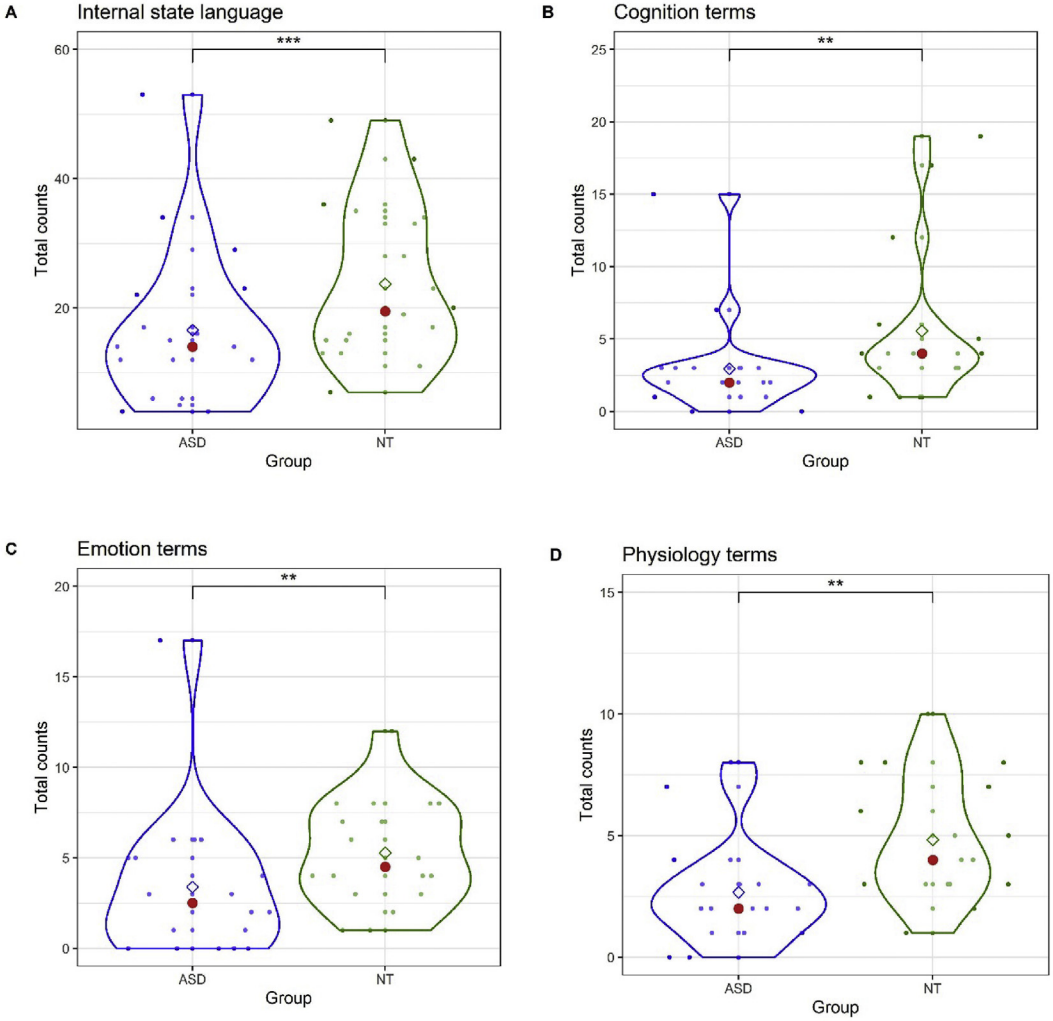


Fig. 9. Violin plots of total internal state language (plot A), cognition terms (plot B), emotions terms (plot C), physiology terms (plot D), modal terms (plot E) and evaluative terms (plot F) per diagnostic group.

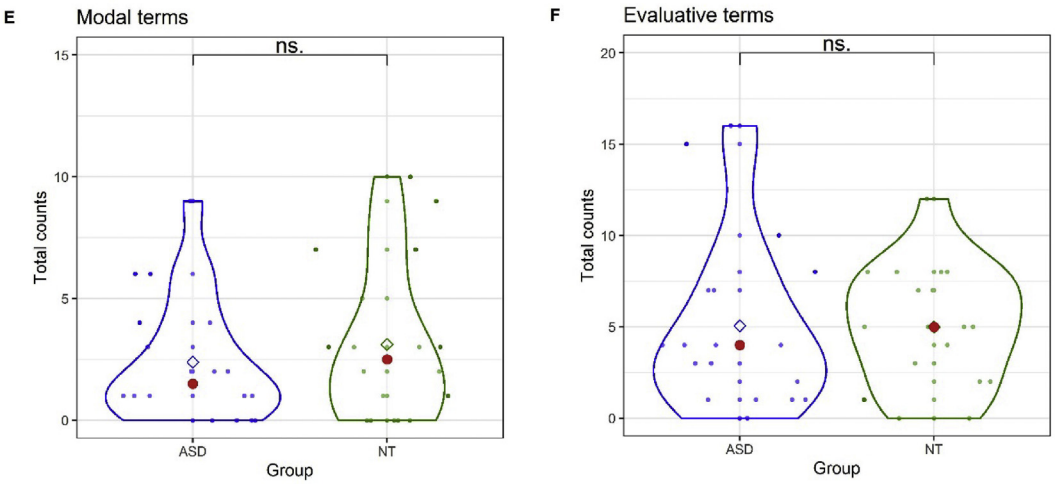


Fig. 9. (continued).

3.4. Summary of coding results

A summary of all coding categories and their associated group effect are summarized in Table 21.

Table 21
Summary of all coding categories and their associated group effect

Narrative dimension	Feature	Group difference
Microstructure	**Syntactic units**	
	Total words	NT > ASD
	Total syntactic sequences	NT > ASD
	Total syntactic units	NT > ASD
	Total dependency clauses	NT = ASD
	Complete dependency clauses	NT > ASD
	Incomplete dependency clauses	ASD > NT
	Verbal dependency clauses	NT > ASD
	Averbal dependency clauses	ASD > NT
	Elliptic dependency clauses	NT = ASD
	Discourse-structuring devices	NT > ASD
	Adjunct	ASD = NT
	Hesitation markers	ASD > NT
Macrostructure	**Story Structure**	
	Main story events	NT = ASD
	Additional story events	NT = ASD
	Extraneous comments	ASD > NT
	Discourse-structuring devices	
	Total connectives	NT > ASD
	Additive	NT > ASD
	Causal	NT > ASD
	Contrastive	NT > ASD
	Temporal	NT = ASD
	Discourse markers	ASD > NT
	Reference	
	Total reference	NT > ASD
	Indefinite reference	NT = ASD
	Definite reference	NT > ASD
	Pronominal reference	NT > ASD
	Reference to main characters	NT > ASD
Internal state language	**Total internal state language**	NT > ASD
	Cognitive	NT > ASD
	Emotional	NT > ASD
	Physiological	NT > ASD
	Modal	NT = ASD
	Evaluative	NT = ASD

4. Discussion

The current study systematically analyzed the features associated with three central dimensions of narrative production (microstructure, macrostructure and internal state language). The results show that the narratives of autistic adults differed from neurotypical participants on all three dimensions of narrative production, lining up with the conclusions of Baixauli et al. (2016). This study also adds to the existing literature on narrative production by yielding new findings, presented in the following paragraphs.

At the level of the microstructure, in addition to being less productive, overall, than their NT peers (fewer words, syntactic sequences and syntactic units), ASD participants also produced narratives composed of more incomplete dependency clauses, viz. more dependency clauses where an obligatory element required by verbs was missing. Example (1) and (2) illustrate the coding of incomplete utterances. In all examples below, dependency clauses are indicated by square brackets, sequences by brackets, non-governed elements by angle brackets and length of silent pauses are indicated in brackets (seconds). Incomplete utterances are highlighted in bold.

In examples (1) and (2), the participants start a clause about the main protagonist (frogs), 'one of them to-' and 'they do not seem to be more' without finishing it. Instead of completing the clause or restarting it, the participants directly move on to a new clause. While incomplete utterances are a typical phenomenon occurring in spoken speech, the fact that ASD participants produced significantly more of them than their NT peers, and hence more than what would typically be expected, suggests that this difference is likely to be perceived by the listener.

(1) **[(une d'elles pr-)]** (0.47) <mais> <heureusement> [(ce petit problème) (fut vite résolu)]
[(one of them to-)] *(0.47) <but> <luckily>[(this small problem) (was rapidly solved)]*

ASD participant (male, 19 years old)

(2) <mais> **[(elles ont pas l'air d'être plus)]** <euh> (6.8) [(c'est un peu) (comme si elles étaient posées) <en fait> (sur leur sur leur feuilles)]
<but> ***[(they do not seem to be more)]*** *<uh> (6.8) [(it's a bit) (like if they were placed) <actually> (on their on their leaves)]*

ASD participant (female, 43 years old)

Furthermore, in comparison to NT participants, ASD participants were less likely to produce complete verbal dependency clauses, i.e., dependency clauses with a verbal head and more likely to produce complete averbal dependency clauses, i.e., dependency clauses without a verbal head. Considering that verbs form the main predicate of sentences and, as such, describe important information such as actions or states, a higher proportion of complete verbal dependency clauses will result in narratives with a focus on the verbalization of the characters' goals and actions (example 3). The verbal head 'seize the opportunity' allows the participant to provide a detailed description of the event: that they change the channels and that they watch their favorite program. In contrast, by including more complete averbal dependency clauses, ASD participants were more likely than NT participants to direct the focus on the story's temporal frame, 'next day/next Tuesday' (example 4) or atmosphere, 'a return to normality' (example 5). The combination of producing less complete and more incomplete dependency clauses with less verbal and more averbal dependency clauses suggests that already at the microstructure of discourse, ASD participants are communicating leaner information than their NT peers.

(3) <et> **[(elles en profitent) (pour pouvoir changer les chaînes et regarder leur programme favori)]**
<and> ***[(they seize the opportunity) (to change the channels and watch their favorite program)]***

NT participant (male, 19 years old)

(4) <et> <euh> **[(prochaine journée]]** <enfin> **[(prochain mardi)]**
<and> <uh> ***[(next day]]*** *<well>* ***[(next tuesday)]***

ASD participant (male, 32 years old)

(5) <après> <voilà> **[(une un retour à la normale)]** (0.52) <voilà>
<then> <there> ***[(a return to normality)]*** *(0.52) <voilà>*

ASD participant (female, 32 years old)

Turning to the macrostructure, participants in both groups structured their stories similarly as there were no differences on any of the main story elements. ASD adults consistently organize their story according to the expected format of narrative discourse: they were as likely than their typical peers to include main story events, to provide a conclusion to their story and to mention pivotal story events. Moreover, the groups did not differ in the production of additional story events, viz. secondary story events. These findings suggest that similar to NTs, ASD adults can systematically organize their discourse according to an implicit structure (Whitworth et al., 2015). Furthermore, mirroring results found by Diehl et al. (2006) on young ASD children, the present findings suggest that ASD adults were sensitive to the importance of gist story events. However, they were more likely to produce extraneous comments about the story events (e.g., I *don't know what's happening here*) and the narrative task itself (e.g., *the sort of tasks that pisses me off*). In other words, while ASD participants did not have difficulties in detecting the main events necessary for story comprehension, they did seem to experience difficulties in using these main events as a common thread, resulting in disrupted narratives which were not focused around the gist events.

Furthermore, although the ASD adults in this study have acquired typical knowledge of story organization, they differed from their NT peers in their use of linguistic devices to maintain internal cohesion and coherence, viz. discourse-structuring devices and referential expressions. Recall that in our coding of discourse-structuring devices, connectives were explicit

markers of logical relations (causal, additive, contrastive or temporal) and discourse markers were explicit markers with a meta-discursive function such as 'bah' (*well*), 'voilà' (*there you go*), 'enfin' (*well*). ASD participants produced less additive, causal and contrastive connectives, but more discourse markers than NT participants. While additive, causal and contrastive connectives provided specific instructions to the listener on how to connect events or ideas together (example 6), discourse markers provided information on the speaker's attitude towards the production of the story and/or the narration task itself (example 7). Furthermore, while additive, causal or contrastive connectives will introduce the development of the preceding state of affair or statement, discourse markers are more likely to introduce a comment or a revision of what has just been said. In example (6), the causal connective 'parce que' (*because*) instructs the listener to establish a causal relation between 1) the fact that the man is seeing weird things fly near his window and 2) his mental state of considering going to bed. By contrast, in example (6), the discourse marker 'enfin' (*well*) introduces a revision of the first statement, viz. the participant starts saying the frog invasion is arriving in a city and then corrects himself by saying that it is not really a city. There is no logical relation to be established between the two parts of the utterance.

(6) il se demande s'il ne devrait pas aller se coucher **parce qu**'il commence à voir des choses bizarres voler par le (0.53) par la fenêtre
and *he wonders whether he should not go to sleep* ***because*** *he starts to see weird things flying through the (0.53) through the window*
NT participant (male, 19 years old)

(7) l'invasion arrive euh dans euh les coins de la ville (0.73) **enfin** c'est pas vraiment une ville
and *the invasion uh arrives uh in parts of the city (0.73)* ***well*** *it's not really a city*
ASD participant (male, 19 years old)

In other words, ASD adults can and do use discourse-structuring devices to piece together their narratives, albeit the relations they establish are less helpful to the listener as they are less informative and more subjective than those established by typical adults. It should be noted that only explicit coherence relations were coded, viz. relations made linguistically explicit. However, relations can also remain implicit and conveyed through the juxtaposition of two sentences or utterances, leaving it up to reader/listener to infer the relation (e.g., Sanders and Noordman, 2000; Taboada, 2009). Leaving a discourse relation implicit will put a higher burden on the listeners who will have to infer the relation themselves (e.g., Zwaan and Radvansky, 1998). For example, it could be the case that ASD participants produce less explicit discourse-structuring devices, but more implicit relations than NT participants, and vice-versa. To gain insight into this hypothesis, future studies should code both for explicit and implicit relations in storybook narratives, in order to explore whether ASD and NT participants differ in their preferences to mark relations explicitly or implicitly.

There were also differences in the frequencies of referential expressions used to mention story characters: ASD participants used less definite nominal and pronominal expressions than NT participants. There were no group differences in the use of indefinite nominal expressions. When looking at within-group frequencies of referential expressions, the distribution pattern was almost identical for the two groups. This suggests that ASD participants know *how* to use different types of linguistic expressions to refer to story characters, however they have more difficulties determining *how often* they should refer to the different protagonists of the story. In addition to analyzing how story characters were mentioned, which characters were being referred to was also examined. The results show that ASD participants referred less often to the main protagonists of the entire story, viz. the frogs/toads as well as important secondary characters of individual main events, namely the man having a late-night snack, the old lady sleeping in front of her television, the frog manipulating the remote control of the television and the solitary frog being chased by the dog. These latter findings suggest that the two groups differed in the type of information they included in these events. All these characters play an important role in understanding the key events of the story. In other words, although ASD participants mentioned the main events of the story, there were some subtle group differences regarding the actors associated with these events. Simply mentioning the event, but not the protagonists involved in it, is not enough to convey a coherent story.

Finally, regarding the dimension of internal state language, ASD participants were less likely to include mental state terms in general than NT participants. When looking at subtypes of internal state language, there were significant group differences in cognitive, emotional and physiological terms, but no group differences in modal and evaluative terms. In other words, the narratives of ASD participant provided less information about the mental reasoning as well as emotional and sensorial experiences of the story characters.

5. Conclusion

Taken together, the comprehensive assessment of narrative abilities in ASD adults and their NT peers suggests that ASD individuals do not lack the ability to create a story, however they are less able than NT to determine accurately *how often* they should incorporate different features in their narrative and how to exploit them together. Difficulties to gauge the accurate 'dosage' of the different linguistic features led to a higher frequency of features foregrounding the development of the participants' own evaluation of the story (e.g., discourse markers) or of the narrative task (extraneous comments), as well as to a lower frequency of linguistic features used to develop the story characters (e.g., definite nominal expressions and pronominal expressions, internal state terms) and to establish a relationship between the story events (e.g., connectives). This unequal dosage of linguistic features is likely to make it harder for the listeners to piece together an enlightening and coherent narrative. Let's take as an example one of the story's main event, namely the chase in the garden. This event unfolds in two

parts, displayed over two story boards. First, there is a frog (detached from the rest of the group) that is wandering in a garden and makes a surprise encounter with a dog. The dog starts chasing the frog who is frightened. Second, this frog is helped by its friends who in turn chase the dog (that is now also frightened). Image 1 illustrates the event.

Image 1. Story boards from the wordless picture book Tuesday (Wiesner, 1991) depicting the chase in the garden.

Example (8) and (9) illustrate how, in spite of creating the structure for the story's event, a failure to use certain linguistic forms when describing this event — a referential expression to single out the frog, terms to refer to the internal states of the protagonists and connectives to indicate the unexpected reversal of situation — will impact the 'goodness' of the story. In example (8), the frog wandering alone in the garden is not singled out, by any linguistic form, from the mass of frogs, described with a plural definite nominal expression (*the frogs*). Lack of reference to this secondary, important protagonist will limit the use of other linguistic forms, such as connectives and internal state language. To see this, compare with the example (9), whereby referring to the single frog (*a frog, it*), the participant now has the possibility to mention the internal state of the frog (*she starts to be scared*). It also creates the possibility to use a contrastive connective (*but*) and an evaluative term (*luckily*) to highlight the fortuitous unexpected turn of the initial situation: all the other frogs come to rescue the single frog and in turn scare the dog away. The description of the event in example (8) thus, stands in stark contrast with example (9).

(8) Part1:
puis y'a un chien qui coure après les grenouilles
then there's a dog running after the frogs
Part 2:
puis bah y'a les grenouilles qui courent après le chien
then well there are frogs running after the dog

ASD participant (female, 33 years old)

(9) Part1:

et puis bon c'est quand même un peu un peu l'heure de rentrer donc là elles commencent à sortir mais là y a le chien et le chien du coup il a envie de savoir un peu ce que c'est une grenouille comme ça donc il commence à l'attaquer donc là elle commence à avoir peur parce que elle se sent qu'elle va se faire manger

and then well it really is time to go back home so there they start going out by there there's a dog and so the dog he wants to know what is a frog like that so he starts attacking so it starts to be scared because it feels it will get eaten
Part 2:

mais heureusement toute la colonie des petits amis viennent la à la rescousse de la grenouille qui se faisait attaquer et là elles se mettent à la poursuite du chien le chien effrayé commence à à s enfuir

but luckily the whole army of friends come to rescue the frog that was being attacked and they start chasing the dog the dog is scared and starts running away

NT participant (female, 26 years old)

In other words, it is not sufficient to include individual linguistic features of cohesion, it is also necessary to combine them in such way that they enhance each other, resulting in a strong, connected story. This is the case in example (9). As still another point of comparison, consider example (10). Here, the participant uses a pronominal expression to single out the frog (*she*), as well as a contrastive marker (*but*) but does not exploit these forms to further develop the internal states of the frog and dog or convey a convincing effect of unexpectedness. On the basis of this rather weak description of the event, the listener will not be able to build a compelling mental representation of the event and important pieces of information are left unspoken (viz. information about the emotions of the protagonists, the rescue mission of the frogs and the escape of the frightened dog).

(10) Part 1: bah elle allait atterrir mais y a un chien
well she was going to land but there's a dog
Part 2: toutes les autres grenouilles font partir le chien
all of the other frogs make the dog go away

ASD participant (female, 40 years old)

While it can easily be derived from the present analysis that ASD participants took into account the listener's needs to a lesser extent than did the NT participants, providing adequate cognitive explanations for this outcome is less straightforward. Nevertheless, we propose here a few lines of thought for future research. In the present narrative task, the experimenter started narrating the story before handing it over to the participant, who has to take on the storytelling task without any support or help from the experimenter. The task results in a monologic narrative, where the participant has to attend to and interpret different cues in the *pictures*. Therefore, a possible explanation for the lower frequencies of certain features could reflect reduced attention to these cues.

It is also possible that ASD participants could have been simply less motivated to create a good story. The finding that ASD participants produced more extraneous comments provides some evidence in favor of this assumption. Extraneous comments created distance with the story. ASD participants did not fully immerse themselves in the processing of storytelling, keeping on their role of participants rather than fully endorsing the role of a narrator. Informal evidence gathered during the narrative task provides further evidence for this assumption. Once the narrative task was over, the ADOS administrator explicitly asked all participants whether they enjoyed the task or not. 67% of ASD participants responded either that they didn't like the story or that they found it very weird. In contrast, 61% of the comparison participants responded that they liked the story or that it was funny. In other words, it could be the case that ASD participants were less motivated to engage in a narrative performance, resulting in narratives that were more difficult to follow by the listener.

Another implication of the present analysis is that NT participants exploited the different features more efficiently than ASD participants to create a coherent narrative. As discussed in the previous discussion, the emergence of coherence does not result from one specific linguistic feature or from the mere presence of these features; rather coherence emerges from the constellation of these features. Discourse analysis of the narratives in this study relied on the underlying assumption that differences in frequency of a certain linguistic form, e.g., a referential expression or discourse-structuring devices, would entail that a certain function, e.g., creating coherence, will not be fulfilled. An outstanding issue is then whether other linguistic forms are used in compensation to fulfill this function. For example, it could be the case that ASD participants compensate for less additive, causal and contrastive connectives by using more discourse markers. Alternatively, they could be compensating for the function of underused connectives with other forms not coded for in this study, for example, with linguistic items of lexical cohesion (e.g. repetitions, synonymy, collocation).

Conversely, in cases where there is no group difference in the frequency of a given linguistic form, it still remains possible that this form is used with different functions in the two groups. For example, in a case study de Villiers (2011) examined the narrative of an autistic boy. She used discourse analysis techniques such as phasal analysis (e.g., Gregory, 2002) to reveal unexpected coherence in a discourse that would be characterized by naïve listeners as incomprehensible. Her detailed analysis highlights that the autistic boy used meaningful, albeit unexpected and unconventional, linguistic patterning (e.g., modality, rhetorical questioning) to create coherence and participate in the on-going interaction. Future studies should complement quantitative analyses with functional analyses to gain a better understanding of the type of features leading to group differences in discourse coherence. In the field of other clinical populations, such as brain-damaged populations, studies on narrative discourse have already implemented such a multi-level approach, merging structural and functional approaches in one analysis (e.g., Marini, Andreetta, del Tin and Carlomagno, 2011). These studies could serve as examples for future narrative analysis in Autism Spectrum Disorder.

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Declaration of competing interest

The authors declare they have no competing interests.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.pragma.2020.04.014.

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