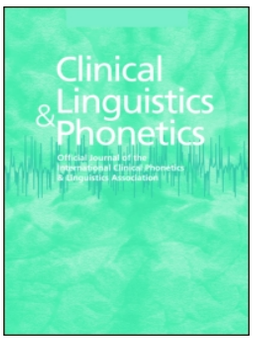

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How do autistic adults use syntactic and prosodic cues to manage spoken discourse?

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ABSTRACT

Discourse studies investigating differences in the socio-communicative profiles of autistic (ASD) and neurotypical (NT) individuals have mostly relied on orthographic transcriptions, without taking prosodic information into account. However, atypical prosody is ubiquitous in ASD and a more accurate representation of their discourse abilities should also include prosodic cues. This exploratory study addresses this gap by segmenting the spoken discourse of 12 ASD and NT adults using the framework of Basic Discourse Units (BDUs). BDUs result from the mapping of syntactic boundaries on prosodic units, which can coincide in different ways and are associated with different discourse strategies. We hypothesized that the discourse of ASD adults would display more atypical strategies than NT adults, reflecting a 'pedantic' style and more difficulties in managing ongoing discourse. While ASD adults did not produce more discourse units associated with didactic or pedantic strategies than NT adults, they did produce less units associated with strategies of interactional regulation. This study provides initial evidence that multidimensional linguistic units, such as BDUs can help differentiate speech delivery strategies of ASD adults from those of their NT peers, even based on simple prosodic cues like silent pauses.

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Introduction

Language in Autism Spectrum Disorder (ASD) is characterized by very heterogeneous linguistic profiles, ranging from individuals who are non-verbal and never develop functional speech to individuals who display average or above average verbal skills (e.g., Eigsti et al., 2011; Tager-Flusberg, 2000). Despite this heterogeneity, the linguistic profiles in ASD show consistent difficulties related to the domain of pragmatics, including discourse skills and conversational abilities, which are robustly attested even in those individuals whose average syntactic, lexical and phonological skills, as well IQ scores, lie within typical ranges (Tager-Flusberg et al., 2005; Volden et al., 2009).

Although the spoken discourse of verbal autistic individuals may superficially appear close to that of their neurotypical (NT) peers, subtle but significant differences prevail in their discourse (e.g., Colle et al., 2008; De Marchena & Eigsti, 2010; Suh et al., 2014). Fine-grained analyses unveil specific linguistic differences between the verbal productions by

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autistic and NT individuals, often leading to the conclusion that the discourse of the former is less coherent (for reviews see Baixauli et al., 2016; Stirling et al., 2014). In a more recent study, Geelhand et al. (2020) performed a systematic analysis of the linguistic features usually associated with three central dimensions of narrative discourse (a widely studied discourse genre in ASD) – microstructure (syntactic complexity), macrostructure (overall story structure and cohesive ties) and internal state language – in pairwise matched groups of ASD and NT adults. While autistic adults did not lack the ability to create a story, they still performed worse than their NT peers on all three narrative dimensions. Specifically, they had more difficulty using and combining certain linguistic elements to construct and convey a coherent narrative discourse. This resulted in a *higher* frequency of features such as discourse markers (e.g., *well*) and irrelevant comments to the storyline (e.g., *the sort of task that pisses me off*), which contributed to the development of the participants' own evaluation of the story. Autistic participants also displayed a *lower* frequency of linguistic features used by NT speakers 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). The resulting discourse composition is likely to make it harder for the listeners to piece together an enlightening and coherent narrative. This conclusion lines up with the existing literature on narrative production in ASD, indicating persistent difficulties in narrative abilities well into adulthood (e.g., Colle et al., 2008; Rollins, 2014).

Most of the studies on spoken discourse in ASD cited above usually perform analyses on coded orthographic transcriptions of speech, stripped from prosodic information. This approach has two important implications. One implication concerns our understanding of speech in autism. Indeed, atypical prosody is very common in autistic individuals (McCann & Peppé, 2003), and tends to persist well into adulthood (DePape et al., 2012; Fusaroli et al., 2017; Kissine & Geelhand, 2019; Kissine et al., 2021; Shriberg, 2001). Autistic prosody has often been described as unusually flat or monotone, variable, sing-songy, pedantic, machine-like, stilted, bizarre or exaggerated (Baltaxe & Simmons, 1985; Lord et al., 1994). It is important to note that these atypical prosodic features do not necessarily render speech unintelligible, but they are among the most salient characteristics contributing to the impression of "oddness" among autistic individuals (Mesibov, 1992; Van Bourgondien & Woods, 1992). Crucially, impressions of atypical prosody can affect the perception other people have of autistic individuals, thus negatively impacting the quality of their social interactions (e.g., Grossman, 2015; Sasson et al., 2017) and impeding the development of socio-communicative abilities (Boyd et al., 2016; Paul et al., 2005). The second implication of using transcripts is that the discourse is represented as a fixed product, detached from its original interaction context. This representation steers the interpretation of the discourse on the conceptual content and structure of the discourse, rather than on how this content and structure is constructed incrementally in the ongoing discourse (Degand & Simon, 2008, 2009a).

Considering that atypical prosody is ubiquitous in ASD, a better understanding of the discourse profiles of autistic individuals would not only require to delineate the language features that characterize the spoken discourse of autistic individuals, but also to understand how these elements are integrated incrementally within the conversational flow. To address this issue, we will rely on the theoretical and methodological framework developed by Degand & Simon (Degand & Simon, 2005, 2008, 2009a, 2009b). The backbone of this

framework is the identification of "the segments that speakers use to build a representation (interpretation) of the discourse, i.e. a kind of "minimal discourse interpretation segment"" (Degand & Simon, 2009a). The underlying assumption is that typical speakers segment their discourse to enable addressees to piece together a coherent representation of the discourse situation. According to Degand and Simon neither the morpho-syntactic structure, nor the prosodic arrangement of spoken speech, suffice on their own to efficiently segment discourse into units. Hence, a minimal discourse unit should be delineated both in terms of prosodic *and* syntactic criteria. Accordingly, their approach requires a two-step segmentation process of the spoken discourse: one segmentation of the discourse into syntactic units and one segmentation of the discourse into prosodic units (see the Materials & Methods section for more detail on these two segmentation procedures). The boundaries of syntactic units and prosodic units are then mapped onto each other to yield Basic Discourse Units (BDUs).

These two types of boundaries can overlap in different ways, resulting in different types of BDUs, corresponding to different discourse strategies of information and interaction management (Degand & Simon, 2008, 2009a). A one-to-one mapping between a syntactic unit and a prosodic unit will result in a **congruent BDU**. The authors hypothesize that with this type of BDU, the speaker communicates information active in her mind in 'one go', without any topicalization strategy, indicating to the addressee that she can interpret this information bundle as one idea. This type of BDU is assigned an unmarked strategy, with information presented in a straightforward and rather neutral way (Degand & Simon, 2009a). Types of BDUs are illustrated by examples from the ACTE Spoken Corpus (Geelhand et al., 2020), which involves semi-structured conversations between an experimenter and an autistic or neurotypical participant. Square brackets indicate the boundaries of a syntactic units and the three slashes represent silent boundary.

3) [c'- c'est pas ma pensée première]$_1$ ///$_1$
[i- it's not my first thought]$_1$ ///$_1$
Autistic participant (male, 54 years old)

The congruent BDU exemplified in (3) was produced during a conversation about weddings, in which the participant was asked whether he would want to have a wedding or not. He expresses his opinion about the topic in one go, namely that his first thought is not to have a wedding.

Speakers can also communicate more than one idea in 'one go' by condensing several syntactic units into one prosodic unit. In this case, there is a many-to-one mapping, yielding an **intonation-bound BDU**. This strategy involves information packaging, which indicates to the listener that the different syntactic units are to be understood as one macro-unit of information. Consider examples (4) and (5).

4) [on va jamais en balade avec son chien]$_1$ [elle elle sort pas ses chiens]$_2$ [c'est bizarre]$_3$ ///$_1$
[we never go walk with her dog]$_1$ [she never walks her dogs]$_2$[it's weird]$_3$ ///$_1$
Autistic participant (female, 43 years old)

5) [il peut t'écouter]$_1$ [tu peux passer du temps normal avec lui]$_2$ [t'es toi-même]$_3$ ///$_1$
[he can listen to]$_1$ [you can casually spend time with him]$_2$ [you're yourself]$_3$ ///$_1$

Comparison participant (male, 20 years old)

In example (4), the topic of the conversation is activities with friends. The participant is explaining that she and her friend never walk their dogs together (syntactic unit 1) and the reason why they don't, is that her friend never goes out to walk her own dogs (syntactic unit 2) and finally, the speaker provides her own evaluation of this situation, namely that it's weird (syntactic unit 3). In example (5), the topic of conversation is how to recognize that someone is your friend. The participant provides three different examples (syntactic units 1, 2 and 3), which are all to be understood as supporting the same opinion about friendship.

There can also be a one-to-many mapping, viz. one syntactic unit corresponds to several internal prosodic units. This type of mapping yields **syntax-bound BDUs**, which fulfill different strategies. First, by chunking one idea into several prosodic units, the speaker can create emphasis. In example (6) below, the topic of conversation is about friendships; the participant is asked to describe her friends. The participant isolates 'une' (*an*) and 'compréhension' (*understanding*) with silent boundaries (silent pause > 200 milliseconds (ms)) to emphasize a certain quality of her friends, namely that her friends are particularly good at understanding social relationships.

6) [ils ont $///_1$ une $///_2$ compréhension $///_3$ des liens sociaux avec les gens $///_4]_1$
[They have $///_1$ an $///_2$ understanding $///_3$ of social relations with people $///_4]_1$

Autistic participant (female, 43 years old)

Alternatively, delivering one idea in several pieces can signal problems with the discourse planning. Consider example (7).

7) PP : [je vais pas chercher à $///_1$ euhm oui à $///_2$ à $///_3]_1$
[i'm not going to $///_1$ <uh> <yes> to $///_1$ to $///_3]_1$
Exp: [trouver de la compagnie]$_1$ $///_1$
[find company]$_1$ $///_1$
PP : [trouver de la compagnie]$_1$ $///_1$
[find company]$_1$ $///_1$

Autistic participant (male, 54 years old)

In example (7), the speaker and experimenter are discussing the feeling of solitude. At this point of the conversation the participant is describing what he does when he feels lonely. However, the participant is struggling to terminate the syntactic clause he initiated, which is visible by this set of features: a hesitation marker ('uh'), an insert ('yes'), a repetition ('to to') and three silent pauses longer than 200 ms (///). His listener, the experimenter, clearly perceives this difficulty and completes his utterance herself.

Whether a syntax-bound BDU will be interpreted as marking emphasis or suggesting planning difficulties will depend on the context and neighboring linguistic features of the major prosodic boundaries. Compare example (6) above, with example (8) below. In example (6), the syntactic unit does not include any dysfluency features such as false starts, hesitation markers, repetitions or repairs. Hence, the silent boundaries segment a 'fluent syntactic unit', serving to mark emphasis on specific aspects of the utterance. In contrast, in example (8), the syntactic unit contains several dysfluency markers such as a repetition (*c'est pas c'est pas*), a false start (*qu-*) with a reformulation (*une chose)* and a hesitation marker (*euh*). This syntax-

bound BDU will be perceived as, indicating planning difficulties, rather than as an attempt to emphasize an element of the utterance. As such, these syntax-bound BDUs may result more from processing difficulties than representing a strategy proper (Degand & Simon, 2009a).

(8) [c'est pas c'est pas qu- une chose à **///$_1$** euh à laquelle j'accorde beaucoup de de valeur **///$_2$**]$_1$
*[it is not it is not som- a thing to **///$_1$** uh which I give a lot of importance **///$_2$**]$_1$*
Autistic participant (male, 54 years old)

In **regulatory BDUs**, a major intonation boundary isolates a non-governed unit such as a discourse marker (e.g., *well*), connective (e.g., *because*) or an adjunct (e.g., *obviously*). Regulatory BDUs reflect a meta-discursive strategy, with a focus on the coherence and/or information structure of the unfolding discourse. Degand and Simon (2009a) describe several ways in which regulatory BDUs contribute to the management of the on-going discourse. One strategy is to introduce a new topic or end an ongoing one. Consider the example in (9).

9) PP : [ouais ouais]$_1$ [voilà]$_2$ [c'est ça]$_3$ [il avait quatorze et demi]$_4$ <bon> <bah>///$_1$
[yeah yeah]$_1$ [exactly]$_2$ [that's it]$_3$ [he was fourteen and half years old]$_4$ <uh> <well> <you know>///$_1$
Exp: <mhm>
<mhm>
PP: <voilà voilà >///$_1$
<so that's it>///$_1$
Exp: [est ce que vous avez///$_1$ un conjoint///$_2$]$_1$
<and> [do you have///$_1$ a partner///$_2$]$_1$
PP: <bah> [j'ai un partenaire]$_1$ [oui]$_2$///$_1$
<well> [I have a partner]$_1$ [yes]$_2$///$_1$
Autistic participant (female, 43 years old)

At this point of the conversation, the topic is the participant's dog that died recently. With the regulatory BDU 'voilà voilà' (*so that's it*) the participant indicates to the experimenter that she agrees with what she said and that she herself has nothing to add. By ending this story line, the participant gives room to the experimenter to start a new topic of conversation. In this example, the experimenter starts a new topic about romantic relationships (whether the participant has a partner or not).

Regulatory BDUs can also reflect the speaker's evaluation of the validity of the information expressed by the interlocutor, as illustrated in example (10).

10) **<mais> <blindé>///$_1$** [je suis tout à fait d'accord]$_1$///$_1$
***<most> <def>///$_1$** [I totally agree]$_1$///$_1$*
Comparison participant (male, 20 years old)

In example (10), the participant indicates to the experimenter that he completely validates what she has said with 'mais blindé' (*most def*) and explicitly confirms with the utterance 'je suis tout à fait d'accord' (*I totally agree*). Regulatory BDUs can also reflect the speaker's focus on his or her personal opinion with respect to what is being conveyed in the interaction. For example, in (11), the participant emphasizes his point of view that

he never had any problems living with another person by first introducing it with 'bah franchement' (*well frankly*).

11) **<bah> ///$_1$** [le mec je le connaissais pas d'avant]$_1$ <tu vois> [c'était la première fois que je le rencontrais]$_2$ <et> <euh>///$_1$ > [y'a jamais eu aucun s- problème]$_1$ <quoi>///$_1$
<well> <frankly> ///$_1$ *[the guy I didn't know him from before]$_1$ <you know>[it was the first time I was meeting him]$_2$ <and> ///$_1$ <and> [there was never any problem]$_1$ <you know>///$_1$*
Comparison participant (male, 20 years old)

A final strategy reflected in the use of regulatory BDUs, is the indication of the speaker's mental processes. For example, in (12), the participant is trying to explain something but has difficulty to do so. To indicate that she is struggling but still wants to maintain her turn, she first says 'allez' (*oh*), before explicitly verbalizing she has difficulties to explain.

12) **///$_1$** [je sais pas je sais pas comment expliquer]$_1$ ///$_1$
<oh> ///$_1$ *[I don't know how to explain]$_1$ ///$_1$*
Autistic participant (female, 43 years old)

Finally, **mixed BDUs** are a 'left-over' category; in these BDUs there is no coincidence between the prosodic and syntactic boundaries, as in example (13). Degand and Simon did not assign any particular strategy to this type of BDU.

13) [oui]$_1$ [j'imagine]$_2$ <fin> [j'i- j'imagine que c'est plus quelque chose ///$_1$ qu'on fait par rapport à son entourage ou pour]$_3$ [oui]$_4$ ///$_2$
[yes]$_1$ [I imagine so]$_2$ <well> [I i- I imagine that it's more something ///$_1$ that you do regarding your relatives or for]$_3$ [yes]$_4$ ///$_2$
Comparison participant (female, 43 years old)

Furthermore, Degand and Simon (2008, 2009a) have demonstrated that the distribution of the different BDUs also varies as a function of discourse genre. Their analysis shows that intonation-bound discourse units are typical of less prepared and informal spoken discourse, such as conversations, while syntax-bound discourse units are typical of more prepared and formal spoken discourse such as radio news or interviews. Congruent BDUs are equally distributed across genres. The discourse strategies of intonation bound units and regulatory BDU are more prevalent in conversations than syntax-bound units and reflect strategies crucial to the successful management of the discourse (e.g., turn-holding, meta-discursive and interactional regulation and information packaging). The different types of BDUs and their strategies are summarized in Table 1.

Taken together, the literature review highlights that specific linguistic elements in the discourse as well as the delivery style of verbal autistic individuals distinguishes it from that of their neurotypical peers. However, these two aspects of their discourse have been investigated separately, like two separate voices of a single musical score. An important outstanding question is, therefore, the extent to which the well-attested atypicality of discourse management in autistic adults may owe to the fashion in which linguistic and prosodic cues are combined within the ongoing discourse of autistic adults. Accordingly, we believe segmenting speech into BDUs is particularly suitable to provide novel insights into the communication difficulties experienced by autistic adults.

Table 1. Summary of the different types of Basic Discourse Units and their corresponding strategies.

BDU	Strategy	Genre
Congruent BDU *One-to-one mapping*	Presenting information in a direct and relatively neutral manner, one conceptual idea communicated in 'one go'	Formal and informal discourse genres
Syntax-bound BDU *One-to-many mapping*	Emphatic, didactic, or resulting from discourse planning (processing difficulties)	More typical of formal genres
Intonation-bound BDU *Many-to-one mapping*	Creation of a macro-unit of information (information packaging), turn-holding device	More typical of informal genre
Regulatory BDU *Adjunct/discourse marker in a major prosodic unit*	A non-governed element is autonomized in a major prosodic unit interactional or meta-discursive regulation	More typical of informal genres
Mixed BDU *Mismatch matching*	No strategy	Formal and informal discourse genres

Aims

In light of the preceding discussion, the aim of this study was to explore whether the often-reported perception of autistic people's discourse as incoherent and atypical could be modelled on the basis of these different types of BDUs and their respective strategies. Specifically, we hypothesized that autistic adults would produce more syntax-bound BDUs, possibly reflecting their pedantic style and/or planning difficulties. Furthermore, we hypothesized that neurotypical adults would produce more silence-bound and regulatory BDUs, reflecting better coherence and discourse management skills than autistic adults.

Materials and methods

This study received ethical clearance from the Ethics Committee of the Faculté des Sciences Pyschologiques et de l'Éductation 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.

Participants

Considering the exploratory nature of the study, on the one hand, and the elaborate segmentation procedure on the other hand, a small portion of the initial participant sample (Geelhand et al., 2020), viz. 12 participants was processed. 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 1 year) and gender. All participants were native French speakers and Caucasian.

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; Lord et al., 1994). 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 & 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 neurotypicality. As can be seen from Table 2, 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. The Wechsler Adult Intelligence Scale-IV (WAIS-IV; Wechsler, 2008) was administered to measure participants' cognitive profile. As Table 2 shows, autistic and neurotypical participants did not differ in Full-scale IQ (FIQ), Verbal IQ (IQ) or Perceptual IQ (PIQ).

Material

The data analyzed in this study come from the semi-structured tasks *Friends, Relationships, and Marriage* and *Solitude* administered during the standard procedure of the ADOS-2. See Geelhand and Kissine (2019) for a detailed description of the material. These two tasks approximate the interactional contexts of four genres (described below) of the LOuvain Corpus of Annotated Speech-French (LOCAS-F) used by Degand and colleagues to analyze BDUs. LOCAS-F is a multi-genre corpus consisting of 48 samples divided across 14 different genres.[1] Degand et al. (2014) define discourse genres according to three situational criteria: 1) degree of interactivity between the participants, 2) degree of preparation of the discourse and 3) media nature of the discourse. Degree of interactivity could be characterized as non-interactive (e.g., political discourse, sermon), semi-interactive where freedom/possibility to interrupt is limited (e.g., radio interview), or interactive where speech is freely distributed (e.g., informal conversation, conversational narrative). Degree of preparation could be characterized as non-prepared/spontaneous (e.g., informal conversation, formal (professional) conversation), semi-prepared whereby the discourse topic is known to participant (e.g., radio interview, political debate) and fully prepared/read discourse (e.g., scientific conference, political discourse). Finally, degree of media nature could be

Table 2. Means and standard deviations (in brackets) of descriptive statistics of participants' characteristics per diagnostic group (ASD is the reference level).

	ASD	NT	t	df	p
N (M:F)	6 (3:3)	6 (3:3)			
Age (SD)	34.71(12.71)	36.56 (10.87)	−0.2709	9.764	0.7921
Age-range	*20.00–52.09*	*20.10–52.01*			
ADOS Total (SD)	11.67 (3.83)	1.17 (1.33)	6.3446	6.1873	0.0006
AQ (SD)	38.40 (9.29)	10.40 (4.67)	6.0219	5.8996	0.001
EQ (SD)	25.00 (13.98)	47.40 (7.50)	−3.1565	6.1274	0.0191
FIQ	116.33 (11.81)	112.17 (8.28)	0.7076	8.9594	0.4972
VIQ	124.00 (10.53)	112.67 (10.41)	1.8756	9.9987	0.0902
PIQ	108.33 (15.31)	108.17 (8.21)	0.0235	7.656	0.982

[1]The description of the LOCAS-F composition comes from a talk given by Anne Catherine Simon at the conference 'Journée d'étude Toulousaine' in 2015.

characterized as non-media (e.g., informal and formal conversation, sociolinguistic interview), semi-media nature whereby the situation implies several communicative roles and whereby participants do not address the public directly and media nature whereby the discourse output is produced solely for the purpose of being broadcasted.

According to these criteria, the discourse output used to determine the BDUs in this study, viz. semi-structured interview questions is characterized as semi-interactive, non-prepared and non-media. Four out of the 14 genres analyzed in LOCAS-F were comparable to the data of this study, viz. informal conversation, formal conversation, conversational narrative and socio-linguistic interview. Table 3 summarizes the characteristics of the four genres.

Procedure

The audio recordings of the two tasks were processed in *Praat* (Boersma & Weenink, 2018) according to the procedure described in Geelhand and Kissine (2019). The most important aspects of this procedure are summarized here for convenience. The audio recordings were first transcribed orthographically. Then, the audio-aligned transcriptions were segmented into syntactic and prosodic units by modelling the segmentation procedure of Degand and Simon (2008, 2009a). The syntactic units were delimited using the coding protocol developed by Tanguy et al. (2012) which relies on the theoretical principles of dependency syntax (Blanche-Benveniste et al., 1990). Specifically, orthographic transcriptions were first segmented into dependency clauses, which were subsequently segmented into smaller sequences. There are three types of dependency clauses: 1) verbal (organized around a tensed verb), 2) averbal (organized around an averbal constituent such as a noun, a pronoun or an adverb) and 3) elliptical (units that are incomplete but can be interpreted as a verbal dependency clause on the basis of the context).

In addition to dependency clauses, adjuncts, discourse-structuring devices and hesitation markers were coded. Adjuncts are elements which are not governed by the verbal head but are nevertheless associated to the verb. These elements are located on the periphery of verbal dependency clauses. Discourse-structuring devices fell into the following categories: 1) connectives, 2) conjunctions and complementizers and 3) discourse markers (lexemes that serve a structuring or meta-discursive function; e.g.,'bah'(well)). Hesitation markers such as filled pauses ('euh' (uh) and 'euhm' (uhm)) were also coded as independent segments if they appeared between dependency clauses.

For practical reasons (time & manpower), we delimited prosodic units in this study only by silent pauses, thus omitting finer-grained acoustic characteristics used by

Table 3. Characteristics of the discourse genres informal conversation, formal conversation, conversational narrative, sociolinguistic interview and semi-structured questions.

	Genre	Interaction	Preparation	Media
LOCAS-F	Informal conversation	Interactive	Non-prepared	Non-media
	Formal conversation	Interactive	Non-prepared	Non-media
	Conversational narrative	Interactive	Non-prepared	Non-media
	Sociolinguistic interview	Semi-Interactive	Semi-prepared	Non-media
ADOS-2	*Semi-structured questions*	*Semi-interactive*	*Non-prepared*	*Non-media*

Degand and Simon. Therefore, the BDUs in this corpus emerged from the mapping between syntactic units and silent pauses (> 200 ms), unpreceded by a hesitation marker). In a study evaluating acoustic cues of prosodic boundaries, Mertens and Simon (2013) show that silent pause is the most efficient cue to detect major prosodic boundaries in comparison to other cues such as lengthening, pitch prominence, pitch rise and pitch fall. Furthermore, studies on speech pauses in ASD have highlighted atypicalities both in length (Feldstein et al., 1982) and quantity (Morett et al., 2016; Thurber & Tager-Flusberg, 1993), making silent pauses a likely relevant cue for discourse segmentation in ASD. Thus, we considered silent pauses to be a sufficient cue to detect prosodic boundaries in the current study. To reflect more precisely the methodology adopted specifically in this study, the term 'silence[2]-bound' BDUs will be used, rather than 'intonation-bound BDUs'. Thus, the aim of the paper is to characterize how syntax and prosody come together, in the speech of autistic and neurotypical adults, to convey information.

Analysis

All statistical analyses were conducted in R (R Core Team, 2016) with generalized logistic models (Poisson family). To analyze group differences in total BDUs, a model was built with total BDUs as dependent variable and group diagnosis as fixed effect. 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 analyze group differences in types of BDUs, models included BDU type as dependent variable and the fixed effects of group diagnosis as well as total BDUs to control for the variability of this measure on the types of BDUs. To examine which specific types differed per group, Tukey post-hoc analyses were conducted using the **emmeans** function from the 'emmeans' package (Lenth, 2016). All significant effects reported in this study remained so when controlling for total number of syntactic units and BDUs.

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 each BDU type, percentage scores were calculated as the total count of given BDU divided by the total number of BDUs. These percentage scores are presented in the tables of summary statistics alongside the raw counts. Models and plots were created using the raw scores of the dependent variables.

The results are illustrated by violin plots. Violin plots represent the distribution and probability density of the data. The distribution shape of the data is displayed by using a kernel density estimation. Violin plots provide more information than boxplots as they show the full distribution of the data, and not only summary statistics (e.g., mean, median, interquartile ranges).

[2]As Liesbeth Degand (p.c.) sensibly pointed out, the use of the term 'silence-bound' might be misleading because silence implies the absence of sound, whereas a silent pause implies an interruption of speech (or sound). However, it was equally misleading to use the term 'intonation-bound' since the BDUs were not mapped based on intonation features. Therefore, for clarity and practical reasons, we opted for the term 'silence-bound' to refer to BDUs in which several syntactic units are bound by one silent pause.

Results

Syntactic coding

- Discourse productivity: words, sequences and syntactic units

Autistic participants produced more words, syntactic sequences and syntactic units overall than neurotypical participants, $\chi^2(1) = 757.59$, $p < .0001$; $\chi^2(1) = 151.29$, $p < .0001$ and $\chi^2(1) = 205.41$, $p < .0001$. See Table 4.

Table 5 provides summary statistics of the different variables of discourse productivity.

In the following figures of violin plots, the median is indicated by a red dot and the mean is indicated by a diamond shape. Figure 1 displays violin plots depicting the data distribution of the following variables: total words, syntactic sequences and syntactic units.

- Dependency clauses

When controlling for total syntactic units, there were no differences in total dependency clauses ($z = 0.19$, $p = .84$), complete dependency clauses ($z = 0.226$, $p = .82$) and incomplete dependency clauses ($z = -0.06$, $p = .95$). Figure 2 contains violin plots displaying the distribution of these variables.

When analyzing types of complete dependency clauses, there were no group differences in verbal dependency clauses ($z = 0.78$, $p = .35$). Neurotypical participants produced more elliptic dependency clauses than autistic participants ($z = 4.77$, $p < .001$). Autistic participants produce more averbal dependency clauses than neurotypical participants ($z = 1.97$, $p = .04$). Figure 3 contains violin plots depicting the data distribution of these three types of dependency clauses.

Table 4. 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	−0.17698 (0.018)***	−0.31859 (0.036)***	−0.41142 (0.034)***

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

Table 5. Means and standard deviations (in brackets) of total words, total syntactic sequences and syntactic units per diagnostic group.

	ASD	NT
Total words	1188.83 (289.33)	996.00 (274.35)
Total syntactic sequences[5]	297.50 (70.83)	216.33 (51.83)
Total syntactic units	364.67 (67)	241.64 (60.84)

[5]The unexpected lower counts of syntactic sequences, sub-units of dependency clauses, compared to the total count of syntactic units is due to the phenomenon of overlapping speech, which student assistants were instructed to code as % (not analyzed). In cases where only a small part of the dependency clause was overlapping, the dependency clause was still included in the analysis, but the overlapping sequence or sequences were coded as % (and hence not included in the final analysis).

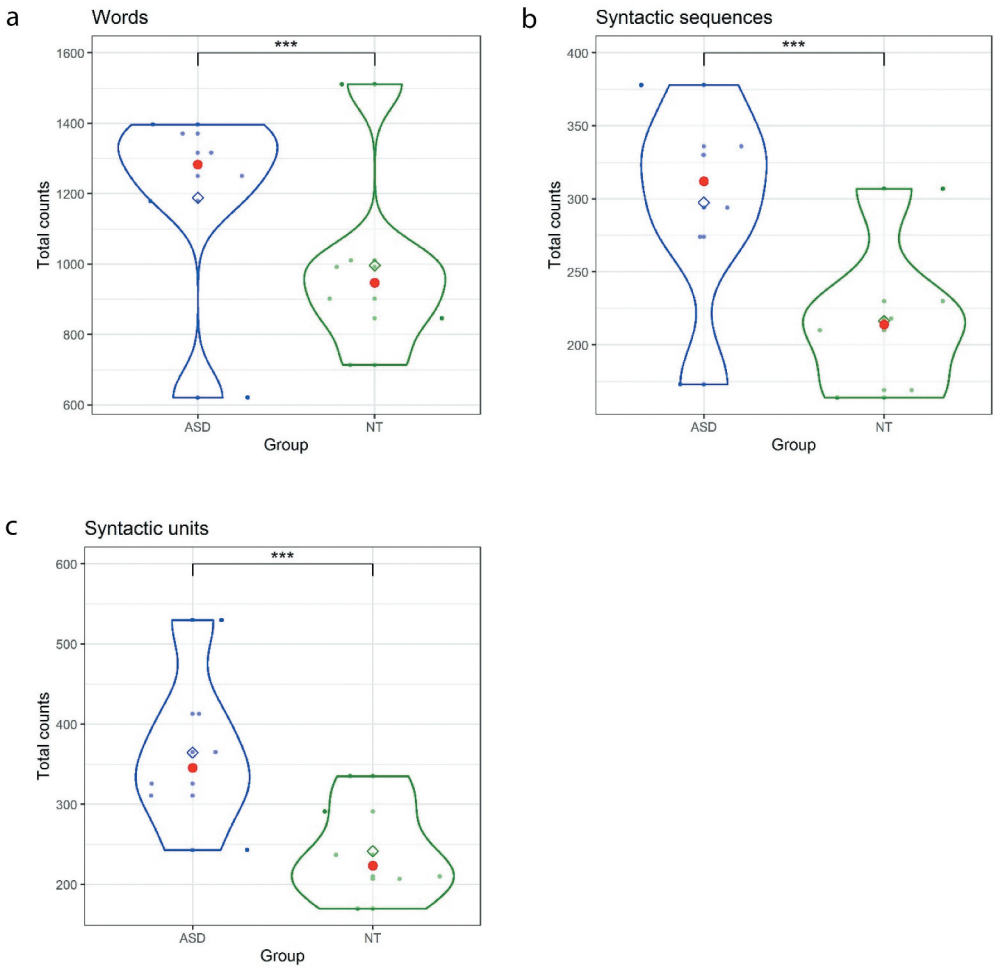

Figure 1. Violin plots of total words (plot A), syntactic sequences (plot B) and syntactic units (plot C) per diagnostic group.

- Additional syntactic categories: adjuncts, discourse-structuring devices and hesitation markers

Autistic participants produced less discourse-structuring devices ($z = -3.16$, $p = .002$) and less adjuncts ($z = -2.98$, $p = .003$). There were no group differences in hesitation markers ($z = 0.03$, $p = .98$). Figure 4 contains violin plots depicting the distribution of the different additional syntactic categories.

Table 6 summarizes the statistics for the syntactic categories of the syntactic segmentation: total dependency clauses, total complete and incomplete dependency clauses, the types of dependency clauses (verbal, averbal & elliptic dependency clauses) as well as the additional syntactic categories of discourse-structuring devices, adjuncts and hesitation markers.

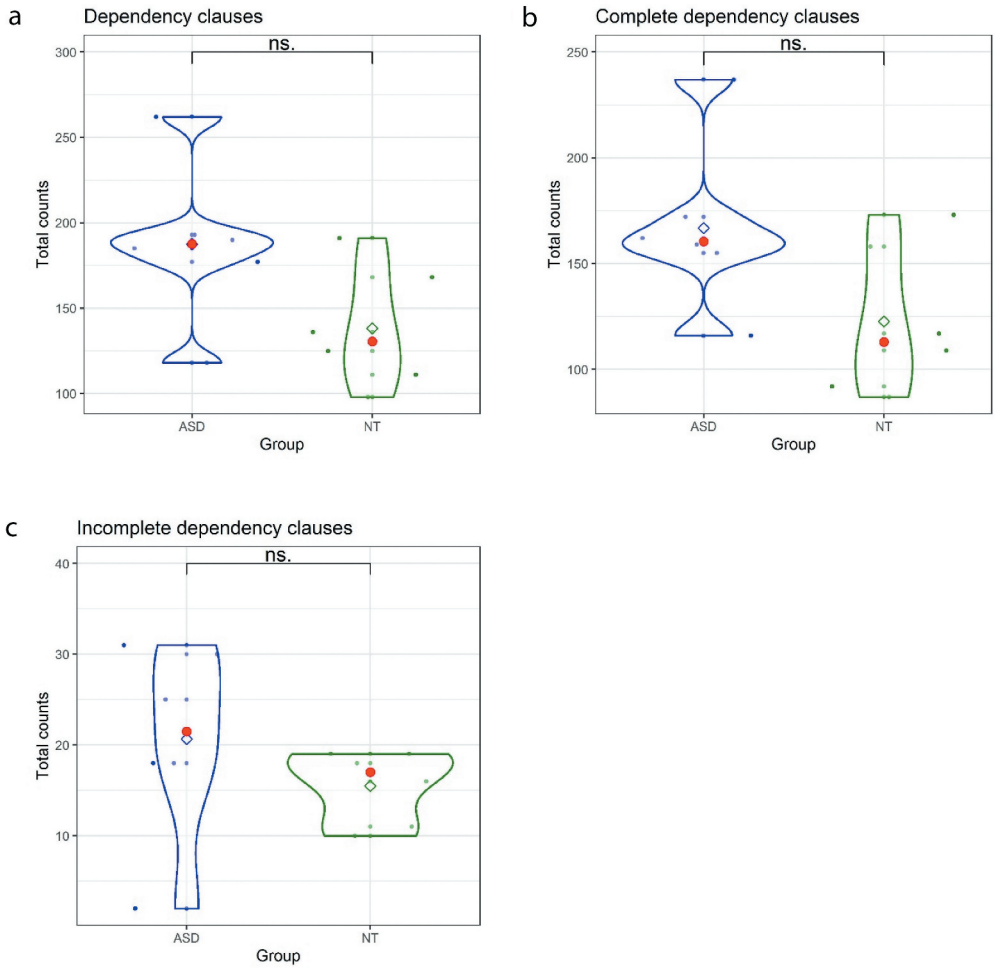

Figure 2. Violin plots for total dependency clauses (plot A), complete dependency clauses (plot B) and incomplete dependency clauses (C) per diagnostic group.

Basic discourse units

There was a significant group difference in total number of BDU produced ($\chi 2(1) = 7.2$, $p = .007$). Overall, autistic participants produced significantly more BDUs than neurotypical participants. When looking at types of BDUs separately, and controlling for total number of BDU, autistic participants produced more silent-bound BDUs ($z = 2.63$, $p = .008$) but less regulatory BDUs ($z = -1.96$, $p = .05$) and mixed BDUs than neurotypical participants ($z = -2.57$, $p = .01$). There were no significant group differences for congruent ($z = 0.33$, $p = .74$) and syntax-bound BDUs ($z = -1.73$, $p = .08$). Table 7 contains summary statistics of total BDUs as well as the five BDU types.

Figure 5 contains violin plots depicting the data distribution of the different BDU types.

Table 8 summarizes the distribution of BDU types within each group for a better visualization of the tendencies of BDU distribution within group.

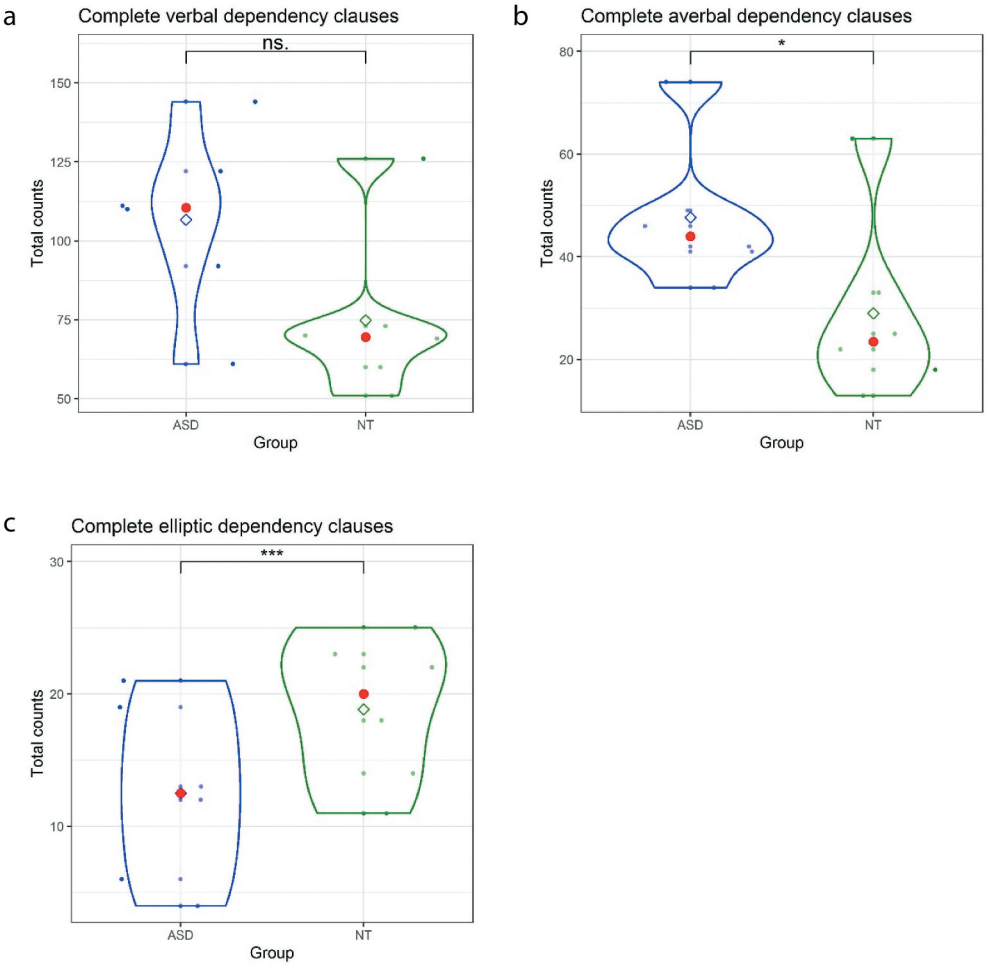

Figure 3. Violin plots for complete verbal (plot A), averbal (plot B) and elliptic (plot C) dependency clauses per diagnostic group.

As a benchmark, the BDU distribution[3] in the corpus LOCAS-F is compared to the BDU distribution in the present study. Table 9 displays the BDU distribution in this study, summarized over diagnostic group. Table 10 displays the BDU distribution of four discourse genres of the LOCAS-F corpus.

As can be seen from the different tables, the distribution patterns of the different BDUs in the present study are quite similar to those of the corpus LOCAS-F. First, congruent BDU (bdu-c) is the most common type of BDU. As can be seen from Tables 9 and 10, the distribution pattern of bdu-c in this study is almost identical to that of formal conversation and sociolinguistic interview. This pattern makes sense as the ADOS interview is a blend of these two genres, viz. semi-interactive like the sociolinguistic interview but non-prepared like the formal conversation. Furthermore, analogous to the four genres of the LOCAS-F, the second most frequent BDU type

[3]The frequencies reported in tables 13 and 14 come from a talk given by Anne Catherine Simon at the conference 'Journée d'étude Toulousaine' in 2015.

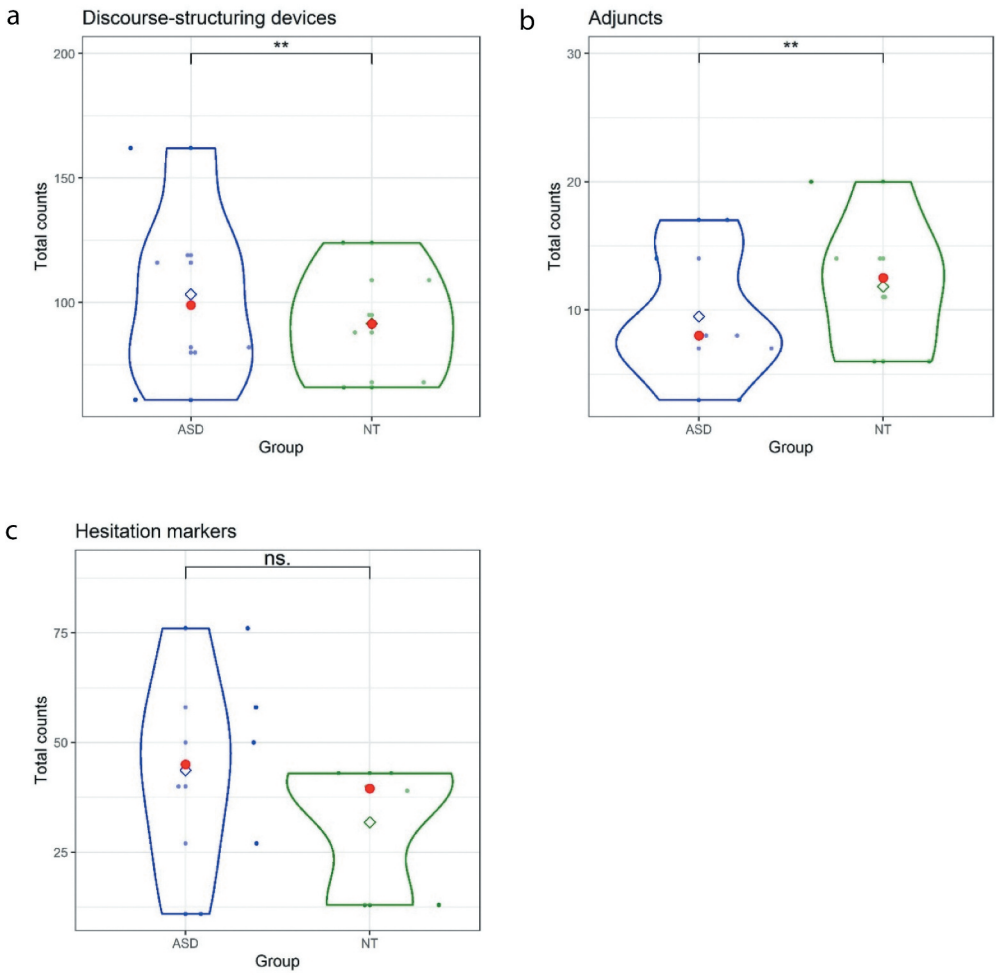

Figure 4. Violin plots for discourse-structuring devices (plot A), adjuncts (plot B) and hesitation markers (plot C) per diagnostic group.

Table 6. Means and standard deviations (in brackets) of counts and percentage of the different syntactic categories of the syntactic segmentation.

	ASD		NT	
	Counts	*Percentage*	*Counts*	*Percentage*
Total dependency clauses	187.50 (45.90)	51.83 (4.51)	138.17 (35.24)	57.17 (2.43)
Total complete dependency clauses	166.83 (39.39)	89.74 (5.35)	122.67 (35.25)	88.25 (3.85)
Total incomplete dependency clauses	20.67 (10.73)	10.53 (5.35)	15.50 (4.04)	11.75 (3.85)
Verbal dependency clauses	106.67 (28.14)	56.62 (4.55)	74.83 (26.33)	53.77 (7.75)
Averbal dependency clauses	47.67 (13.87)	25.90 (6.03)	29.00 (17.97)	20.32 (9.35)
Elliptic dependency clauses	12.50 (6.77)	6.95 (3.97)	18.83 (5.49)	14.16 (5.17)
Discourse-structuring devices	103.33 (36.44)	28.37 (6.39)	91.67 (22.76)	38.02 (3.10)
Adjuncts	9.50 (5.09)	2.66 (1.55)	11.83 (5.38)	4.81 (1.56)
Hesitation markers	43.67 (23.02)	13.43 (8.76)	31.83 (14.68)	14.09 (7.82)

in this study is silence-bound BDUs (bdu-sil). With 34%, the frequency in this study is closest to the frequency of intonation-bound BDUs in informal conversations (30.95%). In the present

Table 7. Means and standard deviations (in brackets) for counts and percent (in italics) of total BDUs, congruent BDUs (bdu-c), silence-bound BDUs (bdu-sil), regulatory BDUs (bdu-r), syntax-bound BDUs (bdu-s) and mixed BDUs (bdu-x) per diagnostic group.

	ASD		NT	
	Counts	*Percentage*	*Counts*	*Percentage*
bdu-c	47.50 (12.79)	*47.08 (6.21)*	38.50 (19.32)	*44.20 (9.52)*
bdu-sil	38.17 (9.02)	*38.67 (8.94)*	24.00 (8.49)	*29.15 (6.65)*
bdu-r	4.33 (3.72)	*4.08 (2.70)*	6.00 (4.05)	*6.57 (4.13)*
bdu-s	4.00 (3.10)	*3.70 (2.24)*	5.33 (2.66)	*6.91 (4.07)*
bdu-x	6.83 (4.88)	*6.47 (4.21)*	9.67 (2.50)	*13.16 (6.61)*
Total BDU	102.67 (23.39)		65.67 (31.37)	

study as is the case in the LOCAS-F corpus, the frequency of syntax-bound BDUs (bdu-s, 5.06%), regulatory BDUs (bdu-r, 5.61%) and mixed BDUs (bdu-x, 8.95%) were quite low.

Summary of results

The variables analyzed in this study and their associated effects are summarized in Table 11.

Discussion

This exploratory study investigated whether autistic and neurotypical adults differed in their strategies to combine prosodic and syntactic information when delivering speech. Taken together, the results provide mixed evidence for group differences in discourse strategies. Before delving deeper into the results of the BDUs, it is important to note an interesting difference in the results of the syntactic segmentation of this study and that of Geelhand et al. (2020), who used the same segmentation procedure. In the latter study, autistic participants were less productive then their neurotypical peers: they produced fewer words, syntactic sequences and syntactic units overall. In the present study, the reversed pattern is observed, as ASD participants produced more words, syntactic sequences and syntactic units overall. This pattern of results in speech productivity favors the assumption that narrative production is a difficult and demanding task for autistic individuals, even more so than conversation (Botting, 2002). In the tasks used in this study, the different questions of the experimenter provided participants with a structure to develop subsequent turns in the conversation.

Likewise, regarding types of dependency clauses, a different pattern emerged. Specifically, in Geelhand et al. (2020), autistic participants produced less verbal but more averbal dependency clauses than their typical peers while elliptic dependency clauses did not differ across groups. In the present study, there were no group differences in verbal dependency clauses but one in elliptic dependency clauses, with neurotypical participants producing more than autistic participants. This latter finding makes sense considering the semi-structured nature of the of task of *Relationships* and *Solitude*. In these tasks the questions asked by the experimenter can provide an adequate context to omit an obligatory element of a clause when responding to the question, without impacting the meaning of the answer. For example, in (14), the experimenter asks the participant a question on solitude, viz. what can be done in moments of solitude, and the participant responds with an elliptic clause (in bold below) omitting the verbal sequence ‘je ne fais’ (I don’t).

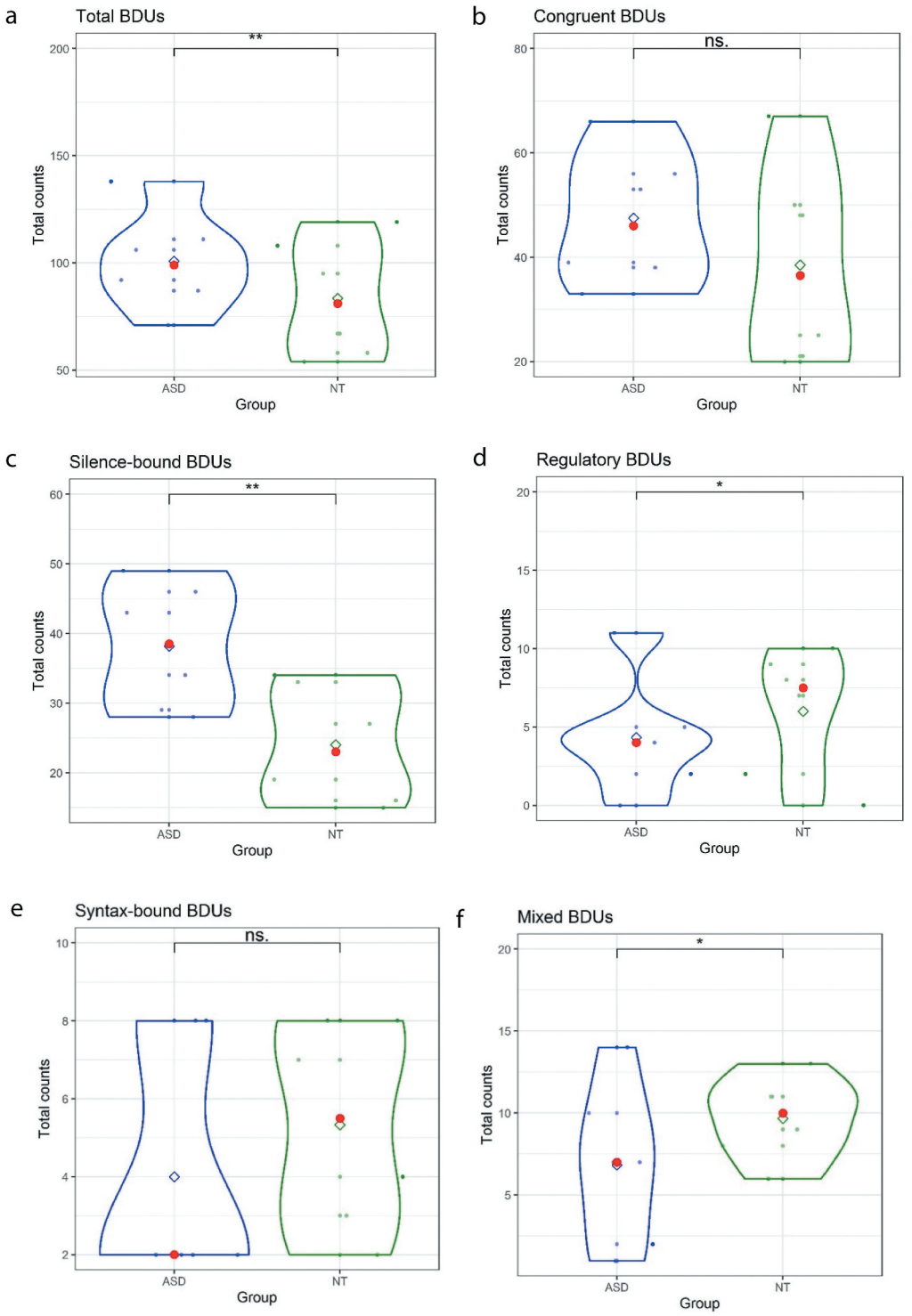

Figure 5. Violin plots for total BDUs (plot A), congruent BDUs (plot B), silence-bound BDUs (plot C), regulatory BDUs (plot D), syntax-bound BDUs (plot E) and mixed BDUs (plot F) per diagnostic group.

Table 8. BDU distribution within diagnostic group.

	ASD		NT	
BDU Types	*Total counts*	*Percentage*	*Total counts*	*Percentage*
bdu-c	285	47.11%	231	46.11%
bdu-sil	229	37.85%	144	28.74%
bdu-r	26	4.30%	36	7.19%
bdu-s	24	3.97%	32	6.39%
bdu-x	41	6.78%	58	11.58%
Total BDU	605	100%	501	100%

Table 9. Distribution of different BDUs summarized over diagnostic group.

BDU Types	Total counts	Percentage
bdu-c	516	46.65%
bdu-sil	373	34.00%
bdu-r	62	5.61%
bdu-s	56	5.06%
bdu-x	99	8.95%
Total BDU	1106	100%

Table 10. BDU distribution in the LOCAS-F corpus across four discourse genres: informal conversation (conv-i), formal conversation(conv-f), conversational narrative(conv-narr) and sociolinguistic interview (int-soc).

	conv-i		conv-f		conv-narr		int-soc	
BDU Types	*Count*	*Percentage*	*Count*	*Percentage*	*Count*	*Percentage*	*Count*	*Percentage*
bdu-c	184	54,76%	92	47,92%	33	28,45%	103	46,60%
bdu-i	104	30,95%	38	19,79%	57	49,14%	43	19,45%
bdu-r	16	4,76%	20	10,41%	10	8.62%	14	6.33%
bdu-s	14	4,17%	30	15,63%	7	6,03%	39	17.65%
bdu-x	18	5,37%	12	6,25%	9	7,76%	22	9.95%
Total count	336	100%	192	100%	116	100%	221	100%

Table 11. Summary of all coding categories and their associated group effect.

Variable	Feature	Group difference
Syntactic coding	Total words	ASD > NT
	Total syntactic sequences	ASD > NT
	Total syntactic units	ASD > NT
	Total dependency clauses	ASD = NT
	Complete dependency clauses	ASD = NT
	Incomplete depedency clauses	ASD = NT
	Verbal dependency clauses	ASD = NT
	Averbal dependency clauses	ASD > NT
	Elliptic dependency clauses	NT > ASD
	Adjuncts	NT > ASD
	Discourse-structuring devices	NT > ASD
	Hesitation markers	ASD = NT
BDU segmentation	Total BDUs	ASD > NT
	Congruent BDUs	ASD = NT
	Silence-bound BDUs	ASD > NT
	Regulatory BDUs	NT > ASD
	Syntax-bound BDUs	ASD = NT
	Mixed BDUS	NT > ASD

14) Exp : [tu fais quoi dans ces moments-là]1 ///1
<and> [what do you do at times like this]1 ///1
PP : [rien de très intéressant]1 ///1 <genre> [je patoufle]1 ///1
<uh> [nothing particularly interesting]1 ///1 <like> [I'm being lazy]1 ///1
Comparison participant (male, 21 years old)

Ellipsis is one way to mark cohesion (Halliday & Hasan, 1976) and is exploited to a greater extent by the neurotypical participants in this study than autistic participants. Furthermore, it is worth emphasizing that group differences in averbal dependency clauses and the additional syntactic category of discourse-structuring devices replicate the results of the narrative study, highlighting these features as a stable difference between the discourse of autistic and neurotypical adults. In other words, although the semi-structured tasks of *Relationships* and *Solitude* might have been less demanding than the narrative task for autistic participants, establishing and maintaining coherence during discourse production remains challenging for them.

Contrary to our initial hypothesis that autistic adults would produce more syntax-bound BDUs, reflecting planning difficulties and/or pedantic style, autistic adults did not produce more syntax-bound BDUs than neurotypical adults. Similarly, the expectation that neurotypical adults would produce more silence-bound BDUs was not fulfilled and, in fact, the exact opposite trend emerged, with autistic adults producing more silence-bound BDUs than neurotypical adults. In other words, autistic adults produced more macro-units of information than neurotypical adults. However, our hypothesis that neurotypical adults would produce more regulatory BDUs than autistic adults was corroborated. An unexpected result was a group difference for mixed BDUs, with neurotypical participants producing more mixed BDUs than autistic participants. There were no group differences in the production of congruent BDUs, the baseline BDUs. Although at first glance, the direction of the study's initial hypotheses was not fully corroborated, the results of the syntactic segmentation and the distribution pattern of the BDU types in the present speech sample converge together to highlight meaningful differences between diagnostic groups, viz. differences in discourse coherence and management.

First, considering that autistic participants produced less discourse-structuring devices overall than neurotypical participants, the finding that they also produced less regulatory BDUs, viz. the isolation of a discourse-structuring device with a silent pause, seems logical. In turn, the lower frequency of discourse-structuring devices leaves room to compensate with alternative means to relate different syntactic units, resulting in more silence-bound BDUs, viz. several syntactic units grouped by one silent pause. Indeed, one way to create discourse coherence is by establishing coherence relations across utterances or text segments (Knott & Sanders, 1998; Sanders & Noordman, 2000; Sanders et al., 1992). Coherence relations can be marked explicitly, by means of connectives, such as 'because', 'however' or 'and', but they can also be left implicit, for example, when a coherence link is conveyed through the juxtaposition of two clauses or sentences. Implicit relations require that the readers or listeners themselves infer the relation between the discourse segments using the information from the linguistic context and/or their world knowledge (e.g., Zwaan & Radvansky, 1998). Discourse studies on annotated corpora of discourse relations suggest that some types of relations can be more easily left implicit than others. For example, while causal and additive relations are often

expressed implicitly, conditional and concession relations tend to be explicitly marked (Asr & Demberg, 2012; Taboada, 2009).

According to Degand and colleagues, intonation-bound BDUs reflect an alternative way of marking coherence relations between utterances. Rather than using explicit discourse-structuring devices, the speaker can use prosody to group otherwise unrelated syntactic clauses, indicating that these clauses should be interpreted as one information unit. In this sense, intonation-bound BDUs resemble an implicit coherence relation. Example (15) is a silent-bound BDU, with an implicit causal relationship between syntactic unit 1 and 2. Specifically, this causal relationship could be made explicit by adding the connective 'parce que' (*because*) in between the two syntactic units as illustrated in example (16).

15) <puis> h> <finalement> <bah> [je crois que les gens me supportent pas]$_1$ [je suis toxique pour les gens]$_2$ ///$_1$
<and> <uh> <ultimately> <well> [I think that people can't stand me]$_1$ [i'm toxic for people]$_2$///$_1$

16) <puis> h> <finalement> <bah> [je crois que les gens me supportent pas]$_1$ **<parce que>** [je suis toxique pour les gens]$_2$ ///$_1$
<and> <uh> <ultimately> <well> [I think that people can't stand me]$_1$ **<because>** *[i'm toxic for people]$_2$ ///$_1$*

Autistic participant (male, 21 years old)

At this point in the discussion, it is important to consider a methodological difference with the prosodic segmentation applied in this study and that applied by Degand and Simon. In this study, major prosodic boundaries were identified according to only one of the criteria of the prosodic segmentation applied by Degand and Simon, viz. silent pauses longer than 200 ms. Due to the exploratory nature of the study and practical reasons, acoustic criteria such as vowel lengthening, and intra-syllabic rise were not taken into account. In other words, the BDUs in our analysis reflect a rather simple prosodic cue to segment the ongoing flow of the discourse. Participants probably deployed a wider range of and more subtle prosodic cues to segment their speech, which is not reflected in the current procedure. One piece of evidence for this assumption is the finding that neurotypical participants produced more mixed BDUs than autistic participants. Recall that a mixed BDU occurs when the boundaries of the syntactic and prosodic units overlapped but did not coincide to yield any of the other types of BDUs. Consider (17) and (18), two examples of mixed BDUs.

17) [c'est la première fois qu'il se voyaient]$_1$ <tu vois> [alors que c'était trois ///$_1$ trois tu vois groupes de de bons potes quoi]$_2$ ///$_2$
[it was the first time they saw each other]$_1$ <you know> [even though it was three ///$_1$ three you know groups of good friends]$_2$ ///$_2$

Comparison participant, male, 21 years old

18) [je vais aussi une fois par semaine aux ///$_1$ aux réunions de section pour les réanimateurs]$_1$ <donc> [là j'ai aussi ///$_2$ des amis]$_2$ ///$_3$
<uh> [also go once a week to ///$_1$ to department meetings for the reanimator]$_1$ [there I also have ///$_2$ friends]$_2$ ///$_3$

Comparison participant, male, 52 years old

Degand and Simon (2009a) do not consider mixed-BDUs as actual basic discourse units but as a left-over category, with no specific discourse strategy. Mixed BDUs could emerge as a result of production difficulties or as a result of insufficient criteria to fully capture the speech being produced. In light of the prosodic segmentation implemented in this study, the distribution pattern of less silence-bound BDUs and more mixed BDUs in the speech of neurotypicals could reflect the latter possibility. For example, in (17), it is possible that the discourse marker *you know* bears a specific prosodic contour that would lead to the detection a major prosodic boundary. This would lead to a change from one mixed-BDU to two BDUs, viz. one congruent BDU (19) and one syntax-bound BDU (20).

19) [c'est la première fois qu'il se voyaient]$_1$ ///$_1$
[it was the first time they saw each other]$_1$ ///$_1$

20) [alors que c'était trois ///$_1$ trois tu vois groupes de de bons potes quoi ///$_2$]$_1$
[even though it was three ///$_1$ three you know groups of good friends ///$_2$]$_1$
Comparison participant (male, 21 years old)

Future studies should examine whether adding the acoustic criteria proposed by Degand and Simon would reduce the frequency of mixed BDUs and increase the frequency of other types of BDU. Future studies could also examine how the proportion of the different BDU types vary as a function of the types of prosodic criteria, viz. simple and gross prosodic features (e.g., silent pauses) and more complex and fine-grained ones (e.g., intra-syllabic rise). Methodologically, such studies would provide further insight into which prosodic features are most reliable and stable to determine prosodic boundaries. Clinically, such studies would also inform on which features might distinguish best between the discourse style of autistic and neurotypical individuals. While refining the methodology might provide further insight into the pattern of silence-bound and mixed BDUs, it is also worth exploring the research avenue that mixed BDUs reflect production difficulties (Degand & Simon, 2009a). Consider the following example of mixed BDUs. Several cues of processing difficulties, viz. hesitation markers (*uh, uhm*) and repetitions (*without any problem*) and reformulation (*well without///without delay*) suggest that the participant is having real troubles delivering her message.

21) [y'a rien à dire]$_1$ [c'est euh c'est quelqu'un sur qui on peut compter]$_2$ <euhm> [c'est quelqu'un qui va te ///$_1$ pardonner ///$_2$ sans sans problème fin sans ///$_3$ sans delai]$_3$ ///$_4$
[there's nothing to say]$_1$ <uh> [it's uh it's someone you can count on]$_2$ [it's someone who's going to ///$_1$ forgive you ///$_2$ without any problem well without ///$_3$ without delay]$_3$ ///$_4$
Comparison participant (female, 39 years old)

While (re)defining reliable segmentation criteria might help reduce some instances of mixed BDUs to actual basic discourse units, there might always be a 'left-over' category, reflecting deeper production difficulties.

Conclusion

Taken together, the present study provides initial evidence that Basic Discourse Units can distinguish the speech delivery strategies of autistic adults from those of their neurotypical peers, even based on simple prosodic cues like silent pauses. More specifically, the coded data

of this study suggest that the discourse output of autistic adults includes less explicit linguistic cues to create coherence, both at the local level (e.g., discourse-structuring devices) and at a global level (less regulatory BDUs, more silence-bound BDUs). Considering that BDUs serve as the minimal input for the interpretation process and inference drawing, the discourse strategies reflected in the spoken discourse of ASD adults are likely to make it more difficult for their listeners to construct a coherent mental representation of the ongoing discourse. Initial support for this assumption may be drawn from Geelhand (2019). She used the recordings of the semi-structured interview on *Relationships* to obtain ratings on the quality of seven discourse features such as coherence and fluency. Her results suggest that naïve listeners provided lower ratings of the discursive features in the audio recordings by autistic adults than those by neurotypical adults.

While our finding that the discourse of autistic adults is less coherent than that of neurotypical adults corroborates the findings in the literature, providing a suitable cognitive explanation for this result is more complicated. One likely line of explanation relates to cognitive load. Interactions (even in the form of a semi-structured interview) may be socially taxing for autistic individuals and leave them with less cognitive resources to manage the content and structure of the ongoing discourse. Considering that we only investigated one discourse genre, we cannot verify this assumption with this study. Hence, future studies should compare different discourse genres to examine whether silence-BDUs' reflect a general preference of autistic participants to deliver their discourse (due to cognitive constraints) or whether this strategy is genre-bound. The discourse strategies characterizing the discourse of ASD adults could also reflect less sensitivity to the specific needs of the current context/addressee and failing to adjust their discourse accordingly.

Another important avenue for future research is to examine in more detail the composition of such macro-units of information. How many dependency clauses, sequences and words do they contain? For example, Degand and Simon (2009a) have observed that conversational narration has shorter dependency clauses (6.2 words per dependency clause) than radio news (16.7 words per dependency clause), political address (15.6 words per dependency clause) and conference talk (15.1 words per dependency clause). Likewise, the duration of a major prosodic unit differs per discourse genre. For example, in conference talks, major prosodic units last on average 4.1 seconds while they only last 2.6 seconds in political address. Analyzing the composition of the different BDUs would provide insights into the information density and structure of the different BDUs. For example, the frequency of congruent BDUs was similar for autistic and neurotypical participants. However, considering that autistic participants produced more words and dependency clauses, their congruent BDUs might be 'denser' than those of neurotypical participants. Finally, in addition to a deeper investigation of the composition of silent-bound BDUs, future research could also examine the quality of these BDUs.[4] Example 15 seems to suggest that ASD participants use silence-bound BDUs as an active strategy to mark coherence relations. However, without a systematic analysis of the composition of silent-bound BDUs, it cannot be excluded that a silent pause also occurs after several dependency clauses because autistic participants need to take breath or a break in order to produce their

[4]We would like to thank one of Reviewers for highlighting this interesting possibility.

next sentence. Conducting a detailed analysis of the relationship between the different dependency clauses of silent-bound BDUs would allow to gain insight into this issue.

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Declaration of competing interest

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