Research in Developmental Disabilities 59 (2016) 234–254

Contents lists available at ScienceDirect

Research in Developmental Disabilities

Review article

Narratives of children with high-functioning autism spectrum disorder: A meta-analysis

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ARTICLE INFO

Article history:
Received 1 May 2016
Received in revised form 24 July 2016
Accepted 10 September 2016
Number of reviews completed is 2

Keywords:
Autism
Internal state language
Narrative
Macrostructure
Meta-analysis
Microstructure

ABSTRACT

Background: The aim of this meta-analysis was to analyze the narrative performance of children and adolescents with high-functioning Autism Spectrum Disorders (ASD) in terms of microstructure, macrostructure and internal state language.
Method: A systematic literature search yielded 24 studies that met the predetermined inclusion criteria. Effect sizes for each study were calculated for eight variables and analyzed using a random effects model. Intellectual ability, age and type of narrative were considered as potential moderators.
Results: Results revealed that the children with ASD performed significantly worse than their peers on all the variables considered.
Conclusions: Findings are discussed taking into account the main explanatory psychological autism theories. Implications for intervention and orientations for future research are suggested.

Contents

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http://dx.doi.org/10.1016/j.ridd.2016.09.007
0891-4222/

What this paper adds?

- This is the first meta-analysis about narrative abilities in children with ASD/HFA (Autism Spectrum Disorders/High Functioning Autism).
- The results revealed that individuals with ASD/HFA showed deficits in all narrative domains (macrostructure, microstructure, and internal state language) compared to controls.
- Findings did not differ in subgroups based on age and narrative type, but for internal state language, differences were greater in magnitude in the high verbal IQ group.
- Narrative, a way of thinking, communicating and sharing reality, is a key deficit in ASD, and it can be related to main explanatory theories about this neurodevelopmental disorder.
- The results highlight the importance of designing effective interventions to address the challenges experienced by individuals with ASD/HFA related to narrative competence.

1. Introduction

Narration is a way of thinking, communicating and sharing reality, a cognitive scheme in which we adjust and reconstruct our experiences in order to better understand them (Bruner, 1991). Narratives commonly describe a series of actions and events that unfold over time, often according to causal principles and with a goal that is to be achieved (Trabasso & Rodkin, 1994). They play a significant role in different developmental areas such as school performance (Petersen, 2011) and reading comprehension (Griffin, Hemphill, Camp, & Wolf 2004). Besides, conversational narratives are one of the main ways of sharing experiences among children, supporting the continuous development of emotional attachment and social relationships (von Klitzing, Stadelmann, & Perren, 2007). In addition, adult-scaffolded narratives contribute to children's memories about their own experiences (Fivush, Habermas, Waters, & Zaman, 2011). People who have well-constructed narratives may be better able to assimilate new experiences into their sense of self with relative ease. Furthermore, creating a story about a conflicting or stressful event is fundamental to being able to incorporate it into one's self-representation (van der Kolk & Fisler, 1995).

In recent decades there has been a considerable increase in studies on narrative competence in Autism Spectrum Disorders (ASD), a neurodevelopmental disorder characterized by persistent impairments in social communication and interaction, and restricted and repetitive behavior. From the first description by Leo Kanner (1943), the conceptualization of ASD has experienced a series of changes related to both its characterization and its name: from Pervasive Developmental Disorder (DSM-IV-TR, APA, 2000) to Autism Spectrum Disorder, the terminology used in the current DSM-5 (APA, 2013). In this nosological evolution process, one constant feature of the ASD diagnosis has been the presence of social communication difficulties. For this reason, the study of the narrative skill becomes especially relevant, and it can also be used to demonstrate the main explanatory theories of ASD, even though it seems evident that autism cannot be understood based on only one deficit (Happé & Ronald, 2008).

First, Theory of Mind (ToM) deficit proposes that people with ASD experience difficulties in the capacity to infer mental states in themselves and others (Baron-Cohen, Leslie, & Frith, 1985) and in the ability to empathize (Baron-Cohen, 2010), which obviously affects communication and social interaction. Therefore, it seems logical to imagine that people with ASD would have challenges in identifying psychological states – thoughts, feelings, motivations – in the characters of a story, and in adapting the narration according to the knowledge shared with their audience. In this regard, Tager-Flusberg and Sullivan (1995) confirmed an association between narrative performance of children with ASD and their performance on ToM tasks. Moreover, when asked comprehension questions, they were less accurate in labeling emotions and gave fewer appropriate causal explanations. Similar results were obtained in Capps, Losh and Thurber's (2000) study, in which children with ASD were less likely to include emotion descriptions within a causal frame, and a correlation between narrative ability and ToM was established.

Second, difficulties in executive functioning –planning, working memory, inhibitory control, flexibility – have been considered one of the fundamental causes of the cognitive alterations found in ASD (Ozonoff, Pennington, & Rogers, 1991). Undoubtedly, good organizational skills and the ability to focus one's attention are necessary in order to express the temporal and causal sequence of the events being narrated (Ygual, Roselló, & Miranda, 2010). Furthermore, a good narration is characterized by having a coherent overall structure, which can be especially difficult for people with ASD, who, according to the Weak Coherence Account (Happé & Frith 2006), have a natural bias toward focusing on the local properties of information and exhibit difficulties in integrating these local features into meaningful representations. More recently, an aspect of WCA has been emphasized, the ability to use context in sense making. According to this proposal, people with ASD would present a lack of contextual sensitivity or "context blindness", which would hinder the use of context in the interpretation of meaning (Vermeulen, 2015).

Although deficits in ToM, executive dysfunctions, or detail-focus are satisfactory working theories, no one cognitive account to date can explain social, communication, and restricted and repetitive behavior patterns in ASD. Happé and Ronald (2008) reviewed evidence at the genetic, cognitive, and neural levels that suggests a different etiology of the social and non-social aspects of ASD. Thus, they proposed a fractioning of the autistic triad of impairments in social interaction, communication, and flexible imaginative functions, with clear implications for the diagnostic process and for research. In any case, narrative analysis may be considered a useful way to provide evidence of the different theoretical perspectives about ASD.

The study of the narrative ability has been the topic of numerous publications reviewed by Stirling, Douglas, Leekam, and Carey (2014, chapter 8). This review, which included 23 studies published between 1980 and 2011, offers a panoramic view of discursive functioning of individuals with ASD, but with inconsistent results. Regarding the narrative microstructure, that is, the internal linguistic structures used in narrative construction (productivity and grammar), some studies claim that the performance of participants with ASD is inferior to that of the neurotypical population. For example, Thurber and Tager-Flusberg (1995) investigated story narratives produced by three groups of children (with ASD, intellectual disabilities and typical development-TD-) matched on verbal mental age. Children with ASD produced significantly fewer propositions, as well as significantly fewer different words. In addition, Capps et al. (2000) compared the narrative abilities of 13 children with ASD, 13 children with developmental delays, and 13 TD children matched on language ability. They found a significant difference among groups in overall story length, measured as the number of propositions, attributable to the longer stories of the TD children. By contrast, other studies like the one by Norbury and Bishop (2003), comparing the narrative skills of children with Specific Language Impairment (SLI), Pragmatic Language Impairment (PLI), ASD, and TD, did not appreciate significant differences in story length measured in terms of syntactic units.

A similar overview can be obtained from the data about grammatical functioning. Some studies report significantly worse performance on indicators such as mean length of utterances in participants with ASD (Gabig, 2008; Tager-Flusberg, 1995; Thurber & Tager-Flusberg, 1993), whereas other studies have not been able to identify significant differences compared to groups with TD (Diehl, Bennetto and Young, 2006). Likewise, there is no consensus about the syntactic complexity of the narrations. Some studies report a lower performance on the frequency of complex syntax (Capps et al., 2000) or the total number of complex sentences (Norbury & Bishop, 2003), whereas other investigations do not detect significant differences on measures such as subordinate clauses per communication unit (Diehl, Bennetto, & Young, 2006)

In contrast with the microstructural examination, a macrostructural analysis considers narrative abilities in terms of overall content and hierarchical organization. The majority of investigations that have analyzed the macrostructure of narratives by children with ASD have demonstrated significant difficulties on this dimension, either in terms of a lower number of causal connections between events (Diehl, Bennetto and Young, 2006), or in the lack of narrative elements and high points (Goldman, 2008).

Another aspect exhaustively analyzed in narratives of children with ASD is the internal state language (ISL), that is, the vocabulary used to convey character perceptions, emotions, and thought processes. Research has also provided conflicting results. Whereas various studies have found a lower number of terms of this type (Baron Cohen, Leslie, & Frith, 1986, Pearlman-Avnion & Eviatar, 2002), other studies have not found significant differences (Tager-Flusberg, 1995; Tager-Flusberg & Sullivan, 1995). However, it should be mentioned that, even when using as many internal state terms as controls, children with ASD seem to make less effort to explain the causes of mental states in their narratives, and they also have a limited ability to monitor and sustain listeners' attention, compared to the narratives of matched controls (Losh & Capps, 2003).

Various factors might explain the lack of consistency in the empirical findings, such as the characteristics of the task employed and the different ways of evaluating the same variable in each study. Along with these methodological questions, other variables that can influence the results are the heterogeneity of the disorder or the matching criteria used for comparison groups. In fact, studies have identified narrative deficits, especially in groups with low cognitive abilities, whereas groups of individuals with high functioning ASD seem to show a pattern of macro and microstructure narrative performance more like that of neurotypical groups, particularly in storybook contexts (Losh & Capps, 2003). The differences in findings may also be due to the fact that the wide age range included in the studies increases the heterogeneity, considering the long time course of narrative development (Berman & Slobin, 1994).

In summary, although the body of work dedicated to the study of narrative in ASD has contributed greatly to our knowledge, given the large number of studies with inconclusive results, the precise state remains to be determined. It is necessary to rigorously analyze the data from the research in order to design the profile of weaknesses and strengths in this population and plan suitable interventions for their needs and difficulties. To do so, the meta-analysis is an ideal methodology that provides a reliable and precise estimation of the effects.

In this paper, we report results of a meta-analysis conducted by combining data on narrative abilities of individuals with ASD, making three contributions to the literature on this topic: a) our study extends the review by Stirling et al. (2014), as the number of studies included is notably greater because in the last five years, 14 articles have been published on this topic; b) It clarifies the inconsistent findings, reducing heterogeneity, as the analysis focuses on studies with children and adolescents with high functioning ASD; and c) it examines evidence about different narrative components.

In order to articulate this meta-analysis, we selected variables reflecting current trends in narrative assessment (Altman, Armon-Lotem, Fichman, & Walters, 2016; Justice et al., 2006), related to macrostructure, microstructure, and ISL. Macrostructural analysis is focused on global content and organization. It can be implemented using various approaches (story grammar, main ideas, information units) and assessment methods (quantitative or based on rubrics or scales). Microstructural analy-

sis, in contrast, considers the internal linguistic structures used in the narrative construction, such as productivity (number of words, lexical diversity) and grammar. In addition, ISL was considered because narratives require the ability to understand characters' mental states and their causal role (Flavel, 2004). Based on this background on narrative constructs, a meta-analysis of empirical research was carried out, guided by the following three questions:

1 Does the narrative microstructure (productivity and grammar) significantly differ in children with ASD compared to children with typical development (TD)?
2 Does the narrative macrostructure (coherence and cohesive adequacy) significantly differ in children with ASD compared to children with TD?
3 Does internal state language (ISL) produced on narratives, that is, the explicit language about perceptions, thoughts, beliefs and feelings, significantly differ in children with ASD compared to children with TD?

Additionally, we considered some factors that could have an influence on narrative performance and, therefore, might act as moderator variables. One of them is cognitive ability because cognition is a strong predictor of language and communication skills in children with ASD (Thurm, Lord, Lee, & Newschaffer, 2007). Narrative requires the cognitive capacity to set up and keep in mind a representation of a complex reality formulated in language (Nelson, 1996). Another relevant aspect is age, as it has been well established that important changes occur in narrative ability over time in typical development (Berman & Slobin, 1994). Finally, type of narrative was another moderator variable because previous work has demonstrated that children with ASD deployed a more restricted range of complex syntactic and evaluative devices than TD children on personal narratives, but the groups did not differ in the storybook context (Losh & Capps, 2003).

2. Methods

2.1. Eligibility criteria for the studies

The articles to be included in the meta-analysis had to meet the following inclusion criteria:

1)They were published in refereed journals; 2) The participants were children or adolescents with an ASD diagnosis (according to the Diagnostic and Statistical Manual of Mental Disorders (DSM), International Classification of Diseases (ICD), the Autism Diagnostic Observation Schedule (ADOS) (Lord, Rutter, DiLavore, & Risi, 2001) and/or the Revised Autism Diagnostic Interview (ADI-R) (Rutter, LeCouteur, & Lord, 2003); 3) The studies included a typically developing comparison group; 4) The two groups, with ASD and TD, were compared on quantitative measures of performance on an oral narrative production task, regardless of the type of narration (auto-biography, fiction, true story, conversational narrative) or the presentation mode (with or without visual support, initial prompting or previous model, or in interview format).

5) The participants in both samples had a full IQ mean above 70, based on the score on a standardized intelligence test. This cut-off was selected because IQ above the intellectual disability range (70) has been used to describe individuals with ASD, particularly, what has been referred to as High Functioning Autism (Chiang, Tsai, Kuen Cheung, Brown, & Li, 2014). Therefore, our study focuses on the narrative abilities of children/adolescents who currently receive a diagnosis of ASD with no intellectual or language impairment on the DSM-5 (APA, 2013) and had previously been diagnosed with Asperger's Syndrome or mild autism/pervasive developmental disorder-not otherwise specified (PDD-NOS) on the DSM-IV-TR (APA, 2000).

The variety in the narrative measures was intended to facilitate the inclusion of an extensive body of research and reflect the diversity of narrative methods applied in both the scientific literature and in educational/clinical contexts; 6) All the studies had to have measures to calculate the effect size and provide enough description to guarantee that methodologically sound research practices were being utilized.

2.2. Data gathering

An advanced search was conducted in the databases of Pubmed, SCOPUS, and PsychINFO to identify the articles that dealt with narrative in children with ASD published in peer-reviewed journals. Key words were used in the search; such as "Autism"; "Asperger Syndrome"; "Autism Spectrum Disorder" and "High Functioning Autism"; which were combined using the "or" operator. In addition; the index term was "Narrative". We set no limits on the publication date in order to identify the earliest studies appearing in the databases. This search strategy resulted in studies from 1986 to December 1st 2015. Fig. 1 shows the trial selection flowchart. The interrater reliability for the exclusion decision of the studies was 92%. The disagreements were resolved through discussion between coders and the re-examination of the full texts.

A manual review of relevant journals on language and/or autism provided another article.

To establish the reliability of the identification of the microstructural variables, macrostructural variables, and internal state language to be analyzed, two authors independently coded a third of the studies (selected at random). Reliability, calculated as the percentage of agreement on microstructure measures of the productivity variables, reached a mean agreement of 96%, and 92% on measures of grammar. The reliability mean for macrostructural measures was 84%; finally, on measures

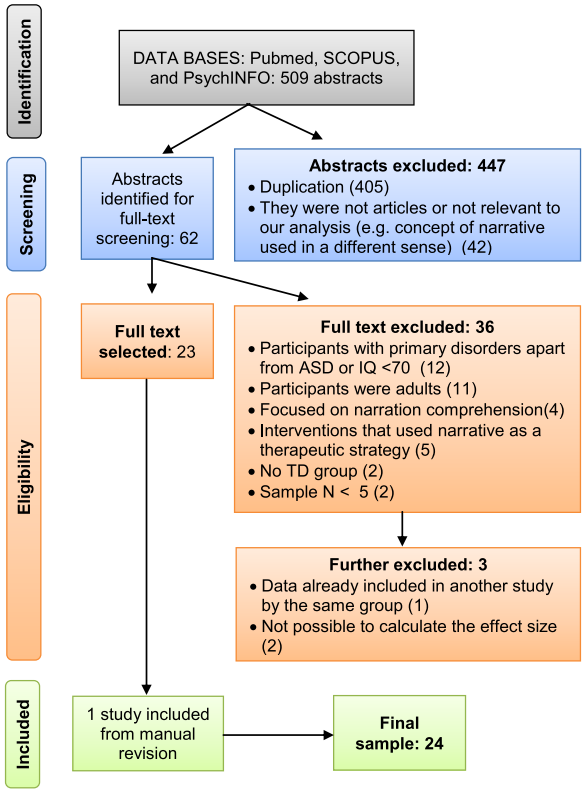


Fig. 1. Report of the trial selection flowchart.

related to ISL, the agreement was 92%. Disagreements were resolved through joint review and discussion of the studies. The authors went on to jointly review the remainder of the studies until 100% agreement was reached.

2.3. Study characteristics

Table 1 presents information about the characteristics of the 24 articles included in the meta-analysis, regarding the groups of participants, the type of methodology used to elicit the narrations, and the outcome measures used in different combinations: number of words, number of utterances, lexical diversity, syntactic complexity, causal statements, evaluative devices, referential accuracy, story structure and ISL.

More specifically, the total number of participants in the studies was 867 (434 in the group with ASD and 433 in the comparison group with TD). The ages of the participants with ASD ranged from 6.5 to 15 years (M = 10.30, SD = 2,38), and 83.25% were male. The ages of the group of participants with TD ranged from 6.7 to 15.2 years (M = 10.02, SD = 2,53), and 76.20% were male. The mean IQ scores of the two groups were quite similar (ASD = 98.80; TD = 105.64).

Sample sizes in 17 studies were rather small (on average, 18 participants in the group with ASD, ranging from 10 to 30 participants) with only 7 (29.15%) studies reporting sample sizes larger than 20.

Different types of narrations were used in the studies. The majority consisted of narrations elicited with a wordless picture book from the Mayer series of frog stories, or the story "Tuesday" from the ADOS, or fictional stories. Other studies used autobiographical memories (Brown, Morris, Nida, & Baker-Ward, 2012), personal stories where the participants told about actual events in which they were involved, or life experiences associated with people acting in everyday activities. In addition, in 18 studies, the two groups compared on narrative measures, ASD and TD, were matched on full IQ, verbal IQ, or verbal abilities scores (Bang, Burns, & Nadig, 2013; Banney, Harper-Hill, & Arnott, 2015; Brown, Morris, Nida, & Baker-Ward, 2012; De Marchena & Eigsti, 2010, 2015; Diehl et al., 2006; Kauschke, van der Beek, & Kamp-Becker, 2015; King, Dockrell, & Stuart, 2013; King, Dockrell, & Stuart, 2014; Kristen, Vuori, & Sodian, 2015; Losh & Capps, 2003; Norbury, Gemmell, & Paul, 2014; Novogrodsky, 2013; Rumpf, Kamp-Becker, Becker, & Kauschke, 2012; Sah & Torng, 2015; Siller, Swanson, Serlin, & Teachworth, 2014; Suh et al., 2014; Young, Diehl, Morris, Hyman, & Bennetto, 2005). In 4 studies, there were differences in linguistic skills (Mäkinen et al., 2014; Mills et al., 2013; Norbury & Bishop 2002, 2003), but the groups were matched on non-verbal abilities (no data were available regarding the performance IQ of the control group in Mäkinen et al., 2014). Finally, one study presented differences in both non-verbal IQ and language (Gabig, 2008). In two studies, the groups were not matched on age (Kristen et al., 2015; Sah & Torng, 2015).

Table 1
Studies about the oral narrative production of ASD children included in the meta-analysis (N = 24).

Reference	Participants: N, mean age years (MA)	Diagnosis of ASD	Measures	Main analyzed variables	Main findings regarding narrative production
Norbury and Bishop (2002)	SLI (n = 16) MA = 9.3 HFA (n = 10) MA = 8.9 PLI (n = 24) MA = 8.9 TD (n = 18) MA = 8.67	DSM-IV/ICD-10 SCQ, ADOS	Story recall without visual support	Recall score. Comprehension score. Analysis of error responses.	Story recall: HFA = PLI = SLI = TD Literal and inferential comprehension: HFA = PLI = SLI < TD. Tendency to perform worse on inferential questions for HFA
Losh and Capps (2003)	ASD (n = 28) MA = 11.3 TD (n = 22) MA = 10.6	DSM-IV ICD-10 ADI-R	Personal narratives. Story telling; Frog, where are you?	Story telling: Length (number of clauses), grammatical complexity, evaluation, structure, frequency of bizarre/irrelevant remarks. Personal narratives: complex syntax, syntactic diversity, evaluation, causal explanations, structure, prompts, irrelevant comments	Story telling: Complex syntax. Syntactic diversity. Evaluation. Eval diversity ASD = TD Causal explanations ASD < TD. Structure components ASD < TD Personal narratives: Complex syntax. Syntactic diversity Evaluation. Eval diversity ASD < TD. Causal explanation: ASD<TD. Prompts and Irrelevant comments ASD<TD.
Norbury and Bishop (2003)	HFA (n = 12)MA = 8.8 SLIT (n = 17) MA = 9.3 PLI (n = 21) MA = 8.9 TD (n = 18) MA = 8.6	DM-IV/ICD-10 SCQ ADOS-G	Story telling Frog, where are you?	Global structure Local structure: Story length (number of words, of syntactic units), syntactic measures (number of complex sentences, number of tense errors), semantic score, cohesion, evaluation, additional information	Global structure. HFA = TD. Local structure: Story length TD = HFA. Syntactic measures: number of complex sentences HFA<TD; tense errors HFA>TD. Semantic score TD = HFA. Cohesion (ambiguous pronouns) HFA > TD. Evaluation (frames of mind score: total number of mental state verbs + total number of references to emotion) HFA = TD
Young, Diehl, Morris, Hyman, & Bennetto (2005)	ASD (n = 17) MA = 8.8 TD (n = 17); MA = 9.9	DSM-IV-TR ADOS, ADI-R	Story retelling: Frog where are you?	Length and complexity: N° of C-Units, average words per C-Unit, n° of clauses per C-Unit. Cohesion. Errors in cohesive ties. Story Grammar (complete episodes) .Comprehension. Fluency (long pauses).	Length and complexity: ASD = TD. Errors in cohesive ties: ASD > TD Story grammar: ASD = TD. Comprehension: factual questions: ASD = TD; inferential questions: ASD < TD. Fluency: ASD = TD.
Diehl, Bennetto & Young (2006)	ASD (n = 17) MA = 8.8 TD (n = 17); MA = 9.5	ADOS, ADI-R Pediatrician or psychologist	Story retelling: Frog where are you?	Narrative length (utterances). Syntactic complex-ity(subordinate clauses per c-units) Coherence (causal connection per-c-units)	Story length and syntactic complexity, ASD children = TD children Sensitivity to the importance of story events, ASD = TD Narrative coherence and the use of the gist for organizing story, ASD < TD

Table 1 (*Continued*)

Reference	Participants: N, mean age years (MA)	Diagnosis of ASD	Measures	Main analyzed variables	Main findings regarding narrative production
Gabig (2008)	AU (n = 15);MA = 6.5 TD (n = 10); MA = 6.7	ADOS, ADI-R DSM-IV, SCQ	Story retelling: The Renfrew Bus Story	Percentages of propositions recalled (IPR) and the average utterance length (LUL)	Tasks performance of verbal memory, AU group < TD group Index of propositions recalled and average utterance length, AD <TD
De Marchena and Eigsti (2010)	ASD (n = 15) MA = 15 TD (n = 15) MA = 15	DSM-IV ADOS SCQ Clinical	Story telling (Two monkeys, ADOS).	Number of utterances. Frequency and types of gestures, story quality and temporal synchrony between iconic gestures and speech.	Number of utterances ASD = TD. Quantity duration of gestures ASD = TD. Narrative quality ASD < TD ASD: gestures significantly less synchronized with speech vs. TD.
Brown, Morris, Nida & Baker-Ward (2012)	AD (n = 30); MA = 9.7 TD (n = 20); MA = 8.9	DSM-IV (Psychiatrist, or psychologist)	Two autobiographical interviews on positive and negative events	Internal States Language: Emotional, cognitive, perceptual, social, physiological	Emotional, perceptual and cognitive terms in the narratives: AD < TD Social terms: AD children = TD children
Rumpf, Kanp-Becker, Becker & Kauschke (2012)	AS (n = 11);MA = 10.5 ADHD(n = 9); MA = 9.9 TD (n = 11); MA = 9.11	ICD-10, DSM-IV ADOS, ADI-R	Telling a story (ADOS) Tuesday	Number of utterances, words types and word tokens, MLU, sentence complexity Coherence, cohesion, Internal language	AS and ADHD < length and coherent narratives than the TD narratives Both clinical groups failed to point out the main aspects of the story Pronominal references and reference to cognitive state: AS < ADHD <TD
Mills et al. (2013)	HFA(n = 10); MA = 9.8 TD (n = 17); MA = 9.2	DSM-IV ADOS ADI-R	Narrative elicitation task (personal story about a conflict)	Narrative length, proportion of morphological errors and proportion of complex syntax	Proportion of complex sentences: HFA< TD Morphological error rate: HFA = TD HFA children with +white matter integrity greater morphological accuracy
Bang, Burns & Nadig (2013)	HFA (n = 20) MA = 11 TD (n = 17) MA = 10.8	DSM-IV ADOS-3, SCQ	Conversational speech on personal narratives	Mental states terms: cognition, perception, physiology, emotion, and desire.	Global production of mental state terms and cognition terms: HFA = TD HFA Smaller proportion of mental terms (no statistical significance)
King, Dockrell, & Stuart (2013)	ASD (n = 27) MA = 12.9 LM (n = 27) MA = 11.4 CM (n = 27) MA = 12.9	Clinical diagnosis	Narratives in 2 conditions −Recount of general event −And specific personal event	Structural language (main body words, N. utterances, MLU, different word roots, mazes). Evaluative measures (mental states, causal statements, evaluative devices)	Structural measures: ASD < CM < LM −Mental states: −General event: ASD < LM < TD. Personal event: ASD < CM −Causal statements: ASD < CM; ASD = LM −Evaluative devices. General: ASD < LM < CM. Personal event: ASD < CM

Table 1 (*Continued*)

Reference	Participants: N, mean age years (MA)	Diagnosis of ASD	Measures	Main analyzed variables	Main findings regarding narrative production
Novogrodsky (2013)	ASD (n = 24) MA = 10 TD (n = 17) MA = 9.8	ADI-R ADOS	Story retelling (Bus Story) S. telling (Frog, where are you?)	Narrative length, 3rd person subject pronouns Number of third-person subject pronoun ambiguous in retelling and in story telling	Narrative length. Number of third person subject pronouns and Number of complex sentences: ASD = TD. Number of third-person subject pronoun ambiguous in retelling: ASD = TD. Number of ambiguous pronouns in story telling: ASD > TD
Mäkinen et al. (2014)	ASD (n = 16) MA = 7.6 TD (n = 16) MA = 7.4	ICD-10 ADOS ADI-R	Story telling (The Cat Story)	Narrative productivity (N. of C-units and different word tokens). Syntactical complexity (clausal density, MLU in words). Referential accuracy Mental states expressions	Narrative productivity. ASD = TD; Mean Length of C-Units ASD<TD. Syntactical complexity: Clausal density ASD = TD. Referential accuracy: ASD = TD Event content: ASD<TD. Extraneous information: ASD>TD. Mental state expressions: ASD = TD.
Suh et al. (2014)	ASD (n = 15)MA = 12.9 ASD-OO (n = 15) MA = 12.4 TD (n = 15) MA = 13	ASD: ADOS and clinical judgment	Story telling (Tuesday, ADOS)	Narrative length/lexical diversity; story elements; ambiguous pronoun references; disfluency; mental state expressions/causal references; idiosyncratic language; unusual references; naming characters	Narrative Length/Lexical diversity ASD = ASD-OO = DT Story elements. ASD < TD; ASD-OO = TD. Ambiguous pronoun references: ASD>ASD-OO > TD; ASD-OO = TD. Mental expressions/Causal references: No differences Idiosyncratic Language: HFA > TD; OO > TD. OO = HFA. Naming characters HFA < TD; OO = TD; OO = HFA.
Siller, Swanson, Serlin & Teachworth, (2014)	ASD (n = 20) M = 86.25 months TD (n = 23) M = 81.83 months	ADOS SRS	Story telling (Frog on his own or Frog goes to dinner). Theory of Mind (ToM) battery	Narrative volume (n. of utterances, words, adjectives and verbs), internal state language (ISL) (emotional and cognitive states), ToM	Narrative volume. ASD < TD Internal State Language (ISL). Emotional states: ASD<TD; Cognitive states: ASD = TD. ToM: ASD<TD. Association between ISL (emotion) and ToM.

Table 1 (*Continued*)

Reference	Participants: N, mean age years (MA)	Diagnosis of ASD	Measures	Main analyzed variables	Main findings regarding narrative production
Norbury et al. (2014) Norbury, Gemmell & Paul (2014)	ASD (n = 26) M = 134.1 months TD (n = 27) M = 118 months LI (n = 22) M = 129.15 months	DSM-IV/ICD-10	Story telling (A boy, a dog and a frog).	Narrative length. Syntactic complexity Semantic and pragmatic competence, semantic/pragmatic relevance, errors. ISL (emotional and mental states, intentions) Story macrostructure	Narrative length: ASD<LI<TD. Syntactic complexity: ASD = LI; LI<TD; ASD<TD. Internal State Lang: ASD = TD.ASD>LI; LI<TD Semantic/pragmatic relevance: LI<TD; ASD = TD Pragmatic errors. ASD>TD;ASD = LI Story macrostructure. LI < ASD < TD
Chen and Chang (2005)	HFA (n = 12) MA = 91.33 months TD (n = 12) MA = 89.50 months	Clinical judgment by doctors	Four sets of pictures in sequence, dealing with daily living experiences	Length. Narrative structure. Evaluation. Referential devices. Affective enhancers. Syntax.	Length: number of words, sentences and propositions. HFA = TD. MLU: HFA < TD. Referential devices: HFA < TD. Narrative structure: HFA < TD. Evaluation: cause/effect, coda HFA < TD emotional utterances and utterances of characters HFA = TD.
King, Dockrell, & Stuart (2014)	ASD (n = 27) MA = 12.9 LM (n = 27) MA = 11.4 CM (n = 27) MA = 12. 9	Clinical diagnosis Statement of special educational needs	Fictional stories. Stems (to complete with narrative generation, accompanied by a picture)	Local/structural variables, mental state, causal statements, evaluative devices. Global structure with Narrative Scoring Scheme NSS (Introduction, Character, Mental States, Referencing, Conflict Solution, Coherence, Conclusion, total NSS).	Number main body words: LM = CM.; ASD < LM; ASD < CM. MLU. ASD < CM; ASD = LM. Mental states references: ASD = LM = CM. Causal statements. ASD<LM; ASD<CM. Total evaluative devices: ASD = LM = CM. Total global structure NSS: ASD<LM; ASD<CM.
Banney, Harper-Hill & Arnott (2015)	ASD (n = 11) M = 138 months TD (n = 17) M = 132 months	ADOS DSM-IV	Story telling (Tuesday, ADOS)	Local structure (length, fluency, errors, semantic content, syntactic structure).Cohesion Global structure (index of narrative complexity and internal states references)	Local structure: ASD<TD. Only in syntactic complexity Cohesion. Ambiguous pronouns: ASD>TD. Global structure: Index of narrative complexity: ASD<TD. Episodic structure: ASD<TD.
De Marchena and Eigsti (2016)	ASD (n = 18)MA = 14.1 TD (n = 18) MA = 15.4	ADOS SCQ SRS	Story telling in two conditions: 1. Private information (PC) 2.Shared information (SC)	Shortening effect: story length (word count). Explicit references to common ground. speech disfluencies Revision rate (revisions per word). Ratings of story quality.	Shortening effect: story length Group/condition: ASD: PC = SC; TD:SC<PC. Explicit references to common ground: ASD = TD. Speech disfluency total rates: ASD>TD Revision rate (per word): ASD > TD. Rating of story quality "easy to follow". According to group: TD >ASD. Group and condition: ASD: SC<PC; TD: SC>PC

Table 1 (*Continued*)

Reference	Participants: N, mean age years (MA)	Diagnosis of ASD	Measures	Main analyzed variables	Main findings regarding narrative production
Kauschke et al. (2015)	ASD (n = 22) MA = 12.5 TD (n = 11) MA = 13.0	ADOS-G ADI-R ICD-10	Story telling (Tuesday, ADOS)	Story length (N. utterances, propositions Tokens and types) Coherence, Cohesion, Evaluative devices Internal state language (emotion, cognition, physiology, evaluation and modality)	Story length and narrative volume: ASD = TD Coherence: No significant group differences Cohesion: References to time: ASD Females < ASD Males and TD Evaluative Device No significant group differences ISL Emotion: ASD Females and ASD Males <TD. ISL Overall: ASD Females> ASD Males
Kristen, Vuori & Sodian (2015)	ASD (n = 24); MA = 8.2 TD (n = 25); MA = 7.1	ADOS ADI-R DSM-5 ICD-10	Language samples in 3 contexts: 1.Narrating context (NC): 2.Eliciting interact (E-IC) 3.Motivating context(MC): ToM Tasks	Number of words, internal state language (ISL; perceptual, physiology, volition. ability, emotion/affect, moral/obligation). References	Internal state language Overall ISL: ASD = TD. ASD: No significant differences in any of three conditions. TD: Significant differences when narrating intentional stories Mental states References E-IC context: Children used more self- and story character-REFERENCES MC context: children used more self and toy-references than other types. Mental states across contexts E-IC: More emotion terms than any category.
Sah and Torng, (2015)	ASD (n = 18) MA = 8.2 TD (n = 18) MA = 7.0	Clinical judgment DSM-IV ADI-R	Story telling Frog, where are you?	Basic narrative measures (n. of clauses, different words) Number of causal connectives. Causal networks.	Basic narrative measures: ASD = TD Number of causal connectives: ASD = TD. Causal connections between events: ASD < TD Number of causal-chain events: ASD = TD. Types of causal connections. Enabling and Psychological: ASD = TD. Physical. ASD < TD

Note: AD, Asperger Disorder; HFA, High-Functioning Autism; ASD, Autism Spectrum Disorder; AS, Asperger's Syndrome; TD, Typically Developing; SLI-T, Specific Language Impairment- Typical; PLI, Pragmatic Language Impairment; ADHD Attention Deficit Hyperactivity Disorder; LM, Language Match Group; CM, Chronological Age Match; DSM-IV, Diagnostic and Statistical Manual of Mental Disorders (4th ed.); ICD-10, International Classification of Diseases; ADOS, The Autism Diagnostic Observation Schedule; ADI-R, The Autism Diagnostic Interview-Revised; SCQ, Social Communication Questionnaire; SRS, Social Responsiveness Scale (Constantino & Gruber, 2005); ASD-OO, Autism Spectrum Disorder with Optimal Outcome; LI, Language Impairments; MLU, Mean Length Utterance.

2.4. Information on narrative variables provided by the studies (See Table 1)

2.4.1. Microstructure

The evaluation of the microstructure of the narrations in our analysis was based on the proposal by Justice et al. (2006). From the studies, we selected information about three indices, in order to account for *productivity* (N° of words, N° of different words, N° of utterances), and information about two indices, in order to account for *grammar* (Length of utterances in words – MLU – and syntactic complexity).

1 Number of Words. The difference in the total number of words in the narratives was compared in ASD children and a control group in thirteen studies: *number of words* (Banney et al., 2015; Chen & Chang, 2005; Kristen et al., 2015; Norbury et al., 2014; Novogrodsky, 2013; Siller et al., 2014), *word tokens* (Suh et al., 2014,) *tokens* (Kauschke et al., 2015), *word count* (De Marchena & Eigsti, 2015), *number of word tokens* (Rumpf et al., 2012), *total morphemes* (Norbury & Bishop, 2003), and *number of main words* (King et al., 2013, 2014).
2 Number of different words. Nine studies specifically included the following data: *number of different words (word types)* (Banney et al., 2015; Norbury et al., 2014; Suh et al., 2014), *number of different word tokens* (Mäkinen et al., 2014), *number of word roots* (King et al., 2013, 2014), *variety of words* (Sah & Torng 2015), and *types* (Kauschke et al., 2015; Rumpf et al., 2012).
3 Number of utterances. Fourteen studies examining the number of utterances used in the narratives met the inclusion criteria. They included studies assessing: *number of utterances* (De Marchena & Eigsti, 2010; King et al., 2013; Novogrodsky, 2013; Siller et al., 2014; Suh et al., 2014), *number of communication units (C-units)* (Diehl et al., 2006; Mäkinen et al., 2014; Norbury et al., 2014), *number of clauses* (Sah & Torng, 2015), *number of T-units* (Banney et al., 2015), *number of propositions* (Kauschke et al., 2015; Rumpf et al., 2012), *total number of syntactic units* (Norbury & Bishop, 2003), and *number of sentences* (Chen & Chang, 2005).
4 Length of T-Units in words (MLU). This measure is calculated by dividing the total number of words by the total number of T-Units or utterances. Nine studies compared ASD children and a control group on this variable in the child's spoken narrative: *Mean length of utterance in words* (Chen & Chang, 2005; Kauschke et al., 2015; King et al., 2013, 2014; Rumpf et al., 2012; Suh et al., 2014), *Mean length of C-units in words* (Mäkinen et al., 2014; Norbury et al., 2014), and *words per c-units* (Diehl et al., 2006).
5 Syntactic complexity. Nine studies compared ASD children and a control group in the following variables: *complex sentences* – coordinate clauses, subordinate clauses- (Norbury & Bishop, 2003; Novogrodsky, 2013), *clausal density* – number of clauses divided by the number of C-Units- (Mäkinen et al., 2014), *syntactic complexity* – clauses per T-unit- (Banney et al., 2015; Norbury et al., 2014), *grammatical complexity* – number of passive and subordinate constructions, number of questions and number of clauses with non-canonical order- (Rumpf et al., 2012), *frequency of complex syntax* – sentences with coordinate clauses, subordinate clauses and passive constructions- (Losh & Capps, 2003; Mills et al., 2013), and *subordinate clauses per C-unit* (Diehl et al., 2006).

2.4.2. Macrostructure: coherence and cohesive adequacy

Macrostructure analyses focus on the overall content and organization of narrative, aspects clearly related to narrative cohesion and coherence. Coherence can be implemented using various approaches (story grammar, main ideas, or information units – Kunnari, Valimaa, & Laukannen-Nevala, 2016). Cohesion is a tool to attain coherence, and it is the meaningful connection between sentences (Norbury & Bishop 2003). In particular, cohesive adequacy is an index of cohesion frequently used to assess if referents in discourse can be unambiguously identified and without mistakes (Liles, 1985). As cohesive markers usually transcend the sentence or micro-linguistic level, cohesion has been analyzed as an indicator of the textual macrostructure (Heilmann, Miller, Nockerts & Dunaway, 2010).

6 Coherence. Narrative coherence refers to the overall structure, plan or schema that orders the propositions in the story (Bamberg, 1984). It also refers to a global representation of story meaning and its temporal and causal structure (Karmiloff-Smith, 1985). Twelve studies used different variables to analyze coherence, reflecting this discourse property in different ways: *event content* (Mäkinen et al., 2014), *story macrostructure* (Norbury et al., 2014), *conflict-resolution* – from the Narrative Scoring Scheme, NSS, Heilmann et al. (2010) – (King et al., 2014), *density of causal chain events* (Sah & Torng, 2015), *episodic structure* – from the Index of Narrative Complexity, Petersen, Gillam, and Gillam (2008) – (Banney et al., 2015), *propositions used for core aspects* (Kauschke et al., 2015), *basic components of the story* (Losh & Capps, 2003), *story recall* (Norbury & Bishop, 2002), *causal connections per C-unit* (Diehl et al., 2006), *Index of propositions recalled* (Gabig, 2008), *ratings of story quality* (De Marchena & Eigsti, 2010), and *story elements* (Suh et al., 2014).
7 Cohesive adequacy. Cohesive adequacy was defined by Liles (1985) as the percentage of instances when a cohesive marker can be easily related back to previously specified information. Seven studies were included, and the variables identified to evaluate this aspect were the following: *percentage of ambiguous 3rd person subject pronoun* (Novogrodsky, 2013), *percentage of ambiguous pronoun references* (Suh et al., 2014), *referential accuracy* (Mäkinen et al., 2014), *referencing* – from the NSS, Heilmann et al. (2010) – (King et al., 2014), *ambiguous references* (Banney et al., 2015), *ambiguous pronouns* (Norbury & Bishop, 2003), and *percentage of errors in cohesion ties* (Young et al., 2005).

2.4.3. Internal states language (ISL)

8 Internal states language (ISL). ISL refers to explicit talk about perceptions, thoughts, beliefs and feelings. To evaluate ISL the following variables were selected: *Mental state expressions* (Mäkinen et al., 2014; Suh et al., 2014), *Internal State Language* (Brown et al., 2012; Kristen et al., 2015; Norbury et al., 2014; Rumpf et al., 2012; Siller et al., 2014), *mental states* (King et al., 2013, 2014) – from the NSS, Heilmann et al. (2010) –, *mental state terms* (Bang et al., 2013), *internal state terms* (Kauschke et al., 2015), e*motion and cognition state* (Banney et al., 2015; Losh & Capps, 2003), *frames of mind–mental state verbs and emotional states-* (Norbury & Bishop, 2003), and *emotional utterances* (Chan & Cheng, 2015).

3. Results

3.1. Statistical analysis

Data extraction from the narrative indicators was independently performed, cross-checked by two of the authors, and entered into RevMan 5.3. To achieve consistency with other meta-analyses and provide a robust estimation of the effects, the different narrative domains were analyzed only if there were data from at least 5 studies.

Effect sizes (Standardized mean difference) were computed to represent the differences in narrative language between the ASD and control groups. Because a large proportion of studies had small sample sizes, we used a correction factor [c(m) = 1–3/(4N – 9)] of the d index for small sample sizes (Botella & Sanchez-Meca, 2015). Separate meta-analyses were carried out for each type of outcome, so that a total of eight analyses were conducted to answer the research questions. A random effects model was used to compute mean effect sizes across sets of studies, and standardized mean differences were combined using the inverse-variance method. The direction of the effect sizes was coded, so that greater narrative abilities in the control group were represented by positive effect sizes. According to Cohen (1988), effect sizes of 0.2 are considered small, 0.5 moderate, and 0.8 large.

Heterogeneity in a meta-analysis is undesirable and implies that the outcome varies across studies. In order to examine heterogeneity, we calculated the Q statistic and I^2 index for each analysis. I^2 ranges from 0% to 100%, with 25% indicating low heterogeneity, 50% moderate, and 75% or above, high heterogeneity (Borenstein, Hedges, Higgins, & Rothstein, 2009). Subgroup analyses with age, IQ and type of narrative as categorical moderators were conducted to examine potential sources of heterogeneity. The small number of studies did not allow the meta-regression of moderator variables. In some cases, we conducted sensitivity analyses, which increase the validity of a meta-analysis by investigating how the results differ when the study inclusion criteria are modified.

Forest-plots were used to graphically present the results of each meta-analysis. The red squares indicate each study's standard mean difference, and the grey horizontal line represents the 95% confidence intervals. The middle of the black diamond represents the overall standardized mean difference, whereas the left and right extremes of the diamond represent the corresponding 95% confidence intervals. Intervals that did not contain zero were considered statistically significant.

3.2. Microstructure: productivity and grammar

The three indices for *productivity* analyzed included number of words, number of different words, and number of utterances:

1 Number of Words. Fig. 2 displays the forest plot of the standardized effect sizes for number of words. Large statistically significant effects were found (standardized mean difference = 0.93; 95% CI = 0.45–1.41); however, heterogeneity was high (I^2 = 83%). In addition, one study (Siller et al., 2014) was identified as an outlier (95% CI was outside the 95% CI of the pooled studies). After its removal, the standardized mean still had a medium to large effect of 0.62 (95% CI = 0.37–0.87), and heterogeneity became smaller (I^2 = 37%) and non significant (Q(11) = 17.55, p = 0.09).

2 Number of Different Words. The forest plot is presented in Fig. 3, indicating moderate statistically significant effects (standardized mean difference = 0.52; 95% CI = 0.18–0.85). Significant heterogeneity was observed (I^2 = 53%). Sensitivity analyses were conducted by excluding the study where the ASD and control groups were not matched on age (Sah & Torng, 2015). After its removal, the standardized mean difference increased to 0.63 (95% CI = 0.38–0.89), and heterogeneity became non significant (I^2 = 13%; Q(7) = 8.08, p = 0.33).

3 Number of utterances. (See Fig. 4). The analysis carried out showed standardized mean difference in number of words was 0.57 (95% CI = 0.13–1.02); using Cohen's conventions for interpretation, this is a medium effect. However, heterogeneity was high (I^2 = 81%). Fig. 4 illustrated that the effects attained in Siller et al. (2014) were again larger than those found in other studies. Analysis excluding these results revealed that the standardized mean difference decreased to 0.30 (95% CI = 0.11–0.50), and heterogeneity was reduced significantly (I^2 = 6%; Q (12) = 12.80, p = 0.38). On the other hand, mean length of T-Units in words and syntactic complexity were the two indices for *grammar* analyzed.

4 Mean length of T-Units in words. Fig. 5 displays the forest plot of the standardized effect sizes for the Mean length of T-Units in words. Medium to large statistically significant effects were found (standardized mean difference = 0.62; 95% CI = 0.26–0.98); however, heterogeneity was moderate (I^2 = 58%, Q(8) = 19.15, p = 0.01).

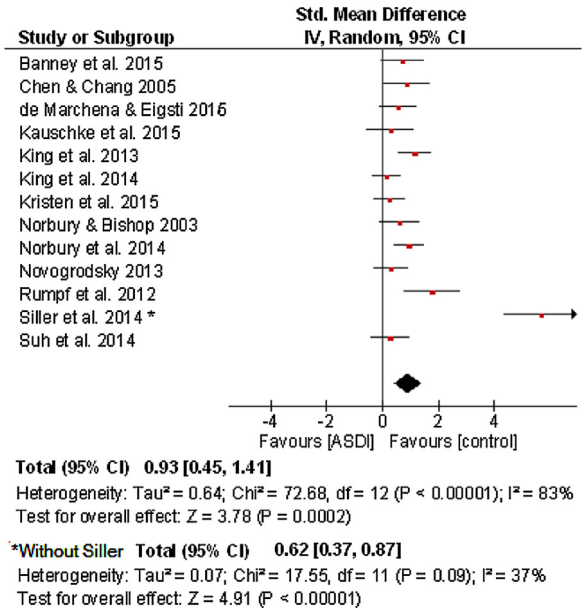


Fig. 2. Forest plot for Number of Words.

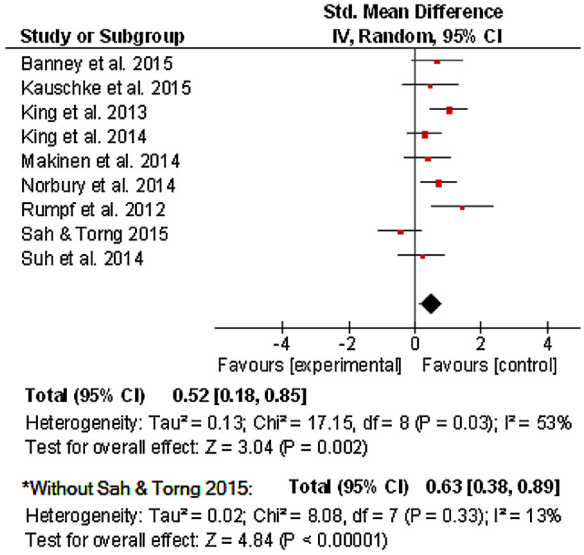


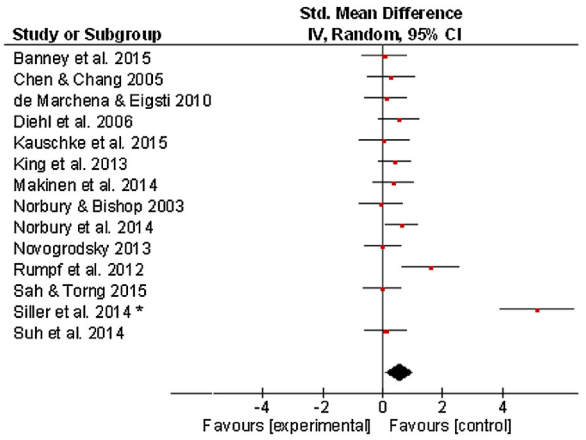
Fig. 3. Forest plot for Number of Different Words.

5 Syntactic complexity. The forest plot for this variable is presented in Fig. 6, indicating moderate statistically significant effects (standardized mean difference = 0.59; 95% CI = 0.29–0.90). Low and non-significant heterogeneity was observed (I^2 = 38%).

3.3. *Macrostructure: coherence and cohesive adequacy*

Macrostructure analysis occurs mainly at the discourse level, with coherence and cohesive adequacy being the core variables analyzed:

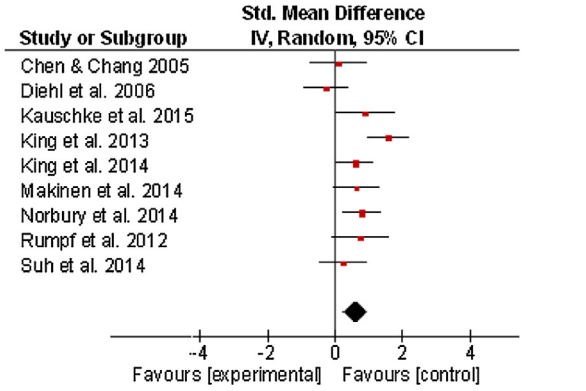
6 Coherence. Fig. 8 shows the forest plot for the analysis of the narrative coherence. The standardized mean difference was high and significant (standardized mean difference = 0.79 (95% CI = 0.49–1.09). Heterogeneity was medium (I^2 = 54%, Q(11) = 23.96, p = 0.01).



Total (95% CI) 0.57 [0.13, 1.02]
Heterogeneity: Tau² = 0.58; Chi² = 69.87, df = 13 (P < 0.00001); I² = 81%
Test for overall effect: Z = 2.52 (P = 0.01)

***Without Siller: Total (95% CI) 0.30 [0.11, 0.50]**
Heterogeneity: Tau² = 0.01; Chi² = 12.80, df = 12 (P = 0.38); I² = 6%
Test for overall effect: Z = 3.01 (P = 0.003)

Fig. 4. Forest Plot for Number of Utterances.



Total (95% CI) 0.62 [0.26, 0.98]
Heterogeneity: Tau² = 0.17; Chi² = 19.15, df = 8 (P = 0.01); I² = 58%
Test for overall effect: Z = 3.39 (P = 0.0007)

Fig. 5. Forest plot for MLU.

7 Cohesive adequacy. The forest plot is presented in Fig. 9, indicating high statistically significant effects (standardized mean difference = 0.93; 95% CI = 0.61–1.26). The heterogeneity index was small ($I^2 = 33\%$) and non-significant ($Q(6) = 9.02$, $p = 0.17$).

3.4. Internal state language

8 Internal state language (ISL). Fig. 7 shows the forest plot for ISL. The standardized mean difference was 0.54 (95% CI = 0.17–0.91), and according to Cohen's conventions, this is a medium effect. Heterogeneity was high ($I^2 = 78\%$), and the effects obtained in Siller et al. (2014) were again larger than in other studies. Analysis excluding these results revealed that the standardized mean difference decreased to 0.36 (95% CI = 0.14–0.58), and heterogeneity was reduced significantly ($I^2 = 36\%$; $Q(13) = 20.30$, $p = 0.09$).

3.5. Subgroup analysis: age, IQ and type of narrative

The statistical homogeneity of most of the meta-analyses suggested that the standard effect size was representative of all conditions. After removing the outliers, significant heterogeneity existed in only two meta-analyses (i.e., MLU and coherence).

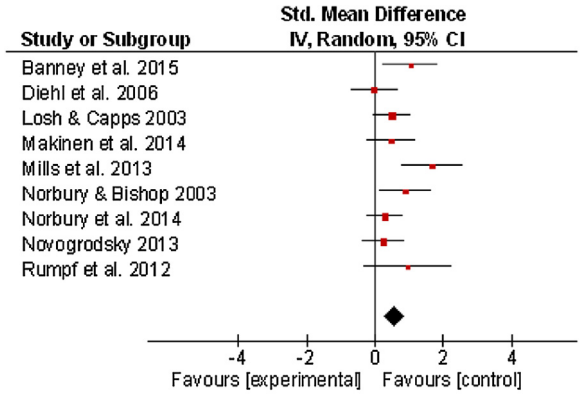


Fig. 6. Forest plot for Syntactic Complexity.

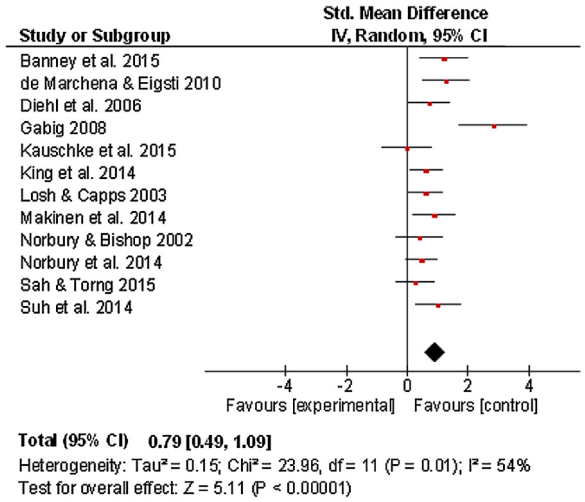


Fig. 7. Forest plot for Coherence.

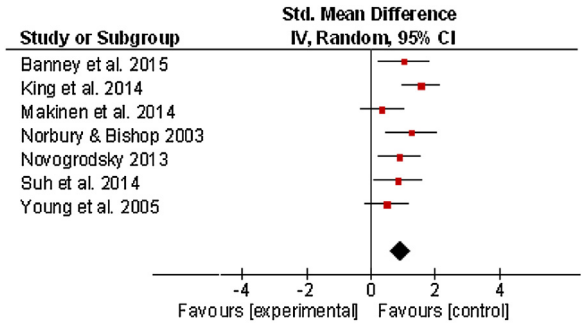


Fig. 8. Forest plot for Cohesive adequacy.

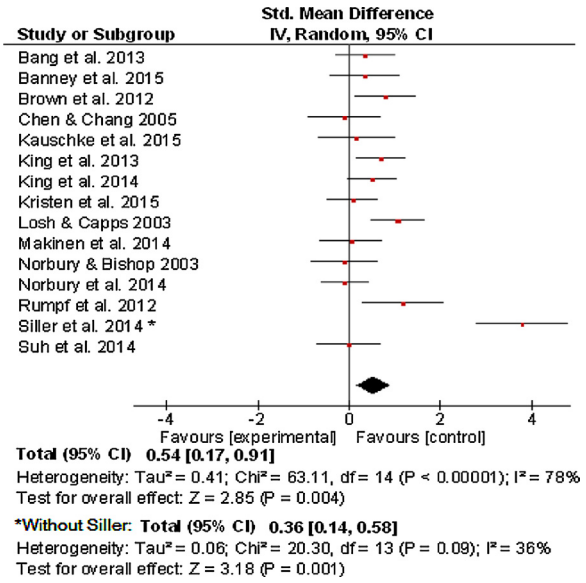


Fig. 9. Forest plot for Internal State Terms.

Three variables were considered as potential moderators: age, IQ, and type of narrative.

The developmental studies show that at around 9 years old, children begin to include complex, embedded, and interactive episodes in their stories (Paul, 2001). Accordingly, in the analysis, samples were divided into younger (6 to 9 years of age) and older (10–15 years of age) groups, referring to the age of the participants with ASD.

The age subgroup analysis revealed that there were no statistically significant differences in the effect sizes across the two age ranges in any variable.

To examine variability in verbal IQ, the studies were separated and analyzed based on whether their standard scores on these tests were above or below 100, taking into account mean IQ score. There was statistically significant heterogeneity between subgroups only on ISL, where the studies with a lower mean IQ had a lower standardized mean difference than the studies with a higher mean IQ ($Q(1) = 4.28$, p=0.04; $I^2 = 76.6\%$). The standardized mean difference remained significant only in the higher mean IQ subgroup, with a moderate effect size (standardized mean difference = 0.51, 95% CI = 0.22–0.80), whereas there was no significant effect in the lower mean IQ subgroup (standardized mean difference = 0.06, 95% CI = −0.25–0.37). Heterogeneity between subgroups was non-significant in all the other meta-analyses.

In addition to age and IQ, a third potential moderator was the type of narrative (picture book/fictional storytelling vs. autobiographical/personal/everyday activities stories), as ASD individuals seem to have more difficulties with personal experience narratives. The type of narrative subgroup analysis revealed that there were no statistically significant differences in the effect sizes across the two conditions. Due to the small number of studies in the second category (personal stories), we conducted sensitivity analyses including only the picture book/fictional storytelling. Again, results showed very similar effect sizes and heterogeneity indicators to those from the original analysis.

4. Discussion

The purpose of this meta-analysis was to more closely examine the narrative abilities of children and adolescents with ASD through the analysis of different indicators of their performance on narrative expression: narrative microstructure and macrostructure and ISL.

This meta-analysis revealed that, in general, individuals with ASD demonstrate lower narrative performance than children and adolescents with TD. They experience significant difficulties on all the variables evaluated, although with different effect sizes.

First, with regard to the narrative microstructure, participants with ASD show a significantly worse performance, with a moderate effect size, on both productivity (indicators of length: number of words and utterances) and lexical diversity (number of different words).

Regarding the indicators of grammar, MLU and syntactic complexity, the results point to a similar tendency. The data obtained are relevant to the degree that opportunities for children to express key grammatical forms are influenced by the extent to which they produce utterances that are long enough to support such structures (Rice, Redmond, & Hoffman, 2006). The results seem to suggest delayed growth in some aspects of morphosyntactic acquisition (Park, Yelland, Taffe, & Gray, 2012).

In the case of the indicators of syntactic complexity, again the data reveal significant differences between groups, with a medium effect size. It should be pointed out that descriptive studies on syntactic abilities in ASD have yielded contradictory results. Some of them have posed the possibility that syntax is an intact domain (Naigles, Kelty, Jaffery, & Fein, 2011), whereas others have referred to a different morphosyntactic trajectory compared to the normotypical population (Eigsti, Bennetto, Dadlani, 2007). The results of our study seem to support the latter proposal, at least when syntactic performance is evaluated through language samples in the subset of population studied here.

Second, the results of this meta-analysis have shown difficulties in the group with ASD on the variables related to the narrative macrostructure, that is, coherence and cohesive adequacy, with a large effect size. The literature indicates that narratives of children with ASD are less causally connected and considerably less coherent than those of controls. They seem less likely to use the gist of the story to organize their narratives according to the story grammar elements. Regarding the cohesion of the narrations, the results reveal significant differences in the adequate use of referential mechanisms by individuals with ASD, who seem to use a greater number of ambiguous pronouns where it is unclear to whom the pronoun is referring. If referential devices are used inappropriately, comprehension and, consequently, the pragmatic adequacy of the discourse can be affected.

Although the design of this study does not allow us to show a causal empirical relationship, the aforementioned alterations could be explained by drawing on the main psychological theories about ASD. Deficits in executive functioning, weak central coherence, and impairments in theory of mind development stand out, bearing in mind that at the cognitive, symptom/behavioral, and genetic levels, autism may be characterized by fractionable impairments (Happé & Ronald, 2008).

Executive function difficulties have been found in ASD, specifically through tasks tapping response inhibition, self-monitoring, and planning (O'Hearn, Asato, Ordaz, & Luna, 2008). A reduced ability to formulate goals, plan how these goals are to be achieved, and carry out the plan might underlie narrative coherence impairments. Likewise, another core component of executive functioning with a strong influence on achieving a correct representation of the discourse is the working memory capacity. In fact, the choice of referential expressions has been related to the degree of activation of mental representations of referents in memory. Particularly, the updating process, which is responsible for monitoring and revising the contents of working memory, has been shown to be relevant when considering the dynamic nature of oral narrative production and the demands of clearly referring to story characters (Whitely & Colozzo, 2013). Furthermore, inhibition may be necessary because speakers must block the optimal form from the speaker's perspective in order to produce the clearest form for the listener. For this reason, theory of mind processes are also expected to be necessary, in order to correctly estimate the shared common knowledge with the listener and, thus, choose the adequate referential procedure. In spite of the difficulties in executive processes experienced by individuals with ASD and their relationship with discourse processing, no studies have been carried out to confirm this connection; consequently, research is needed in this area.

In addition, the Weak Central Coherence hypothesis (WCC) (Frith & Happé, 1994; Happé & Frith, 2006) provides an interpretive approach in which to frame deficits in macrostructure. According to WCC, ASD is characterized by a detail-focused processing bias, resulting from superior processing of local information in the context of relatively poorer processing of global information. Although the results of our study indicate a deficient performance on both local and global discourse levels, it is true that the effect size is greater for the variables that evaluate the narrative macrostructure. Difficulties with narrative coherence might be a test of the verbal domain to support WCC. In fact, there have been some successful attempts to prove the relationship between tasks assessing WCC and narrative competence in individuals with AS. Barnes and Baron-Cohen (2012) demonstrated that adults with ASD were less likely than controls to tell information about the characters, conflict, setting, and resolution, during a narrative task describing film clips. They showed difficulties distinguishing elements that are relevant to the "big picture" from those that are not, and this extended beyond the realm of mental states or social cognition. Likewise, Nuske and Bavin (2011) examined the extent to which the WCC cognitive style affected comprehension and inferential processing of spoken narratives. Children with ASD experience difficulties in integrating information in order to make script inferences, just as TD children do. Given the theoretical implications of these studies, more research is needed to clarify the role of WCC in communicative abilities of individuals with ASD.

Apart from discourse dimensions like micro and macrostructure, an aspect that has been analyzed exhaustively is ISL. Mental language in narratives is required in order to generate the more complex narrative structures to talk about what story characters are trying to do and what the characters' motivations are (Gammannosi & Pinto, 2014). Furthermore, some studies have shown the intricate interrelations between autistic children's use of ISL and their overall comprehension of the mind (Sodian et al., 2015 Sodian, Schuwerk, & Kristen, 2015), as well as their ToM abilities (Siller et al., 2014). According to the results of the meta-analysis, individuals with ASD include significantly fewer ISL terms, with a medium effect size, with IQ acting as a moderator variable. In fact, participants with a higher intelligence level present significant difficulties, compared to their peers, in the recognition and verbal identification of internal states. This could suggest an asynchrony in their development, an uneven growth in cognitive and linguistic aspects with socioemotional meaning, which seem to follow different developmental paths. Only longitudinal studies can respond to this question.

Moreover, the significance of the data analyzed also stems from their cross-linguistic nature, as they include studies in languages with different typologies (Chinese, German, Finnish, English). It should also be highlighted that the studies considered different types and assessment procedures. Contrary to expectations, our data show that there were no statistically significant differences across the two conditions (story telling versus personal stories). However, the small number of studies included in the analysis does not allow us to draw firm conclusions.

It would have been especially relevant to analyze the influence of the linguistic level on narrative abilities, as matching ASD and TD participants on this variable seems to eliminate some differences related to narrative length and syntactic complexity (Diehl et al., 2006). However, we were unable to analyze this aspect because of the small number of the studies that included this variable, and there was high heterogeneity in the instruments assessing different aspects of receptive and expressive language. Future research will provide clearer answers to this issue.

Our study has also identified gaps in the scientific research. For example, most of the participants in the studies are male children and adolescents, which reflects the reality of the prevalence of the diagnosis in boys compared to girls (Zablotsky, Black, Maenner, Schieve, & Blumberg, 2015). However, it would be interesting to find out how the aspects analyzed affect the population of females with ASD in order to design evaluations and interventions that fit their profile of strengths and weaknesses.

Although this meta-analysis has focused on narrative production, it would be advisable to have more studies that look more closely at story comprehension difficulties, given that comprehension deficits can reduce a child's understanding of narratives and influence the quality of the responses. Our study has also focused on the oral modality. It would be interesting to find out whether the results obtained are generalized to written narratives, as pointed out in a recent study where students with ASD performed significantly better on measures of productivity and accuracy, but had low scores on measures of text quality (Dockrell, Rickets, Charman, & Lindsay, 2014).

Finally, another step in the research on narrative performance would involve performing a detailed analysis of the narrative sequences integrated in spontaneous conversation. An attempt was made to explore these types of dialogic narrations in the pioneer study by Solomon (2004). Through video and audio recordings of real life interactions at home and at school, the results showed that children with ASD were especially competent in the use of stable introductory practices when launching fictional narratives, perhaps due to the relative stability of introductory formats. Their challenge was not in the introduction, but rather in the narrative co-telling, which was often not globally organized around an extended set of propositions. Bottema-Beutel and White (2015) also adapted discourse analysis methodology to analyze storyboards created using photographs in group meetings between adolescents with ASD and TD over the course of a two-week summer camp. The study showed that, although many individuals with ASD exhibited a sophisticated awareness of narrative structure, with strict adherence to its essential components, the interactional engagement was more difficult for adolescents with ASD than it was for their peers. Therefore, this is an area in which to concentrate applied research efforts.

Our study has some limitations that must be pointed out. The first has to do with the functional level of the participants, which affects the extent to which these findings can be generalized to the total population of individuals with ASD. Other issues are related to the approach used in this meta-analysis and in most of the studies reviewed, focused on the description of deficits, and not on searching for strengths or compensating for difficulties through the use of alternative, conscious strategies. As Prizant (1983) stated more than three decades ago, there is a need for studies that are preoccupied not with nomenclatures of deficits and deviance, but rather with strategies and processes that underlie patterns of individuals with ASD communicative behavior. Finally, other limitations of the study are inherent to the methodology of the meta-analysis itself. We attempted to control some factors, such as the duplication of shared samples to prevent effects introduced by an inflated sample size. However, other elements are more difficult to neutralize, such as the source and methodology of the recruitment employed in every investigation and any problems that can threaten the validity of the individual studies and, therefore, the meta-analysis of these studies (Green, 2012).

5. Conclusion

In summary, this comprehensive review and meta-analysis made it possible to draw a general profile of narrative abilities that can contribute to the endophenotypic characterization of ASD and the establishment of intervention objectives in this area. Narrative is a vulnerable domain in children and adolescents with ASD, and it is a particularly useful instrument due to the limitations of standardized tests, such as lack of sensitivity (Botting, 2010). Based on the results of our study, their performance is worse on all the variables considered, with a larger effect size in aspects that evaluate the macrostructure of the story. Consequently, for clinicians it is crucial to plan interventions designed to improve this weakness in discourse competence, especially considering the close relationships among the narrative domain, academic achievement, and social relations.

Although only incipiently, recent studies have been published consisting mainly of single-subject research designs. For example, Petersen et al. (2014) targeted story-grammar elements and linguistic complexity through an intervention that involved repeated retellings of customized model narratives and the generation of personal narratives with visual supports. Results showed immediate improvement on targeted language features, although there was mixed evidence of maintenance afterwards. Other studies have tried to compare this approach with others focused on promoting the development of mentalist skills and causal language, emphasizing characters' emotions and cognitive states of mind (Dodd, Ocampo, & Kennedy, 2011). Interventions in this direction, designed to improve the use of mental state and causal language, have produced positive gains in fictional narration abilities, effects that were maintained after intervention was discontinued (Gillam, Hartzheim, Studenka, Simonsmeier, & Gillam, 2015; Tsunemi et al., 2014). One aspect that has not been considered in interventions addressed to improving narrative competence is the motivation for narrating. Telling a story not only requires linguistic resources, but also interest in telling something and sharing it with the partner. Along with this communicative initiative, the creation of a shared space with the partner is a key factor in the development of the communicative compe-

tence and, specifically, the narrative ability. Therefore, this might be a promising area of applied research to considerably improve children's with ASD ability to understand, communicate and interact socially with others.

Conflict of interest

The authors declare that they have no conflict of interest.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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