Morphosyntactic Development and Bilingualism in Children with Autism Spectrum Disorder: A Case Study

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28/05/2025

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ACKNOWLEDGEMENTS

I would like to express my gratitude to Dr. Montserrat Capdevila for wisely supervising this dissertation.

I would also like to sincerely show gratitude to Dr. Adriana Soto-Corominas. Though unable to supervise this thesis in the end, her initial spark and vision have been of great value for its inception. I am deeply convinced that university needs more professors like you.

Furthermore, this endeavor would not have been possible without the invaluable support and guidance of Dr. Io Salmons, who patiently advised me throughout this journey. I also extend my deepest appreciation to Dr. Cristina Real-Puigdollers for connecting me with Dr. Io Salmons, as well as for her suggestions on syntax.

I would also like to thank D. T. Without your ideas, this piece of work would not have been possible.

Finally, words cannot express my sincere appreciation for the support that I received from my mother, who always trusted me. There is nothing in this world like the genuine and deep love and support of a mother.

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Abstract

The relationship between morphosyntactic processing, bilingualism and Autistic Spectrum Disorder (ASD) has increasingly been of interest during the last 30 years. Thus, several linguists and psychologists have proposed that here might be a connection between Theory of Mind (ToM), and Executive Functions (EF), especially Working Memory. Furthermore, research is progressively demonstrating that bilingualism is not detrimental for Language Acquisition, and it might even be beneficial in cognitive terms. This thesis aims at understanding the relationship between the mastery of subordinate clauses and its connection with ToM and EF. Additionally, it also seeks to investigate the effects of bilingualism in children with Normal Language ASD (ASD-NL). To do so, a case of a 15-year-old English speaking teenager with ASD-NL was studied by means of a Sentence Repetition Task and a low-verbal ToM task. The results suggested that there seems to be a correlation between morphosyntactic abilities and ToM, as well as with a good Working Memory. Furthermore, bilingualism did not seem to affect his processing of morphosyntax, at least in his L1.

Keywords: Autistic Spectrum Disorder, Theory of Mind, Executive Functions, Morphosyntax, Bilingualism.

1. Introduction

The intersection of Autism Spectrum Disorder (ASD) and language has increasingly been explored in recent decades within the domain of psycholinguistics. Recent literature has suggested that there may be linguistic differences between some profiles of ASD and Typically Developing (TD) children, especially in pragmatic contexts, due to the nature of the condition itself (Schaeffer et al., 2023, pp. 436-437).

Such language impairments have also been analyzed in morphosyntax. For instance, some authors, such as Modyanova, Perovic and Wexler (2017), claim that some people with ASD exhibit certain morphosyntactic deficits that might be directly related to the ASD condition itself. Furthermore, it has also been stated that morphosyntactic processes might play a key role in the linguistic and cognitive performance of children with ASD, as well as in tasks related to the comprehension of false beliefs and Executive Functions (EF) (Meir & Novogrodsky, 2019, p. 12; Andreou et al. 2020).

However, although scientific literature in the field has increased over the past few years, the comprehension of the morphosyntactic processing in ASD children, in comparison to their neurotypical peers, is still under debate (Modyanova et al., 2017; Schaeffer et al., 2019). Thus, more research is needed to understand how morphosyntax affects cognitive processes, such as Theory of Mind (ToM) and Executive Functions (EF). Additionally, the knowledge of the effects of bilingualism on people on the autistic spectrum is still under discussion. While some experts still defend that bilingualism may be detrimental for people with ASD, recent literature indicates that this hypothesis might not be true (Drysdale et al., 2015, pp. 34-35; Paradis et al., 2021, p. 306).

This dissertation aims to contribute to our knowledge of the connection between cognition, language and ASD, by conducting a psycholinguistic experiment with a 15-

year-old boy diagnosed with ASD. To do so, the purpose of this paper is twofold. On the one hand, it intends to explore the connection between morphosyntax and cognition in ASD people, especially focusing on ToM and EF. On the other hand, it seeks to clarify whether bilingualism may have adverse, neutral, or beneficial cognitive effects on people on the spectrum.

Therefore, the present study will first set a theoretical background concerning ASD, cognition and bilingualism. It will then delve into the linguistic differences between ASD children and their neurotypical peers, as well as the relationship between morphosyntax and ASD and its potential clinical applications. In light of these considerations, this paper will introduce the main objectives of the study, and the methodology of the experiment. Later, the results of this experiment will be presented, and consequently discussed. Finally, the conclusion section will provide a summary of the study's main findings and outline directions for future research.

2. Theoretical Background

2.1. Autistic Spectrum Disorder and Language Development

Autism Spectrum Disorder (ASD) has been defined by the DSM-V (APA, 2022) as a neurodevelopmental disorder. Individuals with this condition show a series of characteristics, such as deficits in social communication and interaction, or restricted repetitive patterns of behavior, interests, or activities (APA, 2022, pp. 56-57). Thus, since individuals with ASD tend to show communicative deficits, linguistic deficits need to be understood as an underlying cause of these (APA, p. 56).

However, even if language impairment seems to be directly correlated with ASD, the fact is that not all children with this condition will show the same linguistic patterns. Due to

that heterogeneity, it is essential to make a distinction between all possible linguistic profiles.

According to Schaeffer et al. (2019, p. 436), three main linguistic profiles may be described: 'Normal Language' (ASD-NL), 'Language Impairment' (ASD-LI), and 'Minimally Verbal Abilities' profiles (ASD-MV). Firstly, NL individuals have linguistic skills comparable to those of their neurotypical peers. Secondly, the LI types are those who present some degree of language disorder, at least in one module of language (morphosyntax, pragmatics, phonology, etc.). Finally, ASD-MV corresponds to those who have very scarce linguistic communication skills, or even those who cannot communicate through oral language.

As for the purpose of this dissertation, we will be focusing on the effects of language in NL ASD individuals. Hence, the first element that we will take into consideration is going to be nonlinguistic cognition, and its association with language.

2.2. The Cognitive Impact of Language on ASD

Aside from core linguistic impairments, individuals with autism also tend to present deficits in linguistic tasks related to cognition. For instance, scientific literature suggests that individuals on the spectrum have difficulties with tasks related to Theory of Mind and Executive Functions (Andreou et al., 2020, p. 1). Therefore, to gain a deeper understanding of the interaction between language and autism, these two elements need to be considered as well.

2.2.1. Language and Theory of Mind in ASD

Theory of Mind (ToM) refers to the "idea of understanding social interaction by attributing beliefs, desires, intentions, and emotions to people" (Astington & Jenkins, 1999, p. 1311). In other words, ToM allows people to understand how other people think

and feel, as well as the otherness of people's mental states. While neurotypical individuals do not tend to present difficulties with Theory of Mind, people on the autistic spectrum usually exhibit deficits in performing tasks related to ToM (Astington & Jenkins, 1999, pp. 1312-1313). These deficits are related to poor performance on pragmatic tasks, since ToM requires a precise comprehension of the context (see 3.1. Pragmatic Impairment).

While the term "Theory of Mind" was initially conceptualized in the study of chimpanzees (Premack & Woodruff, 1978), the concept swiftly became a central focus for understanding human social cognition and development (Wimmer & Perner, 1983). One of the best-known experiments testing ToM skills in humans in existing literature is the Sally-Ann experiment. In this experiment, children are shown a scene where two dolls (Sally and Ann) are next to a basket and a box, respectively. Sally puts a marble in the basket and leaves the scene. Then, Ann changes the place of the marble and puts it in the box. When Sally returns to the scene, the participant is asked where Sally will look for the marble (Baron-Cohen, Fritz & Leslie, 1985, p. 41).

This experiment tests the capacity of the individual to comprehend that what they see (the state of the world) may not be equivalent to what other people believe (a state of someone's mind). This will not only be interesting for the study of pragmatic skills, but also for morphosyntax. We will later explore the implications that morphosyntax may have in Theory of Mind.

2.2.2. Language and Executive Functions

Similar to their difficulties with Theory of Mind (ToM) tasks, individuals with ASD often exhibit challenges with Executive Function (EF) tasks. According to Diamond (2013), EFs might be defined as follows:

> Executive functions (EFs; also called executive control or cognitive control) refer to a family of top-down mental processes needed when you have to concentrate and pay attention, when

> going on automatic or relying on instinct or in tuition would be ill-advised, insufficient, or impossible (Diamond, 2013, p. 136).

As such, EF may be classified into three main categories: inhibition, working memory, and cognitive flexibility (Diamond, 2019, p. 136). In particular, inhibition and working memory seem to be impaired in ASD, as has been observed in some neuropsychological studies (O'Hearn et al., 2008, pp. 1103, 1124).

Inhibition, also known as inhibitory control, is the EF that allows us to control our own impulses (Diamond, 2019, p. 137). Working memory, conversely, "involves holding information in mind and mentally working with it" (Diamond, 2019, p. 142). Given the observed impairments in these two executive functions in individuals with ASD, many studies analyzing morphosyntax in children with ASD, such as Andreou et al. (2020, p. 9) or Meir and Novogrodsky (2019, p. 5), measure both inhibition and cognitive flexibility. For instance, in order to analyze working memory, children were exposed to an N-back task. Several digits were shown to them, and they had to press a button when they detected the same number after two trials (Andreou, 2020, p. 9). This allowed the researchers to have a better grasp of the relationship between EF and language, beyond linguistic tests. For instance, Meir and Novogrodsky (2019), they observed how working memory predicted performance on third-person subject pronouns. Furthermore, Andreou (2020) detected a correlation between ToM and language pragmatics.

2.2.3. Bilingualism in ASD

Finally, one of the main subjects of interest concerning language and ASD is the effects of bilingualism within this population. It is a common belief that speaking two or more languages can be counterproductive for children on the spectrum (Paradis, 2021, pp. 302, 309-310), since it might potentially delay their language development process. However,

recent literature on this topic suggests quite the contrary. Since this belief has gained popularity among society, one of the aims of this paper is to question this presumption by analyzing the effects of bilingualism in ASD, from a morphosyntactic perspective.

According to a systematic review conducted by Drysdale, Van Der Meer, and Kagohara (2015, p. 34), bilingualism was not a delaying factor in language acquisition in people with ASD. After conducting a systematic search, they only found eight articles appropriately addressing the issue of bilingualism in ASD. None of them could empirically demonstrate that bilingualism is negative for children on the autistic spectrum. Similarly, Paradis et al. (2021) reached the same conclusion:

> The bilingual children with ASD did not differ significantly from the monolingual children with ASD on standardized tests of expressive and receptive vocabulary and other language skills in their dominant language. (…) Systematic reviews of studies using this approach have concluded that bilingualism does not appear to result in differential disadvantages in children with ASD in the early years (Paradis, 2021, p. 306).

Thus, if the main question is not whether it is harmful or not for people with ASD, we might rather question whether it is beneficial or neutral. In this regard, there is still no clear evidence of the exact nature of the effects of bilingualism within people on the spectrum. For example, Drysdale et al. (2015) concluded that, from eight relevant studies, five claimed bilingualism to be neutral, two claimed it to be positive, and the one remaining did not assess it (pp. 30-32).

Nevertheless, in the case that bilingualism is neutral in terms of cognitive and linguistic development, it would still hold advantages in other domains. For instance, it might be beneficial in terms of job opportunities or in the sense that they might be able to communicate with more people. Hence, in light of these considerations, bilingualism seems to be potentially beneficial, even though it does not present any apparent cognitive benefit.

3. Language Impairment and Clinical Applications of Morphosyntax in ASD children

3.1. Pragmatic Impairment

When studying linguistic deficits in ASD, one of the first areas that appears to be affected is pragmatics. This branch of linguistics studies the meaning of language in context, by taking into account knowledge of the world (Griffiths, 2006, p. 1). Since children on the spectrum tend to have difficulties understanding others' beliefs, pragmatic difficulties are the most visible type of linguistic deficit.

For instance, children with ASD tend to display impairment in interpreting figurative language, as a result of their literal interpretation of discourse (Bennetto, Dadlani, and Eigsti, 2006, p. 1008). Furthermore, they usually present problems in applying the Gricean maxims of quality, quantity, relevance, and manner (Grice, 1989). That is why people with this condition are prone to using pedantic speech in inappropriate contexts (Eigsti et al., 2006, p. 1008).

Additionally, pragmatic impairment has also been reported to be related to other linguistic areas, such as at the pragmatic-prosody interface (Schaeffer et al., 2023, pp. 439-440). The explanation lies in prosody's potential to convey extralinguistic meanings, which are rooted in the social/pragmatic level (Shaeffer et al., 2023, p. 439). Consequently, research has shown prosody to be at the center of pragmatic deficits in individuals with ASD, since problems with both production and perception of lexical stress, intonation or phrase boundaries appear to be common (Paul et al., 2005, pp. 213-214).

In fact, not only does pragmatic-prosody impairment rely on pure linguistic and cognitive deficits, but it also seems to have a neural basis. Studies such as Eigsti et al. (2012) demonstrated through fMRI (brain imagery) that there are neural differences between

ASD and neurotypical individuals in the activation of neural regions related to prosody. This is another factor to take into consideration when analyzing the interaction between language and ASD as a neurological disorder.

However, even though linguistic deficiencies in ASD have been largely studied, research in other areas, such as morphosyntax, has been notably less explored (Eigsti et al., 2006, p. 1008). Hence, in the present study, we will try to analyze this perspective more in depth from a morphosyntactic approach.

3.2. Morphosyntactic Impairment and Acquisition

Beyond pragmatics, one of the modules that also appears to play an important role in the linguistic skills of people with ASD is morphosyntax. Indeed, most of the literature indicates a correlation between morphosyntax and cognitive development within this population (Astington and Jenkins, 1999, p. 1318; Andreou et al., 2020, p. 18). Thus, as stated in the section above for pragmatics, morphosyntax appears to be impaired and differently acquired in people on the spectrum.

One of the aspects of morphosyntactic impairment that has been examined is the expression of tense in early stages of language acquisition in ASD children. Studies such as those of Walenski, Mostofsky, and Ullman (2014) or Modyanova, Perovic, and Wexler (2017) analyzed the production of finiteness in children with ASD compared to those with Typical Development (TD). As a matter of fact, the latter suggested that a higher production of errors in finiteness is related to the level of cognitive maturity in people with ASD, rather than age. This consequently indicates a correspondence between cognition and morphosyntax.

In the same vein, other studies have focused on the use of complex sentences to understand this connection between cognitive processes and morphosyntax. It has been

proposed that complex syntactic structures, such as subordinate clauses, may be more difficult to acquire for children on the autistic spectrum than simple syntactic structures, since the former imply more complex cognitive processing (Durrleman et al., 2019). In the next section, we will discuss the main implications of subordinate clauses and the cognition of individuals on the spectrum by considering Theory of Mind.

3.2.1. Subordinate Clauses and ToM

As discussed above (see 2.2.1. Language and Theory of Mind in ASD), Theory of Mind is pivotal to understanding the cognitive deficits that autistic individuals may display. However, even if people on the autistic spectrum tend to perform poorly at ToM tasks compared to their neurotypical peers, this deficit is not only present in their conduct. As has been studied, these deficits also seem to be directly reflected in language.

For instance, one of the most relevant findings in this field was the discovery of the connection between subordinate clauses and ToM. In fact, studies such as Astington and Jenkins (1999) or De Villiers and Pyers (2002) have already pointed to this relationship. Since ToM implies distinguishing that the reality that one perceives may differ from that of another person, language needs to reflect that metarepresentational reality (Astington and Jenkins, 1999, p. 1318). Thus, syntax allows this representation through the use of complement clauses with mental verbs, as we may observe in (1) (De Villiers and Pyers, 2002, p. 1038).

(1) Peter thinks *that the sky is green*.

In (1), the verb *think* requires a direct object, which may be filled with a Noun Phrase (NP) or with a complement subordinate clause. It is pivotal to note that the subject is semantically an experiencer, since the subject is perceiving something, instead of performing or undergoing an action (Fromkin, Rodman, and Hyams, 2003, pp. 164-165).

This semantic requirement for the subject is also inherent to the verb. This theta-role allows the experiencer subject to process the reality contained in the following subordinate clause that is dependent on the main verb (in this case, *think*).

In other words, in order to represent a reality that is different from ours, embedded clauses with mental verbs are needed. Consequently, it has been observed that these complex structures might be more challenging to people on the autistic spectrum (Durrleman et al., 2015). In the same vein, Durrleman et al. (2019) studied the possible clinical applications of the mastery of complementation. Their findings suggested that strengthening complementation skills had a direct correlation with their understanding of false beliefs (Durrleman et al., 2019, pp. 7, 12). It is also important to mention that this is the first study of this nature, which underlines the necessity for further research in this topic.

Interestingly, as for the intersection between subordinate clauses and cognition, some findings have been of great interest. Andreou and Tsimpli (2020) already detected a difference in cognitive processing between complement clauses and adverbial clauses. According to their findings in a sentence repetition task in TD Albanian-Greek speaking children, the processing of complement clauses was observed to be tied to the specific properties of each language (core syntax), whereas the processing of adverbials rather appeared to be related to discursive skills, which might be transferable from one language to another (Andreou and Tsimpli, 2020, p. 152). Consequently, it can be affirmed that complement clauses are best analyzed as part of the core syntax of a language, while adverbial clauses are part of the syntax-discourse interface.

Indeed, these underpinnings are relevant in order to comprehend the implications of morphosyntax and ASD, since they might be transmittable to the linguistic abilities of people on the spectrum. Furthermore, another study by Andreou et al. (2020, p. 16)

demonstrated that subordinate complement and relative clauses were differently processed in monolingual and bilingual children. That is why, in the next section, we will discuss the implications of bilingualism, morphosyntax, and ASD.

3.2.2. Bilingualism and Morphosyntax in Children with ASD

As stated above, recent research indicates that bilingualism does not seem to have a negative impact on people on the autism spectrum. However, there seems to be an association between bilingualism, morphosyntax, and ASD.

To the best of my knowledge, only two studies investigated the effects of morphosyntax in monolingual and bilingual children with ASD. The first one, conducted by Meir and Novogrodsky (2019), studied the effects of syntactic and cognitive differences between monolingual ASD infants in Hebrew and bilingual Hebrew-Russian children with ASD in terms of the use of the third-person pronoun in both languages. Hebrew is a partial pro-drop language, since it only allows pro-drop subject pronouns in some specific morphosyntactically restricted contexts, whereas Russian does not allow pro-drop subjects, except for subordinate clauses (Meir & Novogrodsky, 2019, p. 4). The study tested their use of these pronouns by means of a pronoun elicitation task, a sentence repetition task, a non-verbal ToM task, and two EF tasks measuring working memory and inhibition (Meir & Novogrodsky, 2019, pp. 6-7).

The second one, conducted by Andreou et al. (2020), studied the processing of subordinate clauses in bilingual Albanian-Greek children. Children were only tested in Greek, which was their L1. They used verbal and non-verbal ToM tasks, an executive function 2-back task and a sentence repetition task (Andreou et al., 2020, pp. 7-11).

On the one hand, Meir and Novogrodsky (2019) found ASD to be an indicator of language impairment in terms of the licensing of third-person pronouns when not allowed by the

morphosyntactic restrictions of Hebrew and Russian. Nonetheless, they concluded that monolingual and bilingual children with ASD scored quite similarly (p. 12). As a consequence, they could not determine bilingualism to be negative for their linguistic proficiency.

On the other hand, Andreou et al. (2020) tested the processing of different types of subordinate clauses (complement, relative, and adverbial) in bilingual Greek-Albanian children with ASD. The results of this study indicated that bilingual children performed better in adverbial and relative clauses. This could be explained given that the command of these types of subordinate clauses is more transferable between languages than the command of subordinate clauses, which is more restricted to the properties of each language, and thus, to the core syntax (Andreou et al, 2020, p. 16).

Even if these findings are quite encouraging, the truth is that research is still scarce on that topic. Our knowledge of the effects of complex morphosyntax on individuals on the autistic spectrum is still limited. Thus, it is of great importance to investigate more in depth the implications of the processing of subordinate clauses in monolingual and bilingual children with ASD, as well as its implications for ToM and EF.

4. Objectives of the study

Given the little amount of research investigating the effects of morphosyntax and bilingualism in ASD, it is essential to keep expanding our knowledge in this field. That is why, in line with the theoretical background exposed above, and the findings obtained by Andreou et al. (2020), the objectives of this study are twofold.

On the one hand, it investigates whether bilingualism may have a negative, a neutral, or a positive impact on people on the autistic spectrum. On the other hand, it explores

whether there is a correlation between an effective processing of subordinate clauses and a strong performance in ToM tasks, involving False Beliefs (FB).

As for the effects of morphosyntax in ASD, in view of the theoretical background exposed above, the present working hypothesis is that there is a correlation between strong ToM abilities and strong morphosyntactic processing. In fact, this would be in line with previous work such as Durrleman et al. (2015; 2019) or Andreou et al. (2020). That is why, in case an individual with ASD presented ToM deficits, that would be immediately reflected in his performance in tasks implying morphosyntax, such as a repetition task, and vice-versa. Furthermore, as for the bilingual variable, the second hypothesis is that bilingualism does not negatively impact linguistic performance in individuals on the spectrum and might even be associated with enhanced abilities. This would align with the results presented in Andreou et al. (2020), where ASD bilinguals tended to outperform their monolingual peers.

5. Methodology

5.1. Participants

This case study was conducted with a 15-year-old male adolescent, diagnosed with Autistic Spectrum Disorder. According to his diagnosis, he is a High-Functioning ASD teenager with proficient linguistic skills. He therefore fits the ASD-NL profile mentioned above (see 2.1. Autistic Spectrum Disorder and Language Development). Since he was born in Ireland, he is a 15-year-old L1 English subject. However, he also had knowledge of Spanish at a medium to high level when he was a child and holds an elementary knowledge of Portuguese.

5.2. Procedure

The test was conducted via an online video call, due to geographical difficulties. A PowerPoint presentation was used to make the experiment more engaging. The tasks were explained to the participant, and, as for the sentence repetition task, he made two attempts with feedback to ensure that he understood it. For the remaining items, he received no feedback.

He was asked to repeat each sentence after three seconds of pause. After five to seven sentences, he had time to take a pause, so that possible errors were not caused by fatigue.

Then, he took a Sally-Ann test. To do so, he was told the Sally-Ann story, and he was asked where Sally would look for her ball. The scoring of this test was 1 (Yes) or 0 (No), since a response such as “in the basket” would imply that he had a robust ToM, whereas a response such as “in the box” would rather imply poor ToM abilities (Baron-Cohen, Fritz & Leslie, 1985).

Both the participant and his parents were given written consent, which they signed. No recordings were obtained to protect his privacy. All the sentences were uttered by the researcher with a normal prosody. Additionally, the entire test was conducted in English.

5.3. Materials

A first sentence repetition task was administered to analyze his processing of subordinate clauses (complement, relative and adverbial clauses), as well as his working memory. This task was retrieved from Andreou et al.’s (2020, p. 8-9) study’s adaptation of the Armon-Lotem and Marinis (2015) sentence repetition task. Although mostly used with children, Andreou et al. (2020) also used it in teenagers until 15.6 years old for their monolingual participants and 14,5 years old for their bilingual participants.

The participant was exposed to twenty-two sentences containing subordinate clauses. Five of these sentences were adverbial subordinate clauses with the causal conjunction *because*, the concessive conjunction *even though*, and the temporal conjunctions *when*, *before*, and *after*. Eleven were complement clauses, which were divided into *that*-clauses, *who*-clauses, and two gerundives and one infinitival complement clauses. Finally, six were relative clauses, with three subject and three object relative clauses. Furthermore, the sentences had a length between eight to thirteen syllables each. The number of content and function words was counted.

Then, he took a Sally-Ann test (see 2.2.1. Language and Theory of Mind in ASD) in order to measure his ToM abilities. A picture was used to do the test (see 10. Apendix).

6. Results

6.1. Sentence Repetition Task

The results for the sentence repetition task are presented in Table 1 and Table 2. Table 1 presents the target structure, the number of exact repetitions (ER, which are equivalent to verbatim repetitions), changes (CH), grammaticality (GR) and the expected structures (STR). Table 2 shows the number of changed words. According to their meaning, words are classified into content words (C) and function words (F). TC and TF stand for the total content and function words of the sentences, and MC and MF stand for the modified content and function words by the participant. The number of omissions, substitutions, and additions are represented in the table as well. The sentences are shown in the Appendix.

Since ER, GR, and STR are Boolean expressions, their score could either be zero or one. As for CH, three points were assigned if there were no changes, two if there was one change, one if there were two changes, and zero if there were three or more changes.

ITEM	Target	ER	CH	GR	STR
1	Adverbial	1	3	1	1
2	Adverbial	1	3	1	1
3	Adverbial	1	3	1	1
4	Adverbial	1	3	1	1
5	Adverbial	1	3	1	1
6	That-Compl	1	3	1	1
7	That-Compl	1	3	1	1
8	That-Compl	1	3	1	1
9	That-Compl	1	3	1	1
10	W-Compl	1	3	1	1
11	W-Compl	**0**	**2**	1	1
12	W-Compl	1	3	1	1
13	W-Compl	1	3	1	1
14	I/G-Compl	**0**	**1**	1	1
15	I/G-Compl	1	3	1	1
16	I/G-Compl	1	3	1	1
17	Subj-Rel	1	3	1	1
18	Subj-Rel	1	3	1	1
19	Subj-Rel	1	3	1	1
20	Obj-Rel	**0**	**2**	1	1
21	Obj-Rel	1	3	1	1
22	Obj-Rel	1	3	1	1
TOTAL		19/22	62/66	22/22	22/22

Table 1. Target Structure, Exact Repetitions, Changes, Grammaticality and Expected Structure.

ITEM	Words				Omissions		Substitutions		Additions	
	TC	MC	TF	MF	C	F	C	F	C	F
1	5	0	4	0	0	0	0	0	0	0
2	4	0	5	0	0	0	0	0	0	0
3	5	0	4	0	0	0	0	0	0	0
4	5	0	4	0	0	0	0	0	0	0
5	5	0	5	0	0	0	0	0	0	0
6	4	0	6	0	0	0	0	0	0	0
7	3	0	9	0	0	0	0	0	0	0
8	5	0	4	0	0	0	0	0	0	0
9	3	0	6	0	0	0	0	0	0	0
10	5	0	6	0	0	0	0	0	0	0
11	5	0	3	**1**	0	0	0	**1**	0	0
12	3	0	5	0	0	0	0	0	0	0
13	3	0	4	0	0	0	0	0	0	0
14	5	**1**	3	**1**	0	0	**1**	**1**	0	0
15	3	0	4	0	0	0	0	0	0	0
16	4	0	1	0	0	0	0	0	0	0
17	4	0	4	0	0	0	0	0	0	0

18	3	0	4	0	0	0	0	0	0	0
19	5	0	4	0	0	0	0	0	0	0
20	4	**1**	4	**1**	0	0	**1**	**1**	0	0
21	4	0	4	0	0	0	0	0	0	0
22	3	0	4	0	0	0	0	0	0	0
TOTAL		2/22		3/22	0/22	0/22	2/22	3/22	0/22	0/22

Table 2. Total of Content and Function Words Modified by Omission, Addition and Substitution.

The participant performed at ceiling in the sentence repetition task (Table 1). He produced 19 exact repetitions (ER) out of 22 and he only made 4 changes. All the sentences remained grammatical and preserved the expected structure.

As observed in the tables above, only three of the twenty-two sentences underwent modifications. Therefore, these modifications are presented below. (2a), (3a) and (4a) are the target sentences, and (2b), (3b) and (4b) are the utterances that the participant repeated.

(2) a. I wonder who left that door wide open.

b. I wonder who left *the* door open wide open.

(3) a. Learning new languages can be good for you.

b. Learning *a language* can be good for you.

(4) a. Mary found the book that you had read.

b. *Mally* found the book that you had read.

As observed above, the participant changed a function word to another function word (*the* instead of *that* in 2b). Furthermore, he changed one content word to a function word with a similar syntactic function (*a* instead of *new* in 3b) and consequently modified the morphology from *language* to *languages* to express plural. He finally replaced a content word with another very similar one (*Mally* instead of *Mary* in 4b).

Despite modifying content and function words, the participant respected the grammaticality and the target structure in all sentences (22 out of 22). The proportion of changes was small in comparison to exact repetitions (Figure 1). Thus, the exact repetitions represent more than 80%.

Figure 1. Exact Repetitions and Changes according to the total amount.

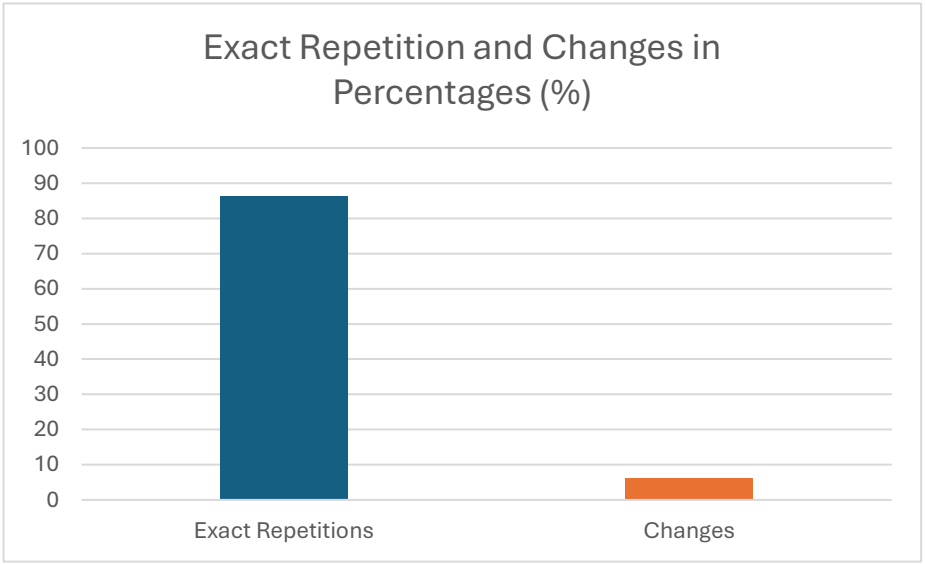

Figure 2. Exact Repetitions and Changes in Percentages.

6.2. Sally-Ann Theory of Mind Task

Since the Sally-Ann task admitted a binary response, the result could be either positive or negative. The participant responded "in the basket," suggesting that he has strong ToM skills and a sufficient comprehension of False Beliefs.

7. Discussion

The results presented above show that there appears to be a correlation between ToM skills and morphosyntactic processing. Despite not finding deficits in morphosyntactic skills as initially expected, this still aligns with the hypothesis that strong morphosyntactic abilities are connected to strong ToM abilities, as well as with an adequate working memory.

In fact, we can infer this from the fact that the sentences that were not exactly repeated remained grammatically correct. This clearly exemplifies that he is proficient in processing complex sentences, since the errors that he made are expectable in a person with normal syntactic abilities. Not only did the participant retain the sentences in his working memory, but he also processed them and provided them with meaning.

Furthermore, the fact that he has a strong command of subordination and ToM seems to be directly related. As stated above, Andreou et al. (2020, p. 2) already indicated that subordinate clauses are "isomorphic to embedding others' perspectives into one's own or vice-versa", meaning that they allow the speaker to represent other's beliefs in their own mind. Hence, his high-performance processing of subordinate clauses might be a direct representation of his cognitive processes of other's beliefs, suggesting that he has a developed ToM. This would be consistent with previous literature, such as Durrleman et al. (2015; 2019) or Andreou et al. (2020).

Actually, these results would not only be compatible with children with ASD, but also with neurotypical children. As De Villiers and Pyers (2002, p. 1057) demonstrated in their study of the acquisition of complementation, children who failed at understanding false beliefs systematically failed at retaining complement clauses with mental verbs (such as *want*, *belief* or *think*). The findings of our study would also be support these results.

It could nevertheless be argued that sentences were too short or that vocabulary might be too undemanding. It is, however, important to note that exposing the participant to longer sentences would no longer accurately measure his capacity for processing subordinate clauses, but rather his working memory abilities. Since the purpose of this task consisted of measuring his capacity of processing subordinate clauses, the experiment appears to be appropriately designed.

In addition, the excellent results in the ToM task might also be an indicator that ToM may not be necessarily impaired in all ASD individuals. Perhaps, a solid performance in tasks involving morphosyntax does not immediately imply solid performance in other linguistic tasks. This would be in line with previous work such as Smith and Tsimpli (1995), where they studied the case of a linguistic savant who spoke several languages. They found that, while having excellent lexical and morphological skills, his command of syntax was poorer (Smith and Tsimpli, 1998, p. 193). That would be consistent with Fodor's modularity (1983, quoted in Smith and Tsimpli, 1998, p. 208), which defended that language is composed of fairly independent modules. Therefore, while the participant in our study shows no impairment in morphosyntax, this does not necessarily imply impairment in other language domains such as pragmatics or lexicon.

As for the bilingual variable, this did not seem to negatively affect the participant's performance in the task. This suggests that bilingualism does not have a negative impact on ASD individuals, as previously stated in the existing literature, such as in Meir and Novogrodsky (2019, p. 10) or in Hambly and Fombonne (2012, p. 1348).

We might even infer that the bilingual component may have a positive effect on morphosyntax and cognition, since the participant achieved outstanding results in both tasks. This would also be congruent with previous investigations, such as Andreou et al.

(2020, p. 16), in which bilingual ASD children outperformed their monolingual peers in low ToM tasks and a two-back task that involved working memory.

It is, however, important to acknowledge that this study also presents some limitations. Firstly, since this paper studied a single case, it is not possible to compare these results with other ASD children. Thus, comparing these results with a monolingual ASD child, or even several children with the same characteristics, would be interesting to extend our knowledge of the effects of bilingualism in ASD.

Secondly, the participant was only tested in his L1 (in this case, English). While we can confirm that bilingualism did not present any detrimental effect in his L1, the results in his L2 and L3 were not measured. A similar task could be done in order to understand his skills in Spanish (L2). It would even be of interest to replicate this experiment with other children speaking different languages. Most studies examining linguistic abilities and ToM rely on Indo-European languages, exemplified by research on Greek and Albanian speakers (Andreou et al., 2020) or English and Spanish speakers (Valicenti-McDermott et al., 2019). Even studies involving Hebrew (a non-Indo-European language) often pair it with an Indo-European one like Russian (Meir and Novogrodsky, 2019). Hence, future studies testing linguistic abilities in bilingual ASD children might include a broader typological diversity.

Thirdly, as stated above, the fact that no impairment was found in morphosyntax, does not immediately imply that other areas of language, such as lexicon or pragmatics, are not impaired either. A pragmatic test, such as the Test of Pragmatic Language (TOPL-2; Phelps-Terasaki & Phelps-Gunn, 2007), or a lexicon test, such as Expressive Vocabulary Test (EVT-3; Williams, 2018), might measure his abilities in these areas. The application of these tests could demonstrate that good morphosyntactic skills do not necessarily need to be connected to an excellent performance in other areas of language. In fact, literature

widely indicates that pragmatics is the primary area affected in the language of individuals with ASD (Schaeffer, 2023, p. 436).

Finally, it is paramount to keep in mind that Autistic Spectrum Disorder is a spectrum. The profiles of ASD people are vastly heterogeneous, which may make the study of language in ASD difficult. As for the purpose of this study, we examined the case of a high-functioning ASD teenager with normal language abilities (ASD-NL). Nevertheless, these results might not be applicable for other linguistic ASD profiles. Studying the cases of more high-functioning ASD people with normal abilities, as well as other profiles presenting Language Impairment (ASD-LI), could also be interesting in order to grasp the relation between language and cognition in ASD.

All these limitations suggest the need for further research. A comparative study involving more bilingual and monolingual ASD children would help to cover this gap in the literature, as well as measuring EF and other linguistic abilities.

8. Conclusion

In sum, this study explored both the connection between complex morphosyntax and ToM, as well as the implications of bilingualism in children with ASD. By analyzing the case of a 15-year-old boy with high-functioning ASD and normal language abilities (ASD-NL), this analysis suggests that there seems to be a correlation between the mastery of subordinate clauses and the understanding of false beliefs. We also found that bilingualism does not seem to affect the linguistic abilities of people on the autism spectrum, at least concerning their L1 linguistic abilities. In fact, bilingualism might even offer cognitive benefits, since the participant showed a solid performance in tasks involving the processing of subordinate clauses.

This study is unique in its characteristics, due to several reasons. Firstly, it is the first investigation focusing on morphosyntactic processing, ToM and working memory in a bilingual English-Spanish young male with ASD. Additionally, this research contributes to dispelling the misconception that bilingualism may have negative effects on people with ASD. Unfortunately, this conception of bilingualism is still prevalent in current society, including clinicians and therapists treating this condition. Lastly, the specificity of the participant (a high-functioning ASD individual with normal language) allowed us to analyze his productions more in detail, which would be more challenging to do in a meta-study comparing many different profiles.

While this experiment offers valuable insights, further investigation into the effects of language in ASD is crucial, necessitating studies with multiple monolingual and bilingual participants. These findings will enhance our comprehension of the underpinnings of language and ASD.

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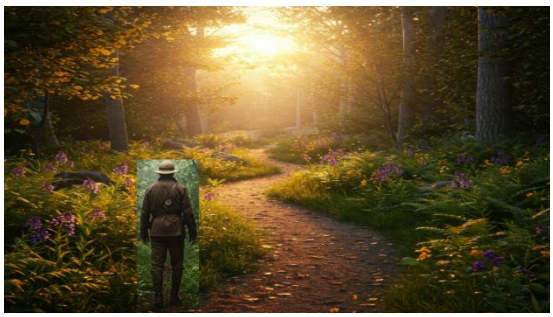
10. Appendix

Appendix 1: Sentence Repetition Task

Item	Sentence	Words		Expected Structure
		Content	Function	
1	He smiled widely **because** the sun was shining bright	5	4	Adverbial
2	**Even though** the rain fell, they continued their hike	4	5	Adverbial
3	**When** the music started, they began to dance	5	4	Adverbial
4	**Before** the guests arrived, she tidied up the room	5	4	Adverbial
5	**After** the movie ended, we went out for some juice	5	5	Adverbial
6	She believed **that** you had the green marker with you	4	6	That-Compl
7	I know **that** they have put in a lot of effort	3	9	That-Compl
8	That woman told Mark **that** the Earth is flat	5	4	That-Compl
9	I understand **that** you might feel a bit nervous	3	6	That-Compl
10	They discussed **who** would be the best person for the job	5	6	Who-Compl
11	I wonder **who** left that door wide open	5	3	Who-Compl
12	She asked me **what** you were doing yesterday	3	5	What-Compl
13	He couldn't decide **what** he wanted for his birthday	3	4	What-Compl
14	**Learning** new languages can be good for you	5	3	Inf-Compl
15	They decided **to go** for a walk	3	4	Ger-Compl
16	He enjoys **reading** interesting novels	4	1	Ger-Compl
17	The book **that** I read is hidden somewhere	4	4	Subj-Relative
18	The movie **that** you watched is awesome	3	4	Subj-Relative
19	The student **who** studied hard had good grades	5	4	Subj-Relative
20	Mary found the book **that** you had read	4	4	Obj-Relative
21	I know the movie **which** your professor mentioned	4	4	Obj-Relative
22	We found the student **that** you met	3	4	Obj-Relative

Appendix 2: Power Point



Presentation used for the Sentence Repetition Task

Picture used for the Sally-Ann test. (Retrieved from Cabrera, 2020)