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TEACHING SENTENCE READING AND RETELLING AND ANSWERING COMPREHENSION QUESTIONS IN A CHILD WITH AUTISM SPECTRUM DISORDER

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Abstract:
Children diagnosed with autism spectrum disorder (ASD) frequently show difficulties in the acquisition of multiple repertoires, including verbal behavior. One type of verbal operant behavior is the intraverbal. It involves the emission of a verbal response under the control of a verbal discriminative stimulus, without point-to-point correspondence between them, and the response is maintained by a generalized conditioned reinforcer. This study focused on narrative retelling, which is a skill that comprises intraverbal chains. It is also discussed in the literature that the teaching of this repertoire may improve gains in text comprehension, which also involves the emission of intraverbals, that is, answering questions. Regarding this skill, previous research investigated procedures that may produce the emergence of answering comprehension questions referred as complex ABC intraverbals (related to the stimulus equivalence paradigm) in typically developing children. In general, they were exposed to cycles in which they first read short texts/sentences relating information on three different stimuli (A, B, and C), Thereafter, the children answered several questions representing all possible complex intraverbal relations among the three stimuli from the sentences. Some learners demonstrated the emergence of all complex relations, and further investigations were carried out with the teaching of simpler intraverbal relations of the type of exemplars and categories before the cycles of reading sentences – probing complex ABC intraverbals. Data indicated that more learners showed the emergence of all, or nearly all, complex relations. The present study comprised two systematic replication experiments, with the inclusion of a child with ASD as participant. Both also involved the teaching of sentence

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reading and retelling through script fading, to analyze the effects of narrative production on the possible emergence of complex intraverbals. In Experiment 1, cycles of teaching sentence reading and retelling – probing ABC intraverbals were administered. As a result, all possible complex relations emerged. Experiment 2 involved the teaching of simpler intraverbal relations of the type of exemplars and categories before the cycles of teaching sentence reading and retelling – probing ABC intraverbals. All possible complex intraverbal relations also emerged. Data were discussed in the sense that, although positive, it is not clear whether the teaching of sentence retelling and simpler intraverbal relations facilitated the establishment of the complex intraverbals. It is possible that reading the sentences was sufficient. The limitations of the research were presented and discussed, as well as recommendations for future investigations that may more clearly isolate the effects of each manipulated independent variable. Anyway, the current study extended previous investigations by showing that complex intraverbal relations of the ABC type may also be established in a learner diagnosed with ASD.

Keywords: autism spectrum disorder, sentence reading, sentence retelling, script fading, intraverbals

1. Introduction

In early education, children, in general, have many opportunities to learn narrative skills, since books with narrative texts and illustrations are consistently used at school. Learners may develop repertoires such as recalling text content; relating information to personal experience; demonstrating narrative retelling; making inferences (Solari et al., 2020). Children diagnosed with autism spectrum disorder (ASD) frequently struggle to learn these skills. Carrying out careful assessments to better understand difficulties is important to subsidize specialized interventions.

Solari et al. (2020) conducted research with 12 students diagnosed with ASD between 5 and 11 years old at school. Their goal was to measure the effectiveness of interventions aimed at developing improvements in vocabulary, narrative retelling skills, and text comprehension. The students were organized in pairs during the administration of assessment and intervention sessions. Firstly, the following repertoires were assessed: Reading short narrative texts and answering related factual and inferential questions; narrative retelling; declaring the definition of several words. Still, regarding the definition of words, the authors also gave the students opportunities to write and make drawings representing the words used in the study. After implementing interventions to teach the repertoires, for all students, there was significant improvement in vocabulary, narrative retelling, and making connections between narrative text events. Nevertheless, a discrete improvement was demonstrated regarding text comprehension, that is, answering factual and inferential questions. The authors discussed the results in the sense that increases in intensity and duration of interventions to produce more gains in

vocabulary and narrative retelling may be important to improve gains in text comprehension, defined by the authors as a higher-order skill.

Still regarding narrative retelling production, Diehl et al. (2006) stated that it represents a way to measure pragmatic language (use of language in socio-communicative contexts). Plus, according to these authors, individuals with ASD commonly show impairments of organization and coherence. They tend to have difficulty representing and retelling essential events that represent central ideas in stories. Many learners lack the ability to retell events without visual resources, such as illustrations from a book. The production and understanding of narratives are important factors for academic success and positive social exchanges. Diehl et al. conducted a study to assess the coherence of narratives in individuals with high-functioning ASD aged between 6 and 14 years old. 17 young people with autism and 17 typically developing young people participated.

In Diehl et al. (2006), the participants first listened to the verbal narration of a story ("Frog, where are you?") while attending to illustrations from a book. Thereafter, they had to retell the story without consulting the book. Then, factual, and inferential questions were presented to them. As a result, participants with ASD performed similarly to those with typical development regarding the measures of length and syntactic complexity, and in remembering the essence of the story. Nevertheless, they had difficulty using the essence to assist the retelling process. The narratives were less causally connected, they lacked coherence. Diehl et al. stated that the narrative process is an important resource to assess pragmatic language because it involves understanding, recalling, and retelling stories in a way that is understandable to the listener.

One way of addressing the lack of skills such as narrative retelling and answering text comprehension questions in children with ASD (skills that contribute to the establishment of reading and reading comprehension) is through procedures from Applied Behavior Analysis (ABA). In Behavior Analysis, these skills represent a type of verbal behavior called intraverbal. According to Skinner (1992), verbal behavior (language) is a type of operant behavior shaped and maintained by mediated contingencies of reinforcement. A speaker emits the verbal behavior and a listener, specially trained by the verbal community, provides a reinforcer to strengthen it. The intraverbal involves the emission of a verbal response under the control of a verbal discriminative stimulus (without point-to-point correspondence between them), and the response is maintained by a generalized conditioned reinforcer (an established form of attention).

As an example of the intraverbal retelling skill, after reading a short text representing a story, a child is asked by a teacher to retell it (e.g., "Tell me the story of Mary"). The child, then, describes the sequence of events coherently (e.g., "She woke up early in the morning; took a shower; put on a blue dress; had breakfast and went to school in the end"). Intraverbals regarding comprehension questions would consist of verbal responses to questions about the events from the sequence (e.g., saying "Mary" under

the question "who woke up early in the morning?"; saying "shower" under "what did she take?"; saying "blue dress" under "what did she put on?"; saying "to school" under "where did she go in the end?") (Conine et al., 2023; Matos & Araújo, 2022)

Matos and Araújo (2022) compared three different procedures (forward chaining – FCP; backward chaining – BCP; and script fading – SFP) to establish intraverbal story retelling in a 6-year-old child with ASD. A specific story was assigned to each procedure. Each story was composed of four parts portrayed by images on cards and sentences. During a baseline condition, the participant was unable to retell the stories after an experimenter read them with her. The interventions to teach the retelling were then carried out alternately. During FCP, the participant was able to retell the story from the first to the last part. In BCP, initially, images and sentences concerning the first three parts of the story were shown and read with the participant. The visual components of the last part were omitted, so the participant could retell that part without cues. As independent performance was demonstrated, the visual components of the remaining parts were also gradually omitted until the story was fully retold without any visual cue. In SFP, initially, all sentences from the story were available so the participant could read them. Then, a gradual fading of the words from the sentences was defined in four steps, so the participant could progressively retell the entire story independently. All procedures successfully established the intraverbal retelling of the stories, but the FCP was the most efficient. The authors also successfully taught the repertoires of answering comprehension questions (literal questions based on sentences from the stories). Since they were established through differential reinforcement, it was not feasible to investigate the influence of teaching story retelling on the acquisition of answering questions.

Conine et al. (2023), as Matos and Araújo (2022), also used BCP to teach intraverbal story retelling to three children with ASD aged 11, 5, and 8. They taught the retelling of five stories with eight parts each. The researchers also assessed comprehension questions (literal questions based on sentences from the stories). Two participants acquired the retelling skill after teaching with the BCP procedure. In the case of the third participant, the simple presentation of the stories (read by an experimenter) sufficiently established the repertoire. Maintenance of correct performance was demonstrated by all participants 24 hours after the last intervention session. Probes indicated that teaching the story retelling influenced the acquisition of answering comprehension questions (they were not directly taught as in the study by Matos and Araújo). This is in line with the argument of Solari et al. (2020) on increasing the intensity of teaching narrative retelling to improve text comprehension gains.

Another recent study on ABA was also concerned with the establishment of intraverbals related to academic skills, emphasizing reading, and reading comprehension (Pérez González & Oltra, 2021). In this study, four experiments were conducted with 7-year-old children with typical development and enrolled in elementary school. In the first experiment, six participants read short texts that established relations among three

stimuli/elements (e.g., "A city in Argentina is Buenos Aires. In Buenos Aires there is a park called El Botánico"). The stimuli defined in the study texts referred to country (A), city (B), and park (C). The researchers assessed the effects of reading the texts on the establishment of intraverbals without direct teaching. For each of two texts in the first experiment, 12 intraverbal relations were probed as in the following examples: A-B country-city direct (e.g., saying "Buenos Aires" under the verbal antecedent "name a city of Argentina"); B-C city-park direct (e.g., saying "El Botánico" under the verbal antecedent "name a park of Buenos Aires"); B-A city-country symmetric (e.g., saying "Argentina" under the verbal antecedent "name the country of Buenos Aires"); C-B park-city symmetric (e.g., saying "Buenos Aires" under the verbal antecedent "name a city of El Botánico"); A-C country-park transitive (e.g., saying "El Botánico" under the verbal antecedent "name a park of Argentina"); C-A park-country equivalence (e.g., saying "Argentina" under the verbal antecedent "name the country of El Botánico"). These relations were referred by the authors as ABC intraverbals. After some cycles of reading texts/probing ABC intraverbals, three of six children from the first experiment showed the emergence of all the 12 ABC intraverbal relations referring to each text used.

In the second experiment by Pérez-González and Oltra (2021), the difference was that a new information was added to each text regarding the country (e.g., "Argentina is a country. A city in Argentina is Buenos Aires. In Buenos Aires there is a park called El Botánico"). So, the new information consisted of specifying in each text that the stimulus "A" was a country. Four of six children demonstrated the emergence of all ABC intraverbal relations. The third experiment was like the second, but before the children could read the texts, they were taught simpler intraverbal relations than the ABC case. The simpler intraverbal relations taught through differential reinforcement involved discriminations of exemplars (e.g., saying "Argentina", "Buenos Aires", and "El Botánico" under the verbal antecedents "tell me the name of a country", "tell me the name of a city", and "tell me the name of a park") and categories (e.g., saying "a country", "a city", and "a park" under the verbal antecedents "what is Argentina?", "what is Buenos Aires?", and "what is El Botánico?"). As a result, all six children in the third experiment demonstrated the emergence of all ABC intraverbal relations. In the end, the fourth experiment was a replication of the previous one, involving new texts and five participants who did not show the emergence of all relations in previous experiments. During the replication, the participants demonstrated the emergence of all ABC intraverbal relations.

The analyzes on ABC intraverbal relations in the study by Pérez-González and Oltra (2021) are derived from the stimulus equivalence paradigm (Sidman & Tailby, 1982). Originally, this paradigm involved the emission of selection responses in matching to sample tasks. Some relations between stimuli are taught through differential reinforcement, so that others may emerge without direct teaching. In Pérez-González and Oltra, the participants read short texts establishing relations among three stimuli. Thereafter, they were subjected to ABC intraverbal probe sessions, writing their answers

on a sheet of paper. Their investigation represents a contribution to the literature concerned with the development of reading and reading comprehension. It is important that procedures aimed at establishing ABC intraverbal relations (text comprehension) are investigated in children with ASD. The current study sought to replicate the second and third experiments of the research by Pérez-González and Oltra with a child with ASD as participant. Moreover, the teaching of the retelling skill concerning short texts/sentences (as in the research by Conine et al., 2023 and Matos & Araújo, 2022) was defined as an additional independent variable for the possible establishment of ABC intraverbal relations. More specifically, the procedure used to teach sentence retelling was script fading.

2. Experiment 1

The purpose of Experiment 1 was to evaluate whether teaching reading and sentence retelling repertoires effectively produced the emergence of answering complex comprehension questions (ABC intraverbal relations) in a child diagnosed with ASD. It consisted of a replication of the second experiment by Pérez-González and Oltra (2021). In the current study, sentence retelling training through script fading was defined as a new independent variable.

2.1 Method

2.1.1 Participant

The research was conducted with just one participant, a 7-year-old boy with ASD. He was able to communicate with other people by using sentences comprising several words and in a functional way. He could label hundreds of non-verbal stimuli such as objects, pictures, and actions and answered a wide variety of questions. The participant also demonstrated a broad repertoire of reading sentences of varying lengths but showed difficulty in text comprehension tasks. Demonstrating fluent sentence reading, but lack in text comprehension, was a defined inclusion criteria in the research. Failure to meet the inclusion criteria would result in dismissal from the study. In fact, repertoires of four other 7-year-old children with ASD (besides the boy who was selected as a participant) were investigated for the possible inclusion of these children in the study. Nevertheless, none of them demonstrated fluent reading skills and were therefore dismissed. All children came from the same university-based research laboratory where they were provided intervention sessions based on ABA. There were 16 other children in the same context, but all of them had even more limited repertoires (e.g., they were unable to establish communication using sentences), making their participation in this study unfeasible.

2.1.2 Materials and Environment

Sentences relating three stimuli (country, city, and park) were used for assessment and teaching sessions concerning reading and retelling skills. The sentences were organized in two groups (G1 and G2). G1 involved the following two cases: "Argentina is a country. A city of Argentina is Buenos Aires. In Buenos Aires there is a park called El Botánico"; "Uruguay is a country. A city of Uruguay is Montevideo. In Montevideo there is a park called el Lecoc". G2 involved the following two cases: "Brazil is a country. A city of Brazil is São Paulo. In São Paulo there is a park called the Trianon"; "Chile is a country. A city of Chile is Santiago. In Santiago there is a park called the Almagro".

The sentences were organized on laminated cards for reading. Data collection took place in the context of a university-based laboratory room where interventions based on ABA are carried out for children with ASD. Customized datasheets were used by an experimenter to record the participant's correct and incorrect reading and retelling responses concerning the mentioned sentences in probe, baseline, and training sessions. The experimenter also used customized datasheets to record the participant's demonstration of 12 possible ABC intraverbal relations for G1 and other 12 possible intraverbal relations for G2 in probe sessions. The 24 relations, considering G1 and G2, can be seen in Table 1.

Table 1: ABC Intraverbal Relations in Experiment 1

Intraverbals	**Antecedent stimuli**	**Response**
Argentina set		
A1B1: (direct) country-city	Name a city of Argentina	Buenos Aires
B1C1: (direct) city-park	Name a park of Buenos Aires	El Botánico
B1A1: (symmetry) city-country	Name the country of Buenos Aires	Argentina
C1B1: (symmetry) park-city	Name the city of El Botánico	Buenos Aires
A1C1: (transitive) country-park	Name a park of Argentina	El Botánico
C1A1: (equivalence) park-country	Name the country of El Botánico	Argentina
Uruguay set		
A2B2: (direct) country-city	Name a city of Uruguai	Montevideo
B2C2: (direct) city-park	Name a park of Montevideo	El Lecoc
B2A2: (symmetry) city-country	Name the country of Montevideo	Uruguai
C2B2: (symmetry) park-city	Name the city of El Lecoc	Montevideo
A2C2: (transitive) country-park	Name a park of Uruguai	El Lecoc
C2A2: (equivalence) park-country	Name the country of El Lecoc	Uruguai
Brazil set		
A3B3: (direct) country-city	Name a city of Brazil	São Paulo
B3C3: (direct) city-park	Name a park of São Paulo	Trianón
B3A3: (symmetry) city-country	Name the country of São Paulo	Brazil
C3B3: (symmetry) park-city	Name the city of Trianón	São Paulo
A3C3: (transitive) country-park	Name a park of Brazil	Trianón
C3A3: (equivalence) park-country	Name the country of Trianón	Brasil
Chile set		
A4B4: (direct) country-city	Name a city of Chile	Santiago
B4C4: (direct) city-park	Name a park of Santiago	Almagro

B4A4: (simmetry) city-country	Name the country of Santiago	Chile
C4B4: (simmetry) park-city	Name the city of Almagro	Santiago
A4C4: (transitive) country-park	Name a park of Chile	Almagro
C4A4: (equivalence) park-country	Name the country of Almagro	Chile

Note: Adapted from Pérez-González and Oltra (2021).

The environment consisted of a table and three chairs. The participant and an experimenter sat facing each other. The experimenter administered assessment and intervention tasks, besides the systematic record of the participant's performance in customized datasheets. In 90% of all data collection, a second observer sat in the third chair next to the experimenter and took data concerning the participant's responses.

The purpose of this was to obtain a measure of agreement between observers. The calculation of the percentage of agreements consisted of dividing the number of agreements by the number of agreements added to the number of disagreements. The result was multiplied by 100. Agreement was 100% for the participant in the research.

2.1.3 Independent and Dependent Variables

The primary dependent variable (DV) of the research consisted of answering verbal questions/instructions (ABC intraverbals), previously presented, relating three stimuli (country, city, and park) (e.g., saying "Argentina" under the instruction "name the country of El Botánico"). See Table 1 for all relations in groups G1 (Argentina and Uruguay sets) and G2 (Brazil and Chile sets). The independent variables (IV) consisted of teaching reading and retelling sentences through script fading (detailed further in the procedure subsection).

2.1.4 Procedure

A. First phase: Initial probe sessions to answer questions about sentences (ABC intraverbals)

In each of the three probe sessions, 12 trials regarding the 12 possible ABC intraverbal relations described in Table 1 for both G1 (Argentina and Uruguay sets) and G2 (Brazil and Chile sets) were administered. In each trial, the experimenter provided an instruction for a given intraverbal relation, and the participant had up to 5s to respond (e.g., saying "Buenos Aires" under the instruction "name a city of Argentina", referring to the A1B1 relation or class). Differential consequences for correct and incorrect responses were not provided. Between sessions, a 60s break was given so the participant could access preferred videos or games (this measure was applied throughout all study conditions).

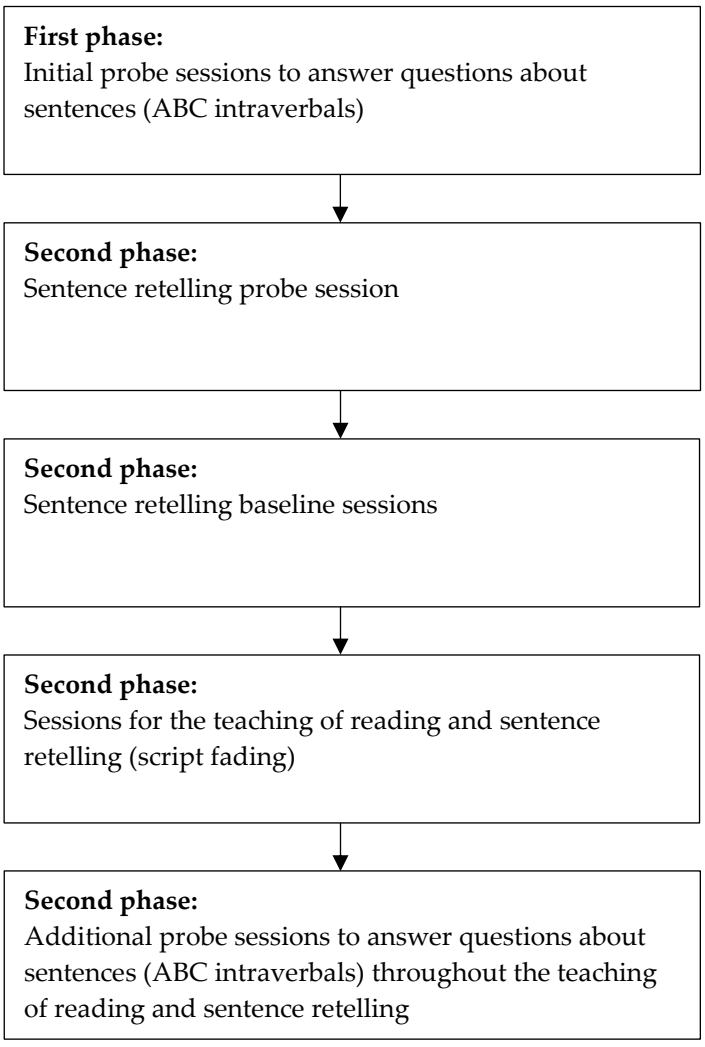
B. Second phase: Probe, baseline, teaching of reading and sentence retelling repertoires and additional probe sessions to answer questions about sentences (ABC intraverbals)

In each session concerning probe, baseline and the teaching of sentence retelling, the participant was asked to retell sentences about countries (Argentina and Uruguay,

considering G1; Brazil and Chile, considering G2) after they were read by him. As an example, the experimenter said in a trial "tell me something about Argentina" as a verbal context for the emission of corresponding sentences by the participant relating information on country, city, and park ("Argentina is a country. A city of Argentina is Buenos Aires. In Buenos Aires there is a park called El Botánico").

Sessions always consisted of 8 trials for each teaching group. In each trial, the participant had up to 5s to respond. Differential consequences for correct and incorrect responses were not provided in probe and baseline trials. The probe condition was administered in a single session. The baseline condition was administered in several sessions until a stability criterion was met. In the case of teaching sessions, all trials involved differential consequences for participant responses. Correct responses always resulted in verbal praise and errors, or lack of response within the allowed time of 5s per teaching trial, which resulted in a correction procedure (the experimenter read the sentences so the participant could repeat them). Initially, the teaching condition involved the presentation of full printed sentences relating to country, city, and park to be read by the participant across session trials.

Figure 1: Flowchart of Research Phases



After a learning criterion (one errorless session for G1 and G2) was demonstrated, a script fading condition was established for the teaching. During this condition, the words from the sentences were gradually removed in five steps (S1 – S5) from the end to the beginning of the sentences. The fading process advanced throughout the five steps to the extent that the participant showed an absence of errors during the training sessions (the learning criterion for each fading step consisted of one errorless session for G1 and G2). The training condition was considered mastered as soon as the participant no longer required visual cues to retell the sentences. Throughout the teaching of reading and sentence retelling, additional ABC intraverbal probe sessions (similar to the first phase) were administered until the emergence of all 12 relations in both groups G1 and G2 (24 relations in total). ABC intraverbal probe sessions were also administered one month after the end of sentence retelling training with script fading.

Figure 1 presents a flowchart of the steps of each phase of the study.

2.1.5 Experimental Design

To ensure the demonstration of experimental control during the teaching of sentence retelling, a multiple probe design across two groups of sentences (G1 and G2) was administered (Cooper et al., 2007). For each group, the process began with a probe session. After this, a baseline condition was established for G1, and it was followed by the teaching condition regarding sentence reading and the five fading steps to establish the retelling repertoire gradually and progressively. As soon as the retelling skill was established for G1, a new probe session was applied for both G1 and G2. Then, baseline sessions were established for G2, and they were followed by the teaching condition in the same fashion as it occurred for G1. Before and during the training conditions regarding the retelling skill for the two groups, ABC intraverbal probe sessions were conducted to measure the effects of teaching the sentence retelling repertoire.

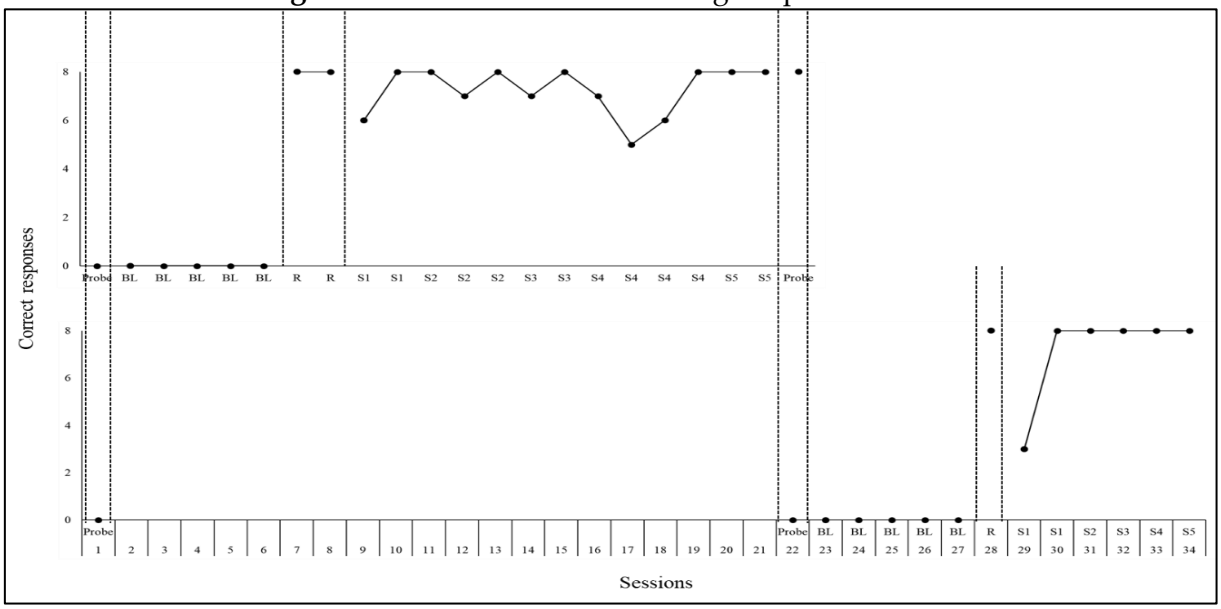
2.1.6 Ethical Procedures

This research was approved by an ethics committee in research with humans (authorization No. 4.284.271) from Federal University of Maranhão, São Luís-MA (Brazil). Those responsible for the participant signed an informed consent form as well as the participant himself. Personal information was confidential, and the study could be interrupted if the participant wished and without any harm.

2.2 Results

Next, data from P1 regarding sentence retelling and ABC intraverbal relations are presented. Figure 2 shows sentence retelling results under probe, baseline, and teaching with script fading conditions.

Figure 2: Correct Sentence Retelling Responses for P1



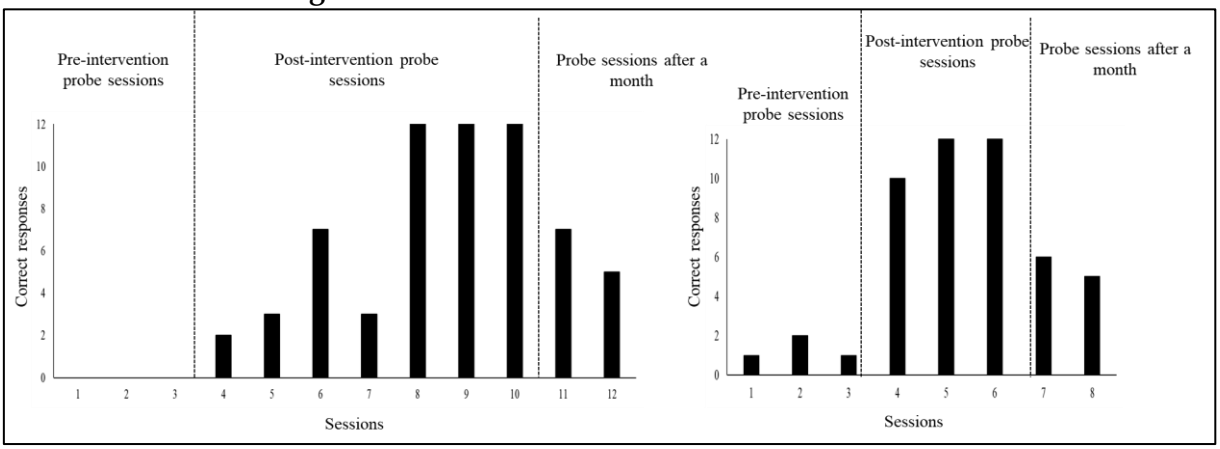
Note: The upper graph represents correct responses under the following conditions for G1 (Argentina and Uruguay sets): Probe, baseline (BL), reading (R), and script fading with five fading steps (from S1 to S5). The lower graph represents the same conditions for G2 (Brazil and Chile sets).

As it can be seen in Figure 2, P1 did not show any correct sentence retelling responses during probe and baseline conditions before intervention for both G1 (upper graph) and G2 (lower graph). When the reading (R) condition commenced (full printed sentences without fading), P1 read all sentences without errors in a single session for the two groups (although for G1, two sessions were run). When the script fading condition was applied, 12 sessions along five fading steps were necessary for P1 to retell the sentences from the G1 group without any reading cues and this performance was maintained in an additional session. In the case of G2, six training sessions sufficiently established sentence retelling without visual cues.

Figure 3 shows correct responses, regarding ABC intraverbal relations (answering questions about sentences), in probe sessions before, after the implementation of sentence retelling training with script fading, and one month after the training was discontinued.

According to Figure 3, no correct ABC intraverbal responses occurred during the three pre-intervention probe sessions, before sentence retelling training with script fading, for G1. In the case of G2, performance was low, varying between one and two correct responses. During sentence retelling training, the emergence of all 12 ABC intraverbal relations for G1 was demonstrated after five post-intervention probe sessions and correct performance remained in two additional probe sessions. In the case of G2, the emergence of all relations was shown after two post-intervention probe sessions, and independent performance was maintained in an additional session. Finally, regarding two additional probe sessions one month after the end of sentence retelling training, performance in ABC intraverbal relations worsened for both groups, resulting in six and four correct responses for G1 and five and four correct responses for G2.

Figure 3: Correct ABC Intraverbal Relations for P1



Note: The graph on the left side of the figure represents correct ABC intraverbal responses for G1 (Argentina and Uruguay sets) in probe sessions before (pre-intervention probe sessions), after (post-intervention probe sessions) sentence retelling training with script fading, and one month after the end of training. The graph on the right side of the figure represents the same process for G2 (Brazil and Chile sets).

2.3 Discussion

The goal of Experiment 1 was to evaluate whether teaching reading and sentence retelling (through script fading) produced the emergence of several ABC intraverbal relations (answering comprehension questions) among stimuli from sentences in a child diagnosed with ASD. The data from this study indicate the emergence of all 24 possible intraverbal relations, considering both groups of stimuli, that is, G1 (Argentina and Uruguay sets) and G2 (Brazil and Chile sets). This result was similar to what happened with four of six typically developing children participating in the second experiment by Pérez-González and Oltra (2021), who demonstrated the emergence of all the same complex ABC intraverbal relations after reading the same short texts/sentences relating information about country, city, and park. In the current study, teaching sentence retelling, which did not happen in Pérez-González and Oltra, was defined as an additional IV and it possibly influenced the acquisition of ABC intraverbals in probe sessions for the participating child with ASD. However, the extent of the influence is not clear, representing a limitation. It is possible that the opportunities to read sentences sufficiently established the emergence of complex intraverbals. New investigations should be conducted in the sense of determining whether having opportunities to read sentences is sufficient for the emergence of complex ABC intraverbals in children with ASD. If not, an additional investigation may be conducted to see if teaching sentence retelling influences the emergence.

Anyway, the previous literature (Solari et al., 2020) discussed that increases in intensity and duration of interventions to produce more gains in repertoires, such as narrative retelling (referred in this study as sentence retelling), may be important to improve gains in text comprehension (referred in this study as answering comprehension questions or ABC intraverbals). This research focused on following this recommendation. Furthermore, the teaching of sentence retelling also addressed a concern in the literature

(Diehl et al., 2006) regarding the development of this repertoire in children with ASD: The lack of organization and coherence in the production of narrative retelling. In this investigation, the systematic teaching of sentence retelling through script fading successfully established an organized and coherent narrative repertoire in the participants with ASD. This outcome is in accordance with previous research in which the acquisition of this type of repertoire occurred using procedures such as script fading (Matos & Araújo, 2022).

In the literature on Applied Behavior Analysis (ABA) to ASD and related disabilities, there is a great concern with the development of procedures for the direct teaching of intraverbals, or even procedures that may produce their emergence. Intraverbals are important for competent social and academic development. Special teaching interventions are warranted when there is a delay in the acquisition of intraverbals (Pérez-González, 2020; Sundberg, 2016). Sentence/text retelling and answering comprehension questions comprise intraverbals and they are important for all human beings, including those with atypical development. Previous research, as the current one, successfully established sentence retelling as intraverbal chains in children with ASD. As told before, this happened, for example, in the study by Matos and Araújo (2022), which investigated the effects of script fading (among other procedures) on the establishment of sentence retelling in a child with ASD. In Matos and Araújo, answering comprehension questions was also addressed, but this skill was not assessed for emergence through the teaching of sentence retelling. In a later systematic replication study (Araújo, 2023), this investigation was conducted on three children with ASD, and they all showed the emergence of answering comprehension questions (without direct teaching) to some extent. Another recent study (Conine et al., 2023) also assessed the emergence of this type of repertoire in three children with ASD, which was demonstrated. In Conine et al., sentence retelling was taught solely through a procedure called backward chaining. Since narrative retelling represents an intraverbal behavior chain, this skill was taught from the end to the beginning of the chain.

In the mentioned literature about teaching sentence retelling and answering comprehension questions (or checking the emergence of the second repertoire from teaching the first) in children with ASD (Araújo, 2023; Conine et al., 2023; Matos & Araújo, 2022), the sentences were considered simple and each one contained subject, verb, and adjective as keywords. The defined comprehension questions were all directly related to the sentences (one simple question per sentence). In the case of the current study, and originally the one by Pérez-González and Oltra (2021) with typically developing children, the sentences related information about three different elements/stimuli (country, city, and park). This type of arrangement made it possible to ask different types of comprehension questions, implying the acquisition of several complex intraverbal relations (ABC or equivalence intraverbals). In this sense, the current research extended the previous investigations, involving children with ASD, by assessing the acquisition of

ABC intraverbals without direct teaching in a child with ASD through the teaching of sentence retelling as intraverbal chains.

This study shows evidence of internal validity of the teaching procedures used (reading and script fading) to establish sentence retelling repertoire. For each group of sentences (G1 and G2), sentence retelling was only demonstrated as the mentioned teaching procedures were applied. In other words, by conducting a multiple probe design (Cooper et al., 2007), experimental control was demonstrated from one group of sentences (G1) to the other (G2). Moreover, although the emergence of all 24 possible ABC intraverbal relations occurred, the fact that the investigation was conducted with only one participant represents a limitation. It is important that further research tests the generality of the procedures in this study with other children with ASD who are also fluent readers. Plus, also considering that many children with ASD are not fluent readers, it is important that new studies may propose adaptations of the procedures to include these learners.

It was previously said that, in a third experiment by Pérez-González and Oltra (2021), similarly to their second experiment, six typically developing children read short texts/sentences relating to three different stimuli (country, city, and park). The effects were measured on the acquisition of ABC intraverbals. After some cycles of reading the sentences/probing intraverbals, all participants showed the emergence of all possible ABC intraverbal relations. However, before the mentioned cycles, simpler intraverbal relations according to the researchers were taught. These types of intraverbals were called exemplars and categories by the authors. In the current study, the following experiment sought to extend this investigation by having a child with ASD as a participant. After teaching simpler intraverbals, reading, and script fading were also applied to teach sentence retelling, and the effects were assessed on the emergence of ABC intraverbals. In this sense, the new investigation was a systematic replication and extension of Experiment 1 from this work.

3. Experiment 2

In a similar way to Experiment 1, this new investigation assessed whether teaching reading and sentence retelling repertoires effectively produced the emergence of ABC intraverbal relations in a child with ASD. However, before this happened, simpler intraverbals (exemplars and categories according to Pérez-González & Oltra, 2021) were taught to verify if these variables increased the efficiency of the emergence of ABC intraverbals.

3.1. Method

3.1.1 Participant

The participant was the same child from Experiment 1. The reason for this was that no other children with ASD, from the University based laboratory where the research took place, were fluent readers, which was the main inclusion criterion for participation.

3.1.2 Materials and Environment

Experiment 2 took place in the same environment as Experiment 1. New sentences relating to three different stimuli (city, beach, and statue) were defined. They were organized into two groups (G1 and G2). G1 involved the following two cases: "São Luís is a city. A beach in São Luis is São Marcos. In São Marcos there is a statue called Os Pesquisadores"; "Fortaleza is a city. One beach in Fortaleza is Iracema. In Iracema there is a statue called Iracema Guardiã". G2 involved the following two cases: "Rio de Janeiro is a city. One beach in Rio de Janeiro is Ipanema. In Ipanema there is a statue called Tom Jobim"; "Florianópolis is a city. A beach in Florianópolis is Praia Mole. In Praia Mole there is a statue called Os Surfistas". All materials used (e.g., cards and datasheets) were organized in a similar way to the case of Experiment 1. The 24 ABC intraverbal relations probed in Experiment 2, considering G1 and G2, can be seen in Table 2.

Table 2: ABC Intraverbal Relations in Experiment 2

Intraverbals	**Antecedent stimuli**	**Response**
São Luís set		
A1B1: (direct) beach-city	Name the city of São Marcos	São Luís
B1C1: (direct) statue-beach	Name the beach of Os Pescadores	São Marcos
B1A1: (symmetry) city-beach	Name a beach of São Luís	São Marcos
C1B1: (symmetry) beach-statue	Name the statue of São Marcos	Os Pescadores
A1C1: (transitive) statue-city	Name the city of Os Pescadores	São Luís
C1A1: (equivalence) city-statue	Name a statue of São Luís	Os Pescadores
Fortaleza set		
A2B2: (direct) beach-city	Name the city of Iracema	Fortaleza
B2C2: (direct) statue-beach	Name the beach of Iracema Guardiã	Iracema
B2A2: (symmetry) city-beach	Name a beach of Fortaleza	Iracema
C2B2: (symmetry) beach-statue	Name the statue of Iracema	Iracema Guardiã
A2C2: (transitive) statue-city	Name the city of Iracema Guardiã	Fortaleza
C2A2: (equivalence) city-statue	Name a statue of Fortaleza	Iracema Guardiã
Rio de Janeiro set		
A3B3: (direct) beach-city	Name the city of Ipanema	Rio de Janeiro
B3C3: (direct) statue-beach	Name the beach of Tom Jobim	Ipanema
B3A3: (symmetry) city-beach	Name a beach of Rio de Janeiro	Ipanema
C3B3: (symmetry) beach-statue	Name the statue of Ipanema	Tom Jobim
A3C3: (transitive) statue-city	Name the city of Tom Jobim	Rio de Janeiro
C3A3: (equivalence) city-statue	Name a statue of Rio de Janeiro	Tom Jobim
Florianópolis set		
A4B4: (direct) beach-city	Name the city of Praia Mole	Florianópolis
B4C4: (direct) statue-beach	Name the beach of Os Surfistas	Praia Mole
B4A4: (symmetry) city-beach	Name a beach of Florianópolis	Praia Mole
C4B4: (symmetry) beach-statue	Name the statue of Praia Mole	Os Surfistas
A4C4: (transitive) statue-city	Name the city of Os Surfistas	Florianópolis
C4A4: (equivalence) city-statue	Name a statue of Florianópolis	O Surfistas

Also, intraverbal relations called exemplars and categories (similar to the third experiment by Pérez-González & Oltra, 2021) were taught. Exemplars and categories, used in this new investigation, are presented in Table 3 and Table 4, respectively.

Table 3: Intraverbals of the Type of Exemplars

Antecedent stimulus	**Response**
City	
Name a city	São Luís
Name a city	Fortaleza
Name a city	Rio de Janeiro
Name a city	Florianópolis
Beach	
Name a beach	São Marcos
Name a beach	Iracema
Name a beach	Ipanema
Name a beach	Praia Mole
Statue	
Name a statue	Os Pescadores
Name a statue	Iracema Guardiã
Name a statue	Tom Jobim
Name a statue	Os Surfistas

Note: São Luís, Fortaleza, São Marcos, Iracema, Os Pescadores and Iracema Guardiã are stimuli from the group G1. Rio de Janeiro, Florianópolis, Ipanema, Praia Mole, Tom Jobim, and Os Surfistas are stimuli from group G2. The relations from each group were taught separately.

Table 4: Intraverbals of the Type of Categories

Antecedent stimulus	**Response**
City	
What is São Luís?	City
What is Fortaleza?	City
What is Rio de Janeiro?	City
What is Florianópolis?	City
Beach	
What is São Marcos?	Beach
What is Iracema?	Beach
What is Ipanema?	Beach
What is Praia Mole?	Beach
Statue	
What is Os Pescadores?	Statue
What is Iracema Guardiã?	Statue
What is Tom Jobim?	Statue
What is Os Surfistas?	Statue

Note: São Luís, Fortaleza, São Marcos, Iracema, Os Pescadores and Iracema Guardiã are stimuli from the group G1. Rio de Janeiro, Florianópolis, Ipanema, Praia Mole, Tom Jobim, and Os Surfistas are stimuli from group G2. The relations from each group were taught separately.

As in the case of experiment one, the participant and an experimenter sat facing each other. The experimenter administered assessment and intervention tasks, besides the systematic record of the participant's performance in customized datasheets. In 90% of all data collection, a second observer sat in the third chair next to the experimenter and took data concerning the participant's responses. The purpose of this was to obtain a measure of agreement between observers. The calculation of the percentage of agreements consisted of dividing the number of agreements by the number of agreements added to the number of disagreements. The result was multiplied by 100. The agreement was 100% for P1 as in the Experiment 1.

3.1.3 Independent and Dependent Variables

The primary dependent variable (DV) of the research consisted of answering verbal questions/instructions (ABC intraverbals) relating three stimuli (city, beach, and statue) (e.g., saying "São Luís" under the instruction "name the city of São Marcos"). See Table 2 for all relations in groups G1 (São Luís and Fortaleza sets) and G2 (Rio de Janeiro and Florianópolis sets). The main independent variables (IV) consisted of teaching reading and retelling sentences through script fading. Additional IV (exclusive to this second experiment) consisted of teaching intraverbals of the type of exemplars and categories.

3.1.4 Procedure

In this new investigation, the same phases from Experiment 1 were conducted, with the same criteria, involving the ABC intraverbal relations and sentences defined for this new investigation (see Figure 1 from Experiment 1). However, after the probe and baseline conditions to assess ABC intraverbals (and before sentence reading and retelling through script fading were taught for P1), teaching simpler intraverbals of the type of exemplars and categories were established. This was the only difference for Experiment 2. No baseline assessment was defined for these simpler intraverbal relations, that is, only the teaching was defined based on the suggestion (by Pérez-González & Oltra, 2021) that this may influence the acquisition of ABC intraverbals after reading short texts/sentences relating three different stimuli.

During the teaching of intraverbal relations of the type of exemplars, P1 had to say the name of exemplars according to their corresponding categories (e.g., saying "Rio de Janeiro" under the verbal instruction "name a city"). Each teaching session consisted of six trials for each group of simpler intraverbal relations (G1 and G2. See the Note from Table 3). The intraverbal relations from G1 and G2 were taught separately. In each trial, participant P1 had up to 5s to respond after the instruction. He was praised for correct responses. If an error was made (or if no response was emitted within the allowed time), the experimenter provided the response verbally so P1 could repeat it. The learning criterion for each group was defined as one single session without errors.

During the teaching of intraverbal relations of the type of categories, P1 had to say the name of the categories according to their corresponding exemplars (e.g., saying "city"

under the question/instruction "what is São Luís?"). Each teaching session consisted of six trials for each group of simpler intraverbal relations (G1 and G2. See the Note from Table 3). The intraverbal relations from G1 and G2 were taught separately. In each trial, participant P1 had up to 5s to respond after the instruction. He was praised for correct responses. If an error was made (or if no response was emitted within the allowed time), the experimenter provided the response verbally so P1 could repeat it. The learning criterion for each group was defined as one single session without errors.

3.1.5 Experimental Design

The same design from Experiment 1, a multiple probe design (Cooper et al., 2007), was used in Experiment 2.

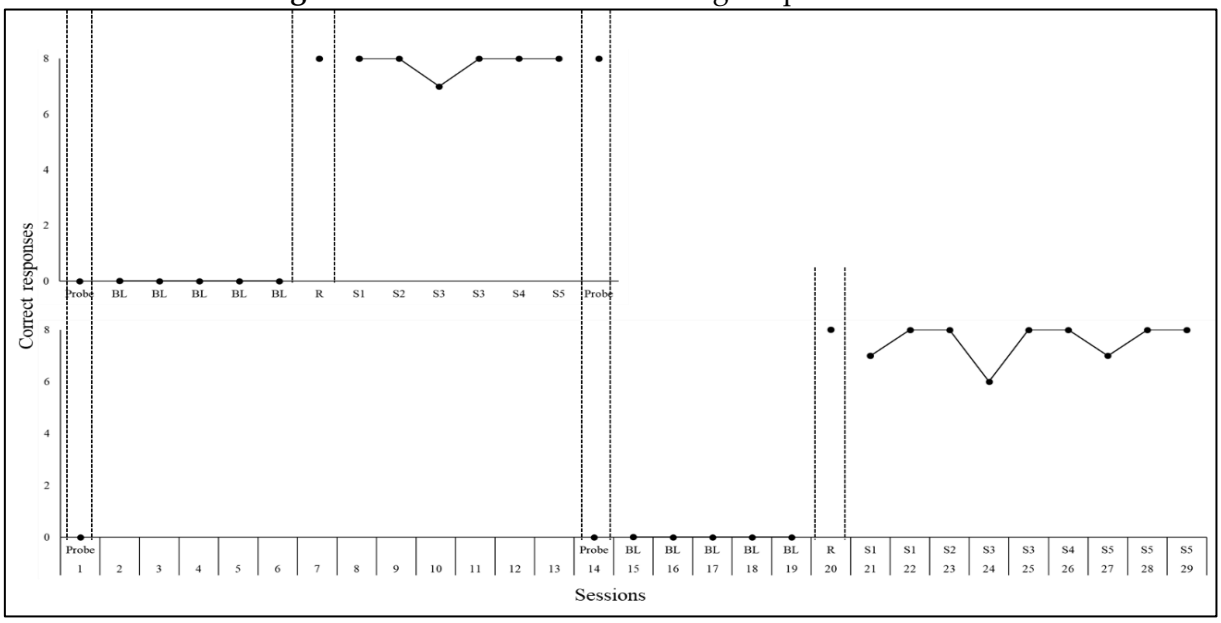
3.1.6 Ethical Procedures

See information from Experiment 1.

3.2 Results

Next, data from P1 regarding sentence retelling and ABC intraverbal relations are presented. Figure 4 shows sentence retelling results under probe, baseline, and teaching with script fading conditions.

Figure 4: Correct Sentence Retelling Responses for P1

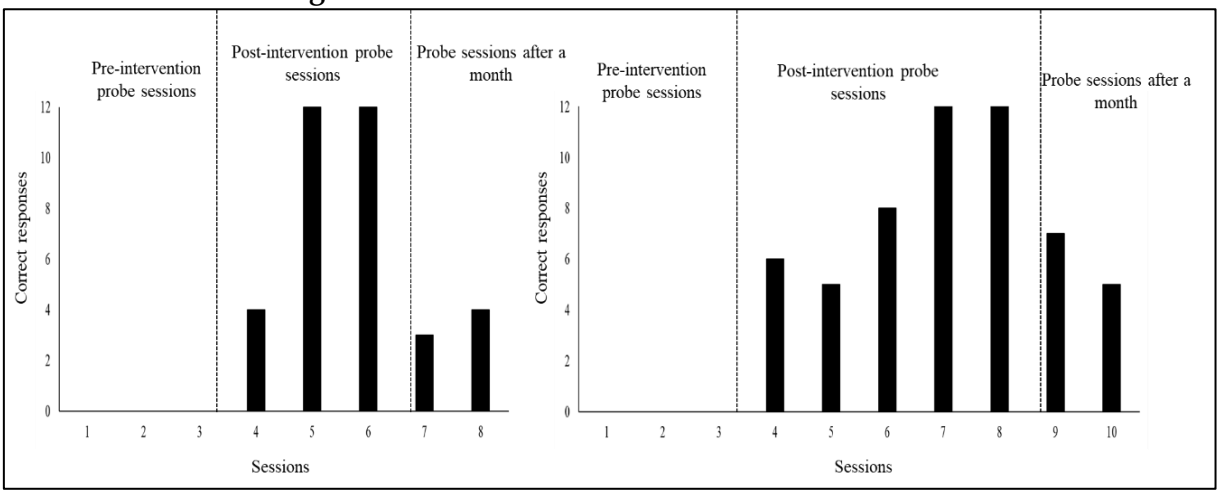


Note: The upper graph represents correct responses under the following conditions for G1 (São Luís and Fortaleza sets): Probe, baseline (BL), reading (R), and script fading with five fading steps (from S1 to S5). The lower graph represents the same conditions for G2 (Rio de Janeiro and Florianópolis sets).

According to Figure 4, as in the case of Experiment 1, P1 also did not show any correct sentence retelling responses during probe and baseline conditions (before intervention) for both groups G1 and G2. After the interventions were administered, one single session

was sufficient to achieve the learning criterion during the reading condition (full printed sentences without fading) for both groups. When the script fading in five steps commenced, P1 needed six and nine sessions for G1 and G2, respectively, to finish this condition. Figure 5 shows correct responses, regarding ABC intraverbal relations (answering questions about sentences), in probe sessions before, after the implementation of sentence retelling training with script fading, and one month after the training was finished.

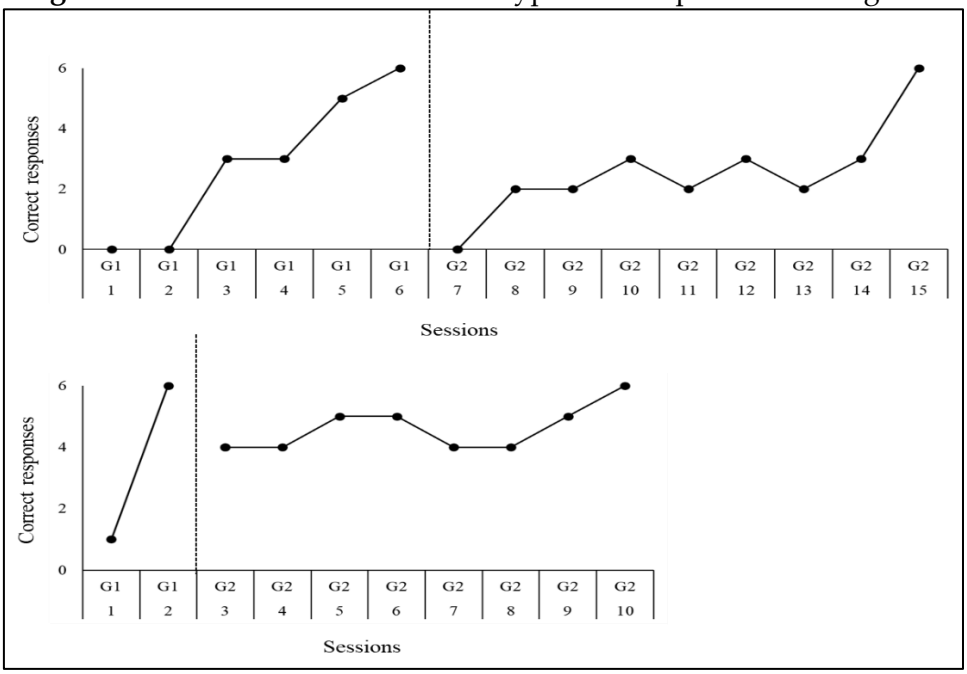
Figure 5: Correct ABC Intraverbal Relations for P1



Note: The graph on the left side of the figure represents correct ABC intraverbal responses for G1 (São Luís and Fortaleza sets) in probe sessions before (pre-intervention probe sessions), after (post-intervention probe sessions) sentence retelling training with script fading, and one month after the end of training. The graph on the right side of the figure represents the same process for G2 (Rio de Janeiro and Florianópolis sets).

As it can be seen in Figure 5, no correct ABC intraverbal responses were emitted during the three pre-intervention probe sessions, before sentence retelling training with script fading, for G1. Along sentence retelling training, the emergence of all 12 ABC intraverbal relations for G1 was demonstrated after two post-intervention sessions and correct performance remained in one additional probe session. In the case of G2, the emergence of all relations was demonstrated after four post-intervention probe sessions and independent performance remained in one additional session. Finally, regarding two additional probe sessions one month after the end of sentence retelling training, performance in ABC intraverbal relations worsened for both groups (as in the case of Experiment 1), resulting in three and four correct responses for G1 and seven and five correct responses for G2. Figure 6 shows correct responses regarding the teaching of intraverbals of the type of exemplars and categories for P1.

Figure 6: Correct Intraverbals of the Type of Exemplars and Categories



Note: The upper graph represents data from the teaching of intraverbal relations of the type of exemplars. The lower graph represents data from the teaching of intraverbal relations of the type of categories. For both graphs, stimuli from group G1 consisted of São Luís, Fortaleza, São Marcos, Iracema, Os Pescadores, and Iracema Guardiã. Stimuli from group G2 consisted of Rio de Janeiro, Florianópolis, Ipanema, Praia Mole, Tom Jobim, and Os Surfistas. The intraverbal relations from each group were taught separately.

The upper graph in Figure 6 (representing the teaching of intraverbal relations of the type of exemplars) indicates that six and nine training sessions were needed for P1 to achieve the learning criterion in G1 and G2, respectively. The lower graph (representing the teaching of intraverbal relations of the type of categories) indicates that two and eight sessions were needed for P1 to achieve the learning criterion in G1 and G2, respectively.

3.3 Discussion

Experiment 2 consisted of a systematic replication of Experiment 1 from this study. And it sought to extend the third experiment by Pérez-González and Oltra (2021) by having a child with ASD as participant. The new investigation assessed whether teaching reading and sentence retelling repertoires through script fading effectively produced the emergence of ABC intraverbal relations in a child with ASD. However, before this happened, simpler intraverbals (exemplars and categories according to Pérez-González & Oltra) were taught to verify if these variables increased the efficiency of the emergence of ABC intraverbals.

In this new investigation, all possible ABC intraverbal relations also emerged for P1 after the teaching of sentence reading and retelling. Moreover, the teaching of intraverbal relations of the type of exemplars and categories was also successful (but baseline assessments were not conducted for these simpler intraverbal relations). As in the case of Experiment 1 and previous investigations in learners with ASD (e.g., Araújo,

2023; Matos & Araújo, 2022), the script fading procedure successfully established sentence retelling as intraverbal chains. Sentence/narrative retelling is considered an important repertoire for the establishment of text comprehension (or ABC intraverbals in the case of this study), and the current investigation followed a recommendation (Solari et al., 2020) by systematically teaching the retelling skill. Plus, as it was verified in Experiment 1, script fading was also important in establishing the emission of sentences coherently and in an organized manner by the participant, addressing a concern by the literature regarding the common lack of organization and coherence in learners with ASD (Diehl et al., 2006). However, Experiment 2 in the current study had major limitations that need to be discussed.

P1 in Experiment 2 was the same child from Experiment 1 in this study. The difficulty of trying to find more participants with ASD was a limitation. As told before, most of the children from the assessment and research university-based laboratory, where data collection with P1 took place, were not fluent readers (they did not meet the main inclusion criterion). In Experiment 1, P1 showed the emergence of all complex ABC intraverbal relations without the teaching of simpler intraverbal relations of the type of exemplars and categories. In Experiment 2, all ABC intraverbals were established as well, but it is not clear whether the teaching of simpler intraverbals of the type of exemplars and categories facilitated the emergence. Due to the previous experience, it is very likely that P1 would demonstrate the emergence of all complex intraverbals without the need to be taught simpler relations. Ideally, the teaching of the simpler intraverbals should have taken place if it was proven that teaching only sentence reading and retelling was insufficient for the emergence of all ABC intraverbal relations.

This occurred in the research by Pérez-González and Oltra (2021) with typically developing children. They conducted a fourth experiment, which included five children who previously failed to demonstrate the emergence of all ABC complex intraverbal relations. In the new experiment, all children (except one) demonstrated the emergence of all complex intraverbals after the simpler intraverbal relations of the type of exemplars and categories were taught to them. In fact, even the child mentioned as an exception showed the emergence of most of the complex relations. This result indicates that the teaching of simpler relations facilitated the emergence of ABC intraverbals for all participants. More recently, Pérez-González and Oltra (2023) conducted a replication of the previous study. In the first experiment, 18 typically developing children between 7 and 8 years old participated. For six of these children, simpler intraverbal relations of the type of exemplars and categories were first taught. After that, they were exposed to cycles of sentence reading – probing ABC intraverbals. In the case of six other children, before going through these cycles, they were taught simpler intraverbals of the type of exemplars only. As to the six remaining children, they were only exposed to the cycles of sentence reading – probing ABC intraverbals, that is, the simpler intraverbals were not taught to them.

The results were the following: All children who were taught both types of simpler relations (exemplars and categories) demonstrated the emergence of all complex ABC intraverbal relations. Five of the six children, who were taught simpler relations of the type of exemplars only, showed the emergence of all complex intraverbal relations. Finally, only one of the six children, who were not taught any of the simpler relations, demonstrated the emergence of all ABC intraverbals. The results were discussed in the sense that the teaching of both simpler intraverbal relations of the type of exemplars and categories facilitates the emergence of complex intraverbals in typically developing elementary school children. A second experiment conducted was similar to the first. However, Pérez-González and Oltra (2023) sought to equate the number of teaching trials among children from different conditions. In the previous experiment, the children who were taught both types of simpler relations (exemplars and categories) were exposed to more teaching trials than the children to whom only one type of simpler relations (exemplars) was taught. According to the authors, more teaching trials may have facilitated the emergence of ABC intraverbals. Thus, in their second experiment, children who were taught only simpler relations of the type of exemplars were exposed to the same number of trials (or more). Four children were taught both types of simpler relations and three of them showed the emergence of all ABC intraverbals. Four other children were taught only simpler relations of the type of exemplars, and two of them demonstrated the emergence of all ABC intraverbals.

The possible facilitating effect of the teaching of simpler intraverbal relations (exemplars and categories) remains to be better investigated in children with ASD. It is important that new investigations be conducted with more learners who are fluent readers. If the teaching of sentence reading and retelling fails to produce the emergence of all complex ABC intraverbals, the teaching of simpler relations may be administered to verify whether these variables influence or facilitate the emergence of all possible complex intraverbal relations in children with ASD. Moreover, as in Experiment 1 from this study, it is also not clear whether the teaching of sentence retelling (which did not occur in previous studies with typically developing children by Pérez-González & Oltra, 2021, 2023) was necessary for the emergence of the complex intraverbals in P1, despite the recommendation to systematic teach narrative retelling to establish text comprehension (Solari et al., 2020). Future research should investigate whether teaching sentence reading is sufficient in producing the emergence of complex intraverbals or, if not, analyze the possible facilitating effect of the teaching of sentence/narrative retelling. Finally, as in the case of Experiment 1, although the results were positive regarding the emergence of complex intraverbals representing text comprehension in a child with ASD, having only one participant also represents a limitation. It is important that future studies extend the investigation with more learners with ASD to check the possible generality of the procedures and findings.

4. Recommendations

A future investigation should represent a systematic replication of the current one. For several children with ASD as participants, the teaching of sentence reading (regarding sentences like the ones from this study) may be defined and the effects investigated on text comprehension (that is, what was referred to as the emergence of complex ABC intraverbal relations). If this step is not sufficient to establish all possible complex intraverbal relations, the teaching of sentence retelling should be applied. If this still is not enough for the full emergence of complex intraverbals, the teaching of simpler intraverbal relations of the types of exemplars and categories should be applied to assess the possible facilitating effect on the emergence of complex ABC intraverbals.

5. Conclusion

In both experiments in this study, the teaching of sentence reading and retelling successfully established the emergence of all possible complex intraverbal relations among three different stimuli mentioned in the sentences. The participant was a child with ASD, a second-year elementary school student who is a fluent reader. Overall, although the results were positive, it is not clear if the teaching of sentence retelling influenced or facilitated the emergence of ABC intraverbals. It is possible that the teaching of sentence reading sufficiently produced the emergence of complex intraverbals and future investigations are warranted to further investigate whether sentence retelling is also necessary or important. Moreover, in the second experiment, the teaching of simpler intraverbals of the type of exemplars and categories was applied to verify if these variables facilitate the emergence of ABC intraverbals. Since the participant was the same child from Experiment 1 (without teaching of exemplars and categories), it is possible that the teaching of the mentioned simpler intraverbals was not necessary for the emergence of complex intraverbal relations. In this sense, future investigations with more children with ASD are also warranted to better isolate the possible facilitating effects of teaching simpler intraverbals. Extending the investigation to include several children with ASD, who are fluent readers, is also important to check the generality of the procedures and findings.

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Conflict of Interest Statement
The authors declare no conflicts of interest.

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