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Investigações sobre Seguimento de Olhar e Tomada de Perspectiva em Crianças com Desenvolvimento Típico e com Autismo

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RESUMO

Esta tese foi escrita no formato de compêndio de textos científicos e contou com quatro estudos que fundamentaram o planejamento e implementação de investigações que visavam identificar parâmetros importantes no estabelecimento dos repertórios de seguimento de direção do olhar e de Tomada de Perspectiva para crianças com e sem autismo. Primeiramente, foi investigado se mudanças em um procedimento já replicado de treino de múltiplos exemplares permitiria verificar características de operante generalizado para duas crianças dentro do Transtorno do Espectro Autista (TEA) (Estudo 1). Em segundo lugar, a partir do levantamento bibliográfico da literatura de atenção conjunta, foi identificada uma carência de estudos que utilizassem delineamento de sujeito único para investigar mudanças em padrões de rastreamento de olhar (via *eye tracking*). Adicionalmente, a grande maioria dos estudos na área teve como foco a caracterização do rastreamento de olhar em tarefas de avaliação isoladamente, sendo pouco explorado como os padrões de rastreamento de olhar variavam ao longo da aprendizagem de respostas, o que norteou a pergunta de pesquisa do Estudo 2. As investigações dos dois primeiros estudos exploraram uma reposta de atenção conjunta (i.e., seguir a direção do olhar do outro) visando melhora na interação social de crianças muito novas, e forneceram informações importantes para planejar intervenções para as crianças com autismo. No entanto, tratando-se de interação social, respostas mais complexas não estavam sendo contempladas nas investigações anteriores (Estudos 1 e 2). Deste modo, na sequência, foi proposta uma investigação teórica desenvolvendo uma análise funcional a partir do modelo Multi Dimensional Multi Nível (MDML) de repertórios relacionais para estabelecimento de respostas para desenvolvimento de Tomada de Perspectiva (Estudo 3). Por fim, a hipótese levantada acerca de repertórios relacionais mínimos necessários para estabelecimento de Tomada de Perspectiva na investigação teórica, inspirou uma investigação empírica (Estudo 4). Este último estudo contou com o desenvolvimento de tarefas de avaliação dos repertórios relacionais em uma criança com e outra sem autismo com perfil de desenvolvimento equivalente. Além disso, em sequência, foi realizado o ensino dos repertórios relacionais necessários para apresentação de Tomada de Perspectiva e que estavam deficitários para a criança com autismo, avaliando posteriormente os efeitos subsequentes nas respostas alvo de investigação, as de Tomada de Perspectiva. Em resumo, a presente tese explorou um repertório mais básico e um mais complexo, fundamentais para estabelecimento adequado de interações sociais: seguimento de direção do olhar (Estudos 1 e 2), e repostas relacionais para Tomada de Perspectiva (Estudos 3 e 4). Os dois repertórios investigados parecem ser fundamentais para superação de barreiras sociais importantes em indivíduos com autismo.

Palavras-chave: autismo, seguimento de direção do olhar, Tomada de Perspectiva, treino de múltiplos exemplares, rastreamento de olhar.

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ABSTRACT

This thesis was written in the form of a compendium of scientific texts. It included four studies that supported the planning and implementation of investigations that aimed to identify critical parameters in the establishment of the repertoires of looking direction and Perspective Taking for children with and without autism. First, the first experiment investigated whether changes in a procedure already replicated for multiple exemplar training would enable the verification of generalized operant characteristics for two children within Autistic Spectrum Disorder (ASD) (Study 1). Second, observing a lack of studies in joint attention literature using a single-subject design, the aim was to investigate changes individually in eye-tracking patterns (via an eye-tracking device). Additionally, the vast majority of the studies in the area focused on the characterization of eye tracking in assessment in isolated tasks, with little explored as the eye-tracking patterns varied throughout the learning of responses, which guided the research question of Study 2. The first two studies explored joint attention responses (i.e., following the direction of someone's gaze), and they aimed to investigate and improve the social interaction behavior in very young children and provided relevant information for planning intervention for children with autism. However, social interaction, in general, can include many more complex responses that were not addressed in both previous investigations (Studies 1 and 2). Thus, for a broad interpretation of this phenomenon, in the sequence, a theoretical investigation was proposed. This investigation aimed to develop a functional analysis based on the Multi-Dimensional Multi-Level (MDML) framework for relational repertoires. This analysis allowed to establish responses for the development of Perspective-Taking (Study 3). Finally, the hypothesis raised about the minimum relational repertoires necessary for establishing Perspective-Taking in the previous theoretical research inspired an empirical investigation (Study 4). This last study involved the development of tasks to assess relational repertoires in a child with and another without autism with a similar development profile. Besides, this study also aimed to teach and develop the necessary relational repertoire that potentially would enable the presentation of Perspective-Taking, which were deficient for the child with autism. Subsequently, this teaching procedure effects for the behavioral repertoire of the participant were evaluated. In summary, the present thesis explored both fundamental and complex repertoire, crucial for the proper establishment of social interactions: gaze-following responses (Studies 1 and 2), and relational responses for Perspective-Taking (Studies 3 and 4). Both repertoires investigated seem to be fundamental for overcoming significant social barriers in individuals with autism.

Keywords: autism, gaze-following, Perspective-Taking, multiple exemplar training, eye-tracking.

SUMÁRIO

APRESENTAÇÃO

Ao longo do desenvolvimento infantil bebês muito novos, a partir de nove meses de idade, gradualmente aprendem como a atenção de outra pessoa pode diferir da sua própria (Bakeman & Adamson, 1984). As crianças começam a aprender a se atentar para a perspectiva visual de outra pessoa em um ambiente compartilhado. Um componente inicial e crítico desta fase é conhecido por atenção conjunta ou seguimento de direção do olhar, no qual a criança segue a direção de um adulto para mudar sua atenção para aspectos mais interessantes do ambiente a sua volta. Uma questão muito levantada na literatura deste tema, trata-se particularmente se o seguimento de direção do olhar pela criança sustenta inferências e predições da mesma acerca de estados mentais das outras pessoas, sendo que se assume que é tomada a perspectiva visual do outro. No entanto, a maneira pela qual as crianças compreendem a "experiência mental do outro de ver algo" ainda é controversa (Jao, Robledo, & Gedeon, 2010). A seguir serão apresentados brevemente os estudos que foram desenvolvidos nesta tese, investigando estes dois repertórios sociais extremamente relevantes para as relações sociais: um mais básico, sendo o seguimento de direção do olhar, e outro mais complexo, sendo a Tomada de Perspectiva.

O primeiro estudo desta tese trata-se de uma replicação modificada do procedimento de Gould, Tarboux, O'hora, Noone e Bergstrom (2011). Este estudo visou investigar um procedimento que possibilitasse ensino de seguimento de direção do olhar, também conhecido por "atenção conjunta", para crianças que frequentemente apresentam déficit destes repertórios, isto é, crianças com Transtorno do Espectro Autista (TEA). A tarefa consistia em apontar ou nomear o item para o qual uma face de perfil de um adulto tivesse seu olhar direcionado. As modificações realizadas no procedimento original visaram investigar se um treino de múltiplos exemplares viabilizaria a flexibilidade destas respostas, de modo que os participantes (duas crianças com autismo) seguissem o olhar a despeito do estímulo que se seguia na direção do olhar do adulto. Ao longo do treino, a inclusão de conjuntos novos de estímulos na direção do olhar do adulto permitiu, posteriormente, avaliar a generalização das respostas de seguimento de olhar ensinadas para outros novos conjuntos, apresentando características de operante generalizado. Os dois participantes apresentaram desempenhos mais significativos nos pós testes em ambiente natural (i.e. com novos conjuntos de estímulos não diretamente ensinados) em comparação com os estudos anteriores (Gould et al., 2011; Hahs, 2015), ressaltando a relevância das modificações propostas nesta replicação.

O segundo estudo desta tese trata-se de uma investigação comparativa dos padrões de rastreamento de olhar utilizando um instrumento de *eye tracking* de um participante com desenvolvimento típico (de 3 anos) e outro com autismo (de 5 anos), tendo ambos, repertório de linguagem receptiva similares. A tarefa utilizada nesta etapa de avaliação tratou-se da mesma utilizada no Estudo 1, isto é, o participante deveria indicar para qual figura a face estava olhando. Ao mesmo tempo que foi identificada acurácia no rastreamento visual e desempenho da tarefa pela criança com desenvolvimento típico (Gabriel), observou-se rastreamento impreciso e baixa acurácia na tarefa pela criança com autismo (Max). Logo, um treino de múltiplos exemplares, consistindo em uma versão resumida do mesmo procedimento de ensino de seguimento de direção do olhar do Estudo 1, foi implementado para o participante com autismo na sequência. Este procedimento, em conjunto com o registro do rastreamento ocular via *eye tracking,* possibilitou identificar mudanças no rastreamento ocular da criança com autismo ao longo da aprendizagem do novo repertório. O principal resultado desta investigação mostrou que o padrão de fixações oculares aos estímulos apresentados na tela que foi observado ao longo da sessão de pré-teste de Gabriel foi o mesmo observado ao longo das sessões de ensino de Max, sendo estes: uma diminuição das fixações oculares ao estímulo modelo no decorrer das tentativas, um aumento das fixações ao estímulo estímulo correto, e ainda, uma diminuição das fixações oculares aos estímulos incorretos. A mudança no rastreamento dos estímulos ao longo da aprendizagem de Max corrobora a hipótese do comportamento de seguir a direção do olhar ter características de operante generalizado.

As investigações dos dois primeiros estudos (Estudo 1 e 2) exploraram uma resposta de atenção conjunta (i.e., seguir a direção do olhar do outro), que comumente aparece muito cedo no desenvolvimento infantil típico, favorecendo melhora na interação social de crianças muito novas. Deste modo, os dois primeiros estudos fornecem informações importantes para planejar intervenções para as crianças com autismo que apresentam déficits nestas respostas sociais iniciais. No entanto, tratando-se de interação social, respostas mais complexas não estavam sendo contempladas nas investigações anteriores (Estudos 1 e 2), o que norteou a investigação em repertórios relacionados com respostas sociais mais complexas como as de Tomada de Perspectiva (Estudos 3 e 4).

A Teoria das Molduras Relacionais (Relational Frame Theory – RFT) é uma abordagem analítico comportamental para a linguagem e cognição humana (Hayes, Barnes-Holmes, & Roche, 2001). A partir desta abordagem é viabilizada uma explicação funcional das respostas envolvidas em Tomada de Perspectiva, indicando a aprendizagem de relações dêiticas como chave para o desenvolvimento deste repertório. Esta análise acarretou no desenvolvimento de um protocolo de avaliação e ensino de Tomada de Perspectiva (que ficou conhecido por Protocolo Barnes-Holmes), possibilitando a realização de investigações empíricas (McHugh, *Barnes–Holmes & Barnes–Holmes*, 2004). Mais recentemente, uma nova organização teórica por meio do MDML - Multi Dimensional Multi Nível, permitiu analisar a dinâmica funcional que embasa o Responder Relacional Arbitrariamente Aplicável (RRAA), indicando Níveis (1- Implicar Mutuamente, 2-Emoldurar Relacional, 3- Reticular Relacional, 4- Relacionar Relações, 5- Relacionar Redes Relacionais) e Dimensões (Complexidade, Derivação, Coerência, Flexibilidade) que influenciam seu estabelecimento (Barnes-Holmes, Barnes-Holmes, Luciano, & McEnteggart, 2017). A partir desta nova organização, passa a ser possível investigar unidades mínimas necessárias para a apresentação de responder relacional em Tomada de Perspectiva.

Deste modo, o terceiro estudo desta tese trata-se de uma investigação teórica acerca de uma nova maneira de compreender as respostas relacionais dêiticas que compreendem o repertório de Tomada de Perspectiva pela Teoria das Molduras Relacionais, utilizando a organização do Multi Dimensional Multi Level – MDML, proposto em Barnes-Holmes, Barnes-Holmes, Luciano, & McEnteggart (2017). O Estudo 3 desta tese, tem então por objetivo principal discutir qual é o repertório relacional prévio mínimo necessário que um indivíduo precisa apresentar antes de ser capaz de inferir a perspectiva dele e de outras pessoas. A princípio, as pesquisas anteriores que identificaram as molduras relacionais dêiticas como fundamentais para apresentação de Tomada de Perspectiva (e.g., McHugh, et al., 2004; McHugh, Barnes-Holmes, Barnes-Holmes, & Stewart, 2006), foram o ponto de partida para esta análise. O modelo do MDML permitiu identificar as molduras que seriam cruciais antes de um indivíduo demonstrar Tomada de Perspectiva (i.e. Coordenação e Diferença no RRAA), os níveis relacionais de estabelecimento mínimo de cada uma delas (i.e., pelo menos Nível 4 para Coordenação e Nível 1 para Diferença no RRAA), e ainda como as dimensões (i.e., flexibilidade, coerência, derivação e complexidade) aprimoram as propriedades dinâmicas e interativas da resposta relacional derivada.

Esta investigação teórica foi fruto do estágio de pesquisa no exterior realizado pela aluna. No seu retorno ao país, foi proposto o último estudo (Estudo 4), o qual foi inspirado na investigação teórica anteriormente desenvolvida, tendo em vista, que a hipótese discutida no estudo teórico necessita ainda de investigações empíricas para sua confirmação.

Por fim, o quarto estudo dessa tese trata-se de uma investigação empírica acerca das unidades fundamentais do RRAA (Responder Relacional Arbitrariamente Aplicável) que devem ser ensinadas, como um conjunto de tarefas, para avaliar e treinar respostas relacionais que caracterizam a Tomada de Perspectiva, utilizando o escopo do MDML. Neste estudo foi possível comparar os desempenhos em RRNAA (Responder Relacional Não Arbitrariamente Aplicável) e de RRAA de uma criança com desenvolvimento típico (Claire) e outra com autismo (Frank), que apresentavam perfil de desenvolvimento equivalente. Apesar de apresentarem perfil de desenvolvimento semelhantes, foram observados déficits substanciais em todos os níveis e molduras de RRAA para Frank. Ademais, foi possível testar a hipótese levantada no Estudo 3, sendo ensinado o repertório relacional prévio mínimo necessário para Frank (i.e., Níveis 1, 2, 3 e 4 de Coordenação e Nível 1 de Diferença), e verificados resultados mais significativos nos pós-testes de respostas relacionais dêiticas, constatando avanços nas mesmas após o ensino proposto.

Em resumo, o compêndio de textos científicos da presente tese compila dois estudos que exploram um repertório fundamental para estabelecimento adequado de interações sociais iniciais, a saber, respostas de seguimento de direção do olhar ou atenção conjunta. Adicionalmente, reúne outros dois estudos que examinam um repertório comportamental mais complexo, imprescindível para interações sociais eficazes na infância tardia, adolescência e vida adulta, a saber, a Tomada de Perspectiva. Em conclusão, esta tese tem a finalidade maior de ampliar a compreensão de repertórios comportamentais chave para correto estabelecimento das relações sociais, viabilizando superar barreiras sociais importantes, especialmente para indivíduos que se encontram no espectro do autismo.

ESTUDO 1

Learning and Generalizing Gaze Following Behaviors to Natural Environment by Autistic Children

Deficits in basic social repertoires, such as low frequency of eye contact and not orienting toward speech sounds, are commonly identified as the first indicators of developmental delay, especially in Autistic Spectrum Disorder (ASD) (MacDonald, Anderson, Dube, Geckeler, Green, & Holcomb, 2006). For children with ASD is often difficult to properly follow the direction of the adult gaze, and to take the perspective of other people. Children with typical development, on the other hand, begin to show signs of perspective taking of themselves and of others from an early age (Carpenter, Nagell, & Tomasello, 1998), and by the age of five show a significant increase in adequate interactions with their social environment (Howlin, Baron-Cohen, & Hadwin, 1999).

One important repertoire in early social interaction that often lacks in infants with autism, is joint attention. Joint attention enables a variety of social interactions, even before the development of speech. Beyond mediating face-to-face interpersonal relationships, it subsequently contributes to the child's visual attention coordination between an object of interest and another individual (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Stern, 1985; Tomasello, 1995). In Developmental Psychology, joint attention refers to a set of behaviors that produce simultaneous attention, from the child and an adult, to some object of interest, so that the two can share the "knowledge" of this object (Dawson, Munson, Estes, Osterling, McPartland, Toth, Carver, Abbott, 2002; Mundy, Sigman, Ungerer, & Sherman, 1986). Commonly, typical children begin to deliver non-vocal joint attention responses between 9 and 12 months of age (Bakeman & Adamson, 1984). Individuals with autism often lack this behavior (Carpenter, Pennington, & Rogers, 2002; Mundy, Sigman, & Kasari, 1994).

One behavioral model for analyzing joint attention proposed by Dube, MacDonald, Mainsfield, Holcomb and Ahearn (2004) and Holth (2005) allows the empirical investigation of joint attention behaviors. According to Dube and colleagues (2004) and Holth (2005), responding to joint attention and initiating joint attention are functionally different, since the former happens when an adult looks or points in the direction of an object / event, and the child's responses toward the object of interest are characterized as instructional obedience (Greer And Ross, 2008; Martins & Harris, 2006), maintained by generalized reinforcers. On the other hand, in initiating joint attention the antecedent is a motivating operation (presence of the adult in the environment) that evokes the response of the child to shift his look between the adult and the object of interest, maintained by social reinforcers. Furthermore, initiating joint attention can be interpreted as the child's mand for responses emitted by the adult, named here as "attention" to the object of interest (e.g., position of the face, body and eyes of the adult), that is different from a mand for the object itself (Skinner, 1957).

Adult "attention" responses serve not only as consequences for initiating to joint attention, but also, they serve as a background to responding to joint attention. Therefore, to discriminate the stimuli related to adult´s "attention" to objects of interest requires, additionally, to detect the direction his/her gaze focus. Thus, children who present deficits in responding to joint attention are most likely to show absence or scarcity of an adult´s gaze following (frequently directed to a target), in other words, the direction of the adult's gaze does not function as a discriminative stimulus for the child response to follow the gaze. In these cases, the child must learn to discriminate the adult´s "attention" stimuli and the direction to his/her target (e.g., face, body, eyes positions), as well as to discriminate the target itself, that is, to be under control of the very object to which the adult looks. This learning will increase the likelihood that the child will emit initiating joint attention responses in the future (Dube et al., 2004), and contact additional consequences mediated by the adult in this interaction (child / object / adult interaction).

An alternative approach, presented by Relational Frame Theory (Hayes, Barnes-Holmes & Roche, 2001; Zettle, Hayes, Barnes-Holmes, & Biglan, 2016) is analyzing the components present in a joint attention episode not individually, but related, and this response as a relational responding. The main reason of proposing this perspective of analysis for understanding joint attention, is to recognize this behavior as a generalized operant contextually controlled and non-arbitrarily applied, implying that in this sense an organism may respond in novel ways based on the physical relationship that exist among the encountered stimuli. This emphasize the idea that any person looking a given stimulus and any stimulus in this relation could alter the functions of this stimulus for an observer increasing the chance of a gaze-following response to be presented. In other words, in this perspective, given the appropriate history this gaze-following response could be understood as a non-arbitrarily applied relational responding under the control of contextual features. To establish this kind of contextual control a Multiple Exemplar Training will enable stimuli to function as contextual cues (Hayes et al, 2001; Torneke, 2010). To summarize, contextual cues may be relevant in selecting a response where the observer may follow the gaze of another person looking at one specific stimulus and not any other. This joint attention response would be a generalized operant, once the observer is not learning to attend to a specific stimulus someone else is attending, but "joint attending" to any stimuli.

Recent empirical evidence with autistic participants has indicated the importance of developing a simultaneous control of the direction of the adult's gaze and the object of interest to learning the responses to follow the direction of other's gaze (e.g., Whalen & Shreibman 2003; Gould, Tarbox, O'Hora, Noone, & Bergstrom, 2011; Hahs, 2015; Klein, MacDonald, Vaillancourt, Ahearn, & Dube, 2009). Two of those studies (Gould, et al., 2011, and Hahs, 2015) proposed a multiple exemplar training to teach autistic children to follow the direction of another individual's gaze in a table-top procedure employing cards with printed pictures.

Gould et al. (2011) presented trials in matching to sample format, the sample stimuli always being a face profile directed towards an object to its left or right. The aim of the study was to teach three 3 to 5-year-old children with autism to indicate the object for which the sample stimulus was directed (“looking”) after the presentation of the question "what does he see?". The comparisons stimuli corresponded to three categories (vehicles, fruits or animals), and were arranged to the right, to the left, above or below the sample stimuli. The researchers used different sizes of arrows as visual prompts, arrows that started from the eyes of the sample and ended over the object that was in the correct direction. This was employed to facilitate the indication of the correct conditional stimulus (object in the direction of the sample's “look”) in relation to the correct stimulus (face profile directed to the right or left). The increase in the number of correct responses of the participants during the training, and in the generalization tests with new stimuli, indicated the potentiality of the procedure to teach the target behavior (follow the direction of the look of another individual). However, variable performances were observed in the natural environment tests. Only an accuracy between 44% to 66% of correct responses were observed for the three participants, which led the authors to describe possible limitations in the transposition of the table-top procedure to the natural environment.

Hahs (2015) replicated the procedure of Gould et al. (2011) in a regular school setting. Three autistic children with 3, 9 and 13 years, participated in the presence of their caregivers and teachers, aiming to approach the context of the natural environment research. The researchers reported that only one of the three participants performed between 63% and 75% of correct responses on tests with objects and actual people, while the other two presented lower performances (both showing 0% in two sessions).

The two studies report improvements in participants' performances after training the response to follow the direction of the gaze from a multiple exemplar training procedure. Although, the variable performances of the participants in the natural environment tests, in both studies, imply questions regarding the procedures used. The first of these questions refers to the difference of the profile picture used as a sample during the procedure and the researcher, who at the time of the tests, should execute the role of the sample looking in a specific direction.

The natural environment test may have added many competing new stimuli that controlled the participants' attention. The environment in which this test was run had a much wider range of distractors (objects) than were available in comparison to the training condition. In addition, the sample stimulus did not vary among the training trials, which may have interfered in the response generalization in the natural environment test for those participants that needed only one set of training stimulus to achieve the criterium to end the training phase.

The results of both studies presented earlier (Hahs, 2015; Gould et. al, 2011) showed successful results regarding the multiple exemplar training, once in general the participants mastered the task very easily. However, the stimuli employed in the multiple exemplar training tasks were not changed except if the participant failed responding during the post-test. This characteristic does not allow to investigate if the gaze following behavior could be understood as a contextually controlled generalized operant.

In this sense, the aim of the present study was to perform a modified replication of Gould et al. (2011), to teach the behavior of following the direction of an adult's gaze through a learning procedure with the main objective to see if this behavior would present generalized operant features. To this end, the modifications of the multiple exemplar training used by Gould et al. (2011) made were: 1) to vary the comparison stimuli gradually presented, according to learning criterion, during the training procedure until the natural environment test; 2) to insert comparison stimuli gradually (from two to four) during the training procedure; and 3) minimize the distractors available in the child's visual field from the natural environment test, presenting more similar configuration in the test setting to the training setting. Additionally, to the visual prompts fading employed, as in the original study, in the present study were employed also physical gestural prompts for the correct comparison stimulus, according to the individual learning pace of each participant. These changes, together, were proposed to strengthen the learning of the planned repertoire, minimize the errors, and possibly promote the generalization of learning to a natural environment context. If this behavior became contextually controlled, new sets of stimuli and different patterns of testing would probably show less challenging for the participants.

Method

Participants

Three children with autism aged 4 to 5 years participated in this study, but only two achieved the inclusion criteria for the research. They attended an institution specialized in behavioral education and conducted daily behavioral intervention programs (15 hours per week, for at least three months before the beginning of the experiment). All three participants continued to receive interventions during the study, and all had a diagnosis of autistic disorder (AD), by an independent professional (e.g., paediatrician) as defined by the DSM-V (American Psychiatric Association, 2013). Participants had previous history of exposure to table-top matching-to-sample tasks and conditional discrimination procedures as part of their intervention programs. The work described has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans, and for this, a confirmation was given that guardian informed consent was obtained.

All children had their verbal repertoire evaluated by the Peabody Picture Vocabulary Test Revised - PPVT-R (Dunn & Dunn, 1981). The PPVT-R was applied by the researcher and evaluates receptive language repertoires of two years or older individuals. It contains 192 boards with four drawings each, in which the individual must select the image that best represents the word spoken by the experimenter. The researcher also applied the Childhood Rating Scale (CARS) (Schopler, Reichler, & Renner, 1986), designed as a clinical rating scale for trained clinicians or researchers to rate items from 0 to 4 that are indicative of Autism Spectrum Disorder (ASD). After direct observation of the child and fulfilling the 15 items (relationship to people, imitation, emotional response, fear and nervousness, verbal communication, non-verbal communication, activity level, level and consistency of intellectual response, and general impressions), the scale provides a composite score of the level of autism observed, ranging from non-autistic to mildly autistic, moderately autistic, or severely autistic. Table 1 shows the chronological age of the two participants that passed the inclusion criteria for the research, gender, age equivalents in PPVT-R, CARS score and edible reinforcing items used in the research for each of them.

Table 1. Characterization of the participants by gender, chronological age, equivalent age in PPVT-R, score and level in CARS and tangible reinforcers used in the research for each one.

Participant	Gender	Age (years-months)	Equivalent Age (PPVT-R)	CARS level	Tangible reinforcers
Arthur	M	4-9	3-5	35,5 (moderate)	Kinder Egg®
Lucas	M	5-9	3-11	34 (moderate)	MMs® or Popcorn

It can be observed that the two participants had below-expected equivalent ages for their chronological ages. Both participants were able to talk using simple words and using few two or three-word sentences directly trained, with few presentations of spontaneous speech. Arthur had a vocabulary of tact's above 150 words, and Lucas above 50 words. The edible reinforcers selected for training were the same as previously defined by the team of therapists through preference tests and interviews with parents.

Materials

The sessions were held at the institution as part of the regular intervention programs planned for the participants, conducted by a single researcher, who sat next to the participant, facing the table in which he presented the stimuli. In the natural environment test sessions, the presence of a second experimenter was necessary. The materials of the test and training sessions consisted of sets of visual stimuli (face profiles, animals, fruit or vehicles) that were presented in the form of 10 x 7cm cards, arranged on a table. The materials of the natural environment test were 20cm tri-dimensional stimuli, selected based on non-preferred toys for both participants.

In a typical trial, the sample stimulus was always presented in the central part of the table, and comparisons were presented alongside it (right and / or left). In some stages, were also used comparison stimuli above and below the sample that functioned only as distractors, as can be seen in Figure 1.

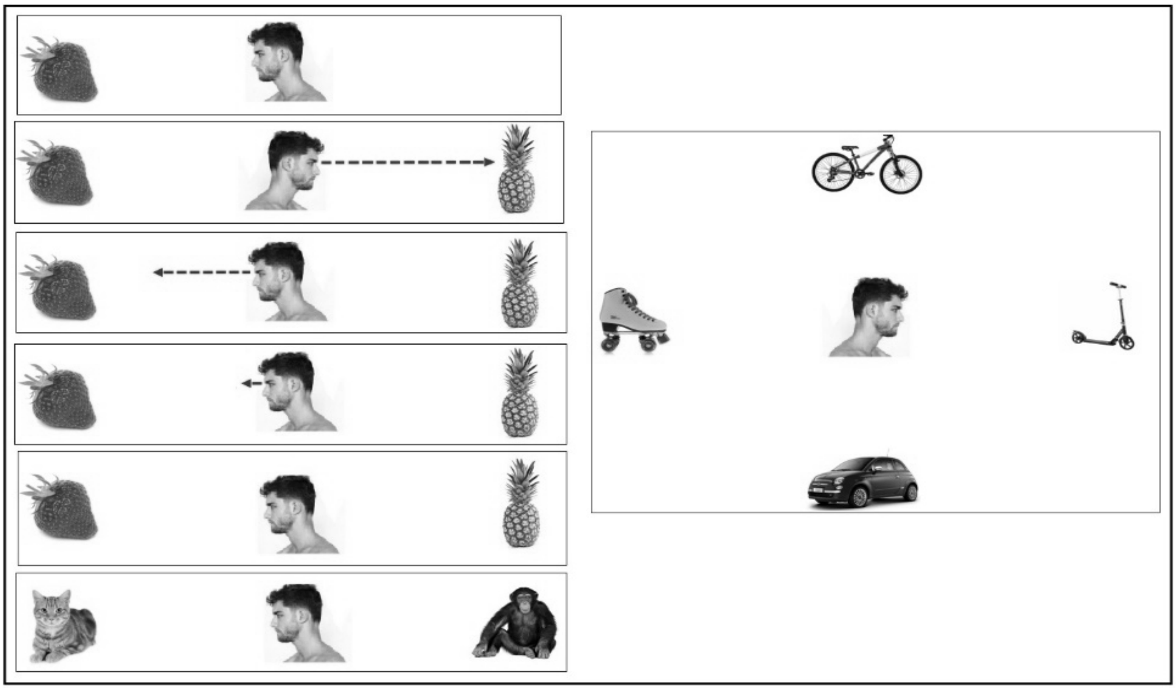

Figure 1. Representation of trial types presented to the participants. Left panel – each one of the training blocks. Right panel – structure presented in the last training block and in the pre-test and post-test blocks (with different comparisons).

The sample stimulus consisted of a face profile in the direction of a picture to its right or to its left, and comparisons stimuli consisted of pictures from one of three categories described earlier. Four exemplars of each category of the pictures were randomly assigned to the training and test blocks. For the natural environment test a second experimenter sat between two low tables, positioned to the right and left of him, with an object on each of them.

Measures of response and interobserver agreement

The dependent variable was to evaluate changes in the child's expected target response after the training phase. By the question "what does he see?", the child would need to point or say the name of the corresponding object, indicated by the direction of the sample´s gaze. During the tests in natural environment the target behavior was the same, but the stimuli were actual people and actual objects in real dimensions. During all sessions, the data were registered considering the percentage of independent responses.

Twenty percent of pre-test and training sessions records were scored for interobserver agreement by a second neutral observer. It was defined as disagreement when one observer recorded that the response occurred and the other recorded that it did not. In doing so, the number of concordances was divided by the total number of concordances and disagreements and multiplying by 100. The first and second observers obtained 98.6% agreement of the sessions for all participants.

Experimental Design

A single-subject, multiple baseline between participants experimental design (Kazdin, 1982) was employed to evaluate the efficacy of the intervention.

Procedures

Identity and Similarity Test. As an including criterion for the research, a test block was carried out before the beginning of the test and training phase, mixing 12 trials of an identity matching-to-sample with the sample stimuli, presenting trials to discriminate the head positions of the sample pictures. This test aimed to identify if all the participants could discriminate the change of the position of the face, to the right and to the left. The trials consisted of presenting two comparative stimuli (right and left directed male profile picture). Then the experimenter would present another picture identical to one of the comparisons (e.g., left directed male profile picture) and instruct "put together", then the participant should place the sample picture next to or on top of the S + (the identical one). The same kind of trial was presented in sequence with the female profile. At last, sample stimuli presented female profiles and comparisons were male profiles, and vice versa. The criteria to pass this phase was above 85% of correct responses in one block.

Pre and Post-test. Sessions comprised 12 trials. Trials consisted in the presentation of a single sample stimulus in the centre of the table (face of a profile directed to the left or right) with four comparison stimuli around it (left, right, above and below), and the statement "what does he sees?". The face sample picture was always directed towards the S + at all stages of this procedure. A total of four stimuli from each category were presented in semi-random order in the two possible positions as S + or as distractors along the trials. No prompts or differential consequences were provided. In order to maintain participant engagement during the session and to ensure reinforcement availability, a learnt response (e.g., motor imitation) was requested, every four trials, which produced social reinforcement in case of correct response. Pre-test sessions were held to assess for repertoire stability until the participant started the procedure, and scores below 60% were criteria to start the training phase.

In the post-test block the participants should present 11 correct answers in 12 trials (more than 90% of the block) to perform the natural environment test. If the participant did not reach the criterion in the block, he should perform the previous stage of training (referring to the stage with four comparison stimuli), with a new set of non-taught comparison stimuli. If the participant did not present 100% correct answers in two consecutive blocks, he returned to the previous stage of training. As soon as the first participant demonstrated 11 correct responses in 12 trials in the post-test, the second participant started the procedure.

Natural Environment Pre and Post-Test. The natural environment test aimed to verify if the training procedure produced generalization to another situation involving actual persons and objects familiar to the participants. Like the pre-test and the post-test, there were no differential consequences for errors or correctness, and scores below 60% were criteria to start the training phase. The block also consisted of 12 trials, in a similar configuration to post-test trials, but with actual persons and actual objects. A second experimenter, familiar to the child, sat in front of the participant exposing the side of his face (similar to the sample) between two low tables, positioned to the right and left of him, with an object on each of them. Twelve toys (e.g. frog, robot, bear, car, etc.) were presented as comparisons throughout the 12 test trials, and the second experimenter positioned six times facing the object on the right or in the left, in semi-random order. Table 2 summarizes all phases of the procedure.

Table 2. Procedure stages ordered by presentation sequence to the participants.

Procedure Stages
Tests
Identity and Similarity Test
Pre-test (Baseline)
Natural Environment Pre-test (Baseline)
Training
2 comparisons with large arrow
2 comparisons with medium arrow
2 comparisons with small arrow
2 comparisons with no arrow
2 comparisons (new set)
2 comparisons (mixed sets)
4 comparisons (mixed sets)
Tests
Post-test
Natural Environment Post-test
Follow up

Training. The comparison stimuli presented in training procedure was different from those used at the pre-test. The criterion of performance throughout the training procedure of each phase was 100% correct answers in two consecutive blocks to advance to the next phase. In case of an incorrect response in a trial, the next trial was presented. In case the participant had to repeat the block, the positions of the correct comparison stimuli of the block and the order of presentation of the right and left positions were changed and balanced. In case of correct answer, three types of reinforcements were presented: social reinforcement (compliment), the delivery of an edible reinforcement and a token in a board for each 12 trials as conditioned reinforcers for a contiguous free time after completion of the session.

Prompts Procedure. Two procedures were employed to incorporate prompts into the training blocks considering the participants' learning performance and rhythm. The visual prompts consisted of red dashed arrows drawn from the sample's eyes to the picture he was looking at (see Figure 1). Initially the whole block was performed with the larger visual prompt (large arrow), and as soon as the participant presented 100% accuracy for two consecutive blocks the prompt was faded out, with the gradual decrease of the size of the arrows in three different dimensions: large arrow (15 cm), medium arrow (7 cm), and small arrow (3 cm). Second, when the participant presented performance equal to or less than 50% of correct responses in two consecutive blocks, a gestural prompt was incorporated. The gestural prompt consisted of the experimenter pointing the correct stimulus comparison (S +) immediately after its presentation in all trials of the block. Likewise, after the participant presented 100% correct responses in two consecutive blocks, the prompt was withdrawn

Training stages - from 2 to 4 comparisons. Training sessions included 12 trials, half of them in each of the gaze directions to be taught (i.e., right or left). In this first stage the trials consisted of the presentation of the sample stimulus (face profile), with two comparison stimuli, one on the left and one on the right. One S + (the picture on the side where the face of the sample was facing) and another S- (the picture aligned to the back of the sample). Initially, the comparison stimuli were kept in fixed positions: on the right, the pineapple and on the left the strawberry. Later, once the participant reached 100% of correct responses for two consecutive blocks, without using the prompts (arrow and / or physical gesture), he advanced to a block with new stimuli of comparison (monkey on the right and cat on the left). Then, demonstrating 100% of correct responses for two consecutive blocks with the new set of comparison stimuli, a mixed block was performed. In this block, in half of the trials the comparison stimuli were strawberry and pineapple and in the other half the monkey and the cat.

Finally, once the participants demonstrated 100% of correct answers for two consecutive mixed blocks, the participant performed a block with all the comparison stimuli already taught (strawberry / pineapple, and monkey / cat), plus two comparisons of each of these categories (apple / orange and pig / horse), plus four comparisons of the category vehicles (car / bicycle / scooter / skates). In this final training block, four comparison stimuli were presented, two of which were distractors (one above and one below the sample).

Maintenance. Each maintenance session consisted of 12 trials, half of the trials were selected from the block of the last stage of training procedure, that is, from the cards with four comparison stimuli, and half selected from the post-test block. The sessions were applied periodically to participants who completed their procedure (once a week or every fifteen days), once they finished the training procedure, and until the completion of the study to verify maintenance of the repertoire taught (for 5 weeks). No prompts, or tangible reinforcements were used in these sessions, but only social reinforcement following different responses (not the responses of the research interest) as in the pre-test.

Results

Arthur and Lucas presented 100% correct responses in the identity test, and for so, were included on this research. Arthur and Lucas completed the procedure and their data are presented in Figure 2, which shows the percentage of correct responses in the baseline and in the training procedure. During the baseline, both showed low percentages of correct answers, averaging 19.4% and 13% of correct responses for Arthur and Lucas, respectively. The breaks in the data line in training represent that the participant reached criterion and changed the type of block, that is, there was an increase in the number of comparison stimuli or change in the number of exemplars as described in the Method section. The breaks also represent the visual prompts (large, medium, small and no arrow) after the participant reached criterion.

In the block of two comparisons using the big arrow Arthur presented the 50% of correct responses for two sessions. Only with the incorporation of the gestural prompt was observed an increase in the percentage of correct responses to 100%, even after the later withdrawal of this prompt. After this modification, even with the gradual disappearance of the visual prompt Arthur´s performance remained above 90% in all subsequent training blocks.

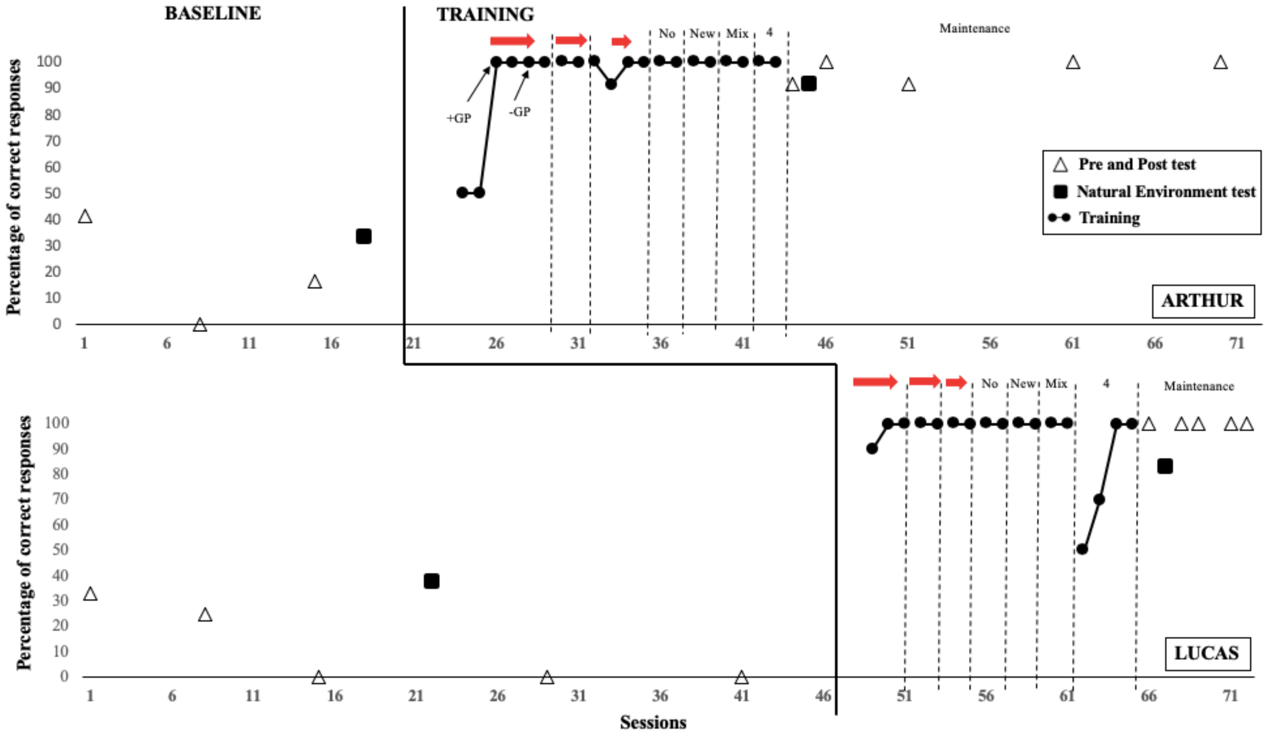

Figure 2. Percentage of correct responses of Arthur and Lucas in the baseline and in the training blocks. The incorporation and withdraw of gestural prompt (+ GP and -GP) are indicated in the figure.

After Arthur mastered the task, a post-test was conducted with new comparison stimuli, in which he got 92% of correct responses. A natural environment post-test was then performed, in which 92% of correct responses were obtained, showing improvement in performance compared to the baseline test (33% of correct responses). Arthur's percentage of correct responses also remained high in the six follow-up sessions, with an average of 98% of correct responses.

Lucas demonstrated 100% of correct responses for two consecutive sessions for each stage. This pattern of correct responses was maintained in all the training blocks similar to Arthur, except in the addition of the comparison's stimuli above and below the sample, where Lucas's performance decreased to 50% and 70%, but recovered to previous levels in the following two sessions. After reaching the learning criterion for the training stimuli sets, Lucas scored 100% correct responses in the post-test with new comparison stimuli. In the natural environment test Lucas responded correctly in 83% of block trials, as opposed to 38% correct responses in the initial baseline test conducted. Lucas's performance remained accurate (100%) during five follow-up sessions.

Discussion

The present study investigated the potential of multiple-exemplar training (MET) to teach children with autism responses to follow the direction of the adult gaze and the potential of this training to generalize the responses to a natural context. The results of multiple exemplar training replicate those reported by Gould et. al. (2011) and Hahs et al. (2015) in a sample of autistic children with low language repertoires, for whom training was effective in achieving high performance in a task of tracking the direction of look. This replication investigated the effects of three variables in training and testing procedure: 1) variation of the comparison stimuli gradually during training until the natural environment test; 2) gradual increase the number of the comparison stimuli throughout training; and 3) minimization of distractors available in the visual field of the child in natural environment test. The modifications were efficient to produce accurate performance in training, and, to promote performances above 80% correct answers for participants in natural environment test. The latter was a considerable increase when compared with previous studies that used similar procedures that achieved mean performances of 52%, 64% and 44% (Gould et al., 2011) and 69% and 0% (Hahs, 2015). The present investigation was concerned with the overlap of evidence found in the literature to date but aimed employing the proposed variables to identify ways to obtain better results in the generalization of learned behavior for natural environment.

It is important to clarify initially, why we are not considering this task a matching to sample task and applying the function of contextual cue and not a conditional stimulus for the face profile. For this end it is necessary to analyze the nature of the required task in training and testing the present procedure. Thanks to the presentation of a sample and comparison stimuli one may be tempted to consider this as a conditional discrimination task. Traditionally, according to Derbert, Matos and Andery (2006), a given response must always be reinforced in the presence of a particular stimulus only if another stimulus is present. That is, only in the presence of the combination of two stimuli would the response be followed by reinforcement. If other combinations of these stimuli are presented with other stimuli, these will not be occasions on which that same response is followed by reinforcement.

In the present study tasks, however, the same stimulus could be considered correct or incorrect when related to the same sample, depending on the position in which it was in the trial (right or left). For example, in a trial that the face was directed to the right and the monkey was presented to the right of this stimulus, its selection would be considered correct. However, in another trial that the face continued to the right, but now the monkey was presented to the left, its selection would be considered incorrect. Thus, the conditionality was related to the position of the face (right or left) and not a direct relationship between specific stimuli. The type of relationship established by teaching was not a stimulus-stimulus relationship, in which a particular stimulus (conditional stimulus) establishes the correct discriminative stimulus. The performance established by this training can best be characterized as a relational performance, where responding to a given set of stimuli is signaled by a specific spatial contextual cue (Törneke, 2011) (in this case the position of the face of the sample to the right or to the left) and not the comparative stimuli itself.

Considering the variables employed in this procedure, one aspect that may have influenced the strengthening of the learned repertoire, and thus the generalization to the natural context, was to guarantee exposure to more than one set of stimuli during training. In previous studies (Gould et al., 2011; Hahs, 2015) all training was performed with a set of fixed stimuli before the application of the generalization test, and in case of low performance in the test the participants performed new training with a new set of stimuli. In the present study, only one pair of comparison stimuli were kept fixed throughout the training blocks with one and two comparisons. However, blocks were programmed with a new pair of comparisons, a block that merged the previously learned pair with the new one, and finally, blocks with the two pairs of learned stimuli plus new ones in the final phase of training (with four possibilities of comparison stimuli).

Additionally, the inclusion of the new stimuli sets could have played an important role considering the necessary conditions for the occurrence of generalization for different types of stimuli, this could potentially have guaranteed that exposure to trials in the absence of consequences would not result in a decline in performance. This is a critical aspect of a multiple-exemplar training, which ensures that the topography of the stimuli is not relevant in the training, but rather the establishment of relational control among these stimuli (Greer, Stolfi, & Pistoljevic, 2007). Initially it was established the control by the relationship between the events (face direction and S +) with different stimulus sets (strawberry / pineapple, monkey / cat). Subsequently, the presentation of new sets (e.g. rollerblades / scooter) strengthened the relationship between face direction and correct comparison stimulus, even though such stimulus had not been directly trained in the past. This phenomenon was observed for both Arthur and Lucas, who maintained their high performances even with the change of the set of comparison stimuli in the blocks that used two comparison stimuli, and in the generalization test without reinforcement with a new set of stimuli.

The most interesting result of the present study was the improvement of the performance of Arthur and Lucas in the natural environment post-test compared to the pre-test. While in the pre-test the performances of both participants were around 35% correct, in the post-test the two presented more than 80% of correct answers. Considering the different variables employed it is likely that this richer in the number of stimuli multiple exemplar training may played an important role. The task developed in the experimental procedure required participants to have a repertoire of non-arbitrary relational responding. The learning of the target behavior in question occurred from the relations that existed between the samples present in the task and the possible locations of the stimuli of comparisons present in each trial. The position of the face profile to the right or left indicated which of the two stimuli should be selected in the trial in question. All these features of the procedure may have acquired the function of contextual control establishing S+ functions to any stimulus the face profile was directed. In this sense, it was not a direct relation between the model and the stimulus that was reinforced but a higher operant class of choosing any stimuli in the direction of the gaze of the face profile. If this reasoning is correct, it seems plausible that employing a multiple exemplar training with a diverse set of stimuli would better establish these above-mentioned contextual cues function also allowing the observation of the precise behavior in new settings.

Furthermore, the other variables employed also may played an important role in the results. Regarding the gradual increase in the number of the number of comparison stimuli, we believe that the training difficulty level were increased gradually, and prepared the participant for the relatively more complex natural environment setting, including a wider range of distractors than the picture training context, which was conducted with three-dimensional stimuli, rather than two-dimensional training. Another relevant modification was in relation to the setting of the natural environment test. Unlike previous studies, the setting of the test was very similar to the training: the number of distractors in the environment was reduced and a single object was placed in the direction line of the experimenter's gaze seated in front of him instead of several objects as in previous studies.

These changes together appear to have contributed to the accurate performances recorded in the natural environment post-test of the present study. It is not possible, however, to assess whether only one of them would be sufficient to produce the results obtained, since all modifications were carried out simultaneously. A replication with gradual insertion of these independent variables could answer what are the isolated effects of each of them.

The results of this study may direct for important practical implications in the clinical area in the scope of training repertoires with children with delayed development. Teaching children with autism more refined joint attention responses, as done in this study, can greatly encourage them to present the possibility of identifying relevant social cues to their social context. Learning to identify what events others attend seems to be a key repertoire for establishing a variety of social interactions. Finally, to discuss about the understanding of the generalization procedure is a main aspect in the procedural decisions for the teaching interventions. Employing the knowledge about relational responding to better investigate this effect may produce more precise understanding on generalization (Stewart, McElwee, & Ming, 2013). It seems relevant to recognize the importance of allowing the children to establish broader contextual control of the relations, presenting more sets of stimuli, sometimes in the absence of direct reinforcement and investigate the establishment of contextual cues.

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ESTUDO 2

Typical and atypical individual ocular patterns on adult gaze following tasks

The diagnosis of children with Autism Spectrum Disorder (ASD) has been more frequent in recent years. According to estimates by the Centers for Disease Control and Prevention [CDC] (2014), about one in every 68 children have been diagnosed with autism. The urgency to discover early developmental biomarkers for diagnostic purposes accompanies the need to provide early treatment, shortening the interval between the diagnosis and the beginning of treatment (Pierce, Liptak & McIntyre, 2009).

Unusual patterns of visual attention have been indicated as preclinical markers of autism. In general, children with autism tend not to pay attention to social attention cues (Naber, Bakermans-Kranenburg, van Ljzendoom, Dietz, van Daalen, & Swinkels, 2008) or present "fixed attention" to other non-social stimuli. The use of eye-tracking technology, which records the tracking of ocular movements, allows a more objective research domain in terms of diagnosis, surpassing an exclusively clinical approach. The diagnosis is currently based mostly on the judgment of descriptions of the Diagnostic and Statistical Manual of Mental Disorders (DSM) (Sacrey, Bryson, Zwaigenbaum, 2013) and other evaluation protocols that also deal with direct observations (Schopler, Reichler, Reichler, Bashford, Lansing, and Marcus, 1990), CARS (Schopler, Reichler, et al. Renner, 1988), ADOS-2 (Lord, Luyster, Gotham, and Guthrie, 2012), among others that aid the diagnostic process.

Studies using eye-tracking in children with autism under the age of three have highlighted a variety of deficits in visual attention. In these studies, it is frequently reported a lower preference fixation in the eyes of peers (Jones, Carr, & Klin, 2008; Jones, & Klin, 2013) or in the head (Shic, Bradshaw, Klin, Scassellati, & Chawarska, 2011) (Bedford, Elsabbagh, Pickles, Senju, & Charman, 2012), and in scenes monitoring during explicit dyadic tips (Chawarska, Macari, & Shic, 2012). These studies together point to a very early origin of social deficits in individuals with autism (Pierce, Marinero, Hazin, McKenna, Barnes, & Malige, 2015).

The study by Pierce et al. (2015) carried out with a sample of 444 children, including 172 children with autism, showed that those with intensive attention fixations for geometric stimuli to the detriment of social stimuli were also children with more severe symptoms of ASD, worse scores on language, and lower performances in intellectual quotient (IQ) measures. At the same time, the children who presented higher fixations of attention to social stimuli were also those with better scores in language, IQ, and milder autism symptoms. This result suggests that individuals with autism who present attention responses to social stimuli present more positive results in areas of language and socialization in the long term.

The effects reported in studies using eye-tracking are often applicable to group designs (Pierce et al., 2015). However, eye-tracking studies that aim to teach visual attention to social stimuli or teach joint attention have the potential to produce data on eye-tracking patterns that would aid in the improvement of these interventions. Despite this, no effort has been made to date.

The eye-tracking technology has been employed before in studies in the field of Behavior Analysis investigating eye movement in several different contingencies allow to observe ocular patterns in a number of behaviors, e.g., responding in concurrent schedules, responding to multiple and mixed schedules, and to simple and conditional discriminations (Huziwara, Silva, Perez & Tomaranri, 2015; Huziwara, 2010; Perez, 2008; Schroeder & Holland, 1969; Schroeder, 1970; Tomanari, Balsamo, Fowler, Farren & Dube, 2007). In general, the results observed show that in simple discriminations tasks (e.g. Schroeder, 1970) the highest number of ocular fixations is directed to the S+ stimulus while in experiments in which the participants were exposed to more complex contingencies (e.g., Tomanari et al., 2007; Perez, 2008) ocular fixations are observed both in the S+ and the S- stimuli. All these studies show the potential of employing the Eye-Tracking technology for a better understanding of the environmental control the procedures exert in the participant's behavior.

In the context of behavior analysis, even seeing the possibility of employing the Eye-Tracking technology for studying more basic behaviors related to social interaction, there was not any reference on this topic. It is possible to find in the literature some investigations that have indicated an effective procedure to teach children with autism to address joint attention responses (RJA), that is, to follow the direction of the adults gaze at objects or events of interest (Gould, Tarbox, & O' Time, 2011; Hahs, 2015). In the study did by Gould et al. (2011) three children aged 3 to 5 years with autism learned to indicate the direction of the gaze of a profile face directed towards a picture to their right or their left. The gradual increase in the number of correct responses throughout instruction for the three participants indicates the potential of this procedure to teach joint attention responses (IJA). Another three children with autism were participants in the study of Hahs (2015), replicating Gould et al. in a school context. Even in both studies, most of the children succeeded in the gaze following training on the table-top procedure, in the natural environment test, the results were not equally robust.

The present study aimed to teach a child with autism to follow the direction of the adult gaze picture through training of multiple exemplars employing stimuli, similar to that done by Gould et al. (2011). This procedure would be registered not only by the software that presented the trials but also would include the recording of ocular movements by an Eye-Tracking device. In a case study design, two participants, one child with autism and one child with typical development with equivalent developmental age, were exposed to the trials investigating eventual differences in the visual tracking patterns. Furthermore, if these participants did not show the gaze following behavior at the beginning of the training, the procedure also aimed to teach this behavior and this allowed to investigate the efficacy of the intervention in the gaze following repertoire.

Method

Participants

Two children (Max and Gabriel) participated in this study. Max was diagnosed with Autistic Spectrum Disorder (ASD) by an independent practitioner as defined by the Diagnostic and Statistical Manual of Mental disorders - DSM-V (American Psychiatric Association, 2013) and attended an institution specializing in behavioral education on a daily intensive intervention program (for 15 hours per week). For this reason, it had a prior history of exposure to structured match-to-sample activities and conditional discrimination procedures as part of daily interventions. Max continued to receive typical interventions during the study. The control participant (Gabriel), with typical development, had an approximate intellectual age of Max. The parents of the participants signed the consent statement for authorizing their participation.

An evaluation was conducted to characterize the verbal repertoire of the two participants, applied by the principal researcher. The Peabody Picture Vocabulary Test-Revised - PPVT-R (Dunn & Dunn, 1981) evaluates receptive language repertoires of individuals from two years on. It contains 192 boards with four drawings each, in which the individual must select the image that best represents the word spoken by the experimenter. The Childhood Rating Scale (CARS) (Schopler, Reichler, & Renner, 1986) was also filled out for Max. CARS was delineated as a clinical screening scale to classify items from 0 to 4 indicative Autism Spectrum Disorder (ASD). After direct observation of the child and completion of the 15 items (relationship with people, imitation, emotional response, body movements, etc.) the scale provides a total score of the level of autism observed, ranging from non-autism to mild autism, autism moderate, or severe autism. Table 1 presents the characterization of the participants.

Table 1.

Characterization and tangible reinforcers used for each participant.

	Max	Gabriel
Gender		
Cronological age	5y 3m	3y 2m
PPVT-R age	2y 3m	3y 0m
CARS	37 (moderate)	
Tangible reinforcements	Candy	Mini dinosaurs

Materials

Tangible reinforcers that would be used in the sessions were previously defined by preference tests and by interviews with the parents. Testing and training sessions were displayed on a computer screen in a university data collection room with good lighting and noise control conditions. Two researchers conducted this study. One of the researchers sat next to the participant for delivery of reinforcement, and to assist him to keep his chin in the eye tracking's support giving cues and reinforcing this posture, while the other sat further away to give the necessary commands in the computer to activate the eye-tracking equipment.

Trials consisted of sets of two to five visual stimuli on the screen (a profile picture and pictures of animals, fruits or vehicles around it) depending on the procedure step, with size 6 cm x 6 cm under a gray background. The sample stimulus was always presented in the central part of the screen and the other stimulus in its right or left side. In some steps, it was used stimuli above and below the sample that functioned only as distractors. Four copies of each category of the pictures in the training and test blocks were randomized. The MATLAB 7.9.0 software was used to present the stimuli and automatically record the responses. Stimuli were observed at 4 x 5.8 degrees of visual angle of the observer on a 23" LED monitor.

An eye-tracking was used to capture and register the eye fixations, called FaceLAB 5, coupled below the monitor of a desktop computer. The remote eye-tracking system used infrared light directed towards the center of the participant's eyes producing visible corneal reflections (the outermost optical element of the eye), which were tracked by a camera. The equipment monitors the fixation locations at a sampling rate of 60 Hz with an accuracy error ranging from 0.5 to 2 degrees of visual angle. The eye-tracking device comprises two infrared cameras, infrared light and an EyeWorks software (Eye tracker Inc.). The internal code written in temporal markers is recorded by MATLAB to analyze the location of the look between the start and end stimuli of the fixations.

Procedure

Pre-training. Initially, training was done so that participant Max learned to keep his chin and forehead supported adequately in the eye-tracking. For this, preferred videos were selected that would act as reinforcement for the response of keeping the head resting on the rest stand. The researcher pointed out the support of the eye-tracking and gently directed the participant to approximate his chin. When the participant was in the correct position, the researcher presented a video of his preference on the computer screen. Every time the participant removed the chin from the holder, the video was paused, and the experimenter pointed the chin holder. The chin and forehead support was adjusted to the participant's height and positioned so that it was comfortable for him before the start of each session. A picture of the experimental situation can be visualized in Figure 1. Four sessions were performed with videos of an average duration of 10 minutes. The participant learned to keep his chin in the holder.

Figure 1. Eye-tracking equipment of the experimental situation.

In the second phase of the pre-training, the researchers presented two sessions of 12 trials, which mixed two trials that involved pointing to items presented on the screen, with the presentation of the video as a reinforcing consequence. The trials were presented in PowerPoint. On each screen, there was a picture. The participant was required to name the picture after hearing the statement "what is it?". All pictures used in the procedure were presented at least once at this phase, and the participant scored 100% of the trials, guaranteeing prior knowledge of the pictures used.

Eye-tracking. The first session of each phase of the pretest and teaching employed the eye-tracking equipment. The remaining sessions were performed only on the computer, with the equipment turned off. At the beginning of each eye-tracking device session, there was a calibration routine. The participant remained seated in front of the computer, with the chin and forehead resting on the holder. The eye-tracking was calibrated with 9 points before starting each experimental session, i.e., the participant was required to look at nine, specifically indicated points on the monitor. A sequence of nine dynamic stimuli was used, considering that they may be more effective in capturing attention and thus result in more accurate data of the participant's gaze.

Pretest. The trials consisted in the presentation of a sample stimulus in the screen center (face of a left or right profile) with four stimuli options around it (left, right, above and below), and the instruction "What is he seeing?" was given by the researcher. The face, i.e., the sample stimulus, was always directed to the S + (correct stimulus) at all phases of the procedure. The number of trials in each session was smaller for participant Max (eight) who could present disruptive behavior in a long session with little reinforcement delivery, and higher for Gabriel (twelve) who did not present difficulties to keep engaged in the task for a more extended time. The comparison stimuli were presented in semi-random order in the two positions (to the right or left of the sample) functioning as S + alternating in each trial. No cues and no differential consequences were provided.

To keep the participant engaged in the task and to ensure reinforcement, a response, not related to this procedure was requested, which the participant was familiar (e.g., motor imitation), every two trials. These responses produced social reinforcement (praise) and the delivery of tangible reinforcer if it was correct. Two pretest sessions were performed using the eye-tracking, and one without the use of the equipment, to verify the stability of participants' repertoire. To carry out the training, as an inclusion criterion, the participant should not present performances above 70% of correct answers at the pretest.

Training. The following will describe the teaching steps that were performed only by Max. The S+ and S- stimuli used in training were different from those used in the pretest. The learning criterion during all phases of training was performances of at least 85% of correct responses (i.e., one error out of 8 trials) in two consecutive blocks. In the second presentation of the session for the same phase, the correct comparison stimuli positions and the presentation order of the right and left positions were balanced. If the participant responded appropriately, his behavior was followed by social reinforcement and tangible reinforcement. In case of an incorrect response in the trial, the next trial was presented.

Increase in the number of comparisons - from 1 to 4 stimuli options. The teaching sessions consisted of 8 trials. In the first phase, the trials presented only two stimuli, the sample, with the face of the profile directed to the right or the left, and a single stimulus option, aligned in the same direction. The S + was a fruit picture (strawberry) when the direction was to the left, or another fruit (pineapple) when it was to the right. This phase aimed to teach the participant that the "face profile" stimulus would always be the wrong stimulus (S-).

After the participant presented more than 85% of correct responses in two consecutive sessions, he advanced to the next phase. During this phase, the trials contained the sample stimulus (face profile), but with two stimuli options, one on the left and one on the right, being one S + (the picture positioned on the side where the sample was facing) and another S- (the picture aligned to the back of the sample). Initially, the comparison stimuli were placed in fixed positions: on the right the pineapple and on the left the strawberry, varying only the direction of the face (left or right) indicating the correct item. This phase presented visual cues. The visual cues consisted of red dotted arrows, drawn from the sample's eyes to the picture he was directed. Initially, the whole block was presented with visual cues, and as soon as the participant presented a success criterion for two consecutive blocks, the visual prompt was withdrawn. Then, this phrase was repeated without the visual prompts (arrows indicating the sample gaze), and as soon as the participant reached the ending criterion for two consecutive blocks, he advanced to a mixed block. The mixed block consisted of trials in which two new stimuli options were presented (monkey on the right and cat on the left) in trials interspersed with the previous stimuli already taught (pineapple on the right and strawberry on the left) (see Figure 2).

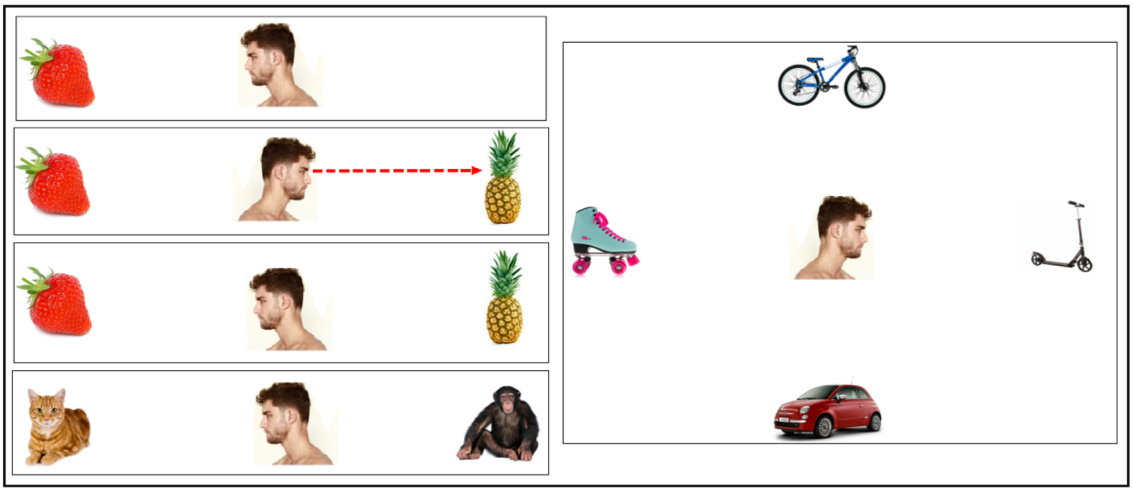

Figure 2. Representation of the trials presented to the participants in each phase. The left panel of the figure - teaching blocks. Figure right panel - last training block (similar to pretest blocks, with different comparisons).

Finally, after demonstrating criteria for two consecutive mixed blocks, the participant carried out a block with all stimuli options presented earlier (strawberry / pineapple, and monkey / cat), with the addition of two comparisons for each of these categories (apple / orange and pig / horse), plus four other stimuli from vehicles category (car / bicycle / scooter / skates). In this final block of training, four comparison stimuli were presented, two of which were only distractors (one above and one below the sample, being always S-).

Post-test. The posttest was performed to test the generalization performance concerning stimuli not taught previously in a similar way to the last phase of training, but with new stimuli set. There were no differential consequences for correct or incorrect responses. Participant Max should have presented 11 correct answers in 12 trials to complete the procedure. Table 2 summarizes all procedure phases.

Table 2.

Phases of the procedure ordered by presentation sequence to participant Max.

Procedure Phases
Pre-training
Pre test
Training
1 comparison
2 comparisons with arrow
2 comparisons without arrow
2 comparisons (mixed sets)
4 comparisons (mixed sets)
Post-test

Results

Ocular fixation is defined as eye-on-stimulus fixation, which occurs when the eyes fix a visual stimulus and move independently of head movement (Holmqvist et al., 2011). The ocular fixation records of the participants were submitted to the EyeMMV algorithm for fixation extraction, whose maximum spatial dispersion parameters were set at 2 degrees visual angle and minimum duration of 100ms. From this analysis, heat dispersion graphs were generated that illustrate the tracing pattern of both participants. The occurrences of ocular fixations were recorded in the first sessions of each phase. Gaze response was defined as directing the gaze focus to the area corresponding to the stimulus presented on the screen. The analysis allowed to identify the stimuli with higher occurrences of fixation of participants gazes throughout the pretest sessions (for Max and Gabriel) and for training and pot test sessions (for Max).

Figure 3 shows the percentage of correct responses from the pretest, teaching, and posttest sessions of Max. It can be observed that during the baseline, Max did not present the correct answers in the three sessions performed. From the beginning of the intervention until the posttest, Max maintained success rates above 85%, that is, presenting at most one error per session, evidencing the success in establishing errorless learning. On the other hand, the control participant with typical development (Gabriel) scored 11 of the 12 trials in the first pretest session (91% correct responses), demonstrating the ability to follow the direction of the sample stimuli, without the need for training.

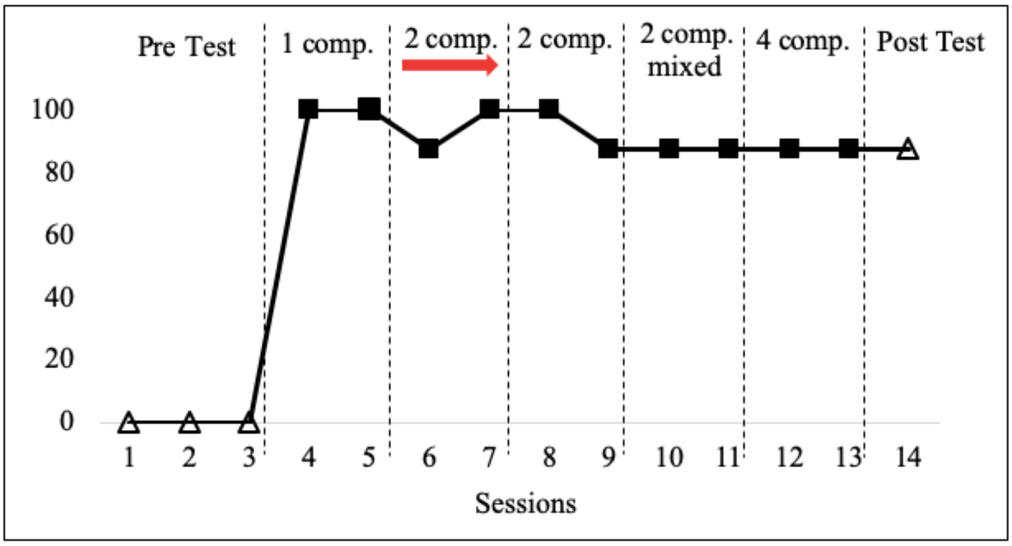

Figure 3. Percentage of Max correct responses for pretest, training, and posttest sessions. It is also indicated in the figure the incorporation of the visual prompt (arrow) in training.

Figure 4 indicates the total of ocular fixations and the total fixation time for each stimulus presented on the computer screen (sample and S+/S- options) in the 12 pretest session trials for Gabriel. Figure 5 shows the same data for Max, but in two different moments in the teaching and testing trials for Max. The elements which ocular fixations and fixation time were recorded were the face profile, all the S- stimuli (Top S-, Bottom S-, Opposite S-) and the S+

stimulus.

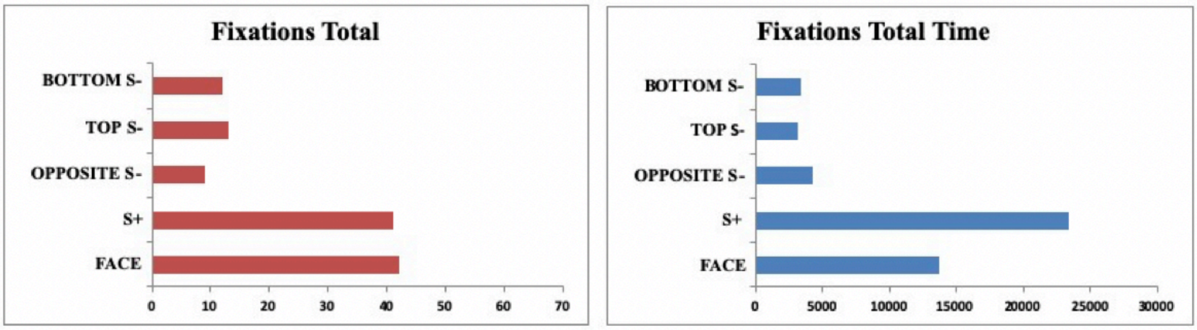

Figure 4. Total of Gabriel's ocular fixations and the fixation total time for each of the stimuli presented on the computer screen (Face, S+ and top, bottom and opposite S-) in all 12 pretest session trials.

Observing Figure 5, it is possible to notice that Gabriel's ocular fixations occurred more frequently on the face profile stimulus and the S+ stimulus. It is possible to observe in Figure 5 that the total number of fixations in these stimuli (S+ and Face profile) were slightly superior to 40 ocular fixations in total, while the total number in the remaining stimuli on the screen was around 12 ocular fixations. An Ordinary one-way ANOVA revealed a main effect considering the type of stimulus $F\ (4,55) = 11.78\ p < 0.0001$. A Bonferroni multiple comparisons posttest revealed that the significant differences could be observed when comparing this S+ and Face profile stimuli with any of the remaining stimuli (all *ps* < 0.01) but there were no statistically significant differences in the comparison of the S+ and Face profile as well the comparisons of the remaining stimuli among themselves (all *ps* > 0.05). This pattern was also observed when we look at the right graph in Figure 5, the fixation time. The time spent looking at the S+ and in the second place to the face profile was longer than in the remaining S- stimuli. An Ordinary One-way ANOVA revealed that a main effect was observed for the type of stimuli $F\ (4,55) = 8.759\ p < 0.0001$ and a Bonferroni Multiple Comparisons posttest allowed to observe that regarding the Fixations Total Time differences were statistically significant only in the comparison of S+ and the others S- stimuli (top, opposite and bottom, all *ps* < 0.0001) but not in all remaining S- (all *ps* > 0.05).

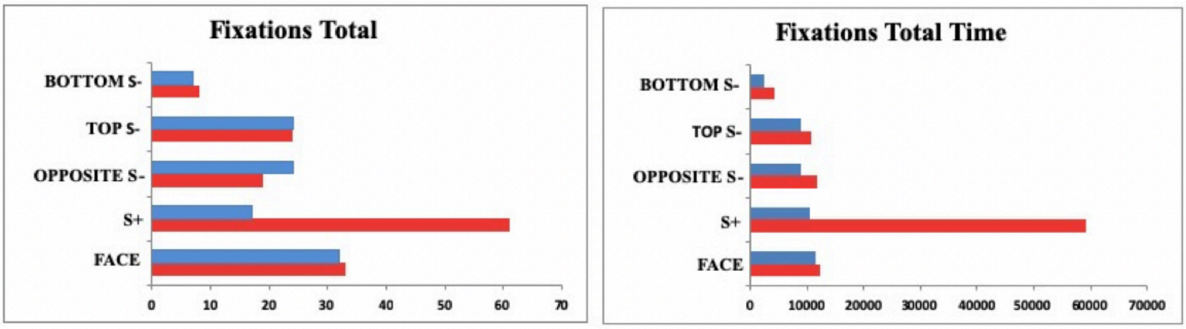

Figure 5. Total of Max's ocular fixations and the fixation total time for each of the stimuli presented on the computer screen (Face, S+ and top, bottom and opposite S-) in all 12 pretest session trials.in all test and training sessions. The pretest is presented in blue, and the pos-test is presented in red.

Likewise, there was a similar pattern observed only in Max's posttest results where he also shows lower fixation densities for the S- stimuli but higher fixation densities for the S+ and Face profile. An Ordinary One-way ANOVA revealed no main effect for the type of stimuli in the pre-test considering the Total of Ocular Fixations F (4,55) = 1.744 p =0.1535 and also the Total Fixations Time F (4,55) = 0.8891 p = 0.4767. However, employing the same test, an Ordinary One-way ANOVA investigating main effects for the type of stimuli, revealed statistically significant differences for the number of ocular fixations F (4,55) = 9.076 $p <$ 0.0001and a Bonferroni Multiple Comparison posttest showed that the differences observed were significant among the comparisons of S+ and all the remaining stimuli (S+ and Face p <0.05; S+ and top S- p <0.01; S+ and opposite S- p < 0.01; S+ and bottom S- p < 0.0001) but not in the remaining comparisons. This effect was the same observed in the Total Fixation Time in Max's posttest data, that employing an Ordinary One-Way ANOVA, main effects were observed for the type of stimuli F (4, 55) = 22.33 p < 0.0001 and a Bonferroni Multiple

Comparisons posttest also showed the same pattern in which the S+ total fixation time was statistically higher than all remaining stimuli (S+ and Face, S+ and opposite *ps* <0.001; S+ and Top, S+ and bottom *ps* < 0.0001) but there were no statistically difference in the remaining comparisons.

A Chi-squared test was employed to compare the data from Max's pre and posttest and also the data from Gabriel. In the comparison of Max's pre and posttest and also comparing Gabriel's data with Max's pre-test Chi-squared test revealed differences among the ocular fixation total, (pre x pos $\chi 2 = 19.26$ $p = 0.0007$; pre x Gabriel $\chi 2 = 22.00$ $p = 0.0002$). This pattern was also observed considering the data from total fixation time (pre x pos $\chi 2 = 15522$ $p = 0.0001$; pre x Gabriel $\chi 2 = 9442$ $p = 0.0001$). No statistically significant difference was observed employing the Chi-squared test comparing the data from Max's posttest and Gabriel performance regarding the number of ocular fixations (Gabriel x pos $\chi 2 = 0.9675$ $p = 0.3231$). Finally, the Chi-squared test revealed significant differences considering Max's posttest and Gabriel data on the total fixation time (Gabriel x pos $\chi 2 = 6978$ $p < 0.0001$).

Figure 6 presents two trials of each participant that exemplify changing the pattern of ocular fixations of both in the same direction, that is, an increase of fixations for the correct comparison stimulus and a decrease for the other stimuli (including the sample stimulus) by consequence. The screens refer to extractions from ocular fixation records generated by the software used that produces heat map figures, in which the red color indicates higher frequencies of ocular fixations and blue color indicates lower frequencies.

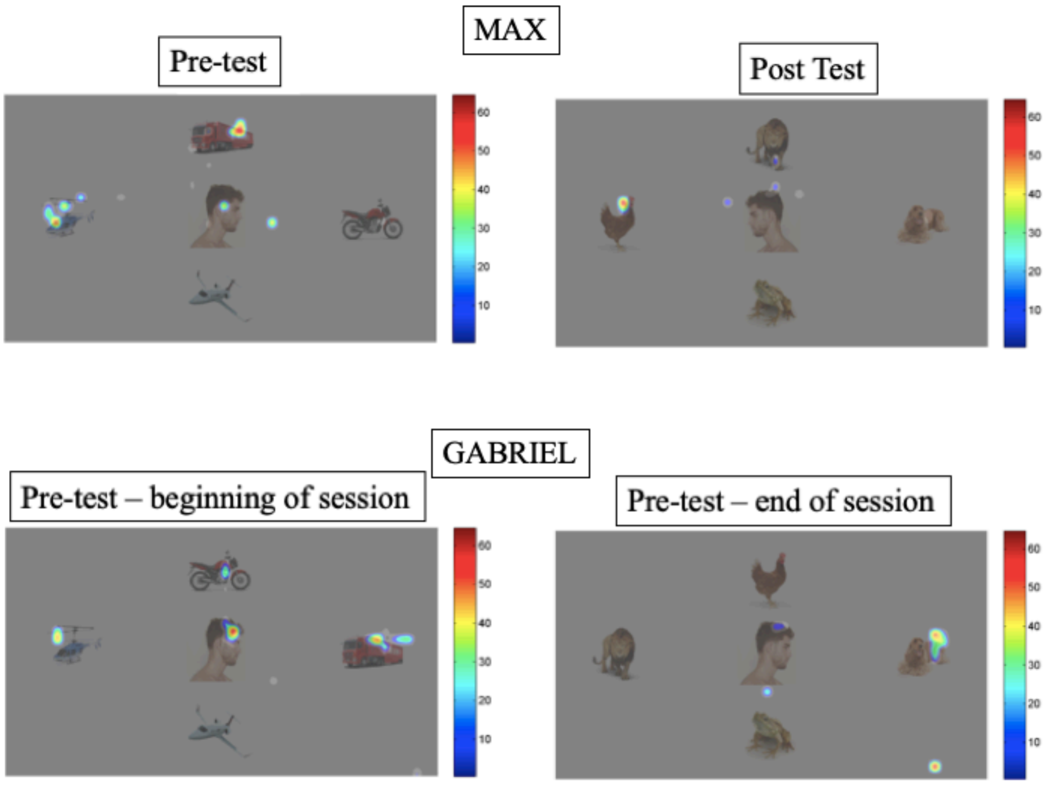

Figure 6. Ocular fixation pattern of Max in the pre and posttest, and Gabriel in the beginning and end trials of the pretest session. The ruler to the side indicates the number of occurrences of ocular fixations (e.g., light blue - 25 occurrences, green - 35, yellow - 40, dark red - 60, and so on).

Discussion

In the first place, it is possible to observe that the training procedure carried out to teach the behavior of gaze-following the face profile was adequate to establish the pattern of ocular fixations desired and enabled the learning of the task by the individual with autism in a few sessions. This result corroborates what was observed in Silveira, de Almeida, Schmidt, and Domeniconi (in preparation) even the present study employing a shorter computerized procedure. Some variables controlled here may have contributed to this result. The first stage of training excluded the other distracting stimuli, leaving only the face profile stimulus and the S+ stimulus on the screen, favoring the selection of the S+ stimulus. Likewise, the gradual increase in the number of distracting stimuli and the use of visual cues that emphasized which stimulus was adequate to select favoring the learning without error and keeping the participant with autism engaged in the task.

The data of eye-tracking reveals the increase of ocular fixations for the S+ stimulus in the learning process, providing relevant information on how this kind of teaching affects the performance of the participants. The tendency to decrease the ocular fixations to the S- stimuli were contingent on the increase of the observations to the S+ stimuli, as the changes in the stimulus control of participant observation behavior with autism could be verified. For this reason, tracking ocular fixations proved to be an essential additional measure for the study of this kind of behavior.

It is interesting to note that although Gabriel was not exposed to the teaching situation, his eye fixation pattern approached Max's, but at a much higher rate. While Gabriel presented decreased face profile fixations and S- stimuli throughout the pretest session, Max needed to start training for the relevant S+ stimulus to become salient so that he would distribute his ocular fixations more to this stimulus, and less for the other stimuli presented on the screen.

In a more general perspective, the differences and similarities observed between these two participants with different developmental profiles suggest the relevance of employing this technology even for diagnostic purposes in identifying common patterns of stimulus tracking in children at risk for developing autism. The nature of this research indicates the need for eye-tracking studies to focus on single-subject empirical questions. Only from experimental studies, which manipulate independent variables, it may be possible to indicate better teaching strategies, taking into account observation responses as a dependent variable. It was observed that Max initially presented more ocular fixations for the social stimulus (face) to the detriment of the others (vehicles, fruits, and animals). Although the literature highlights the difficulty of children with autism to observe social stimuli (e.g., Falck-Ytter, Bölte, and Gredebäck 2013, Pierce, Marinero, Hazin, McKenna, Barnes, and Malige, 2015, Sasson, Tsuchiya, Hurley, Couture, Adolphs, Piven, 2007), apparently this was not the main difficulty that would be hindering the participant's learning of the task. To better investigate this and other patterns of behavior, the potential use of this technology can only be evaluated, carrying out more extensive studies to map the specificities in the participant's behavior repertoire.

It is important to consider here that the similarities observed in Max's posttest and Gabriel's results highlight the relevance of developing teaching strategies for children with autism. As confirmed by the Chi-squared test, the pattern of ocular fixations observed between these participants was no longer statistically significative after the intervention. It was also important to mention that even their ocular fixations occurring in an approximate frequency, there was a difference when considering the ocular fixation time. This also may be an essential variable enabling to employ the eye-tracking device for helping in diagnose, if more generally mapped.

Additionally, one substantial effect observed in the present experiment regards to the description of the learning contingency employed. Silveira et al. (in preparation), discussed the possibility of this behavior representing not a direct training among the S+ and S- stimuli (representing a simple discrimination training) neither conditional discrimination (considering the face profile as a sample and the stimuli as S+ and S- comparisons). As discussed by Silveira et al. (in preparation) the multiple exemplar training carried out at the beginning of the procedure, may stablish the face profile as a spatial contextual cue that could control the non-arbitrarily applicable relational response of selecting the right or left stimuli.

The results from Max and Gabriel could add some elements in this discussion. It is interesting to note that once in simple and conditional discriminations, the S- stimulus likely can contribute to the response, once they acquire a function and contribute for this response. Some studies showed this pattern as Tomanari et al. (2007) where the participants responded in a multiple and mixed schedule of reinforcement in simple discriminations tasks, showing a similar frequency of ocular fixations for both S+ and S-. Furthermore, Perez (2008) studying selection and rejection control in conditional discriminations also observed for most participants smaller differences in the total number of ocular fixations between S+ and S- stimuli. If Silveira et al. (in preparation) analysis are correct, and the present procedure shows a different contingency, it would be reasonable to observe different patterns of ocular fixations. The results of the present experiment show that the participants presented statistically significant differences considering the number of ocular fixations presented to the S+ stimulus compared to the remaining stimuli in the task. This effect may support the proposal that we are observing a non-arbitrarily applicable relational responding and not conditional discrimination as proposed by Gould et al. (2011) and Hahs (2015).

One limitation of this study was developing a case study design. The main reason for this choice was the access to young children presenting the two different developmental profiles and the need of the eye-tracking lab structure to produce more precise data recordings. Future studies, if could install this structure in a school or a clinical institution, may benefit from the replication of this procedure among a more extensive set of participants. Another limitation was the response required from the participants. Even the ocular movements being the response of interest here, the software did not allow that only this response being sufficient for recording the response. The participants were required to point or say the name of the stimuli to consider a correct or incorrect response and present the appropriate consequence. It is possible that the production of the selecting response, primarily pointing, affect even slightly the ocular movement register. This variable could also be considered in future studies.

Finally, the results observed here corroborate the procedure developed by Silveira et al. (in preparation) and also by Gould et al. (2011) and Hahs (2015) including another aspect that is the ocular movement recording. As we mentioned above, this additional response may contribute to a better analysis of the contingency the participants are inserted and may also show some diagnostic power. More studies in this topic may favor the development of technologies that diminish the differences observed in children with delayed development in social interaction behaviors, as gaze-following.

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ESTUDO 3

Analyzing Deictic Relational Responding with the Multi-Dimensional Multi-Level Framework for RFT

Awareness of the mental and emotional states of oneself and others is a highly complex set of behavioral repertoires that typically incorporate the skillset known generally as *perspective-taking* (Baron-Cohen, 1995; Borke, 1971; Sullivan, Bennett, Carpenter, & Lewis, 2008). It is not surprising, therefore, that perspective-taking is considered to be fundamental to the development of self (Stewart, 2013); communication and social interaction (Galinsky & Moskowitz, 2000; Rehfeldt, Dillen, Ziomek, & Kowalchuck, 2007); and social tolerance (De Bernardis, Hayes, & Fryling, 2014).

Perspective-taking and Theory of Mind (ToM)

In mainstream psychology, the concept of perspective-taking, especially when referring to *cognitive* perspective-taking, is often used synonymously with Theory of Mind (ToM), as first proposed by Baron-Cohen (1995). This approach suggests that cognitive perspective-taking comprises five levels of knowledge of informational states, that once mastered allow an individual to take the perspective of another, including their emotions (Mori & Cigala, 2015). Level 1 acknowledges that different people can see different things. For example, if two children are seated opposite with a card held up between them, each child should recognize that they can see only one side of the card, while the other child will see the other side. Level 2 involves knowing that others may see the same things differently. For example, if two children are seated opposite with a card placed down on the table between them, each child should recognize that they see the card from a different vantage point to the other child (i.e., the card may be the right way up for one child but the wrong way up for the other child). At Level 3, a child should understand that seeing leads to knowing. For example, if a child observes an adult placing shoes in a shoe box, the child will know as a result that the box contains shoes, even when the shoes are no longer visible. Similarly, Level 4 involves predicting actions based on knowledge. For example, if a child is told that the cat is in the garden, the child will be able to respond correctly to the question "Where do you think the cat is?" even when the child has not seen the cat in the garden. Finally, Level 5 involves understanding false belief and predicting actions on its basis. For example, if a child is asked about what is in a covered candy jar, they will assume it contains candies, because they have seen candies there previously and they may not be aware that the candy jar actually contains something else.

The ToM approach also differentiates between *first-order* false beliefs that distinguish self from others and *second-order* false beliefs that distinguish self from two others (Boucher, 2002). First-order false beliefs are synonymous with Level 5 in perspective-taking. In the Sally-Anne Test, typically used to assess this level, a child is asked about a protagonist known to hold a false belief about a situation of which the child holds a true belief (e.g., believing there is candy in a candy jar, rather than biscuits). Wellman et al. (2001) reported that children aged four years typically demonstrate this skill.

Second-order false beliefs are often assessed through the Unexpected Location Test and determine whether a child can understand that another person can hold a false belief about a third person (e.g., Flobbe, Verbrugge, Hendriks, & Krämer, 2008). Consider a child presented with the following scenario: ‘Mary and John are given candies to share after school. They agree to put their candies in the closet for later. Mary returns home from school first, she takes the candies from the closet, and puts them in her schoolbag. Later, both children are told that they can eat their candies.’ The child is then asked: “Where does Mary believe that John believes the candies are?” The correct response (Mary believes that John believes the candies are in the closet) would indicate the child’s attribution of a second-order belief (see Sullivan, Zaitchik, & Tager-Flusberg, 1994). Astington, Pelletier, and Homer (2002) reported that children aged six to seven years old typically demonstrate this skill.

A strong vein of ToM research has explored potential deficits in perspective-taking in atypical samples of children, especially those with a diagnosis of autism spectrum disorder (ASD, see Frith, Morton, & Leslie, 1991). Indeed, some researchers have proposed the "*Impaired ToM" Hypothesis* and argued that this may be characteristic of this population (see Baron-Cohen, Leslie, & Frith, 1985). This hypothesis is based on evidence that at least some children and even adolescents with this diagnosis fail to show perspective-taking (e.g., Baron-Cohen, 1989). On balance, some researchers have questioned the existence of this type of deficit in perspective-taking in ASD. For example, Boucher (2012) in a review highlighted evidence that individuals with ASD can pass both first- and second-order false belief tasks (e.g., Scheeren, de Rosnay, Koot, & Begeer, 2013). And, Happé (1995) has proposed that language-able individuals with ASD may not have specific deficits in perspective-taking, but may instead have broader deficits in the processing of social, affective information processing (see also Tager-Flusberg, 2007).

Relational Frame Theory (RFT)

While the ToM approach has dominated the conceptual and research landscape on perspective-taking for around 30 years, an alternative formulation of these skills was proposed in the early 2000s by behavioral researchers working under the rubric of Relational Frame Theory (RFT; Hayes, Barnes-Holmes, & Roche, 2001; Barnes-Holmes, Barnes-Holmes, Roche, Healy, Lyddy, Cullinan & Hayes, 2001), a functional-analytic approach to human language and cognition. For RFT, perspective-taking itself comprises complex repertoires of arbitrarily applicable relational responding (AARR, see below) involving the deictic relations of I-YOU, HERE-THERE, and NOW-THEN (Barnes-Holmes, McHugh, & Barnes-Holmes, 2004; Hayes, et al., 2001). In the section below, we briefly summarize the core concepts of RFT, followed by the theory's approach to perspective-taking.

At its most basic, RFT proposes that AARR is the core unit of human language and cognition (Hayes et al., 2001). As such, the theory differentiates, in functional-analytic terms, between responding to stimuli on the basis of *nonarbitrary* (physical) stimulus properties versus responding to stimuli on an *arbitrarily applicable* basis (i.e., *not* on physical features). The latter comprises the core behavior of AARR and RFT research has demonstrated a number of patterns of AARR that appear to constitute human language. These include: similarity (e.g., Dymond & Barnes, 1996); opposition (e.g. Whelan & Barnes-Holmes, 2004); distinction (e.g., Foody, Barnes-Holmes, Barnes-Holmes, & Luciano, 2013); comparison (e.g., Dougher, Hamilton, Fink, & Harrington, 2007); hierarchy (e.g., Gil, Luciano, Ruiz & Valdivia-Salas, 2014); and deictic (e.g., Rehfeldt, Dillen, Ziomek, & Kowalchuck 2007) relational responding. These repertoires of AARR, also referred to as *relational frames,* appear to be acquired through extensive histories of *multiple exemplar training* through which contextual cues acquire control over emergent (unreinforced) relational responses (Zettle, Hayes, Barnes-Holmes, & Biglan, 2016). For example, the phrase “is” as in “today is hot” is a contextual cue that specifies responding to the two stimuli (“today” and “hot”) as coordinated.

Responding in accordance with *coordination relations* has been observed in infants from 18-24 months (Lipkins, Hayes, & Hayes, 1993; Luciano, Gomez-Becerra, & Rodríguez-Valverde, 2007) and has been established in children with ASD (O’Connor, Rafferty, Barnes-Holmes, & Barnes-Holmes (2009). For example, if you teach a child, across multiple exemplars, that A is the same as B and B is the same as C, they will derive that B is the same as A (called a *mutually entailed relation*), that C is the same as B, and that A and C are the same (called a *combinatorially entailed relation),* even though this response has never been directly reinforced.

Dunne, Foody, Barnes-Holmes, Barnes-Holmes, and Murphy (2014) established responding in accordance with *distinction relations* in children with ASD. For example, if you teach a child that A is different from B, they will derive the mutually entailed relation that B is different from A. If you establish that A is different from B and B is different from C, then a verbally-sophisticated child should derive that A and C may or may not be different (i.e., the A-C relation is as yet unspecified).

Barnes-Holmes, Barnes-Holmes & Smeets (2004) established responding in accordance with *opposition relations* in children aged from 4 years to 6 years and two months, while Dunne, et al. (2014) established this pattern in children with ASD (see also Luciano, Rodríguez, Manas, & Ruiz, 2009). While not unlike distinction relations, opposition relations require a child to abstract a specific dimension along which stimuli sit at either end of a continuum. For example, if you teach a child that A is the opposite of B, they can derive that B is the opposite of A. If you also add that B is the opposite of C, then A and C are the same, hence a combinatorially entailed opposition relation comprises a coordination relation.

Barnes-Holmes, Barnes-Holmes, Smeets, Strand et al., (2004) established responding in accordance with *comparison relations* in children aged between 4 and 6 (see also Berens, & Hayes, 2007; Hayes, Stewart, & McElwee, 2016). Dunne et al. (2014) also established this pattern in children with ASD (see also Gorham, Barnes-Holmes, Barnes-Holmes, & Berens, 2009). Similar to opposition relations, comparison relations require a child to compare stimuli quantitatively or qualitatively along a specified dimension. For example, if you teach a child that A is darker than B and B is darker than C, they will derive that B is lighter than A, C is lighter than B, A is darker than C, and C is lighter than A.

Mulhern, Stewart, and McElwee (2018) established responding in accordance with hierarchical relations in children aged five-six years. Hierarchical relations are exemplified by the concept of containment and family trees are a common example. For instance, if a child is taught that dogs and cats are both types of pet, they can derive that both are members of the category pet and thus have some similarities. However, the containment of both stimuli in the pet category also facilitates distinction relations between the two stimuli, for example one is canine and one is feline. Hence, hierarchical relations comprise other types of relations and the coordination between the stimuli is highly specified (e.g., being members of one category but not others).

In addition to the various patterns of relational responding described above, RFT accounts for the psychological properties of human language and cognition through the transfer or transformation of stimulus functions, which describe how the functions of a stimulus transfer to, or are transformed by, the arbitrarily applicable relation specified between the stimuli (Dymond & Rehfeldt, 2000; Hughes & Barnes-Holmes, 2016). For example, if you are told that all dogs are dangerous (i.e., an aversive function is attached to all dogs) and I tell you that "lupo" is a type of dog, you will derive that lupo is dangerous (i.e., in placing lupo within the category of dogs, the aversive function of dogs now transfers to lupo). For RFT, complex repertoires of AARR provide a functional-analytic account of higher cognition, including thinking, remembering, imagining, and problem-solving (for an extensive review of RFT, see Hughes and Barnes-Holmes, 2016).

The RFT Approach to Perspective-Taking

According to RFT, perspective-taking involves responding on the basis of combinations of the deictic interpersonal relations (I-YOU), spatial relations (HERE-THERE), and temporal relations (NOW-THEN; Barnes-Holmes, McHugh, Barnes-Holmes, 2004; Hayes, et al., 2001). For example, operating from your own perspective typically involves responding on the basis of I-HERE-NOW. As with all patterns of AARR, repertoires of responding on the basis of the deictic relations emerge from an extensive history of exemplar training that typically includes learning to answer questions, such as "Did you and your brother get to school (there) at the same time (then)?" Perhaps paradoxically, as this simple example illustrates, deictic relational responding is complex and typically requires competence in the other relational repertoires noted above. For instance, in responding to the question above, the child must respond to himself in a distinction relation with his brother. Indeed, some evidence indicates that deictic relational responding emerges only after at least some aspects of the other relational repertoires are established (Galvin, 2014; Kent, 2014; Luciano, Rodriguez, Mañas, Ruiz, Berens, & Valdivia-Salas, 2009; Pomorska, 2017).

Most of the empirical research on deictic relational responding has employed variations of a developmental protocol developed by Barnes-Holmes (2001) that parsed out the three deictic relations (I-YOU, HERE-THERE, and NOW-THEN) and three levels of relational complexity, known as simple, reversed, and double reversed relations (Weil, Hayes & Capurro, 2011; Davlin, Rehfeldt & Lovett, 2011). In attempting to map out a typical developmental trajectory along which these skills might emerge naturally, the protocol targeted I-YOU relations first (Level 1), HERE-THERE relations next (Level 2), and NOW-THEN relations last (Level 3). Each level incorporated simple, reversed, and double reversed relations in that sequence in order to systematically increase relational complexity.

Level 1 first targeted simple I-YOU relations, presented to a child as the statement (no actual objects were present) “I have a red brick and you have a green brick” followed by the questions “Which brick do I have? Which brick do you have?” Reversed I-YOU relations were targeted next with the statement “If I have a red brick and you have a green brick and *if I was you and you were me*” followed by the questions “Which brick would I have? Which brick would you have?”.

Level 2 first targeted simple HERE-THERE relations, but these now incorporated the previous I-YOU relations, with the statement “I am sitting here on the blue chair and you are sitting there on the black chair” followed by the questions “Where am I sitting? Where are you sitting?” Reversed HERE-THERE relations were targeted next with the statement “I am sitting here on the blue chair and you are sitting there on the black chair, *if here was there and there was here"* followed by the questions "Where would you be sitting? Where would I be sitting?" Finally, Level 2 targeted a combination of the I-YOU and HERE-THERE relations in a double reversal presented in the statement "I am sitting here on the blue chair and you are sitting there on the black chair, *if I was you and you were me and if here was there and there was here"* and followed by the questions "Where would I be sitting? Where would you be sitting?"

Level 3 first targeted simple NOW-THEN relations, with the statement "Yesterday I was watching television, today I am reading" followed by the questions "What am I doing now? What was I doing then?" Reversed NOW-THEN relations were targeted next with the statement "Yesterday I was watching television, today I am reading. *If now was then and then was now*" followed by the questions "What was I doing then? What would I be doing now?" Level 3 also targeted a combination of HERE-THERE and NOW-THEN in double reversals presented in the statement "Yesterday I was sitting there on the blue chair, today I am sitting here on the black chair. *If here was there and there was here and If now was then and then was now*" and followed by the questions "Where would I be sitting then? Where would I be sitting now?"

Many studies have employed this developmental deictic relations protocol with typically-developing children (see Montoya-Rodrígeuz, Mollina, & McHugh, 2017, for a review) and indeed the evidence supports a number of RFT predictions. Specifically, the data supports functional-analytic distinctions among the three types of deictic relations and among the three levels of complexity (Heagle & Rehfeldt, 2006; McHugh, Barnes-Holmes, & Barnes-Holmes, 2004), as well as a developmental trend in which the simple level of relational complexity and the I-YOU relations emerge first (McHugh, Barnes-Holmes, Barnes-Holmes, & Stewart, 2006). Some researchers have also employed the protocol with atypically-developing children, especially those with ASD. Again, the evidence is supportive of RFT assumptions. Specifically, children with ASD produce weaker performances than typically-developing counterparts (Rehfeldt, Dillen, Ziomek, & Kowalchuk, 2007); these performances can also be differentiated by type of deictic relation and level of complexity (Jackson, Mendoza, & Adams, 2014); and deficits can be remediated with training (Gilroy, Lorah, Dodgea, & Fiorello, 2015). A new venue of analysis to Deictic Responding and Perspective Taking is possible now considering the dynamics of arbitrarily applicable relational responding based on the MDML Framework (Barnes-Holmes et al., 2017).

The MDML Framework for RFT

The Multi-Dimensional Multi-Level (MDML) framework is a recently-developed formulation for analyzing the dynamics of derived relational responding (Barnes-Holmes et al., 2017). While clearly based on existing RFT concepts, the framework formulates AARR into five developmental levels and four intersecting dimensions of responding. According to its authors, the primary aim of the MDML framework is to orient researchers to all aspects of AARR that can be analyzed systematically and to develop the theory further. Indeed, the 20 intersections that emerge between each level and each dimension offer an experimental unit of analysis.

Multiple Levels of Relational Development

The five levels of relational responding highlighted by the MDML framework are not new in RFT, and indeed all were described in the first RFT book in 2001. However, in the framework the levels are now structured in a manner that reflects the broad developmental trajectory in which repertoires of AAR likely emerge, from the simplest unit of mutual entailment to the relating of relational networks to other relational networks.

Level 1: Mutual entailing. Mutual entailing represents the most basic level of derived relational responding among two stimuli. (i.e., if A=B, B=A).

Level 2: Relational framing. The derived relational responding among two not previously directed related stimuli, that demonstrate the three core properties of mutual entailing, combinatorial entailing, and the transformation of functions. For example, if it is trained that “A is opposite to B, and B is opposite to C” it is possible to derive that “C is similar to A”.

Level 3: Relational networking. Derived relational responding that contains more than the basic number of relata necessary to a relational framing. Given some context of learning more complex networks are established. This level describes the derivation of responses among any network that contains four or more elements related, for example “A is similar to B; B is opposite to C, and C is similar to D” it could be derived that “A is opposite to D”.

Level 4: Relating relations. This level describes the derived relations among two separate sets of combinatorial entailed relations. For example, “A is similar to B and B is similar to C”, also “D is similar to E and E is similar to F”. Someone could derive that “A is similar to C” and “D is similar to F” (Level 2) but also that “A is similar to C as D is similar to F”. The coordination relation between these two derived relations is what characterize this level. This is the level where analogical reasoning is inserted. The relational responding “the electron is for the atom, as the planet is for the solar system” demands that the spatial relations among electron and atom, and also the planet and the solar system are related by coordination.

Level 5: Relating relational networks. It is similar to the earlier level in which two separate sets are related, however, this level will involve more than the minimal number of relata. Given that “A is similar to B, B is similar to C, and C is similar to D” and also that, “E is opposite to F, F is opposite do G and G is similar to H” someone could derive that “A is similar to D as E is similar to H”.

Multiple Dimensions of Relational Development

The four dimensions presented by the MDML were based in characteristics that have been used by researchers for a long time in their experimental practice. These dimensions enhance the dynamic and interactive properties of the derived relational responding and help to make previsions and inferences about this behavior.

Relational coherence. Represents how much of the relational response is consistently followed by reinforcing or punishing consequences. The higher the Relational Coherence, more reinforcing stimuli follow a given response.

Relational complexity. This dimension considers all the specific parameters possible on the establishment of one relational responding, like the type of relation, number of elements related in the network, etc. For example, Opposition relations are more complex than Coordination; Larger relational networks are more complex than smaller ones.

Derivation. How much one relational responding has been exhibited before. For instance, the first occurrence of the behavior indicates high derivation and each new observation of the same behavior decreases the derivation dimension.

Relational flexibility. If the relational responses are more or less sensitive to the context. For example, a higher flexibility will allow a weak resistance to change however a lower flexibility will allow to infer a strong resistance to change.

Even accentuating the interaction and the relationship of the levels of relational development and the dimensions of arbitrarily applicable relational responding we will propose analyzing them individually when thinking about perspective-taking. We believe that this will allow a more didactic evaluation and understanding of PT properties. Perspective-taking repertoire has unique characteristics, and even being itself a product of derived relational responding, will likely affect many of our verbal and nonverbal interactions, in a very broad way. After comprehending individually how each of this levels and dimensions enable the understanding of perspective-taking repertoire in each of the interactions among levels and dimensions that it fits. In this way, we will present the relations of perspective-taking and the MDML levels, and later its relations with the MDML's dimensions of AARRing.

Understanding Perspective-Taking Using the MDML Levels

Given the complexity involved in perspective-taking as deictic relational responding, it makes intuitive sense that mastery of the other relational frames will be essential prerequisites (see Barnes-Holmes et al., 2001). As mentioned above, to understand and to be able to take the perspective of someone depends on the establishment of three fundamental deictic relations the interpersonal (I versus You) the spatial (Here versus There) and the temporal (Now versus Then) (McHugh & Stewart, 2012). Each of these relations are probably learned individually and the term "versus" is employed to imply that discriminating this notion of perspective, in the interpersonal relations, results not only in learning about our own perspective but also about the perspective of others.

Torneke (2010) infers that this dynamic observed in the interpersonal relations will be also observed in the spatial and temporal frames. These frames are so important that once they are established in the behavior of any individual they become an intrinsic property of most of his or her verbal events (Roche & Barnes, 1997). The relevant point for this analysis is to make clear that when someone is able to experience "having a perspective" of him or herself the relations to different perspectives are not only possible but necessary elements to this experience. We will never be able to experience the perspective of someone else directly in the sense that "having a perspective" is a continuous experience. We are behaving from the same "self" or perspective and to infer, imagine, and preview the feeling, thoughts or states of someone else is a verbal response that will occur also from this perspective.

The most important point to highlight is that the relations of two separate sets or networks of entailed relations are intrinsic to this behavioral repertoire. Perspective-taking, as defined above, most likely occurs at Level 4 (relating relations) and Level 5 (relating relational networks) of the MDML framework. It will necessarily involve at least the derived relations between other derived relations. As described above, the earlier three levels of the MDML describes simpler relational responding that will be necessary to be developed to make perspective-taking possible, however, they are not sufficient to correspond to the notion of Perspective-taking. This notion requires the relating relations or relating relational networks levels to analyze in a comprehensive way the observed or predicted patterns of relational or functional contextual control, that will be responsible for verbally experiencing one other perspective. This requirement of the higher levels of the MDML for understanding PT is similar for the requirement of Analogical reasoning explanation.

Analogical reasoning is also understood to interact and overlap other behaviors as predictor of educational success and also contributing to problem solving (Lipkens & Hayes, 2009). Once analogical reasoning and perspective-taking have the same behavioral process to explain them, it is likely that they would emerge together in a behavioral repertoire. It is possible to observe in the experimental evidence, from a developmental perspective that both these repertoires are understood to develop in a similar period, between 5 and 9 years (Carpentier, Smeets, Barnes-Holmes, 2004; McHugh et al., 2004). From a functional-analytic perspective, it is possible to infer that both these behaviors depend on being able to demonstrate the derived repertoire described in the fourth level of MDML, relating relational relations. The higher levels of the MDML framework, relating relations and relating relational networks, are particularly important for language generativity and allow entire sets of relations or networks to impact other relations or networks (Stewart, Barnes-Holmes, Hayes, & Lipkens, 2001).

The verbal organisms can exhibit responses in all levels during the development of the higher levels, so, as mentioned above, the responses should be observed functionally and never topographically. For instance, a young child may learn to call herself “me” or “I” and his father "daddy", these mutual entailed elements will very likely not be related in more complex relations for an early learner. However, after more experience, these elements when established in the interpersonal relation (I – YOU) will imply many different possible relations derived, not only coordination relations between "me" and the child and "daddy" and the father, and all other elements related to these *relata*. There is an enormous difference in the behaviors and interaction possibilities that when moving from the level three (Relational networking) for the levels four and five. It would be possible even to consider this mark, being able to relate relational responding, as a behavioral cusp as described by Rosalez-Ruiz and Baer (1997). The behavioral cusp will definitely change their interaction in the environment allowing the contact with many different and new contextual control. At this moment the individual is able to reflect or think about himself and the others.

Despite the effectiveness and the advances that RFT approach about PT have presented, some researchers do not consider that this view constitute a "comprehensive approach" once the most important aspect, i.e. "knowing and relating" to other individuals are considered to be overlooked (DeBernardis, Hayes, & Fryling, 2014). We recognize that different approaches to Perspective-taking exists, however it is not the objective of this work to compare them. The objective proposed here is presenting a more suitable understanding of this complex repertoire, i.e. Perspective-taking, making use of a recently proposed framework the Multi-Dimensional Multi-Level. The MDML, was recently described as a conceptual framework for analyzing the dynamic properties of arbitrarily applicable relational responding and the interaction of its units (Barnes-Holmes, Barnes-Holmes, Luciano, & McEnteggart, 2017). It is presented in five levels and four dimensions, described later, that allow to understand the basis of each arbitrarily applicable relational responding and the learning history that selected that behavior.

The objective of the analysis presented here is to draw the fundamental units of deictic repertoire using the MDML framework considering its complexity. For instance, the behavior that configure Perspective-taking is clearly more complex and can only be considered in the higher levels of MDML. For example, the derived relational response “If I were my brother, I would eat coco pops at breakfast” (see Figure 1). This example, describes not only establishing mutual entailments between each one of them and their favorite food, he is also relating these derived mutual entailed relations, what is a whole complete different level in MDML, requiring at least level four. In other words, anyone able to describe individually the preferred food of each of the brothers (exhibiting coordination relations among the item and the person, and also when they would eat it [I, pancake, breakfast] [my brother, coco pops, breakfast]) is not perspective-taking. Perspective-taking, can be observed, however, only a when the child is able to relate these two combinatorial entailments. As Figure 1 illustrates, only when a derived relation is observed between both Relational Framings (one and two), this response could be considered AARR at Level 4 (i.e., relating relations). We believe that this analysis will allow a more precise comprehension of these specific relational responses raising relevant questions that might not be easily considered before without the employment of this framework.

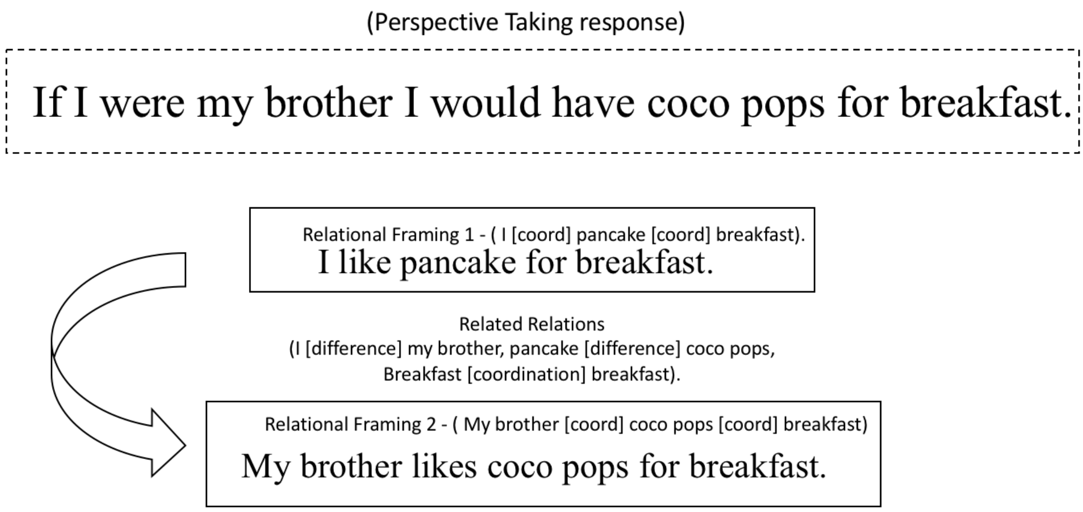

Fig. 1 A perspective-taking response at Level 3 of the MDML. The sentence at the top of the figure shows the perspective-taking response as relating relations, while the lower part of the figure shows the relation between the two relations.

We are considering that perspective-taking repertoire necessarily fits in the MDML framework's Levels 4 and 5. It is important to mention that the distinction between these two levels will not be so clear in many occurrences of these responses. The differentiation between these levels is "fuzzy" because in many situations it will be impossible to infer precisely the relational processes that were derived to emit one given relational response. In this way, generally, what will be definitive for placing any given PT responses being analyzed in this framework will be the hypothetical number of elements related in a given set.

For example, a perspective-taking response at Level 4 might involve correctly answering the question "Where are you and where are your brother?" in this case, if the child is in the school, the answer will require that the contextual elements are coherently related, responding "I am at school" [mutual combinatory entailed relation = Relational Framing, level 2] this will imply that the interpersonal (I), the spatial (school – where am I?) and the temporal (now – when am I there?) are the essential for deriving accurately this response. At this moment, it is possible to observe that the minimal number of *relata* related allow to infer the level two, relational framing but if the child is capable of level four relational responding, level four could be inferred. To make sure about the relational repertoire of this kid, the mother could insist in the question also saying "Ah ok, you are at school and where are your brother?". If this child correctly developed the deictic relations he should be able to derive all the elements considering his perspective and also his brother informing that "I am at school, but my brother is at home" [two combinatorial mutual entailed relations "I am at school now" + "my brother is at home now" related by difference "but"] , consisting of a response at Level 4 of the MDML. This will imply that the interpersonal (I), the spatial (school – where am I?) and the temporal (now –

when am I there?) and also that the interpersonal relation is differentially related to my brother (YOU) that is in a coordination relation to the spatial (home) and temporal (now), as presented in Figure 2. Only when the relational framings presented at the top of this figure are in a derived relation with each other, the individual is capable of inferring and imagining, and verbally experiencing what is happening in the perspective of his brother. This repertoire demands that the elements in Relational Framing 1 are in a derived relation with the Relational Framing 2. However, children that are not able to relate relations, at this moment may be confused or assume him and his brother are in the same place "my brother is at school", just because himself is there, or even both Relational Framings at the top of the diagram could be observed, but not in a difference relation between them (only Level 2 in MDML).

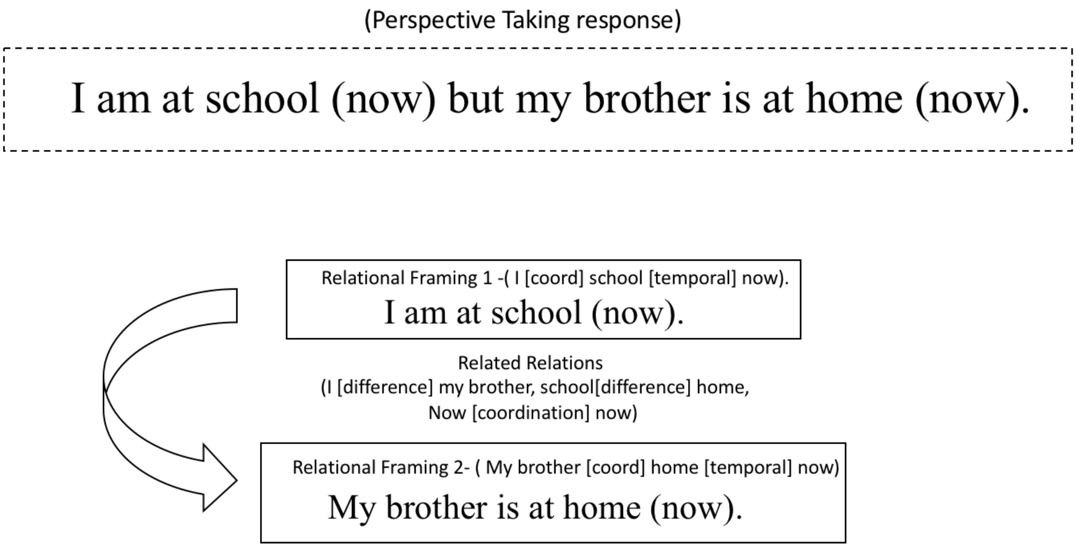

Fig. 2 A perspective-taking response at Level 4 of the MDML. The sentence at the top of the figure combines two relational networks, which, on the lower part of the figure, are related on the basis of difference.

The perspective of myself in relation to any different perspective will be the sets of combinatorial entailed relations in this kind of response. The example above, showed two combinatorial mutual entailments related by difference, this is the minimal number of elements to observe the perspective-taking response and any other aspect included would change it to level five. For example, “I am doing a class at school and my brother is sick at home”, including the actions there are more than the minimal elements for a combinatorial mutual entailment and in this sense each of these relations become a relational network (Level 3 of the MDML framework). The addition of any element in the episode will make the given response at Level 5 of the MDML framework, like in the former example, one brother is studying and the other is sick.

One other example of responding at Level 5 could be seeing someone that works at night really tired early in the morning and thinking “I slept really well, but he must be really tired from working last night”. The relational network derived will include the interpersonal relation (He – substituting You) the spatial relation (his workspace) and the temporal relation (last night – substituting Then) and also the description of his appearance (very tired) [So, “He must be really tired from working last night” is one relational network that is related by difference to “I slept really well (yesterday)” another relational network] . These four elements in each network exceed the minimal number of relata to fit combinatorial entailment and so they can be described individually as fitting at least as level three, relational networking as represented in Figure 3. This is a very complex behavior; however, it is not the topography that defines it as a perspective-taking response at Level 5 of the MDML framework it is important that the derived relations are observed among the derived elements of both relational networks. i.e. “I” would be able to take “HIS” perspective only if the Relational Network 1 (“I am rested because I slept yesterday”) are in a derived relation of difference with the Relational Network 2 (“He must be tired because he worked during last night”). The relevant aspects to understand a given perspective-taking relational responding will be observing the relational repertoire of the organism.

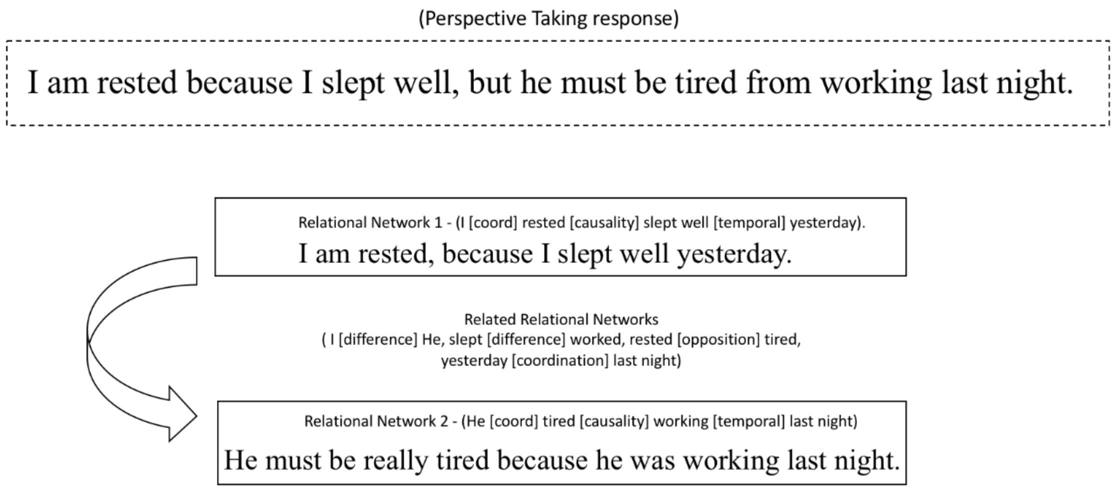

Fig. 3 A perspective-taking response at Level 5 of the MDML. The sentence at the top of the figure combines two relational networks, which, on the lower part of the figure, are related on the basis of difference.

Finally, it is important to say again that the structure or topography of the relational response it is not the defining element to consider in one specific level, but how the elements in one response are being related and how the functions are being transformed. It is important to say that, for considering a perspective-taking response we should be able to observe not only individual relational framing (Level 2) or relational networking (Level 3). It is essential that relations among these relations (Level 4) or these networks (Level 5) are derived and affect the basic properties of the arbitrary applicable relational responding. In the end, it is possible to observe how fluent and dynamic any relational response can fit one specific level, and the derived relations (observed explicitly or inferred implicitly due knowing the repertoire of a given organism) are the elements we have to do this analysis.

Understanding Perspective-Taking Using the MDML Dimensions

As described above, the MDML framework presents four dimensions of relational responding and emphasizes their interactions with one another. All the dimensions will be critical for understanding the interaction of specific variables important for the establishment and selection of these complex relational responses. Coherence, flexibility, derivation and complexity, in a similar way affect simpler relational responding, and will give more elements for the researcher to know about the learning history of a given AARR. It is important to mention that it is expected that the dimensions will vary in each of the interactions in the MDML framework, this is the relevant characteristic that enable to explore their patterns and contribute to the interpretation of derived relational responding. The dynamics of the interactions between levels and dimensions is also crucial for understanding the MDML framework (i.e. any specific variation in any dimension will or will not produce changes in the other dimensions and even in the levels, regarding the evaluated derived relational response).

Relational Coherence in Perspective-Taking

As is the case with all four dimensions of the MDML framework, relational coherence is best understood on a continuum. They will generally vary from low to high, and all the differences in this continuum will be always relevant for the development of derived relational responding. It is possible to infer that, generally in the beginning of the learning, high coherence will allow some constancy and help to establish early relational responses, in other words, it is desirable. For example, when a child is learning his name, it is important to observe high coherency for this mutual entailed response "I am Jack" will generally evoke direct reinforcement from the parents. We mentioned that specially at the beginning of the multiple exemplar training a large number or relational responses will be directly reinforced, but even later when derived responses are observed sometimes they will be followed by some consequence. However, the constant maintenance of the high coherence context will not allow important aspects of behavior to be learned. In many other cases it is important that low levels of coherence are presented for enhancing the chance to develop flexibility. In some pretend play with the parents the child cannot be "Jack" anymore, in that context he could be "Godzilla" destroying a "city" (toys arranged on the ground).

Controlling the variation of the coherence dimension is extremely fundamental for the adequate learning of the relational repertoire. Relational coherence corresponds to possible types of consequences that may follow some relational responding. In a more basic sense, it is possible during the establishment of this relations that some relational responses will be more probably punished in some contexts and not in another (e.g., if a child says “we are at home” this could be coherent with the context or may evoke “No, we are in a supermarket” from the mother).

Relational Flexibility in Perspective-Taking

This is one very important aspect of perspective-taking and it is highly desirable that this kind of behavior is highly flexible. However as mentioned for coherence, it is impossible to just maintain one dimension high, this would raise problems especially during the learning of the derived relational responses.

Flexibility is very important for perspective-taking once relations established could be derived fluently to several different perspectives, in a huge number of different spaces, in any given time. In addition, established in a large number of types of relations, for instance, my preference can be similar, different, opposite, more or less developed than someone else. There are literally infinite possibilities to compare aspects of our perspective with other’s perspectives. Moreover, we must consider some contextual cues that are frequently observed in deictic relational responding as “If-then” as in “If I were you…” statements. It is possible to infer, considering the relevance of flexibility for deictic relational responding, that the elements essential for establishing the three fundamental relational relations (interpersonal, temporal and spatial) should be established in a very flexible way. For instance, depending on the context the derived perspective-taking responses about someone else’s feeling will be completely different if this person won a lottery prize I would imagine he would be really happy, otherwise if his football team was defeated by 6 x 1 he would probably be devastated.

Except for the deictic elements that describes the own perspective (I-here-now) all the other deictic elements of the others perspective will be probably in constant change, so flexibility is relevant. Even if we consider the temporal and spatial elements related to my own perspective they could be changed (here can be also my home or my work space, I can say about something that is happening now, or can now say about something that happened five years ago). In other words, the fact that these deictic elements are not related to obvious counterparts also give a sense of the importance of flexibility for this relational response.

Relational Complexity in Perspective-Taking

The complexity dimension will consider the parameters to establishing a given relational response. The deictic responses will include every individual relational frame already learned and also affect the verbal repertoire as a whole. In general terms, this dimension would present higher complexity once even the minimal relata needed for a deictic relational response will comprise at least two sets of combinatorial entailed relations related (Level 4 of the MDML framework). It is important to say that some types of relational responding are more complex and demand a more developed relational repertoire. For instance, a child establishing coordination relations among "I" and herself, and "mommy" and her mother is simpler than establishing a relation of difference between "me" and "mommy". This means that even when we are observing two different deictic responses "I like ice cream, but 'mommy' likes candy" and "I like candy and 'mommy' likes candy", relating relations by difference is more complex than coordination, so in the first response the complexity would be higher than the second. As in any other derived relational response, the inclusion of different types of relations would make any of these relations or networks more complex, which would also make the related relations in perspective-taking more complex in these cases.

Finally, one extra point about the complexity of deictic relational responses is that taking the perspective of someone else is more complex than taking my own perspective.

Taking the perspective of someone else involves more relational framing and there is also evidence that this behavior produces longer reaction times (McHugh, Barnes-Holmes, Barnes-Holmes, Whelan, & Stewart, 2007).

Derivation in Perspective-Taking

Derivation will describe how many times one relational response has been exhibited earlier. Observing perspective-taking responses, some occurrences would be really low in derivation, as for example, “I am John” (inferring that more elements are in derived relations implicitly in this utterance) to “Who are you?” or emitting the response “I am here at the University today and my wife is at home”, could be even directly trained. On the other hand, many unusual derived relational responses could be possible and high on derivation as for example “I wish I had your precision in describing the flavors present in the Indian cuisine”. It is important to say that even when these responses reach a very low level of derivation, it is very hard to infer a decrease in the flow of relational framing or networking. Once this complex relational repertoire is learned, the verbal repertoire will likely modify his or her interaction with the environment establishing his or her perspective. Having a perspective create a permanent “section” (better described as many relations possible to be established) among the first person or the speaker and the subjects that are being spoken about.

Perspective-taking as Dynamical Relational Responding

As it was repeatedly mentioned above the system described by the MDML framework is fluent and dynamic, this is the only correct way of employing it in any analysis of derived relational responding. This is also true for Perspective-taking analysis. If we consider any given PT response, as it was described individually earlier, all the variations among levels and dimensions will necessarily be described and impact each other element due to the higher interaction present in the framework. The history of learning that make possible the adequate observation of perspective-taking responses will be intrinsically related to coping with the innumerous aspects of the environment, allowing the organism to deal with the high flexibility and complexity possible when observing this relational repertoire. It is possible to infer that, to be highly adaptive to the environment one perspective-taking response will be generally low in coherence and high in flexibility. Complexity will interact actively with coherence and derivation. This is just a general perspective of the processes that will likely be present in a more frequent given perspective-taking response. The behavior is highly variated, and the topography is never sufficient to determine these responses. The levels observed in the MDML, are organized considering its relational complexity, however, being able to exhibit one will not indicate the cease of exhibiting responses on the earlier levels, the earlier levels are just less likely to be inferred.

Additionally, Perspective-taking is a skill to predict my own or someone else behavior and it is highly related with some sort of knowledge about myself or someone else state or condition in the relevant moment for the context. In other words, the knowledge about myself or my reinforcement history or someone else will constitute relational networks that will be essential considering the adequacy or probability of reinforcement of these relational responses. This history or summary is essential in social interactions and supply information for the individual when he is talking about his own perspective (Torneke, 2010). Regarding this aspect, responding about our own perspective is a fundamental element to establish the self, that is, derived relational responding will enable descriptions and evaluations for ourselves and other selves and these “histories” or “summaries” can be understood as coherent relational networks (Stewart, 2013).

So, we can say that, if I actually know about someone, i.e., the relational network established about his or her behavior will be more likely to allow the precise derivation of the persons feelings, interests etc. However, if I am asked to answer about someone I actually do not know or about some aspect of my perspective that I never experienced or have fewer elements to derive relations it is less likely that the appropriate relational responding will be observed. In these sense, the learning history and the relations we establish about someone will be important to affect the way the dimensions and levels will be interacting with each other. As mentioned earlier, all the dimensions will be constantly varying in specific contexts. An example of this point would be an uncle who says, “It is my nephew birthday, I do not like chess, but he loves it, so I will buy a new chessboard as a gift”. We can infer that this is a perspective-taking response, because in this context the verbal organism (uncle) is probably deriving new relational responses among the elements present in previous relational networks (nephew “summary”) selected by the context (nephew birthday) presenting this utterance. It probably fits the fifth level once it contains a relation among the preferences of the uncle and the nephew about some activities (playing chess and buying a gift). The variation on the dimensions can be observed in two different ways. It is possible that the uncle always observes the items in the nephew’s house, a lot of chess books, many timers and old chess boards, even maybe some chess trophies. In this case, it is possible to say that this perspective-taking response is highly coherent (has a high probability of being followed by reinforcement), is low in derivation and flexibility (he has directly noted that the nephew likes to play chess every time, even when he had other options) and it is high in complexity (once it is relating many different *relata,* e.g., birthday, his preference, his nephew preference, what he will buy, why he will buy, etc.).

Just to make a clear distinction that the important point it is not the topography, but the processes involved and the functions in the context of a given relational response, we will interpret the exact same response from the former example changing some of the dimensions in the MDML. Imagine that, maybe this uncle is from another country, and visited his nephew one year before, for few days. In this case, it is possible that the relations he will derive about the perspective of his nephew are not so precise anymore and he appreciate music instead of chess. In this context, the uncle's perspective-taking response would be low in coherence (probably the chess board will not be an exciting gift) high in derivation (he saw some chess elements, but just that) low in flexibility (paid more attention to one old chess board than a number of musical posters) and high in complexity (once many elements where related again). It is clear in these examples that many of these relational responses are derived, they are contextually controlled and sensitive to consequences, so when awkward or unexpected social interactions happen, this will lead to different derivations in the future.

Conclusions

Relational Frame Theory provide an experimental way to investigate, evaluate and establish the complex repertoire of Perspective-taking. The MDML framework allowed to address empirically the properties of this repertoire. In this way, to analyze perspective-taking based on the MDML framework will add more precision to the analysis and the description compared to the definition and description possible just employing the classical Relational Frame Theory terms. The interpretation realized here was abstract, but it allowed new possibilities broadening the understanding of perspective-taking response and highlighting its dynamic properties. Furthermore, this theoretical interpretation employed the MDML framework allowed to recognize important elements that were not clear enough in the earlier discussions about perspective-taking and opening new venues for teaching of this behavior.

First considering the fact that perspective-taking repertoire fits only in the higher levels of MDML (at least level 4), highlights the importance of the earlier relational components and also concede more precision when considering the minimal relations among the *relata* present. As it was discussed topography is not the criteria to define a perspective-taking response. It is proposed that the necessary elements and relations to fit them as relating relations or relating relational networks will be the basis of its definition. When the verbal organisms are able to relate relations or relate relational networks, it is possible to accurately infer that the initial deictic relations (interpersonal, spatial and temporal) are now constituting the deictic frame. Each of the possible eight interactions among these higher levels (Levels 4 and 5) and each of the four dimensions presents the characteristics of this behavior, that is generally highly flexible, whose coherence is based on a very complex context, that present many different levels of complexity due the innumerous possibilities of relations.

Second, considering perspective-taking at least in the level four implies an essential element of relating relations or relating relational networks to this repertoire. In this sense, perspective-taking, and analogical reasoning share the characteristic that is the relevant distinction between the earlier levels (1, 2 and 3) and the final levels (4 and 5) in the MDML framework. There are some evidences of similar developmental periods between these complex relational repertoires (Carpentier et al, 2004; McHugh et al. 2004), however no study directly evaluated if one of this interacts with the other. This could be an important empirical question for investigation, if learning analogical reasoning could be an important intervenient variable to enhance the perspective-taking repertoire.

Third, the analysis of perspective-taking based on the MDML framework unraveled not only the elements present in this repertoire but also revealed what can be considered the simpler relational elements essential for these responses. It is possible now to propose an agenda focused on teaching fundamental relational behavior that will likely enable the development of perspective-taking. We mentioned earlier that changing from the third to the fourth level of MDML could be considered as a behavioral cusp (Rosalez-Ruiz and Baer,1997). It is important to mention, that not only changing from level 3 to 4 but also learning each one of the levels could be understood in the same way. Each of the derived relational responses or levels of relational development, once established in a behavioral repertoire will affect in a definitive way all the behaviors of the verbal organism.

Finally, the importance of the development of this repertoire is critical for human interaction. The proposition of its analysis employing the Multi-Dimensional Multi-Level framework enabled a clearer picture on thinking how this behavior have been investigated and also figuring out new possibilities of intervention. As described in the MDML framework a very complex relational repertoire must be observed before establishing the Deictic Framing, not only the early levels described in the MDML but also specially the relating relations or relating relational networks is essential. At this moment we still do not have empirical evidences of what is being proposed by the employment of MDML framework to evaluate PT repertoire, but there are now several possibilities to be developed that will potentially increase the knowledge about this phenomenon.

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ESTUDO 4

Employing the Multi-Dimensional Multi-Level Framework to Build a Derived Relational Responding Curriculum for Perspective Taking

Perspective-Taking usual definition considers this behavior as the capacity for demonstrating awareness of informational states in oneself and others (Rehfeldt, Dillen, Ziomek, & Kowalchuk, 2007; Hayes, Barnes-Holmes & Roche, 2001). The study of this behavior is especially relevant once many socially related inadequacies may be related to a less developed repertoire of Perspective-taking (Griffin, Dunning, & Ross, 1990; De Bernardis, Hayes & Fryling, 2014). Further, a more comprehensive and functional analysis of the essential features of Perspective-Taking behavior may enable a better knowledge of this repertoire but also forms of intervention.

This analysis may be precisely carried out in the context of Relational Frame Theory (Hayes, Barnes-Holmes, Roche, 2001; Zettle, Hayes, Barnes-Holmes & Biglan, 2016). Relational Frame Theory focuses primarily on the study of derived relational responding and the importance of this behavior for human language and cognition. Derived relational responding is observed in verbally capable human since an early age, and it is directly related to language generativity and complex behavioral repertoires (Kent, Galvin, Barnes-Holmes, Murphy & Barnes-Holmes, 2017).

Generally, Relational Frame Theory will explain derived relational responding based on some properties that highlight relational and functional aspects of this repertoire as mutual entailment, combinatorial entailment, and transformation of functions (Hayes et al., 2001; Torneke, 2010). Derived relational responding is a relational behavior under the contextual control of contextual cues, and verbally able humans learn how to respond to these cues in a Multiple Exemplar Training. Incidentally or even planned, we learn to relate environmental events in many different ways as Coordination, Difference, Opposition, Comparison, Hierarchy, etc., in a non-arbitrary domain. Once these contextual cues are sufficiently stable in selecting relational behavior, we became able to derive arbitrary relations; in other words, relations without any formal support (physical properties). This explanation of derived relational responding was revisited recently, and a framework, the MDML - Multi-Dimensional Multi-Level framework (Barnes-Holmes, Barnes-Holmes, Luciano, & McEnteggart, 2017) was proposed, targeting functional and relational properties of this response.

The MDML, organize the derived relational responding in five levels and four dimensions, that will not make any change in the original proposal of Relational Frame Theory, but instead, will orient and help researchers to a clearer perspective on new variables to be investigated (Barnes-Holmes et al., 2017). The levels of relational development organize how derived relational response increases in complexity the more complex a relational repertoire is, the first level is Mutual Implication, the second level is Relational Framing, the third Level is Relational Networking, the fourth level is Relating Relations and the fifth level is Relating Relational Networks. The dimensions presented by this framework are Complexity, Flexibility, Coherence, and Derivation (for more information about the MDML see Barnes-Holmes et al., 2017 and Silveira, de Almeida, Barnes-Holmes & Barnes-Holmes, in preparation).

The explanation from Relational Frame Theory to human cognition and language enables, among several complex behaviors, the study of Perspective-Taking (Barnes-Holmes, McHugh, & Barnes-Holmes, 2004; Hayes, et al., 2001) that recently was analyzed employing the MDML with the aim of evidencing its functional features (Silveira et al., in preparation). This new perspective proposes that Perspective-Taking responses depend on a complex relational behavior (at least Relating Relations) to enable its observation. In this sense, there are no such direct prerequisites of PT as proposed in previous studies (e.g., Gould, Tarbox, O'Hora, Noone, & Bergstroom, 2011; Hahs, 2015) but more profound learning on how human learn derived relational responding is more crucial to understanding Perspective-Taking.

Several authors support the view that more investigations should be developed, aiming to understand the ideal sequence in which the relational frames are established. They are still very rare, but necessary (Kent et al., 2017, Luciano, Rodríguez, Mañas, Ruiz, Berens &

Valdivia-Salas, 2009). The evidence we have now suggest that Coordination frame is the most basic one, playing an important role for the development of the other frames (e.g., Cassidy, Roche, & Hayes, 2011; Luciano, Gomez-Becerra, & Rodriguez- Valverde, 2007). There are also suggestions that Difference frame might be the second that together with Coordination frame may establish the foundation for Opposition and Comparison, once stimuli must be identified to be opposed or compared (e.g., Dunne et al., 2014; Kent et al., 2017).

Talking more directly about Perspective-Taking repertoire, the Deictic frame seems to be one of the most complexes depending on the establishment of several other frames before being present (e.g., Barnes-Holmes, Kavanagh, & Murphy, 2016). The complexity of these frames is also justified by the fact that the relations established do not have formal environmental support, and the perspective is constantly changing. Besides, the proposal that establishing one frame should facilitate the learning of others (Rehfeldt & Barnes-Holmes, 2009) more recently it is suggested that the development of the relational repertoire is more interactive considering the different frames (e.g., Galvin, 2014).

Considering the proposal presented by Silveira et al. (in preparation) the Perspective-Taking repertoire, it gives support to Galvin (2014) perspective on the study of deictic relations being favored by the better knowledge of the learning sequence of relational responding. Two studies can be observed in RFT literature that are exploring directly the learning sequence of this verbal repertoire. The first one, Dunne et al. (2014) indicated the importance for educational interventions in a more widespread knowledge of relational responding learning sequence, once derived relational responding have been related before to several educational behaviors evaluated by intelligence probes (e.g. Gore, Barnes-Holmes, & Murphy, 2010; O'Hora, Pelaez, Barnes-Holmes, & Amesty, 2005; O'Toole & Barnes-Holmes, 2009). In this sense, Dunne et al. (2004) aimed to establish a training and testing sequence in key-frames with nine children with autism and analyzed the possible relations among prerequisites for each frame, and its correlates in VBMAPP (Sundberg, 2008). These authors stated that the four studies presented in this paper enable a precise verification of behavioral competencies in arbitrary and non-arbitrary relations in the relational frames of coordination, opposition, distinction, and comparison for each participant, showing a robust demonstration of derived relational responding with new stimuli. On the other hand, only two of the nine participants completed all the tasks, and the prerequisite relations aimed to be studied did not seem mapped. In conclusion, although the analytical results, the authors suggest the importance of new investigations with similar nature.

The second one, Kent et al. (2017), aimed to directly investigate the establishment of relational repertoire in children with autism. To this end, the experimenters manipulated training and testing sequences of the basic relational responding repertoire and compared the performances with children with and without autism. Kent et al. (2017), developed three experiments showing that five typical development children presented fluent performances in the probed relational repertoires (Experiment 1), but this fluency was absent in eleven participants with atypical development (Experiment 2). Only four participants completed all the protocol, and the remaining seven needed a more significant number of trials to achieve finishing criterion only in the non-arbitrary relations. In the third Experiment, four participants with autism completed all the training and testing protocol, besides all participants demanded direct training in opposition relations (P1, P2, and P4) or difference (P3), later showing derived relational responding. The results of Kent et al., (2017) also sustain earlier studies supporting the relevance of multiple-exemplar training, with explicit feedback for non-arbitrary relations enabling the learning of arbitrary relations (Vitale, Barnes-Holmes, Barnes-Holmes, & Campbell, 2008; Barnes-Holmes, Barnes-Holmes, Smeets, Cullinen, & Leader, 2004; Barnes Holmes, Barnes Holmes, Smeets, Strand, & Friman, 2004; Gorham, Barnes-Holmes, Barnes-

Holmes, & Berens, 2009). Finally, they also show a correlation among the verbal repertoire of the participants and the success in relational tasks.

The present study aimed to investigate the proposal presented in Silveira et al. (in preparation) that perspective-taking repertoire could be observed more fundamentally if derived relational responding of Level 4 enabled relations among deictic aspects. In this sense, to draw the fundamental units of arbitrarily applicable relational responding, specifically for deictic repertoire, using the MDML framework and propose a set of tasks to evaluate and train perspective-taking. The initial repertoire of a typical development child and a child with autism were evaluated. In case of the lack of perspective-taking skills, the underlying correspondent repertoire was trained and re-evaluated. This study would potentially add information for a better understanding of perspective-taking repertoire establishment.

Method

Participants

One 4-year old girl, with typical development, and one 5-year old boy diagnosed with Autism Spectrum Disorder (ASD) given by an independent professional as defined by the DSM-V (American Psychiatric Association, 2013), participated in the study. The work described has been carried out under the Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans, and the principal researcher obtained informed consent from the parents before the children's participation in the study. For confidentiality reasons, the participants will be referred to as Claire and Frank.

Both children had their behavioral repertoire evaluated by the Psychoeducational Profile-Revised (PEP-R). Schopler, Reichler, Bashford, Lansing, and Marcus (1990) developed PEP-r to assess and formulate individualized training plans for children with learning difficulties. It is most indicated to be used for the ages of 6 months to 7 years. The PEP-r is consisted of seven different scales that measures infancy developmental milestones and provides information on developmental level for each of the following areas: imitation (16 items), perception (13 items), fine motor (16 items), gross motor (18 items), eye-hand coordination (15 items), cognitive performance (26 items), and cognitive verbal (27 items). These seven scales form the Developmental Scale, which yields a Developmental Age measure. The Developmental Score is the sum of all individual item passing scores on the Developmental Scale and yields a standardized Developmental Age score.

Claire pre-experimental developmental age as measured by the Psychoeducational Profile-Revised (PEP-R) test was four years and seven months (matching her chronological age), and for Frank was four years (below his chronological age). Table 1 shows their score for each one of the seven areas and the correspondent developmental age for each area.

Table 1.

Participants scores and correspondent developmental age for each area as measured by the PEP-r.

	Claire		Frank	
	Score	Developmental Age	Score	Developmental Age
Imitation	16	5y 8m	14	3y 11m
Perception	13	5y 3m	13	5y 3m
Fine Motor	15	4y 11m	16	6y
Gross Motor	18	5y 2m	18	5y 2m
Eye-hand Integration	8	3y 4m	13	5y
Non-verbal Cognitive	23	4y 6m	18	3y 3m
Verbal Cognitive	22	4y 9m	13	3y 4m
Development Score	115	4y 7m	105	4y

Setting and Materials

Sessions occurred in a quiet room free from distraction located in a psychology clinic with Claire, and in Frank's house (where his Applied Behavior Analysis sessions took place). During each session, the experimenter and participant sat on opposite sides of the table. Each session lasted between 20 to 50 minutes, with 5 minutes breaks as soon as the participant demonstrated any evidence of tiredness.

The non-arbitrary evaluation protocol consisted of 250 trials, with five types of frames (Coordination, Difference, Comparison, Opposition, and Hierarchy), with five levels each, and ten trials per level assessed. The arbitrary evaluation protocol consisted of 266 trials since it included the five frames plus one more, i.e., perspective taking with ten trials (6 with visual support and 4 without visual support).

For these evaluations, the materials needed were a computer with Microsoft PowerPoint, paper, identical and different everyday items. The training protocol for coordination and difference used only with Frank consisted of 10-12 trials for the training blocks and 8-12 trials for the tests. For the training, the materials needed were only a computer with the Psychopy software installed (Psycho Py 2 1.90.3 PY 3 version) (Pierce, 2007).

Experimental Design

The training procedure developed with Frank was an ABA single-subject design. This procedure was used to assess the effects of the multiple exemplar training on the percentage of correct perspective-taking responses. For Claire only the evaluations were presented.

Procedure

Before starting the pretest, the experimenter exposed the participants to one session of priming blocks intending to access their knowledge regarding the stimuli that they needed to recognize to be able to do the task. For example, the participants responded in this block about colors and geometric shapes names.

Pretest. ***Non-arbitrary evaluation protocol.*** The first task tested in this protocol was the Coordination relation in MDML Level 1 (mutual implication). During this task, each trial consisted of three stimuli presented on the screen of the computer. Two of them presented identical aspects, and one was different. Each block consisted of ten trials. The experimenter instructed the participant by presenting one specific aspect and asking which ones were similar in this aspect (e.g., colors, shapes, items, etc.), for example: "Which ones have the same color?"/"Which ones have the same shape?". The finishing criterion in this first block was making at least eight correct responses. Achieving 80% in the testing trials was considered a mastering criterion, and any performance under this criterion represents a failure to present that specific functional repertoire. If the participant achieved the criterion, he followed for the next level in the MDML, and however, if the participant made more mistakes than 2, the evaluation protocol would be finished for that specific frame.

Coordination Level 2 (relational framing) block, was similar to the previous level, but more stimuli were presented in the screen (5, 6 or 9) and required the participant to relate three stimuli to give the correct response. Following the same criterion described before, if the participant performance was above than the required, he followed for the next level. Trials in Level 3 (relational networking) were similar, but now, the participants were required to relate simultaneously four stimuli in each trial. Observing the same criterion in Level 3, participants were exposed to Level 4 (relating relations) where two or three similar or different stimuli were presented simultaneously, circled by a frame that visually indicated that it was a compound stimulus. Another two stimuli as these were the comparisons, and the participants were required, as previously, to show which ones had the same color/shape. The required responses would demand the participant to relate relations among these sets of circled stimuli. Once achieving the finishing criterion, participants were directed to Level 5 (relating relational networks) testing. Level 5 was similar to Level 4, but instead of compound stimuli of two/three stimuli, it was presented compound stimuli with at least four items.

During this phase, no feedback was provided on participant responses in the protocol, but a general verbal compliment was given after three test trials praising the engagement of the child in the task. Figure 1 presents an example of a trial from each level of the coordination frame. After the participant completed all Levels from Coordination, he started the evaluation for the Difference frame, then for the Comparison, then for Opposition, and finally for Hierarchy.

The stimuli chosen for each type of frame were specific to assess relations of these types. For the Coordination, Difference and Comparison frames the stimuli consisted of known items (animals, objects) and colored geometrical pictures.

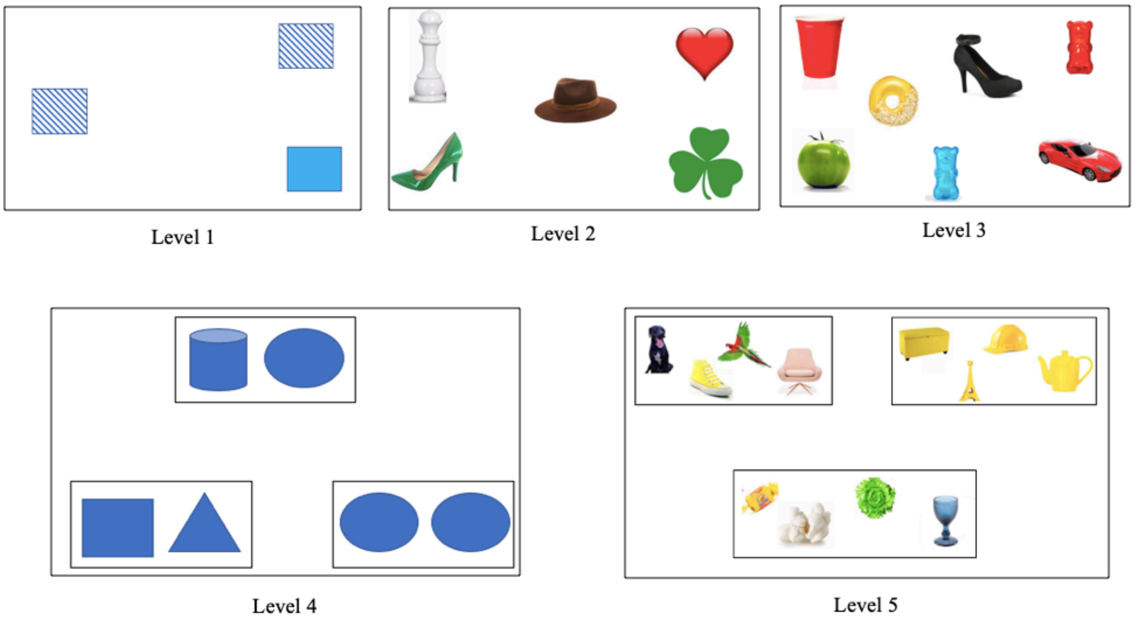

Figure 1. Computer screen examples for each level of non-arbitrary difference relations tests. The instruction always involved presenting the functional contextual cue that allowed selecting the specific response for that trial. Figure 1 presents examples of each level for the difference relations tested. For the difference relations, the instruction of each trial involved "Which ones have a different shape?"/"Which ones have different colors?".

For the Comparison frame, the instruction was "which ones are smaller/bigger than this one." For the Opposition frame, the stimuli consisted of pictures that represent opposite characteristics (e.g., clean and dirty rooms/objects, full and empty recipients, day and night), and the instruction was "which ones are the opposite from this one?". For the Hierarchy frame, the stimuli consisted of pictures with recipients and rooms that contained different contents, and the instruction was "which ones are contained in this one?" or "which one contains this one?". The Hierarchical relations include trials presented in a different format from the other frames trials. These trials were in a tabletop and not on the computer. Plastic recipients and containers were used to present hierarchical relations among elements.

Arbitrary evaluation protocol. This protocol was similar to the previous one, but with stimuli that required participants to relate them arbitrarily. The stimuli were abstract black and white pictures. The instructions and consequences were the same as the previous protocol, as the sequence of presentation of the Levels and frames used. At the end of this protocol, both participants responded in one Perspective-Taking block. As suggested by Silveira, de Almeida, Barnes-Holmes & Barnes-Holmes (in preparation) when we employ the MDML for analyzing Perspective-Taking, it only makes sense of observing this repertoire in Level 4 or Level 5. The task presented here included only Level 4 trials. This block consisted of a 10-trial block, where six trials were presented using visual support and four trials without visual support. For the six trials that used visual support, the stimuli chosen were pictures of the participant, the experimenter, and one of his parents, and familiar pictures that represented the tested relations.

Each trial consisted of two questions, for example: "You are short, your dad is tall. If your dad was you, what would he be? Moreover, if you were your dad, what would you be?". After this, another trial with two questions was presented: "Short people rides horses, and tall people plays basketball. If you were your dad, what would you like to play/ride? Additionally, if your dad was you, what would he like to play/ride?". Both questions in each trial were asked successively. Another example of trials in this procedure with visual support (with the stimuli set You-young, Me-old) is provided above in Figure 2. The circle was not present for the participant, and it is only to represent for the reader the expected correct response.

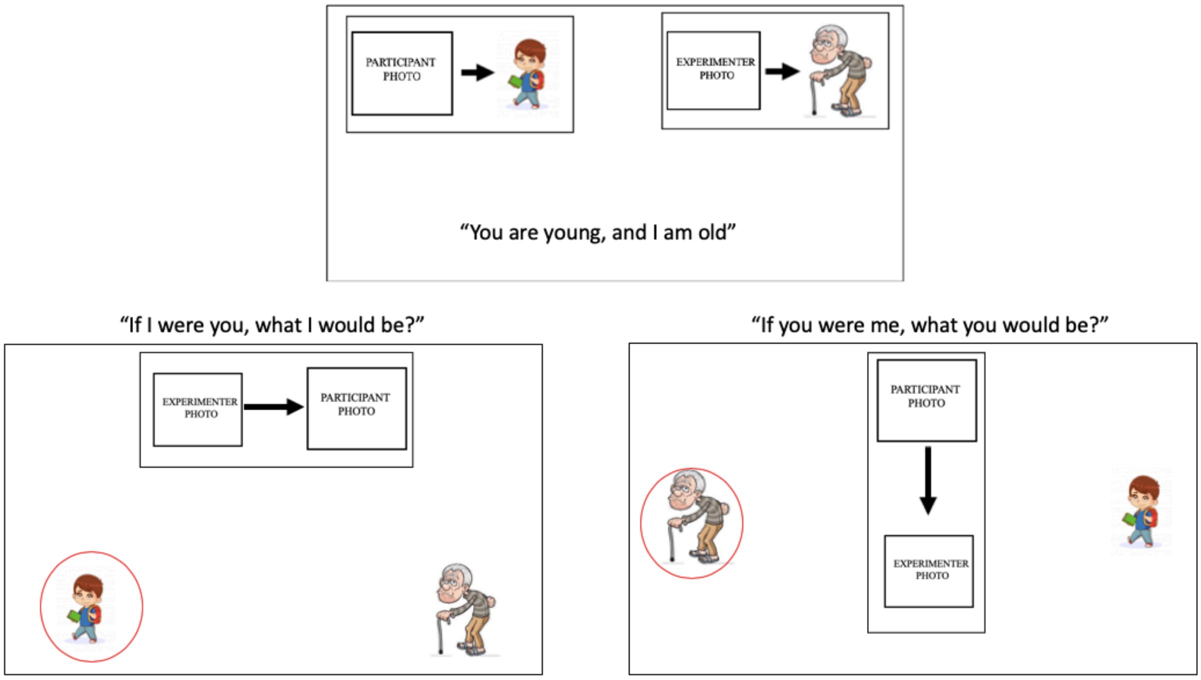

Figure 2. Examples of some relations needed to access Perspective-Taking repertoire.

After the participant answered correctly to the questions "If I were you" and "If you were me," the following relations were presented, and the critical responses to access Perspective-Taking. Therefore, the experimenter presented a new relation followed with two questions as "Old people work, and young people study. If I were you, what would I do? If you were me, what would you do?". Both questions in a trial had to be answered correctly in order to be correct. Each trial had visual support with the pictures represented with arrows for the participant to answer the questions, as shown in Figure 2. After completing trials with visual support, if the participant reached 80% of correct responses, the other four trials without visual support and with new sets of stimuli were presented.

Training. During the training blocks for each correct response, the participant saw a friendly robot with a star, and for each incorrect response, the screen turned black, followed by the next trial. At the end of the block, he could count how many stars he did at that block. For the testing blocks, the consequence was always one enemy robot, called the "spy robot," for correct and incorrect responses — the contextual cues and consequences used during the procedure as shown at Figure 3. The friendly robot and stars were selected as positive consequences based on the preference of the child. The mastery criteria for training blocks were two consecutive blocks with more than 80% of correct responses, and one block with more than 80% of correct responses for testing blocks.

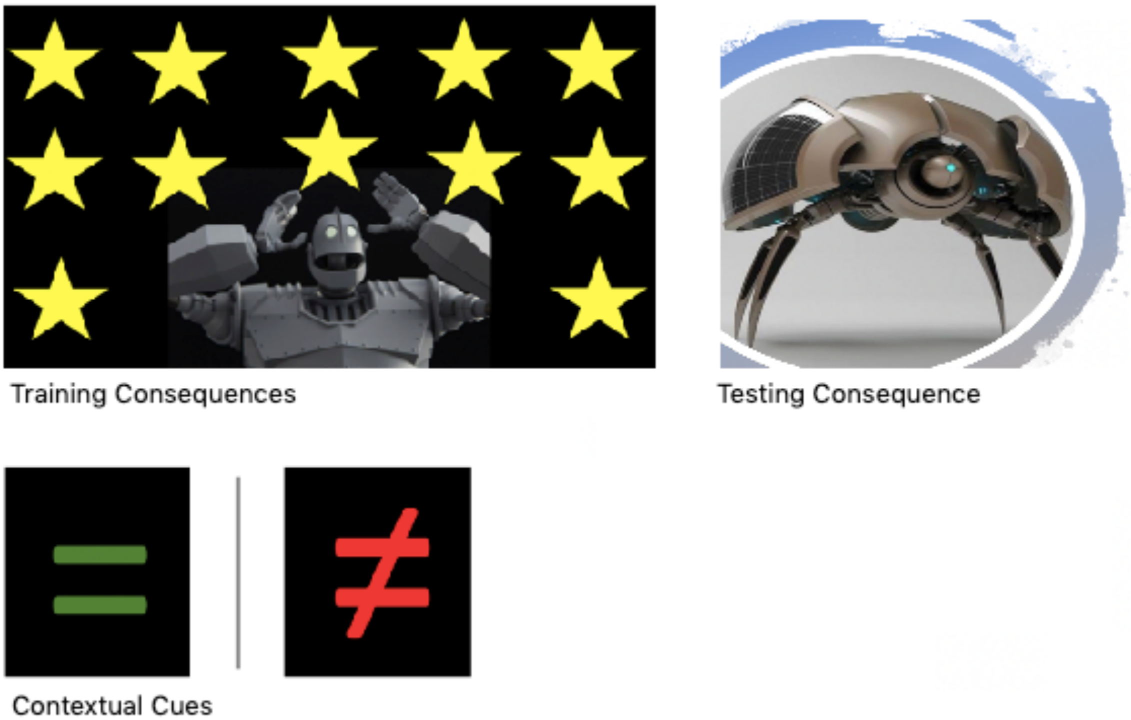

Figure 3. An example of the final screen showing the number of stars the participant earned on the training block, the picture of the “spy robot” consequence for the test trials and the contextual cues used for same and different procedures.

Coordination and Difference Relational Contextual Cues training and testing. Initially, the participant was exposed to a non-arbitrary training to teach the contextual cues for the same and different employing the pictures of the animals. The blocks consisted of 10 trials, with differential feedback for correct and incorrect responses. The first block trained BB relations using mixed (same and difference) contextual cues. Then, a correction 10-trials block was presented with only Difference BB relations. After, a mixed block (same and difference) with BB relations. Following this, the participant trained coordination AA relations, then different AA relations and, lastly, a mixed block with same and difference AA relations. After each block where the participant achieved the criterion, there was the presentation of the same block without consequences as a testing block. The stimuli used are presented in Figure 4.

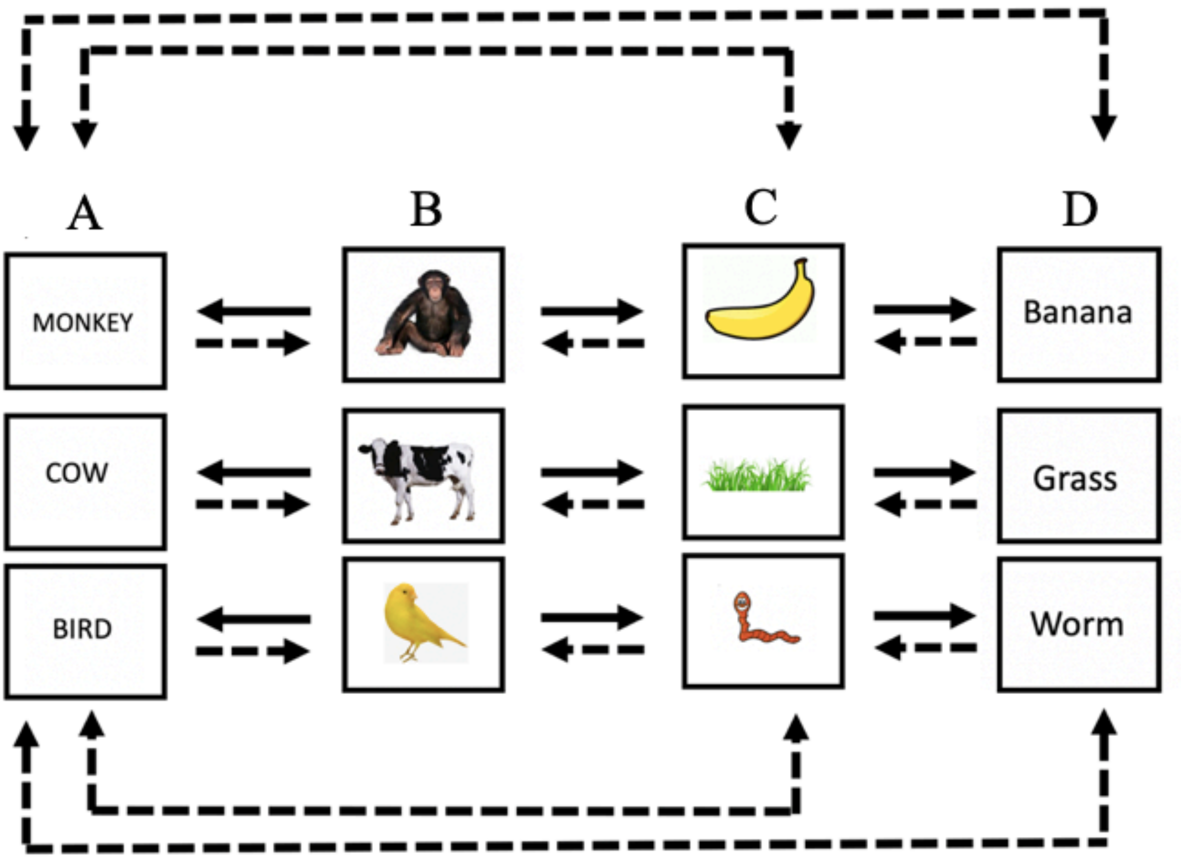

Figure 4. Relations trained and tested/derived during the training phase for Frank.

We labeled all the stimuli used to facilitate the description of the procedure as it follows: A – Animals Printed Names (in English), B – Animals Pictures, C – Foods Pictures that these Animals Eat, and D – Foods Printed Names that these Animals Eats (in English).

Figure 4 shows the relations that were trained (arrows in black) and tested/derived (dashed arrows).

Coordination and Difference Arbitrary Relations Training and Testing. This training first consisted of teaching the participant to relate correctly pictures of animals and their corresponding names in English (since the participant was Brazilian and did not know how to speak their names in English). Then he needed to learn to relate correctly pictures of the foods those animals commonly eat with the pictures of the animals. Next, testing trials included mutual implications (Level 1 in MDML) (names in English and pictures of the animals, pictures of food and pictures of the animals). If the participant did not achieve the criterion in this test, this relation would be directly trained, and a new set of stimuli would be used in a new training block. When the participant shows the required performance in the first test, he would be presented with a mixed training including both relations and then exposed to a test for combinatorial implications (Level 2 in MDML) (names of animals and pictures of food). If the participant achieved at least eight correct responses in two consecutive blocks of each of these relations, he was trained in relations with pictures of food and names of the food in English. After that, trials investigate the derivation of relations between animal names and the food names in English (Level 3 in MDML).

Table 2 presents the training sequence. The arbitrary relational training started with the first set (Set 1) of stimuli (dog/cat). It was presented a 10-trial block of BA training with same relations and tested 8-trial block AB relations (to test for Level 1 of coordination frame). If the participant did not achieve the mastery criterium in the test, the AB was directly trained, and a new set of stimuli was presented (Set 2). After achieving mastery criterium for AB relations with same relations on the test, the participant was exposed to training blocks with BA relations of difference and tested for AB relations of difference (to test for Level 1 of difference frame). Subsequently, it was added one stimulus on this second set of stimuli (Set 2+1) and trained 12-trial blocks of BC relations mixed (same and difference), following a 12-trial block CB test. After that, two blocks of 12-trials to revise BA and BC relations was presented, following a 12-trial block of CA/AC test (to test for Level 2). Subsequently, of achieving mastery criteria for the previous phase, two 12-trial block training for CD relations, followed by the DC test were presented. For last, a mixed BA/BC/CD training with 12-trial blocks was presented, followed with an AD/DA + CA (maintenance) 12-trial test (to test for coordination in Level 3). Finally, a test including Level 4 (Relating Relations) was carried out. This test presented two blocks of 12 trials of derived mutual entailment and the stimuli were compounded stimuli. After this block, two 12-trial blocks testing for derived combinatorial entailment were presented. Examples of the trials can be observed in Table 2.

Posttest. After the above-mentioned training and testing procedure the participant was re-exposed to the arbitrary test verifying for the 4 initial levels in Coordination frame and only level 1 in Difference frame. In the end he was re-exposed to the Perspective-Taking test containing ten trials, 6 with visual support and 4 without visual support.

Table 2.

The sequence of the training and testing phases of the complete training procedure with examples of trials.

Phases	Examples					
Contextual Cues	Model	Comparison 1	Comparison 2	Comparison 3	Contextual cue	Train./Test
Mixed BB	Dog picture	Dog picture	Cat picture	_	same/different	training
Diferrent BB (correction)	Cat picture	Dog picture	Cat picture	_	different	training
Mixed BB	Cat picture	Dog picture	Cat picture	_	same/different	training
Same AA	Word dog	Word cat	Word dog	_	same	training
Different AA	Word cat	Word cat	Word dog	_	different	training
Mixed AA	Word dog	Word dog	Word cat	_	same/different	training
Arbitrary - Set 1						
Same BA	Dog picture	Word dog	Word cat	_	same	training
Test AB	Word dog	Cat picture	Dog picture	_	same	test
Arbitrary - Set 2						
Same BA	Monkey picture	Word cow	Word monkey	_	same	training
Test AB	Word monkey	Monkey picture	Cow picture	_	same	test
Different BA	Cow picture	Word cow	Word monkey	_	different	training
Test AB	Word cow	Monkey picture	Cow picture	_	different	test
Arbitrary - Set 2+1						
Mixed BC	Monkey picture	Banana picture	Grass picture	Worm picture	same	training
Test CB	Grass picture	Bird picture	Cow picture	Monkey picture	same	test
Mixed BA/BC	Cow picture	Word cow	Word monkey	Word bird	same	training
	Cow picture	Grass picture	Banana picture	Worm picture	same	training
Test CA/AC	Grass picture	Word monkey	Word bird	Word cow	same	test
	Word monkey	Worm picture	Banana picture	Grass picture		
Same CD	Grass picture	Word grass	Word banana	Word worm	same	training
Test DC	Word worm	Grass picture	Worm picture	Banana picture	same	test
Mixed BA/BC/CD	Bird picture	Word monkey	Word bird	Word cow	same	training
	Monkey picture	Banana picture	Grass picture	Worm picture		
	Banana picture	Word worm	Word grass	Word banana		
Test AD/DA + CAmain	Word monkey	Word worm	Word grass	Word banana	same	test
	Word worm	Word monkey	Word bird	Word cow		
	Banana picture	Word cow	Word monkey	Word bird		
Test Relating Relations-ME	Monkey+banana	Bird+worm	Cow+bone	_	same	test
	Cow+ grass	Bird+banana	Money+bone	_	different	test
Test Relating Relations-CE	Monkey + Word banana	Bird + Word worm	Cow + Word bone	_	same	test
	Cow + Word grass	Bird + Word banana	Monkey + Word bone	_	different	test

Results

Table 3 presents Claire's performance on the non-arbitrary evaluation protocol. For the Coordination, Difference, and Comparison frames she presented the criterion for correct responses for the five levels assessed. For the Opposition frame she did not master any levels and for Hierarchy only Level 1.

Table 3.

Claire's performance on Levels 1, 2, 3, 4, and 5 for non-arbitrary relations on each type of frame (Coordination, Difference, Comparison, Opposition, Hierarchy)1.

Non arbitrary					
Level	Coordination	Difference	Comparison	Opposition	Hierarchy
1	10/10	9/10	10/10	0/10	10/10
2	9/10	9/10	10/10	_	0/10
3	10/10	10/10	10/10	_	_
4	10/10	9/10	10/10	_	_
5	9/10	9/10	10/10	_	_

Table 4 presents Claire's performance on the arbitrary evaluation protocol. For the frame of coordination, she achieved master criterion for Levels 1, 2, 3 and 4, for the Difference frame only Level 2, and did not achieve for any levels on arbitrary Comparison, Opposition and Hierarchy frames. For Perspective-Taking, she presented mastery criterion at this level with visual support, and then without visual support.

Table 4.

Claire performance on Levels 1, 2, 3, 4 and 5 for arbitrary relations on each type of frame (Coordination, Difference, Comparison, Opposition, Hierarchy and Perspective Taking).

Arbitrary							
Level	Coordination	Difference	Comparison	Opposition	Hierarchy	PT (visual)	PT
1	10/10	10/10	2/10	0/10	0/10	_	_
2	10/10	2/10	_	_	_	_	_
3	9/10	_	_	_	_	_	_
4	8/10	_	_	_	_	6/6	3/4
5	_	_	_	_	_	_	_

Table 5 presents Frank's performance on the non-arbitrary evaluation protocol. For the frames of Coordination and Difference, he presented criterion for the five levels assessed. On the frame of comparison, he mastered Levels 1 and 2 and did not master any levels for Opposition and Hierarchy.

Table 5.

Frank's performance on Levels 1, 2, 3, 4, and 5 for non-arbitrary relations on each type of frame (Coordination, Difference, Comparison, Opposition, Hierarchy).

	Non arbitrary				
Level	Coordination	Difference	Comparison	Opposition	Hierarchy
1	8/10	9/10	10/10	0/10	5/10
2	9/10	10/10	10/10	_	_
3	8/10	8/10	1/10	_	_
4	8/10	8/10	_	_	_
5	8/10	8/10	_	_	_

Table 6 presents Frank's performance on the arbitrary evaluation protocol. For all frames tested (Coordination, Difference, Comparison, Opposition, Hierarchy, and Perspective-Taking with visual support), he failed to demonstrate master criterion for all Levels. Once he did not show mastery in the Perspective-Taking with visual support he was not tested in trials without visual support.

Table 6.

Frank performance on Levels 1, 2, 3, 4, and 5 for arbitrary relations on each type of frame (Coordination, Difference, Comparison, Opposition, Hierarchy).

	Arbitrary						
Level	Coordination	Difference	Comparison	Opposition	Hierarchy	PT (visual)	PT
1	1/10	2/10	1/10	0/10	0/10	_	_
2	_	_	_	_	_	_	_
3	_	_	_	_	_	_	_
4	_	_	_	_	_	1/6	_
5	_	_	_	_	_	_	_

Table 7 presents Frank's performance for the training phase. Initially, he did the non-arbitrary training for the contextual cues (same and difference), and then, the arbitrary training with the frames of coordination (until Level 3) and difference (until Level 2). In the first phase, he did two consecutive 50% of correct responses on the BB blocks with mixed contextual cues (same and difference). Because he was only making incorrect responses for the difference relations, a correction block with only difference BB relations separately were presented. After achieving the mastery criteria, he was again exposed to the mixed BB block, and also achieved mastery criteria. Then he was exposed to a training block with the same AA relations and one with difference AA relations, and presented 100% and 90% of correct responses, consecutively. Lastly, he was exposed to a mixed AA relations block (same and difference) and presented 100% of correct responses.

Table 7.

Frank's performance through Levels 1, 2, and 3 for coordination relations and Levels 1 and 2 for difference relations.

	Blocks					
Contextual Cues	1	2	3	4	5	6
Mixed BB	5/10	5/10				
Diferrent BB	8/10	10/10				
Mixed BB	10/10	10/10				
Same AA	10/10					
Different AA	9/10					
Mixed AA	10/10					
Arbitrary - Set 1						
Same BA	8/10	5/10	8/10	4/10	9/10	9/10
Test AB	1/8					
Same AB	6/10	10/10	9/10			
Arbitrary - Set 2						
Same BA	10/10	10/10				
Test AB	7/8					
Different BA	9/10	9/10				
Test AB	8/8					
Arbitrary - Set 2+1						
Mixed BC	11/12	11/12				
Test CB	10/12					
Mixed BA/BC	11/12	12/12				
Test CA/AC	6/12					
Mixed BA/BC	10/12	11/12				
Test CA/AC	10/12					
Same CD	7/12	11/12	11/12			
Test DC	12/12					
Mixed BA/BC/CD	12/12	12/12				
Test AD/DA + CAmain	9/12 + 6/6					
Mixed BA/BC/CD	12/12	12/12				
Test AD/DA + CAmain	9/12 + 6/6					
Mixed BA/BC/CD	12/12	12/12				
Test AD/DA + Camain	11/12 + 6/6					
Test Relating Relations-ME	12/12	12/12				
Test Relating Relations-CE	10/12	11/12				

After the participant learned the contextual cues for the same and different in the BB and AA relations training, he initiated the arbitrary training phase. The first set of stimuli (Set 1) consisted of pictures of a cat and a dog (B stimuli) and their names in English (A stimuli). The first relations trained were BA (coordination), and he needed to repeat six blocks to achieve mastery criteria. As we can see in Table 7, he did not derive the AB relations in the test, so the

AB relations were trained, and he mastery within three blocks. A new set of stimuli (Set 2 – monkey and cow) were presented in the same sequence, training the BA relations (for coordination). Since he got two consecutive blocks with more than 80% correct responses, he did the AB test and passed with 87% correct responses, deriving the mutual entailment relations (Level 1 – MDML/Coordination). Then, the same BA relations were presented, but with the difference contextual cue, and he got the mastery criteria with only two blocks, and also derived the AB relations with 100% correct responses in the block (Level 1 – MDML/Difference).

The next phase was to start the training of the previous relations needed to assess combinatorial mutual entailment or Relational Frame (Level 2 – MDML/Coordination) in sequence. After that, a mixed (same and difference as contextual cues) BC block was presented (B – picture of the animal, C – picture of the food), and he achieved criteria with only two blocks and derived the mutual entailment relations of CB with 83% of correct responses in the block.

Before presenting the critical test (the AC and CA relations) for combinatorial mutual entailment, it was presented a baseline review with mixed BA and BC relations, and he achieved criteria within two blocks. In the AC/CA test, he could not derive all the relations, reaching only 50% of correct responses. The baseline review was repeated for two blocks again, and then he demonstrated 83% of correct responses on the AC/CA test.

To be able to assess Relational Network (Level 3 – MDML/Coordination), the procedure included a new relation, the CD (C – pictures of food, D – printed names of foods). He achieved criteria after three blocks and got 100% correct responses for the mutual entailment relations of DC. Another baseline review was presented, with BA/BC/CD relations, and with two consecutive blocks, he got criteria. After that, it was presented the critical test, 12-trials of AD/DA relations, and also 6-trials of CA relations (to assess the maintenance of the relations derived previously). He achieved 100% correct responses in the CA test, but only 75% in the

AD/DA relations test. Therefore, the baseline review was repeated for two consecutive blocks, and again the same result was observed in the test. It was presented for the third time the baseline review with two consecutive blocks with 100% correct responses, and the participant achieved 100% in the CA test, and 91% of correct responses in the AD/DA test, deriving relational networking.

In the end, Frank was exposed to test for relating relations of mutual and combinatorial entailment. He made only correct choices in mutual entailment relating relations in two consecutive blocks of 12 trials and 10 and 11 correct trials in two consecutive blocks of combinatorial entailment relating relations. Finally, he was re-exposed to the MDML test for Coordination (levels 1 to 4) and Difference (Level 1 only). In these tests he showed the required criterion for all tested levels. After that, the made only correct answers in the Perspective-Taking test with and without visual support as can be observed in Table 8.

Table 8.

Arbitrary Coordination (Level 1, 2, 3, 4) and Difference (Level 1) posttest, and Perspective Taking posttest.

Level	Coordination	Difference	PT	PT (no support)
1	10/10	10/10	_	_
2	9/10	_	_	_
3	9/10	_	_	_
4	10/10	_	6/6	4/4
5	_	_	_	_

Discussion

This experiment was developed, aiming to understand better the minimum derived relational repertoire necessary for observing Perspective-Taking. To this end, two children with different development profiles were tested evaluating their first performances in the non-arbitrary and arbitrary relational repertoire and also trials probing perspective-taking skills. Both participants showed similar performances in the non-arbitrary probes. However, Claire, the typical development child, performed very well in the tests for arbitrary derived relational responding and also in the perspective-taking trials while Frank showed deficient performances in both tests. Establishing the four initial levels in the coordination frame seemed to favor a high-performance outcome.

Relational Frame Theory proposes that we learn to respond along with our incidental interactions since very early childhood relationally, and this repertoire is how we became able to verbally interact with the environmental events (Luciano et al., 2009). The results observed in Claire data support this effect, once there was no need to train specific frames. On the other hand, individuals with delayed development seem to struggle in learning this repertoire incidentally. Even their developmental profiles being similar, in an RFT-perspective we would consider the performances of both participants in the pretests hugely different. Observing the possibility of derived relational responding, it could be said that Claire was verbal at that moment, and Frank was not.

Additionally, even considering Claire being verbal from a functional perspective, it was also noticeable that her relational repertoire was still in development. Some sophisticated frames as opposition and hierarchy were not observed in the test results, which gives support to other similar investigations in the literature that expects all of these to be stablished around the age of eight years (e.g., Luciano et al., 2009; Kent et al., 2017). Furthermore, the data observed in this experiment also support other studies that show the relevance of early intervention training arbitrary and non-arbitrary relations crucial for derived relational responding (e.g., Barnes-Holmes, Barnes-Holmes, Smeets, Cullinen, & Leader, 2004; Barnes Holmes, Barnes Holmes, Smeets, Strand, & Friman, 2004; Gorham, Barnes-Holmes, Barnes-Holmes, & Berens, 2009; Kent et al., 2017).

This difference observed in the participant's initial performance also correlates with the idea that participants with better results in the PEP-r in the Verbal Cognition scales also performed better in the derived relational responding. This effect shows probably a similar overlap of the behaviors as when relational responding is related to intelligence for example (Cassidy et al., 2011; O'Toole et al., 2009).

Considering the final performance presented by Frank, it is possible to notice that his derived relational repertoire completely changed after the multiple-exemplar and relational training. It is interesting to see that he mastered some of the contextual cues in the initial probes, however, when these same cues were employed in arbitrary-relations tasks, i.e., in tests that did not present relevant physical characteristics, he was unable to respond correctly. After the training, he was able to apply the characteristics arbitrarily. The difference in his performance, especially in coordination frame is very robust. At that moment, when he started to show derived relational responding consistently, represented a turning point in his repertoire - from that moment on we had evidence to consider his behavior as verbal, in RFT- perspective. This turning point seemed to enhance his possibilities in relating environmental stimuli in a more sophisticated form, we re-exposed to the perspective-taking test, and he was able to flawlessly derive the expected Level 4 relations. The impacts of beginning to derive arbitrary relations may present to his daily environmental interactions are potentially robust.

Finally, more evidence is necessary to support the importance of derived relational responding for complex human behavior, as Perspective-Taking. Only with a large-scale study mapping the repertoire of children with the different profile we will be able to start learning about the basis of complex human behavior and how to improve and modify its state when it is valuable for the patients.

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CONCLUSÕES FINAIS

A presente tese teve por objetivo investigar, a partir do modelo da Teoria das Molduras Relacionais, respostas relacionais essenciais para estabelecimento adequado de Tomada de Perspectiva. Os dois primeiros estudos seguiram a hipótese inicial de que respostas de seguimento de direção do olhar seriam fundamentais, e até pré-requisitos, para estabelecimento de Tomada de Perspectiva (Gould et al., 2011; Hahs, 2015). No entanto, apesar da replicação dos resultados encontrados nos estudos anteriores, sendo que as crianças com autismo aprenderam a tarefa de seguimento de direção do olhar em ambos estudos (Estudo 1 e Estudo 2), ainda não estava claro a papel destas respostas como pré-requisitos na derivação de relações dêiticas. A análise realizada dos padrões de fixação dos movimentos oculares utilizando equipamento de *eye tracking* do Estudo 2, amparou a compreensão das respostas de seguimento de direção do olhar como um operante generalizado de ordem superior. As fixações oculares para os estímulos com função de S- terem sido menores em comparação com o S+ a partir do momento que o indivíduo era capaz de seguir a direção do olhar de outra pessoa, sugere que as dicas contextuais da direção da face, eram suficientes para a criança indicar o estímulo olhado pela face modelo, não fazendo-se necessário olhar para os demais S- como aconteceria em uma tarefa de discriminação condicional tradicional.

A análise teórica do Estudo 3, por outro lado, indicou que respostas prévias que são cruciais para apresentação de Tomada de Perspectiva estariam mais diretamente relacionadas com um repertório de RRAA bem estabelecido em molduras de Coordenação (pelo menos Nível 4) e de Diferença (pelo menos Nível 1). Considerando que respostas de seguir a direção do olhar foram entendidas como repertório de RRNAA (i.e., dependentes de propriedades físicas claras entre os estímulos relacionados para apresentação de respostas derivadas), estas não seriam consideradas pré-requisitos diretos para Tomada de Perspectiva. Tomada de

Perspectiva por esta racional, trata-se de um repertório relacional extremamente complexo, que dependeria em parte de um repertório prévio de Responder Relacional Não Arbitrariamente Aplicável, mas que não seriam suficientes para sua apresentação. A hipótese teórica, da necessidade de um repertório de RRAA bem estabelecido em molduras de Coordenação Nível 4 e de Diferença Nível 1, pôde ser corroborada na investigação empírica do Estudo 4.

No Estudo 4, foi observado uma criança com autismo que demonstrou respostas de Tomada de Perspectiva após ter aprendido o repertório mínimo de RRAA indicado como repertório prévio chave. Evidentemente, faz-se ainda necessário muitas investigações adicionais bem como replicações dos resultados encontrados para outras crianças para ser confirmada a hipótese levantada acerca do repertório essencial anterior que viabilizaria a apresentação de respostas de Tomada de Perspectiva em uma visão analítico-comportamental. Não obstante, os resultados encontrados contribuem significativamente na compreensão de que antes de ser capaz de inferir a perspectiva de outra pessoa, uma resposta relacional de bastante sofisticada, que depende de um repertório relacional não arbitrário e arbitrário prévio suficientes.

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ANEXOS

Termo de Consentimento Livre e Esclarecido

Eu, Carolina Coury Silveira de Almeida, responsável pela pesquisa “Ensino e avaliação do seguimento de direção do olhar para crianças com autismo”, convido seu(s) filho(s) a participar(em) como voluntário(s) deste estudo. Esta pesquisa pretende avaliar e ensinar respostas de atenção conjunta, consideradas fundamental para o desenvolvimento social e cognitivo de qualquer indivíduo.

A participação de seu(s) filho(s) consistirá da realização de tarefas simples em mesa, nas quais ele(s) deverá(ão) selecionar figuras a depender de outra figura. As tarefas serão realizadas em sessões curtas intercaladas com brincadeiras, em atendimentos de até 2 horas. Serão registradas em vídeo cerca de 30% das sessões, esses vídeos não serão divulgados, mas apenas utilizados na etapa de análise dos resultados.

Pretende-se que as tarefas previstas não acarretem em prejuízos para seu(s) filho(s). Serão utilizados procedimentos já consagrados pela literatura da área, a qual relata perigo mínimo relacionado a eles, seja físico ou psicológico. O risco dessa pesquisa é o mesmo que qualquer atividade no computador, o(s) participante(s) poderá(ão) ficar cansado(s) e/ou desinteressado(s). A pesquisadora responsável se compromete a, diante de qualquer desconforto, mal-estar e cansaço apresentado por este(s), suspender imediatamente a tarefa realizada para analisar as possíveis variáveis envolvidas na situação e planejar procedimentos alternativos que cessem a possibilidade de reaparecimento de desconforto.

Durante todo o período da pesquisa você tem o direito de tirar qualquer dúvida ou pedir qualquer outro esclarecimento, bastando para isso entrar em contato com a pesquisadora ou com o Conselho de Ética em Pesquisa. Você tem garantido o seu direito de não aceitar participar ou de retirar sua permissão, a qualquer momento, sem nenhum tipo de prejuízo ou retaliação, pela sua decisão.

As informações desta pesquisa serão confidencias, e serão divulgadas apenas em eventos ou publicações científicas, não havendo identificação dos voluntários, sendo assegurado o sigilo sobre sua participação. A participação de seu/sua(s) filho(a)(s) não envolve nenhum custo financeiro.

Autorização:

Eu, ____, após a leitura deste documento e ter tido a oportunidade de conversar com o pesquisador responsável, para esclarecer todas as minhas dúvidas, acredito estar suficientemente informado, ficando claro para mim que a participação de meu/minha(s) filho(a)(s) é voluntária e que posso retirar este consentimento a qualquer momento sem penalidades ou perda de qualquer benefício. Estou ciente também dos objetivos da pesquisa, dos procedimentos aos quais meu/minha(s) filho(a)(s) será(ão) submetido(s), dos possíveis danos ou riscos deles provenientes e da garantia de confidencialidade e esclarecimentos sempre que desejar. Diante do exposto expresso minha concordância de espontânea vontade em autorizar meu/minha(s) filho(a)(s) a participar deste estudo.

____

Assinatura do representante legal do(s) voluntário(s)

Declaro que obtive de forma apropriada e voluntária o Consentimento Livre e Esclarecido deste voluntário para a participação neste estudo,

____

Assinatura do pesquisador responsável

Dados do pesquisador responsável:

Carolina Coury Silveira de Almeida, telefone: (16) 997234211, email: carol_coury@hotmail.com

Dados do CEP: Comitê de Ética em Pesquisa em Seres Humanos - Pró-Reitoria de Pesquisa – Universidade Federal de São Carlos (UFSCar), endereço: Via Washington Luiz SP-310, Km. 235 - Caixa Postal 676 CEP 13.565-905 - São Carlos - SP – Brasil, telefone: (16) 3351-9683, email: cephumanos@.ufscar.br

Termo de Consentimento Livre e Esclarecido

Eu, Carolina Coury Silveira de Almeida, responsável pela pesquisa “Avaliação e ensino de padrões de rastreamento de direção do olhar para crianças”, convido seu(s) filho(s) a participar(em) como voluntário(s) deste estudo. Esta pesquisa pretende avaliar e ensinar respostas de atenção conjunta, consideradas fundamental para o desenvolvimento social e cognitivo de qualquer indivíduo.

A participação de seu(s) filho(s) consistirá da realização de tarefas simples no computador, nas quais ele(s) deverá(ão) selecionar figuras a depender de outra figura. As tarefas serão realizadas em sessões curtas intercaladas com brincadeiras, em atendimentos de até 2 horas. Serão registradas em vídeo cerca de 30% das sessões, esses vídeos não serão divulgados, mas apenas utilizados na etapa de análise dos resultados.

Pretende-se que as tarefas previstas não acarretem em prejuízos para seu(s) filho(s). Serão utilizados procedimentos já consagrados pela literatura da área, a qual relata perigo mínimo relacionado a eles, seja físico ou psicológico. O risco dessa pesquisa é o mesmo que qualquer atividade no computador, o(s) participante(s) poderá(ão) ficar cansado(s) e/ou desinteressado(s). A pesquisadora responsável se compromete a, diante de qualquer desconforto, mal-estar e cansaço apresentado por este(s), suspender imediatamente a tarefa realizada para analisar as possíveis variáveis envolvidas na situação e planejar procedimentos alternativos que cessem a possibilidade de reaparecimento de desconforto.

Durante todo o período da pesquisa você tem o direito de tirar qualquer dúvida ou pedir qualquer outro esclarecimento, bastando para isso entrar em contato com a pesquisadora ou com o Conselho de Ética em Pesquisa. Você tem garantido o seu direito de não aceitar participar ou de retirar sua permissão, a qualquer momento, sem nenhum tipo de prejuízo ou retaliação, pela sua decisão.

As informações desta pesquisa serão confidencias, e serão divulgadas apenas em eventos ou publicações científicas, não havendo identificação dos voluntários, sendo assegurado o sigilo sobre sua participação. A participação de seu/sua(s) filho(a)(s) não envolve nenhum custo financeiro.

Autorização:

Eu, ____, após a leitura deste documento e ter tido a oportunidade de conversar com o pesquisador responsável, para esclarecer todas as minhas dúvidas, acredito estar suficientemente informado, ficando claro para mim que a participação de meu/minha(s) filho(a)(s) é voluntária e que posso retirar este consentimento a qualquer momento sem penalidades ou perda de qualquer benefício. Estou ciente também dos objetivos da pesquisa, dos procedimentos aos quais meu/minha(s) filho(a)(s) será(ão) submetido(s), dos possíveis danos ou riscos deles provenientes e da garantia de confidencialidade e esclarecimentos sempre que desejar. Diante do exposto expresso minha concordância de espontânea vontade em autorizar meu/minha(s) filho(a)(s) a participar deste estudo.

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Assinatura do representante legal do(s) voluntário(s)

Declaro que obtive de forma apropriada e voluntária o Consentimento Livre e Esclarecido deste voluntário para a participação neste estudo,

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Assinatura do pesquisador responsável

Dados do pesquisador responsável:

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Termo de Consentimento Livre e Esclarecido

Eu, Carolina Coury Silveira de Almeida, responsável pela pesquisa “Analisando Respostas Relacionais Dêiticas a partir do modelo Multi Dimensional Multi Nível para a RFT”, convido seu(s) filho(s) a participar(em) como voluntário(s) deste estudo. Esta pesquisa pretende avaliar e ensinar respostas de atenção conjunta, consideradas fundamental para o desenvolvimento social e cognitivo de qualquer indivíduo.

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