Running head: Effect of training

Comentado [SMS1]: Aquí pone "Effect of training" mientras que el header pone "The effect of training", sugiero que sean igual.

Con formato: Inglés (Estados Unidos)

The effect on intelligence quotient of training fluency in ~~coordinate~~ relational frames~~ing~~ of coordination

Abstract

Relational training protocols based on Relational Frame Theory (RFT) are showing ~~showing~~ promising results as regards increased ~~promising results to increase~~ intelligence quotient. This study aimed to analyze the effect on intelligence quotient of a fluency and flexibility training protocol based on relationships of coordination.~~in coordinate relational responding.~~ Two ~~children~~ students from ~~attending~~ the same school were the study participa~~nts~~~~ted in this study~~. ~~One~~ Two children were randomly assigned the roles of experimental participant ~~of the children~~ (a boy aged 4 years~~, and~~ 1 month) ~~was~~ and ~~randomly assigned to be the experimental participant while the other child acted as a~~ control participant (a girl aged 3 years~~, and~~ 11 months). The *McCarthy´s Aptitudes and Psychomotricity Scale* (MSCA) was used to evaluate c~~C~~ognitive and psychomotor development~~. was evaluated using the *McCarthy´s Aptitudes and Psychomotricity Scale* (MSCA).~~ The ~~training~~ 8-hour training protocol ~~lasted 8 hours and~~ was ~~carried~~ implemented ~~out~~ over a 2~~-two~~ month periods. The experimental participant showed an increase ~~above~~ of more than 1.5 *SD* in the General Cognitive Index (GCI) of the MSCA (from 106 to 132) whereas the control participant showed a 10-point increase. The experimental participant partly maintained the improvements at the 6-month follow-up. This study ~~adds~~ provides further empirical evidence of the potential of RFT training ~~to~~ for improve~~ing~~ cognitive abilities and intelligence.

Keywords: Relational frame theory; Intelligence; Multiple-exemplar-training; Derived relational responding.

Con formato: Inglés (Estados Unidos)

Novelty and significance

What is already known about the topic?

- Relational frame theory (RFT) provides a functional, contextual account of human language and cognition.
- Trainings based on RFT are beginning to be successfully applied to improve IQ.

What does tthis paper addscontribute?

- An analysis of It analyzes the effect on intelligence quotient of training fluency in coordinate relational frames ingof coordination in a 4-year-old child, as compared to with a control participant.
- The IQ of the experimental participant significantly improved IQ after the training whereas the control participant merely only showed a small minor improvement. The e improvement of the experimental participant participant's improvement was maintained at the 6-month follow-up.

The effect on intelligence quotient of training fluency in ~~coordinate~~ relational frames of ~~ing~~coordination

Relational Frame Theory (RFT; Hayes, Barnes-Holmes, & Roche, 2001) is a functional-contextual approach to complex human behavior that suggests that fluency and flexibility in different patterns of arbitrarily applicable relational responding—or relational framing—underlie linguistic and cognitive abilities. In~~P~~simpler terms~~y~~, relational framing means responding to one event in terms of another event, where the relationship between ~~the two~~both events is not based on nonarbitrary features, but rather on arbitrary relational cues (e.g., *same as*). For instance, consider the case of a boy who very much likes cakes ~~very much~~ and is told that *tarta* is the Spanish word for cake (i.e., cake *is the same as* tarta). Later, he feels like eating cake when hearing his grandmother say "I have bought a tarta~~,~~", ~~because~~ given~~of~~ the arbitrary relationships between *tarta*, *cake*, and an actual cake.

The simplest form of relational framing ~~is relating~~relates stimuli through~~by~~ coordination (*is, same as*). However, ~~, but~~ there are other types of relational framing such as distinction (*is different from*), opposition (*is opposite to*), comparison (*more than*, *less than*), hierarchy (*is part of*, *includes*), etc. Each type of relational framing is defined according to three properties: mutual entailment, combinatorial entailment, and transformation of functions. Mutual entailment involves the bidirectionality of stimulus relations: if A is related to stimulus B, then B is related to A (e.g., if *tarta* is the same as *cake*, then *cake* is the same as *tarta*). Combinatorial entailment means that two or more stimuli that have acquired the property of mutual entailment can be combined. For example, if A is related to B, and B is related to C, then C and A are related (e.g., if *tarta* is the same as *cake*, and *cake* is the same as an actual cake, then *tarta* is the same as the actual cake, and vice versa). Transformation of functions means that the function of a stimulus can change the functions of other mutually or combinatorially associated stimuli ~~that are mutually or combinatorially related~~. In the previous example, if C acquires an appetitive function, then B and A will have the same appetitive function due to the mutual and combinatorial relations of coordination, respectively (e.g., the boy feels like eating a cake when hearing the sounds *tarta* and *cake*).

Recent empirical evidence has shown that relational framing abilities correlate with performance on standardized intelligence tests (for a review, see Cassidy, Roche, & O'Hora, 2010) and with specific cognitive skills such as analogical reasoning (e.g., Ruiz & Luciano, 2011). Indeed, psychometric

Comentado [SMS2]:

Comentado [SMS3R2]: Should this word "sounds" be "words"?

Con formato: Inglés (Estados Unidos)

measures of intelligence can be deconstructed into the specific relational responses required to solve their items (Cassidy et al., 2010).

An important premise of RFT is that all relational framing patterns are generalized operant behaviors ~~that are~~ learned through multiple exemplar trainings (MET). MET consists of a process ~~that provides~~providing multiple examples of mutual and combinatorial relations and transformations of functions with a specific relational framing pattern, ~~using~~ through multiple sets of stimuli. Empirical evidence supports that relational frames ~~such as~~of coordination, opposition, or comparison can be trained through MET (e.g., Barnes-Holmes, Barnes-Holmes, & Smeets, 2004; Berens & Hayes, 2007; Luciano, Gómez-Becerra, & Rodríguez-Valverde, 2007; Vizcaíno-Torres et al., in press).

The previous main tenets of RFT defend that linguistic and cognitive abilities might be established and improved through MET in different relational framing patterns. Indeed, preliminary evidence shows that RFT-based trainings can produce significant increases in intelligence both in normally and developmentally delayed individuals (Cassidy, Roche, & Hayes, 2011; Ruiz, Suárez, & López, 2012; Vizcaíno-Torres et al., in press). In Cassidy et al.'s study, four normally developing children, aged 8 to 12 years, were matched against a non-treatment control group and received automated METs ~~for~~ over two years (15 hours in total) to promote fluency in stimulus equivalence and relational frames~~ing~~ ~~through~~ of opposition and comparison. The study ~~was conducted in~~comprised two different stages. In the first stage, experimental participants only received a MET of stimulus equivalence, which showed limited efficacy ~~to~~ in increasing ~~e~~ IQ. Approximately 18 months later, the experimental participants were exposed to opposition and comparison METs, and subsequently showe~~d~~ing significant improvements in IQ (M = 27.25 points), ~~-~~whereas control participants remained roughly the same. In a second study, an improved training protocol was implemented ~~for~~ over nine months (approximately two 90-minute sessions per week) with eight schoolchildren, aged 11 to 12 years, with ~~who presented~~ educational and behavioral difficulties. All but one participant improved their IQ scores ~~above~~ more than 1 standard deviation (M = 13 points), with statistically significant ~~and~~ pre-post differences ~~were statistically significant~~. Ruiz et al. (2012) presented a case study with a 4-year-old autistic child who showed an improvement of 35 IQ points after six months of treatment of 2-3 hours per week, basically using ~~. The treatment was mostly based on~~ MET to establish fluency and flexibility with the most basic relational frames. Lastly, Vizcaíno-Torres et al. (in press) analyzed the effect of a training protocol in

fluency and flexibility in relational frames of cing through coordination, opposition, and comparison in a 4-year-old child. The training was effective in establishing relational responding based onin opposition and comparison frames as well asand in promoting fluency and flexibility in all the three types of trained relations. After this training, the child's IQ showed an increaseincreased above more than 1.5 standard deviations in IQ (from 106 to 131 points).

The goal of the current study aimed was to contribute to add additional evidence of the improvement on f intelligence measures by derived of training fluency and flexibility in coordinate relational frames ofing coordination in a normally developing 4-year-old child as compared to a another child who served as control participant. At the beginning start of the study, both children completed the Fluency in Naming Test and McCarthy's Aptitudes and Psychomotricity Scale. Subsequently, one of the childrен was trained in three different types of coordinate relations (visual-auditory, visual-visual, and auditory-auditory relations) for during approximately two months (eight, 1-hour sessions). The child's mother was also given sSome guidelines to promote fluency in coordinate relational framing were also provided to the child's mother. Afterwards, both children completed the same tests administered at the beginning of the intervention. Lastly, the experimental participant underwent a a 6-month follow-up assessment was applied to6 months later the experimental participant.

Method

Participants, experimenter, and experimental context

Two children who participated in this study: SV, a boy aged 4 years and 1 month, and DN, a girl aged 3 years and 11 months. According to their teachers' reports, both SV and DN were at an age-appropriate stage stage of social development and grade level, though without although they did not excelling in any particular subject. They were enrolled in the same school in Valencia (Spain) during the study period of the study. Their parents reported described them as that they were healthy, and happy children. SV was occasionally shy and DN was quite extroverted.

The first author, a final-year university student pursuing studies in last-year Teaching student, administered all tests and relational trainings. She was trained in RFT by the second author. All tests and trainings were conducted iin a quiet room atn the children's homes in a quiet room.

Design

The study design ~~of this study~~ was *N* = 1 with a control participant. SV was randomly assigned ~~to be the~~as experimental participant and DN ~~was assigned a~~as control participant. The main dependent variables were the children's scores on the Fluency in Naming Test and the McCarthy's Aptitudes and Psychomotricity Scale (~~see~~ details of these tests ~~below~~follow). These instruments were ~~administered~~ applied before and after the administration of the independent variable: a ~~coordinate~~ relational frames of coordination ~~ming~~ training protocol~~l~~. Figure 1 shows the three phases of the training protocol. Phases 1 to 3 were dedicated to training fluency with visual-auditory, visual-visual, and auditory-auditory relationships of coordination ~~relations~~, respectively. Lastly, only SV underwent an assessment 6 months later. D~~a 6-month follow-up assessment was conducted only with SV because D~~N moved to ~~other~~ another city and therefore, did not complete said assessment.

INSERT FIGURE 1 HERE

Instruments

Fluency in Naming Test (FNT). This test, ~~was~~ designed for thi~~s~~e ~~current~~ study, ~~and consisted of~~comprised three subtests: (a) receptive naming without delay, (b) productive naming without delay, and (c) delayed receptive and productive naming. No feedback was ~~provided~~ given ~~throughout~~ during the test. In each subtest, four pictures of unknown stimuli were presented (~~see~~ Table 1). The first subtest consisted of 16 trials. In the first trial, stimulus A was presented by picking it up and saying "This is an X (e.g., thimble). What is this?" and waiting until the child responded with the name of the object (i.e., thimble) to ensure that the child had paid attention to the experimenter. Then, the experimenter put stimulus A with stimulus B, mixed them, and asked: "Give me the X (i.e., thimble)." If the child gave the experimenter the correct stimulus, the trial was considered ~~as~~ correct; otherwise, the trial was ~~deemed~~ considered incorrect. The second trial was the same as the first but with stimulus B (e.g., blade). Next, the two previous trials were repeated but without presenting stimuli to the child (i.e., only saying "give me the X"). The same process conducted with stimuli A and B was also performed with ~~stimuli~~ stimuli C (e.g., mascara) and D (e.g., hairpin) ~~from~~ between the fifth ~~to~~ and~~the~~ eighth trials. Finally, two mixed 4-trial blocks were conducted with all stimuli of the set available as response options. The mastery criterion to pass this subtest was responding correctly to at least 15 trials.

The productive naming subtest followed the same rationale and mastery criterion as the receptive subtest, but with a novel set of stimuli (i.e., Set 2) and, instead of having to give the stimuli, the child was

asked to ~~pronounce them~~name it after the question "What is this?" Lastly, the delayed receptive and productive naming test consisted of 8 trials and was conducted with Set 3. The experimenter first presented the child the four stimuli of the set, similarly to the previous subtests. After a 15-min delay, a mixed 8-trial block was conducted with four receptive and four productive trials (one trial per stimulus of each trial type). The mastery criterion was responding correctly to at least 7 of the 8 trials.

INSERT TABLE 1 ABOUT HERE

McCarthy's Aptitudes and Psychomotricity Scale (MSCA; McCarthy, 1988). The MSCA is a widely used psychological test that provides normative T-scores (i.e., *M* = 50 and *SD* = 10) in several developmental areas for children ~~from~~ aged 2 to 8.5~~2 years to 8.5~~ years: verbal, perceptual-manipulative, numerical, motor skills, and memory. A general index, the General Cognitive Index (GCI), with a mean of 100 and a standard deviation of 16, is also obtained by adding the verbal, perceptual-manipulative, and numerical subscales. This index ~~can~~ is~~be~~ considered ~~as~~ an intelligence quotient. The MSCA provides 90% confidence intervals for the scores on every scale and for the GCI. The GCI has very good psychometric properties and there is evidence of its factorial and predictive validity (Kaplan & Sacurzzo, 2012). Very strong correlations have been found between the GCI and the Wechsler Preschool and Primary Scale of Intelligence and the Stanford-Binet Intelligence Scales. This study used the~~e~~ Spanish adaptation by TEA Ediciones ~~was used in this study~~.

Materials. The sessions and child's responses were recorded using the webcam of an Inspiron 15 Intel Core laptop ~~was used to record the sessions and the child's responses~~.

Procedure

The study lasted approximately 2 months during which 13 sessions were ~~conducted~~held: 5 to administer the above-mentioned instruments and 8 to apply the training protocol. The study began when SV was 4 years and 1 month old and DN 3 years and 11 months old.

Pre-intervention assessment. The FNT and the MSCA were administered during three sessions in the first two weeks of the study. Sets 1 to 3 were employed in the FNT. The MSCA was applied according to the guidelines provided by the test developer.

Training protocol. The protocol was based on the guidelines presented in Luciano et al. (2009). During all phases, SV's correct responses were~~nding was~~ followed by positive social feedback. Incorrect responses were~~ding was~~ followed by the experimenter saying: "No, SV, that is not right" or "No, that is

not correct." Some guidelines were provided to SV's mother, ~~because~~ as ~~she was~~ the person ~~who had more~~in greatest contact with SV, for her to offer daily interactions similar to the training protocol to support and maximize its effects~~the training protocol and maximize its effect by providing daily interactions similar to the training protocol~~. Specifically, ~~the~~ ~~she~~mother was ~~told~~ instructed to: (a) not respond for SV when someone asked him questions or not finish his sentences ~~for him~~ when he wanted to say something, and (b) ~~everyday,~~ she had to show SV five novel objects every day and ask about them at the end of the day~~, she had to ask about them~~; ~~and~~ if SV ~~asked~~ responded correctly, he ~~obtained~~ was given a candy.

Comentado [SMS4]: Should this read "responded correctly" instead?

Phase 1. Training fluency with visual-auditory coordinate relations. This training phase was conducted following the same rationale as the FNT but providing feedback in every trial (except for sets ~~employed~~ used for testing). Sets 4 to 20 were presented over f~~F~~our 1-hour sessions ~~were employed in which Sets 4 to 20 were used~~ (~~see~~ Table 1). SV was first trained in receptive naming until meeting the criterion, then in productive naming, and finally in delayed receptive and productive naming. The mastery criteria to pass the receptive and productive naming ~~were~~ entailed~~to~~ respond~~ing~~ correctly to at least 15 out of 16 trials in two consecutive sets, the first one with feedback and the last one without feedback (test set). Regarding ~~the~~ delayed receptive and productive naming, the mastery criterion ~~was~~ entailed~~to~~ respond~~ing~~ correctly to at least 7 out of 8 trials in two consecutive sets. Sets 4 to 6 were used in ~~the~~ receptive training, Sets 7 to 16 in ~~the~~ productive naming, and Sets 17 to 20 in ~~the~~ delayed receptive and productive naming.

Phase 2. Training fluency with visual-visual coordinate relations. This phase was designed to determine whether SV was able to derive mutual and combinatorial visual-visual relations. Figure 2 shows the abstract shapes used in this phase. Alphanumeric labels (e.g., A1, B1, C1, etc.) ~~are used to~~ identif~~ied~~ the stimuli, though these labels~~but these labels~~ were not presented to SV. Four conditional discriminations (B1-~~-~~A1, C1-A1, B2-A2, and C2-A2) were trained in a *many-to-one* matching to sample procedure. Afterwards, mutual (A1-B1, A1-C1, A2-B2, and A2-C2) and combinatorial relations (B1-C1, C1-B1, B2-C2, and C2-B2) were evaluated. The trials were presented on sheets ~~that were~~ covered with a cardboard. The sample stimuli were presented in the center of the upper third of the sheet and the comparisons appeared in a line on the lower third of the sheet. T~~The positions of t~~he comparison stimuli ~~changed~~ were positioned randomly. In a ~~A~~ typical trial ~~was as follows:~~ the

experimenter presented the sample by sliding the cardboard off the top of the sheet. Then, while ~~discovering~~ revealing the lower ~~portion~~ third of the sheet, the experimenter pointed to the sample and said: *"SV, what goes with this?"* or *"Tell me what goes with this."*

INSERT FIGURE 2 ABOUT HERE

The training sequence commenced with the presentation of a respondent trial with the B1-A1 relation by saying: "This (B1) goes with this (A1). What goes with this (pointing to B1)"? After emitting a correct response, trials with the B1-A1 relation with two comparisons (i.e., A1 and A2) were conducted. When SV responded correctly to two consecutive trials, the same relation was presented with three comparison stimuli (i.e., A1, A2, and A3) and SV had to emit two consecutive correct responses. Then, the relation B2-A2 was trained in the same manner as the B1-A1 relation. Afterwards, mixed 4-trial blocks with the B1-A1 and B2-A2 relations (two trials per relation) were presented until SV responded correctly to all trials of a block. C-A relations were trained in the same manner as the B-A relations, but beginning with C2-A2 and following with C1-A1. Subsequently, mixed 4-trial blocks with B-A and C-A relations (one trial per relation) were presented until SV responded correctly to all trials of a block. Lastly, SV was told that no feedback would be provided during the next trials and the same mixed block was presented until he responded to it correctly.

When SV passed the previous training, an 8-trial mutual relations test was conducted with two trials per relation. The mastery criterion ~~was~~ entailed responding correctly to at least 7 trials. After passing the latter test, SV was exposed to an 8-trial combinatorial test (2 trials per relation) with the same mastery criterion.

SV responded correctly to all trials of the mutual and combinatorial tests. Accordingly, SV proceeded to the next phase (a MET with novel sets would have been conducted in case of failing some of the tests).

Phase 3. Training fluency with auditory-auditory coordinate relations. Similar to Vizcaíno-Torres et al. (in press), 25 short stories were used to train fluency with auditory-auditory coordinate relations. Each story or set contained four trials: 2 mutual and 2 combinatorial trials. There were two types of sets: (a) eight short stories of children and toys, and (b) seventeen sets of synonyms.

An example of ~~the~~ a short sto~~ryries~~ is: *There was a teacher who played with his students in the following way: When the teacher drew a square* (A) *on the blackboard, the children raised their hands*

(B). *What did the teacher draw on the board so that the children would raise their hands? (B➔A mutual trial) When the children raised their hands* (B), *a violin sounded* (C). *What did the children do to make the violin sound? (C➔B mutual trial) What did the teacher draw on the board in order to make a violin sound? (C➔A combinatorial trial) If the teacher drew a square on the board, what could be heard? (A➔C combinatorial trial).*

An example of a set of synonyms is ~~the following~~: *A sacapuntas (A; i.e., pencil sharpener) is the same as an afilador (B). What is the same as an afilador? (B➔A mutual trial). An afilador (B) is the same as a cortalápices (C). What is the same as a cortalápices? (C➔B mutual trial). What is the same as a sacapuntas? (A➔C combinatorial trial; if the child said stimulus B, he was asked "And what else?" to instigate stimulus C). What was the same as cortalápices? (C➔A combinatorial trial; if the child said stimulus B, he was asked "And what else" to instigate stimulus A).*

This Phase ended when SV responded correctly to all trials of seven consecutive sets.

Post-intervention assessment. This evaluation was conducted in two sessions at the end of the study. Sets 21 to 23 were ~~employed~~ used in the FNT.

Follow-up assessment. Approximately six months after the post-intervention assessment, the MSCA was administered again to SV. It was not possible to evaluate DN because she moved to another province with her parents.

Data analysis

SV and DN's direct scores on the MSCA at pre- and post-intervention were interpreted according to the scales for ages 3 years and 10 months to 4 years and 3 months. At the 6-month follow-up, SV's scores on the MSCA were interpreted according to the scales for ages 4 years and 4 months to 4 years and 9 months. Ninety percent confidence intervals were obtained from the MSCA manual.

The integrity of the protocol administration was measured by means of inter-observer agreement (agreement between two independent observers divided by the sum of agreement and disagreement, multiplied by 100). Both observers claimed 100% agreement in evaluation, training, and tests regarding the correct presentation of the trials, identification of SV's responses, and adequate feedback provision.

Results

Figure 3 shows that both participants displayed a similar performance level in the FNT at pre-intervention. Neither ~~of them~~child passed the FNT. SV improved his scores on a task similar ~~task~~ to the

FNT with feedback (Phase 1 of the training protocol). He needed three, ten, and four sets to meet the mastery criterion on ~~the~~ receptive, productive, and mixed delayed training, respectively. At post-intervention, SV passed the FNT, but DN ~~still did not~~failed to pass any of the subtests.

INSERT FIGURE 3 ABOUT HERE

SV passed Phase 2 on his first attempt. Figure 4 shows the evolution of SV in the percentage of correct responses in Phase 3 (auditory-auditory trials). Twenty-five stories were ~~employed~~used. At the beginning, SV achieved about 50-75% of correct responses. He met the mastery criterion at story 25 (i.e., correct responses to 7 consecutive stories ~~correctly responded~~).

INSERT FIGURE 4 ABOUT HERE

Figure 5 presents ~~the scores of~~ both participants' scores in the MSCA (~~see the direct scores in~~ Table 2 displays the direct scores). SV ~~showed~~ improv~~ed~~ements in all MSCA subscales from pre- to post-intervention, with notable increases in T-scores in ~~the~~ verbal (13), perceptive-manipulative (18), memory (17), and motor (19) subscales. In general, DN showed slight increases in the subscales, except for memory, where she ~~showed~~ obtained a 16-point increase. With respect to the GCI, SV showed a 26-point increase from pre- to post-intervention, ~~which~~ represent~~inged~~ an increase of 1.625 standard deviations, from 106 (90% CI [99, 113], direct score of 103.5) to 132 points (90% CI [125, 139], direct score of 141.5). DN showed a 10-point increase ~~id her score o~~n the GCI ~~by10 points~~, from 105 (90% CI [98, 112], direct score of 102.5) to 115 (90% CI [108, 122], direct score of 113), ~~which~~ represent~~inged~~ an increase of .625 standard deviations.

INSERT TABLE 2 ABOUT HERE

INSERT FIGURE 5 ABOUT HERE

SV part~~ially~~~~ly~~ maintained the improvements at the 6-month follow-up. H~~e~~~~is~~ score~~d~~ ~~on~~127 (90% CI [121, 135], direct score of 146.5) on the GCI. Though his~~I was 127 (90% CI [121, 135], direct score of 146.5). He showed generally slight decreases in the T-scores of the~~ MSCA T-scores slightly decreased, ~~but~~ all scores were higher than those obtained at pre-intervention.

Discussion

SV and DN entered the study performing at average levels in the MSCA and failing to meet the mastery criteria of the FNT subtests. They were then randomly assigned ~~to~~ as~~be the~~ experimental (SV) and control ~~participant~~ (DN) participants. After the ~~implementation of the~~ training protocol was

implemented with SV, he ~~showed~~ improve~~d~~ments in all areas of the MSCA, with increases greater than 10 for T-scores in the ~~the~~ verbal, perceptive-manipulative, memory, and motor subscales. SV also improved his CGI by 26 points from pre-intervention (106) to post-intervention (132), and passed all FNT subtests. DN ~~showed~~ slight~~ly~~ increase~~ds in~~ her scores in~~on~~ the MSCA subscales, except for the memory subscale, and ~~. She also~~ slightly improved her CGI by 10 points, from 105 to 115. Like at pre-intervention, she did not pass any of the FNT subtests at post-intervention. Anecdotal reports by SV's teacher and family were consistent with the improvement found in the MSCA. For instance, SV's teacher expressed her surprise with SV's school performance during the months of the training and asked the parents whether they were ~~doing anything~~taking action with the child in this regard. Similar anecdotal reports were also collected during the 6-month follow-up.

In summary, this study ~~adds~~ contributes empirical information ~~about~~ on the efficacy of RFT-based trainings to improve IQ in normally developing children. Like in Vizcaíno-Torres et al. (in press), the current study also incorporated daily natural interactions to promote fluency and flexibility in coordinate relational framing ~~according to coordination~~ by providing SV's mother with some related guidelines ~~about relational framing~~. Anecdotal reports ~~showed~~ inform that SV's mother followed the guidelines and was very satisfied with her son's progress.

Although the current study ~~advances~~ makes progress in a relatively unexplored topic, it ~~has~~ is not exempt of i~~i~~mportant limitations. First, only two children participated in the study, and the effect of the training protocol was only observed in one child. ~~In this sense~~As regards this issue, our ~~first~~ initial idea was to replicate the effect observed in SV with DN, but this was not possible because DN and her parents moved to another province in Spain right after the post-intervention assessment. Second, all evaluations and trainings were conducted by the first author. Thus, the IQ assessor was not blind to treatment assignment. This ~~was~~ entails a limitation because the experimenter could have inadvertently provided some cues that would have facilitated SV's responses in the FNT and MSCA, ~~although~~ though we must mention that this event was not observed in the recordings. Third, the training protocol ~~used~~ applied ~~only~~ included only coordination fram~~es~~i~~ng~~. Further studies should study the effect of a protocol training including relational framing ~~through~~ including~~the~~ relations of opposition, comparison, distinction, hierarchy, spatial, causality, and deictic relations. Lastly, although this study ~~incorporated~~ included a control subject, participants could be ~~matched~~ more closely matched (e.g., same sex and ~~exact same~~ age).

In conclusion, the current case study provides promising evidence of the effect of an RFT-based training ~~to~~ on improving~~e~~ ~~the~~ linguistic and cognitive abilities categorized within the construct of intelligence. However, further studies ~~better~~ with improved control~~sled~~ ~~studies~~ are required to analyze the potential of these RFT-based trainings.

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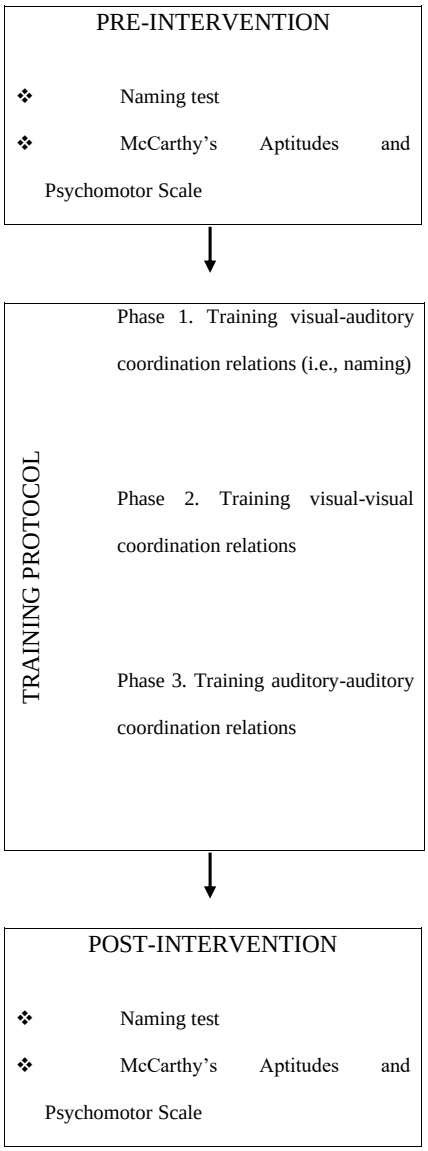

Figure 1. Design sequence.

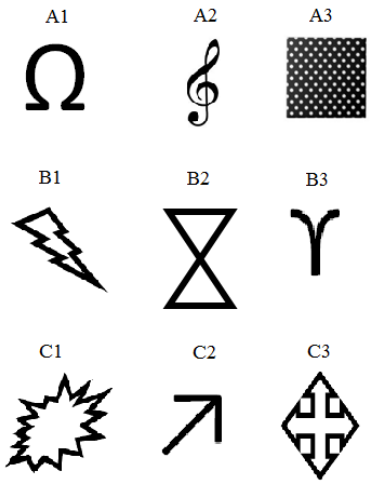

Figure 2. Abstract shapes used in Phase 2.

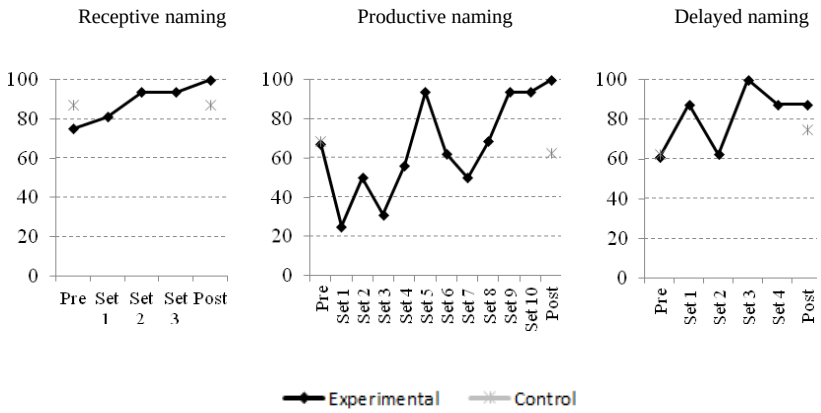

Figure 3. Evolution of the percentage of correct responses in the FNT and training in Phase 1

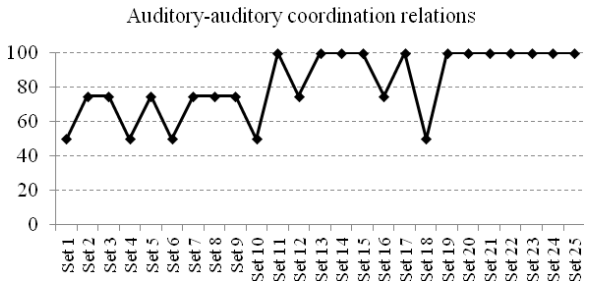

Figure 4. Evolution of the percentage of correct responses in the training of auditory-auditory coordination relations (Phase 3).

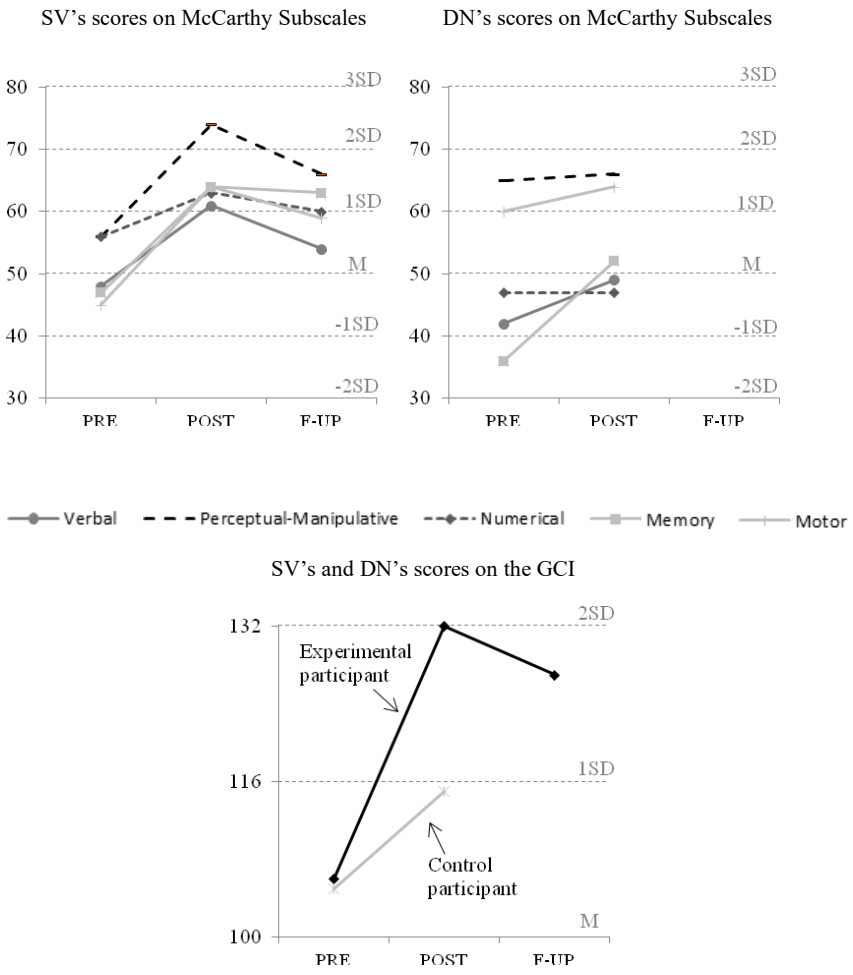

Figure 5. Evolution of the scores in McCarthy's Scales with M referring to normative mean scores and SD to the standard deviations.