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ORIGINAL ARTICLE

# Effect of Learning Tacts or Tacts and Intraverbals on the Emergence of Intraverbals About Verbal Categorization

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**Abstract** This research explored the effects of teaching tacts with two procedures on the emergence of intraverbals in 5- and 6-year-old children. Three children in Experiment 1 learned 2 verbally controlled tacts in the presence of a picture of a woman. For example, when they were asked "Name the country," they learned to say her country (e.g., Pakistan); when they were asked "Name the tribe," they learned to say the name of her tribe (e.g., Kalash). Then, the 2 country-tribe intraverbals were probed without reinforcement (e.g., "Name the tribe from Pakistan"—"The Kalash"). The three children demonstrated the emergence of the intraverbals. Seven children in Experiment 2 learned a tact (either to name the country or the tribe), as in Experiment 1, and an intraverbal (either "Name the tribe from Pakistan" —"The Kalash" or "Name the country of the Kalash" —"Pakistan," respectively). Five children demonstrated the emergence of the probed intraverbals. These procedures were demonstrated to be effective to produce the emergence of the intraverbals. We discuss why the procedure in Experiment 1 was slightly more effective than that of Experiment 2 in terms of the discriminative control exerted by the nonverbal and verbal stimuli in each condition. The procedure can be useful for promoting the emergence of intraverbals in children with and without learning disabilities.

**Keywords** Intraverbals · Tacts · Verbal behavior · Stimulus equivalence · Stimulus relations · Reasoning · Transitive inference · Children

Intraverbals are verbal operants characterized by the emission of a verbal response after the presentation of a verbal stimulus that shows no point-to-point correspondence with the response (Skinner, 1957). Intraverbals are a relevant part of our complex language repertoire and they may have a big influence in social relations and reasoning. Intraverbals can be directly taught (e.g., Braam & Poling, 1983; Chase, Johnson, & Sulzer-Azaroff, 1985; Partington & Bailey, 1993; Sundberg & Sundberg, 1990; Vignes, 2007; Watkins, Pack-Teixteira, & Howard, 1989; see reviews by Axe, 2008; Cihon, 2007) or they can be brought about with other teaching strategies (e.g., Greer, Yuan, & Gautreaux, 2005; Kisamore, Carr, & LeBlanc, 2011; Sautter, LeBlanc, Jay, Goldsmith, & Carr, 2011).

An important developmental milestone occurs when a person demonstrates novel skills that have not been taught directly to him or her, as an extra outcome of learning related skills, typically by direct contingencies (Greer & Ross, 2008; Pérez-González, 2015). When a person responds correctly to new relations that have not been directly taught after learning other related relations, it is said that an *emergent* process has occurred. Being able to respond to questions after observing the environment and tacting its elements, for example, demonstrates the emergence of novel verbal skills. Emergent processes are involved in generative behavior and in responding to novel verbal utterances; for example, in the generation and understanding of metaphors, analogies, and transitive inference (see Pérez-González, 2015, for an extensive analysis of the importance of emergence). The emergence of intraverbals has been broadly demonstrated (e.g., Belloso-Díaz &

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Pérez-González, 2015a, b; Carp & Petursdottir, 2012; Kisamore et al., 2011; May, Hawkins, & Dymond, 2013; Partington & Bailey, 1993; Pérez-González, Belloso-Díaz, Caramés-Méndez, & Alonso-Álvarez, 2014a; Pérez-González & García-Asenjo, 2015; Pérez-González, García-Asenjo, Williams, & Carnerero, 2007; Pérez-González, Herszlikowicz, & Williams, 2008; Pérez-González, Salameh, & García-Asenjo, 2014b; Petursdottir, Carr, Lechago, & Almason, 2008; Petursdottir & Haflidadóttir, 2009; Petursdottir, Ólafsdóttir, & Aradóttir, 2008; Polson & Parsons, 2000).

The theoretical analysis of stimulus equivalence can be useful for analyzing the existing possibilities to teach skills that result in the emergence of intraverbals. Of importance is to note that for the most studied types of emergence, stimuli in simple or conditional discriminations are linked to one another because a stimulus A1 is related to a stimulus B1, and B1 is related to a stimulus C1. Given certain learning and probing experiences, the three stimuli are related, such that, for example, a person demonstrates that relates stimulus C1 to A1; also, that person relates B1 to A1 (e.g., see Sidman, 1994). Demonstrations of the novel relations are verified in probed, not taught, discriminations. When a person demonstrates these discriminations, the emergence of each specific relation is documented. The emergence of intraverbals is possible from learning discriminations with common elements. The fact that these elements are of different modality or function (e.g., stimuli and responses) does not preclude the emergence, as demonstrated in the studies with intraverbals (e.g., Belloso-Díaz & Pérez-González, 2015a, 2015b; Carp & Petursdottir, 2012; May et al., 2013; Pérez-González et al., 2014a Pérez-González, García-Asenjo, Williams, & Carnerero, 2007; Pérez-González, Herszlikowicz, & Williams, 2008; Pérez-González 2014b; Petursdottir & Haflidadóttir, 2009; Petursdottir, Ólafsdóttir, & Aradóttir, 2008; Polson & Parsons, 2000).

The simplest preparation to probe the emergence of intraverbals after learning related skills with nonverbal stimuli involves two verbal stimuli of the intraverbals and one nonverbal stimulus. For example, intraverbals can emerge after learning other intraverbals, tacts, and selections. In that vein, Petursdottir, Carr et al. (2008) studied the emergence of intraverbals with words in Icelandic and Spanish in four Icelandic children who knew these words (i.e., had learned relations between the verbal stimuli in Icelandic and their corresponding nonverbal stimuli). They taught the children either (a) to tact the pictures in Spanish or (b) to select a picture after hearing its Spanish word, and probed the remaining relations. The two children who learned the tacts responded above 83 % in the emergence probes of the Icelandic–Spanish and the Spanish–Icelandic intraverbals. The other two children did not respond above that level in most probes. Petursdottir and Haflidadóttir (2009) studied the emergence of intraverbals with words in Icelandic and Italian in two Icelandic children who knew these words (i.e., had learned relations between the verbal stimuli in Icelandic and their corresponding nonverbal stimuli). They taught the children either (a) to tact a drawing in Italian, (b) to select a drawing after hearing the Italian word, (c) the Italian–Icelandic intraverbals, or (d) the Icelandic–Italian intraverbals, and probed the remaining relations. The intraverbals emerged in only one child in only two of the four conditions. The results of these studies (and other similar studies like the one by Petursdottir, Carr et al., 2008) indicate how difficult is to design procedures that result in the intraverbal emergence.

Another study demonstrated the emergence of intraverbals after learning two related tacts: Lipkens, Hayes, and Hayes (1993) taught a 2-year-old boy to say the names of uncommon animals in response to "What is this?" and to say the supposed sound in response to "What does this say?" in the presence of the pictures in both cases. The child demonstrated the emergence of two intraverbals: "What does [name of the animal] say?," for the name-sound intraverbal, and expression like "Listen [animal sound], what do you hear?" for the sound-name intraverbal. These results were replicated by May et al. (2013) with three adolescents with autism. They taught them to respond to "What is the name of this monster?" while presenting a picture of the monster (e.g., "Simon"). Then, they taught them to respond to "What food does this monster eat?" while presenting the same picture of the monster (e.g., "chips"). Finally, they probed intraverbals such as "What food does Simon eat?" and "Which monster eats chips?" All three children demonstrated the emergence of the intraverbals.

The present study is a first attempt to systematically investigate the emergence of intraverbals after learning operants with one nonverbal stimulus (e.g., a picture) and two verbal stimuli (e.g., two names related to the picture). Three types of relations are involved: contextually controlled tacts, in which the stimulus is the nonverbal stimuli and the response is verbal; selections, in which the selection response to one of several nonverbal stimuli is controlled by a verbal stimulus; and intraverbals, in which a verbal stimulus controls a verbal response. After learning two relations, the remaining relations can emerge. In the present study, we analyzed the emergence of intraverbals after learning either two tacts or after learning one tact and one intraverbal. Thus, in Experiment 1, we explored emergence of intraverbals in which two related tacts were taught in the presence of a picture. The skills taught and probed were similar to those used by Lipkens et al. (1993) and May et al. (2013). In Experiment 2, we explored the emergence of one intraverbal after learning the picture-verbal stimulus relation (a tact) and the symmetrical intraverbal. In addition, we used words related to categorization in a different way; in fact, we used pictures of women as

nonverbal stimuli and the names of the country and the tribe they belong to as verbal stimuli. (Although most tribes belong only to a country, it is not always the case and the words *country* and *tribe* have not such a bidirectional relation to a particular woman as the woman's name could have; i.e., a country may have many tribes, and a tribe has many women, whereas a particular woman has a bidirectional relation with the name of that woman.) The main goal of the present study was to explore the emergence of intraverbals after learning other relations. In addition, we asked whether the procedures of Experiment 2 could result in more instances of intraverbal emergence than the procedures used in the studies that taught tacts, used in Experiment 1. Yet, a comparison among the results in the three conditions could be useful for understanding the processes involved in the emergence of these types of intraverbals.

**Table 1** Name, sex, and age (years and months) of the participants

| Name | Sex | Age |
|---|---|---|
| Experiment 1 | | |
| Alberto | Male | 5y 6 m |
| Álvaro | Male | 5y 5 m |
| Andrés | Male | 5y 2 m |
| Experiment 2. Condition 1 | | |
| Bruno | Male | 5y 10 m |
| Bea | Female | 5y 7 m |
| Bárbara | Female | 5y 7 m |
| Blanca | Female | 5y 8 m |
| Experiment 2. Condition 2 | | |
| Celia | Female | 5y 5 m |
| Carlos | Male | 5y 11 m |
| Celso | Male | 6y 2 m |

## General Method

### Participants

Ten Spanish-speaking children, four females and six males, with ages between 5 years 2 months and 6 years 2 months, participated (see Table 1). They were typically developing and attended the third grade of preschool in a public school. The children were randomly assigned to one of the two experiments and to one or the two conditions of Experiment 2.

### Stimuli and Definition of Correct Responses

All the study was conducted in Spanish. There were intraverbals, tacts, and selections (see definitions below). See an overview of the relations in Figs. 1 and 3.

**Intraverbals** Two types of intraverbals were used: the A-B Country-Tribe and B-A Tribe-Country intraverbals (see Table 2). For example, in an A1-B1 Country-Tribe intraverbal, the antecedent stimuli were "Name the tribe from Pakistan" and the correct response was "The Kalash"; in the B-A Tribe-Country intraverbal, the antecedent stimuli were "Name the country of the Kalash" and the correct response was "Pakistan." The other two A-B and B-A intraverbals were analogous, referring to Ethiopia and the Surma.

**Tacts** Two types of tacts were used: the P-A Picture-Country and P-B Picture-Tribe tacts (see Table 2). In the P1-A1 Picture-Country tact, the antecedent stimuli was the picture of a woman from Pakistan and the verbal instruction "Name the Country," and the correct response was "Pakistan"; in the P1-B1 Picture-Tribe tact, the antecedent stimuli was the same picture of the woman from Pakistan with the verbal instruction "Name the tribe," and the correct response was "The Kalash." The other two P-A and P-B tacts were analogous, referring to Ethiopia and the Surma.

**Selections** There were also two types of selection skills: the A-P Country-Picture and the B-P Tribe-Picture (see Table 2). These were conditional discriminations in which the sample was the name of the country or the name of the tribe, and the comparisons were the pictures with the woman of each country/tribe. In A1-P1 Country-Picture skill, the antecedent stimuli were "Point to that from Pakistan," and the correct response was to select the picture of the woman from Pakistan. In the B-P Tribe-Picture skill, the antecedent stimuli were "Point to that from the Kalash," and the correct response was to select the picture of the woman from Pakistan.

### Procedures

**Setting, Instructions, Stimulus Presentation, and Consequences** The research was conducted in a quiet room

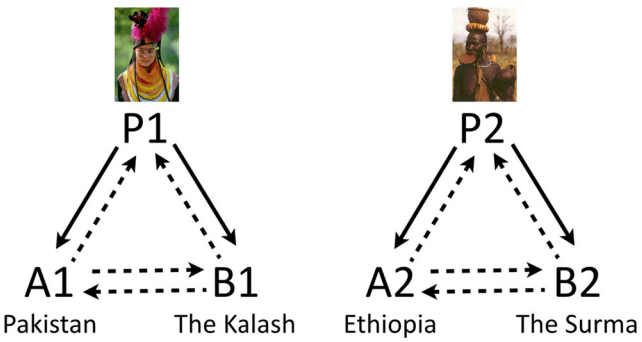


**Fig. 1** Taught (solid lines) and probed (dashed lines) relations in Experiment 1

**Table 2** Stimuli and response components of the taught and probed relations

| Antecedent stimuli | | | Correct response |
|---|---|---|---|
| P-A Picture- Country tact | | | |
| Dime | el país | [P1] | [A1] Pakistán |
| Dime | el país | [P2] | [A2] Etiopía |
| *Name* | *the country* | *[P1]* | *[A1] Pakistan* |
| *Name* | *the country* | *[P2]* | *[A2] Ethiopia* |
| P-B Picture-Tribe tact | | | |
| Dime | la tribu | [P1] | [B1] Los Kalash |
| Dime | la tribu | [P2] | [B2] Los Surma |
| *Name* | *the tribe* | *[P1]* | *[B1] The Kalash* |
| *Name* | *the tribe* | *[P2]* | *[B2] The Surma* |
| A-P Country-Picture selection | | | |
| Señala | la de Pakistán | [P1] [P2] | Selecting [P1] |
| Señala | la de Etiopía | [P1] [P2] | Selecting [P2] |
| *Point to* | *that from Pakistan* | *[P1] [P2]* | *Selecting [P1]* |
| *Point to* | *that from Ethiopia* | *[P1] [P2]* | *Selecting [P2]* |
| B-P Tribe-Picture selection | | | |
| Señala | la de los Kalash | [P1] [P2] | Selecting [P1] |
| Señala | la de los Surma | [P1] [P2] | Selecting [P2] |
| *Point to* | *that from the Kalash* | *[P1] [P2]* | *Selecting [P1]* |
| *Point to* | *that from the Surma* | *[P1] [P2]* | *Selecting [P2]* |
| A-B Country-Tribe intraverbal | | | |
| Dime | la tribu de | [A1] Pakistán | [B1] Los Kalash |
| Dime | la tribu de | [A2] Etiopía | [B2] Los Surma |
| *Name* | *the tribe of* | *[A1] Pakistan* | *[B1] The Kalash* |
| *Name* | *the tribe of* | *[A2] Ethiopía* | *[B2] The Surma* |
| B-A Tribe-Country intraverbal | | | |
| Dime | el país de | [B1] los Kalash | [A1] Pakistán |
| Dime | el país de | [B2] los Surma | [A2] Etiopía |
| *Name* | *the country of* | *[B1] the Kalash* | *[A1] Pakistan* |
| *Name* | *the country of* | *[B2] the Surma* | *[A2] Ethiopia* |

*Note.* The notation within brackets was not spoken. The English translation appears in italics below each relation type.

located in the participant's school. The room was equipped with one table and four chairs; moreover, children's drawings and pictures decorated the walls. Silence was guaranteed by assuring that no other person could interrupt the session. During the experimental sessions, the experimenter (the first author) sat in front of the participant. At the start of the first session, the experimenter told the participant the following: "I am going to ask you some questions. Sometimes I will let you know whether your answers are correct, but other times I will not tell you anything. Try to do the best you can do. I will record all your answers, and if you do well, I will give you some [collection] stamps. OK?" Later on, the experimenter read each question aloud to the participant, waited for 5 s for his or her response, presented the appropriate consequences, wrote down the response, and moved on to the next trial.

For each trial, only the first response of the participant after the question read to him or her by the experimenter was considered as his or her response for that trial. If the participant said the first syllable of an incorrect answer, then the response was considered incorrect. The absence of any answer to the question presented by the experimenter within 5 s was also considered as an incorrect response. During the teaching phases, correct responses were followed by expressions such as "Very good!," "Excellent!," or "How clever you are!"; incorrect responses were followed by "No, [the correct response]" or just by the correct response (e.g., "Name the country——"The Kalash" was followed by "No, Pakistan" or "Pakistan"—a correction). The expressions for correct responses proved to function as reinforcers in the context of this research; also, the consequences for incorrect responses decreased incorrect responding. During the probes, no consequences were provided. Sessions lasted the time that was necessary to complete a probe-teaching-probe cycle—approximately, 15 to 20 minutes. At the end of each session, the experimenter gave the child three collection stamps, regardless of performance.

**Overview of the Sequence Followed in Each Study and Condition** All children received preintervention probes to ensure that they had not acquired the relations prior to the experiment. Then, they learned the two relations assigned to each experiment or condition in Phases 1–3 and 4–6, and received Phase 7 in which the two learned relations were intermixed, with the restriction that the four questions appeared every four trials. This phase ended after 12 consecutive correct responses. Finally, they received the Postintervention Probe. If the child did not respond correctly to the 12 relations in the probe, Phase 7 of each teaching condition was reviewed and the Postintervention Probe was repeated. If the child achieved the criterion, stopped to respond during two probes, or after a maximum of 7 probes, the child's participation finished.

**Pre- and Postintervention Probes** In the Preintervention Probe, the antecedent stimuli of the 12 relations described on Table 2 were presented in random order (12 trials). In the Postintervention Probe, when the probe was presented to evaluate the effect of the teaching procedures on the emergence of the remaining relations, it consisted of presenting the 12 relations twice (a total of 24 trials), also in random order.

**Teaching P-A Picture-Country Tacts** We taught the P-A tacts in 3 phases. In Phase 1, the experimenter presented the picture of the woman from Pakistan (P1) an asked, "Name the Country." She provided the correct response ("Pakistan" [A1])

in the first two trials. After three consecutive correct responses without prompts, the experimenter moved to Phase 2. Phase 2 was identical to Phase 1, but she presented the picture of the woman from Ethiopia (P2) and the correct response was "Ethiopia" (A2). In Phase 3, the two pictures of Phases 1 and 2 were intermixed randomly, with the restriction that two trials of each picture appeared every four trials. The experimenter did not provide prompts in any trial, but incorrect responses were followed by the correct response emitted by the experimenter (a correction). After 12 correct consecutive responses, the experimenter moved to the next phase.

**Teaching P-B Picture-Tribe Tacts** We taught the P-B tacts in three phases, exactly as the P-A tacts. The experimenter presented the picture of the woman from Pakistan (P1) and asked, "Name the tribe" ("The Kalash" [B1] was the correct response), or presented the picture of the woman from Ethiopia (P2) ("The Surma" [B2] was the correct response).

**Teaching A-B Country-Tribe Intraverbals** We taught the A-B intraverbals in three phases. In Phase 1, the question was, "Name the tribe from Pakistan" (A1), and the correct response was "The Kalash" (B1). The experimenter provided the correct response in the first two trials. After three consecutive correct responses without prompts, the experimenter moved to Phase 2. Phase 2 was identical to Phase 1, but the question was, "Name the tribe from Ethiopia" (A2), and the correct response was "The Surma" (B2). In Phase 3, the two questions of Phases 1 and 2 were intermixed randomly, with the restriction that two trials of each question appeared every four trials. The experimenter did not provide prompts in any trial, but incorrect responses were followed by a correction. After 12 correct consecutive responses, the experimenter moved to the next phase.

**Teaching B-A Tribe-Country Intraverbals** We taught the B-A intraverbals using the same procedure as that used for teaching A-B Country-Tribe intraverbals but the question in Phase 1 was, "Name the country of the Kalash" (B1), and the correct response was "Pakistan" (A1), and the question in Phase 2 was "Name the country of the Surma" (B2), and the correct response was "Ethiopia" (A2). Moreover, these two questions were presented in Phase 3.

### Experimental Designs

The dependent variable was the emergence of the two intraverbals, in Experiment 1, or the emergence of the probed intraverbals, in Experiment 2. Ancillary, the emergence of tacts and selections was also recorded. The independent variable was the procedure used in each condition, which consisted of teaching two relations. Experiment 1 consisted of one condition and Experiment 2 consisted of two conditions. Within conditions, a pre–post experimental design with repeated probes was used. Typically, each child started and finished the experimental sessions at different days (thus, this manipulation controlled the effects of external variables, like in a nonconcurrent design). This manipulation controlled that the children had not learned the probed relations outside the experimental sessions.

### Data Recording and Interobserver Agreement

A second observer was present in some sessions to take data independently for computing the interobserver agreement. In the study, 841 trials of a total of 2,576 were observed (32.6 %). The interobserver agreement (agreements / [agreements + disagreements] × 100) was 99.8 % (range across children from 99.6 % to 100 %). The observer verified that the experimenter presented the antecedent and consequent stimuli according to the predetermined experimental plan. The procedure was always performed according to it.

## Experiment 1

The goal of Experiment 1 was to replicate, with simpler procedures, Lipkens et al.'s (1993) and May et al.'s (2013) studies. The procedures were aimed also to solve some of the limitations of May et al.'s procedures.

### Specific Methods

The overview of the procedure consisted of teaching the P-A Picture-Country and the P-B Picture-Tribe tacts and probing the selections and the intraverbals (see Fig. 1). The detailed procedures were the following: We conducted the Preintervention Probes, taught the P-A Picture-Country tacts and the P-B Picture-Tribe tacts in Phases 1–3 and 4–6, respectively, mixed them in Phase 7 and conducted the Postintervention Probe. If the criterion was not reached, then Phase 7 and the Postintervention Probe were repeated.

### Results

**Preintervention Probes** All children responded correctly only in some trials of the selection skill, and none responded correctly to all of them. The reason they responded correctly to only some of these trials was that their response was based on selection, and the probability to respond correctly was 50 %. None of the three children responded correctly to any of the rest of the relations probed.

**Postintervention Probes** Figure 2 shows the results. Detailed results appear in Appendix, Table 5. All children demonstrated the emergence of all new relations. Participants Alberto, Álvaro, and Andrés demonstrated the emergence (i.e, made

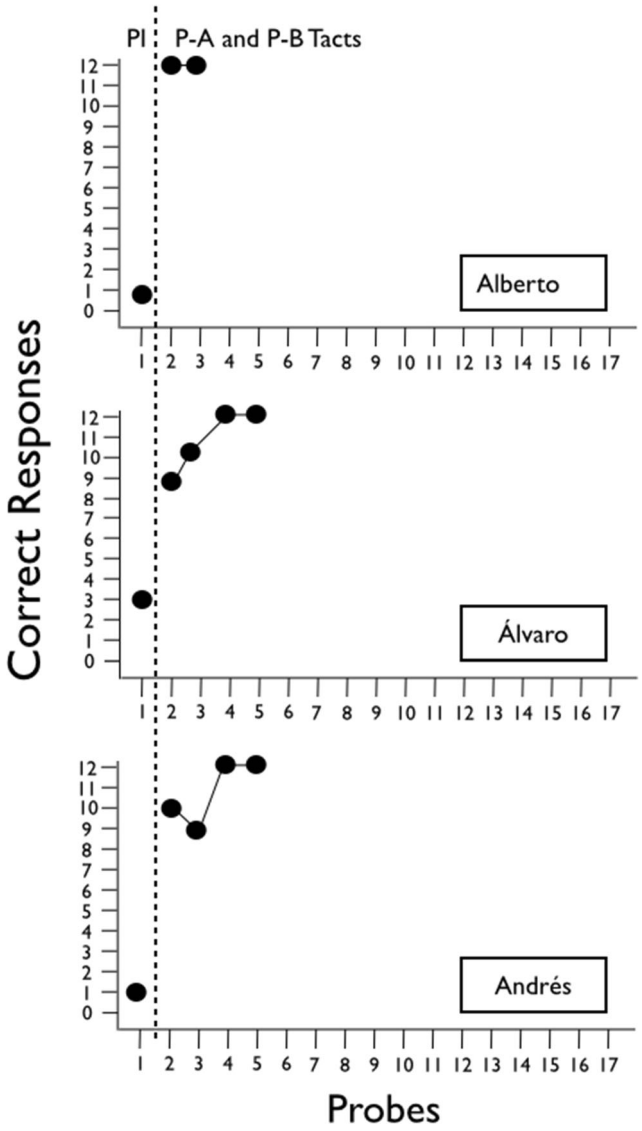


**Fig. 2** Results in the 12-trial probes of Experiment 1, corresponding to four tacts, four intraverbals, and four selections (results of each operant appear in Appendix Table 5). *Note.* PI indicates "Preintervention probe." Dotted lines indicate that the P-A and P-B tacts were taught. The probes were conducted twice in each session. After every two probes represented by two circles, the teaching phases with the P-A and P-B tacts were reviewed

four out of four correct responses) of all probed relations in one, two, and two probes, respectively. Alberto demonstrated the emergence of A-P and B-P selections and the A-B and B-A intraverbals in the first probe after learning P-A and P-B tacts. Álvaro demonstrated the A-P and B-P selections and the B-A intraverbals in the first probe after learning P-A and P-B tacts. Álvaro demonstrated the all relations in the second probe. Andrés demonstrated the emergence of A-P and B-P selections, B-A intraverbals, and some trials of A-B intraverbals (those related to the stimuli "Ethiopia" and "the Surma"), but he responded incorrectly to the taught P-B tact relation related to the stimuli "Ethiopia" and "the Surma" in the first probe after learning P-A and P-B tacts. Andrés demonstrated the emergence of all relations in the second probe.

### Discussion

All three children demonstrated the emergence of the intraverbals. The results replicated those obtained by Lipkens et al. (1993) and May et al. (2013). The procedure in the present study, however, was simpler than in the cited studies: First, Lipkens et al. used animal sounds. Because the relational frame with the sounds could have been taught to the child by his caregivers, this likely fact could have facilitated the emergence with the animal sounds used in the experiment (even though the sounds used in the study were novel to the child). Second, May et al. explicitly taught the relational frame before the children showed the emergence. That teaching could have facilitated the emergence. The result of the present study, instead, cannot be accounted for by using stimuli and relations similar to other learned by the children or by explicitly teaching a relational frame. Instead, the data of the present study shows a clear relation between learning the tacts and the emergence of intraverbals because children did not receive any pretraining and the stimuli used were not common stimuli in their daily life. The present results could have been affected by learning related relational frames, but the effect of such learning would be more remote than in the cited studies.

## Experiment 2

Experiment 1 demonstrated the emergence of two intraverbals (and two selections) after learning two types of tacts. The goal of the present experiment was to explore the emergence of one complex intraverbal after learning the other (symmetrical) intraverbal and one of the two types of tacts.

### Specific Methods

There were two conditions (see an overview in Fig. 3). In Condition 1, we taught the P-A Picture-Country tacts and the A-B Country-Tribe intraverbals. In Condition 2, we taught the P-B Picture-Tribe tacts and the B-A Tribe-Country intraverbals. In each condition we conducted the Prentervention Probe, taught the P-A Picture-Country or the P-B Picture-Tribe tacts in Phases 1–3 and the A-B Country-Tribe or B-A Tribe-Country intraverbals in Phases 4–6, mixed them in Phase 7, and conducted the Postintervention Probe. If the criterion was not reached, then Phase 7 and the Postintervention Probe were repeated. Thus, as explained in the General Method section, within conditions the experiment was a pre–post intervention design with repeated probes. Across conditions, the results in the emergence of the

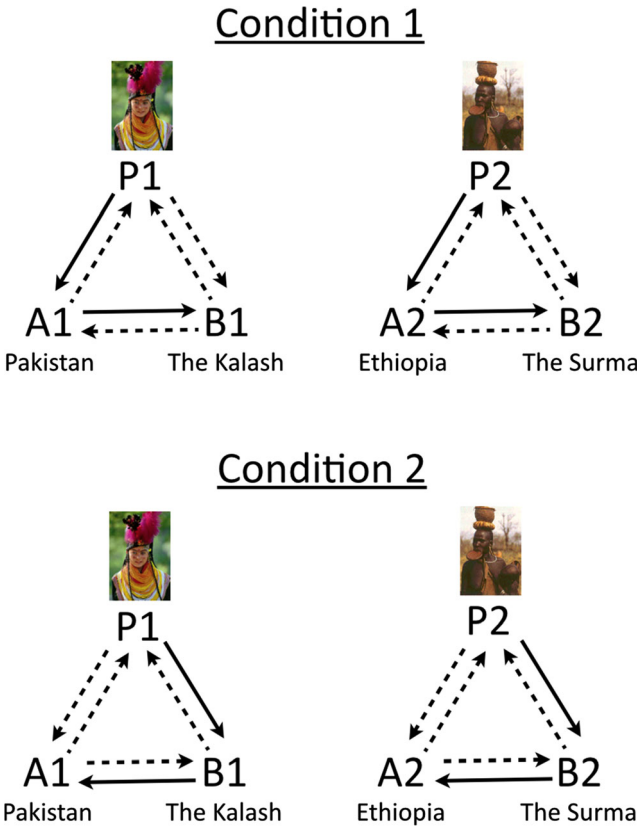


**Fig. 3** Taught (solid lines) and probed (dashed lines) relations in Experiment 2

intraverbals were compared to find out what type of intraverbal could be more likely to emerge.

## Results

**Condition 1** Figure 4 shows the results of the participants in the probes. Detailed results appear in Appendix, Table 6. Three of four children demonstrated the emergence of all probed relations (i.e., reached the criterion of four correct responses in the four trials of each probed relations). Bruno, Bea, and Bárbara demonstrated the emergence of all probed relations after learning P-A tacts and A-B intraverbals by the second, second, and third probe, respectively. Bruno demonstrated the emergence of the A-P and B-P selections and the B-A intraverbals, but he respond incorrectly to one trial of P-A tact related to the stimuli "the Surma" and one trial of the taught P-A tact related to the stimulus "Pakistan." Bruno demonstrated the emergence of all relations in the second probe. Bea responded correctly to two trials of P-B tacts, five trials of A-P, and B-P selections in the first probe after learning the P-A tacts and the A-B intraverbals. Bea demonstrated the emergence of all probed relations in the second probe. Bárbara demonstrated the emergence of A-P selections and B-A intraverbals, but she did not respond correctly to all trials of B-P selections, and the P-B tacts in the first probe after learning P-A tacts and A-B intraverbals. In the second probe, Bárbara responded correctly to all relations except one trial of P-B selections. She demonstrated the emergence of all probe relations in the third probe. Blanca demonstrated the emergence of only the A-P selections in the first probe after learning the P-A tacts and the A-B intraverbals. After the first probe, Blanca started to respond incorrectly to more trials in the probe; then, her participation finished.

**Condition 2** Figure 4 shows the results of the participants in the probes. Detailed results appear in Appendix, Table 7. Two of three children in Condition 2 demonstrated the emergence of all probed relations. Celia demonstrated the emergence of all probed relations in the first probe after learning the P-B tacts and B-A intraverbals. Carlos, in the first and second probes, demonstrated the emergence of A-P and B-P selections and responded correctly to some trials of A-B intraverbals and P-A tacts, but he failed to respond correctly in two trials of the taught P-B tact in the first probe. Carlos demonstrated the emergence of all probed relations in the third probe. Celso demonstrated the emergence of all relations except the A-B intraverbal related to the stimulus "Pakistan" and "the Kalash" after seven probes.

## Discussion

Five of seven children in this experiment demonstrated the emergence of the symmetrical intraverbals after learning the taught intraverbals and the tacts. These results indicated that the tacts can facilitate the emergence of bidirectional intraverbals in children. This studied replicated the results of Petursdottir, Ólafsdóttir et al. (2008) in that the children that learned the tacts demonstrated the emergence of the intraverbals. They contrast with the results obtained by Petursdottir and Haflidadóttir (2009) because in this study only one of the two children in one of the two stimulus sets demonstrated the emergence of one of the two probed intraverbals. The reasons for these differences can reside in specific procedures. The children in these two studies had already learned tacts and selections with the names in their native language. This fact could have affected the results. Moreover, the difference between the two studies (i.e., Petursdottir, Ólafsdóttir et al.'s and Petursdottir & Haflidadóttir's) was that in the latter they taught tacts, selections, and intraverbals with four stimuli. That number of stimuli could have affected the emergence of the intraverbals in that the emergence could be more difficult than if the number of stimuli were lower (in that line, see

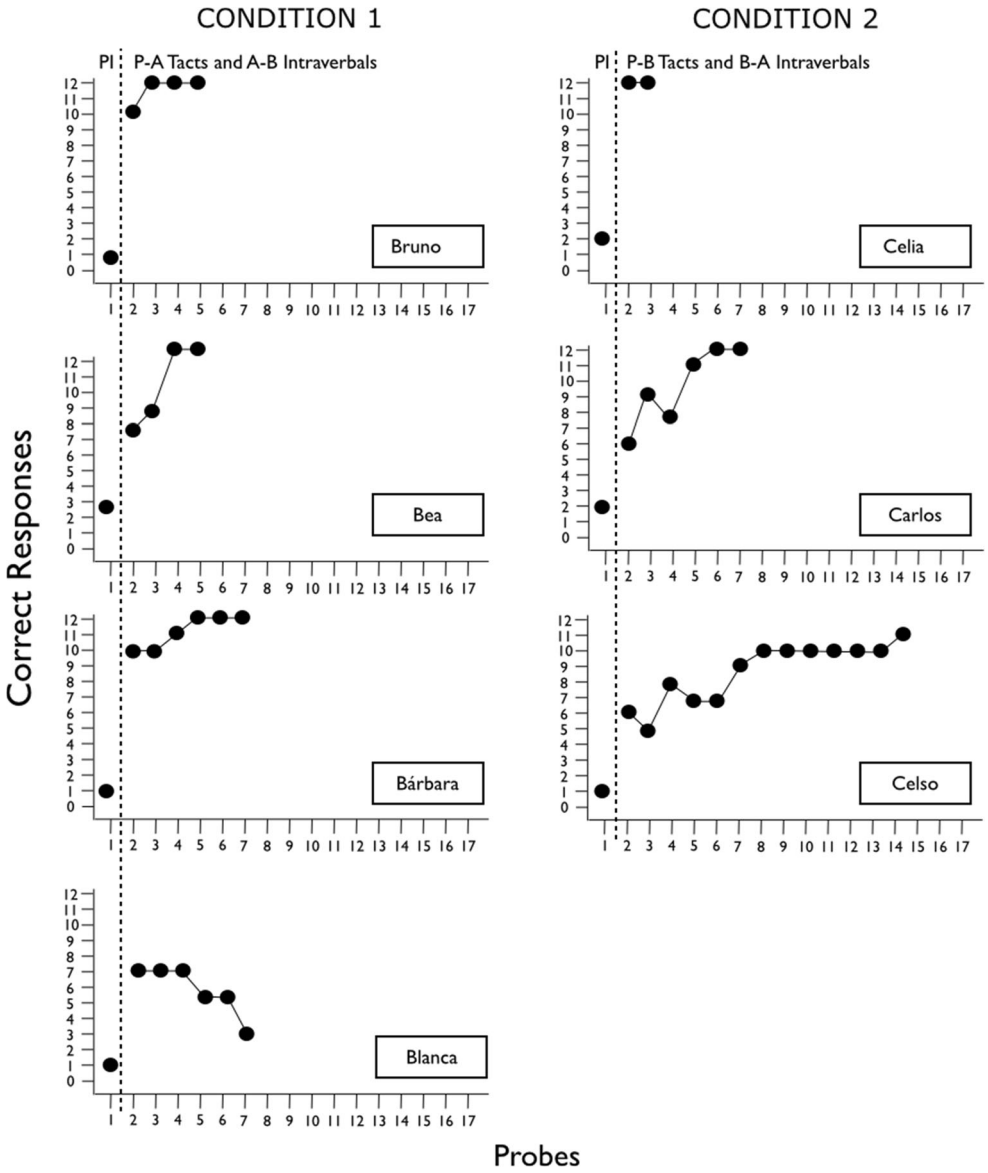


**Fig. 4** Results in the 12-trial probes of Experiment 2, corresponding to four tacts, four intraverbals, and four selections (results of each operant appear in Appendices Tables 6 and 7). *Note.* PI indicates "Preintervention probe." Dotted lines indicate that the P-A and A-B intraverbals (in Condition 1) or the P-B tacts and B-A intraverbals (in Condition 2) were taught. The probes were conducted twice in each session. After every two probes represented by two circles, the teaching phases were reviewed

probable effects of teaching order on the emergence of the intraverbals in Belloso-Díaz & Pérez-González, 2015a).

## General Discussion

The three children of Experiment 1, who learned the P-A and P-B tacts, demonstrated the emergence of the two intraverbals. Five out of seven children of Experiment 2, who learned either the P-A and the A-B intraverbals or the P-B tacts and the B-A intraverbal, demonstrated the emergence of the other intraverbal. Thus, most children demonstrated the emergence of the intraverbals.

Experiments 1 and 2 produced similar results. The procedure of Experiment 1, however, was more effective than that of Experiment 2 for the emergence of the intraverbals, as all children of Experiment 1 demonstrated the emergence of the intraverbals whereas two children of Experiment 2 failed to show the emergence. The intraverbals used in Experiment 1 were *complex* intraverbals, in the sense that the intraverbal response was under the control of two *relevant* stimuli; for example, the spoken words *country* and *Kalash*. The tacts were also complex tacts (also denominated *intraverbal tacts*) because the response was under the control of two *relevant* stimuli; for example, the picture of the woman from Pakistan and the verbal instruction, "Name the country." The intraverbals, on one hand, and the tacts, on the other, taught in groups as in the present study, consisted of conditional discriminations because the response in each trial was controlled by two antecedent stimuli (see Alonso-Álvarez & Pérez-González, 2006, 2011, 2013; Axe, 2008; Eikeseth & Smith, 2013; Pérez-González & Alonso-Álvarez, 2008;

**Table 3** The discrimination presented in Phase 7 of Experiment 1, in Spanish and the English translation (italics)

| Relation | Irrelevant stimulus | Relevant Stimuli | | Response |
|---|---|---|---|---|
| | | Verbal stimulus | Non-verbal stimulus | |
| Spanish | | | | |
| P1-A1 | Dime | el país | [Picture 1] | [A1] Pakistán |
| P2-A2 | Dime | el país | [Picture 2] | [A2] Etiopía |
| P1-B1 | Dime | la tribu | [Picture 1] | [B1] Los Kalash |
| P2-B2 | Dime | la tribu | [Picture 2] | [B2] Los Surma |
| *English* | | | | |
| *P1-A1* | *Name* | *the country* | [Picture 1] | *[A1] Pakistan* |
| *P2-A2* | *Name* | *the country* | [Picture 2] | *[A2] Ethiopia* |
| *P1-B1* | *Name* | *the tribe* | [Picture 1] | *[B1] The Kalash* |
| *P2-B2* | *Name* | *the tribe* | [Picture 2] | *[B2] The Surma* |

*Note. T*he relations are identical in both languages. Both the verbal stimulus and the picture control the response. Therefore, it is a conditional discrimination.

Pérez-González, Herszlikowicz, & Williams, 2008). In fact, when the children of Experiment 1 learned to respond to the P-A and P-B tacts, they learned to respond in the presence of two relevant stimuli (see Table 3). Moreover, the response was verbal and it was the same as in the probed intraverbals. Even more, as in May et al.'s (2013) study, the four taught tacts were intermixed across trials in Phase 7. For the participants to reach criterion in this phase, they had to attend both to a verbal stimulus (either "country" or "tribe") and also to the picture (either Picture 1 or Picture 2)—they did not need to attend to the remaining stimuli. The response in each trial was under the control of the two stimuli. The participants in this experiment demonstrated the emergence of the intraverbals very quickly. This fact indicates that the procedure used in Experiment 1 can be very effective to produce the emergence of complex intraverbals in children. Conversely, in the teaching phases of Experiment 2 the children did not have the opportunity to respond according to two relevant stimuli. Instead, they learned to respond to only one stimulus in an intraverbal and to one stimulus in the tact, even in Phase 7 when the P-A tacts and the A-B intraverbals were intermixed across trials (see Table 4). In the P-A tacts, children could respond correctly attending only to the picture shown because the remaining stimuli of the verbal instruction were the same across trials (i.e., "Name the country" in the P-A tacts); moreover, in the A-B intraverbal, children could have responded correctly attending only to one stimulus ("Pakistan" or "Ethiopia") because the remaining portion of the verbal instruction was the same across trials (i.e., "Name the tribe of"). Thus, the response in each trial was under the control of a single stimulus—the skill was a simple discrimination. Although several children demonstrated the emergence of the intraverbals, not all of them were successful. These facts indicate that if the conditional discrimination is not guaranteed, some children may not learn to respond under the appropriate stimulus control and the emergence is less likely. In summary, the main contribution of the present study, as suggested by the results of Experiments 1 and 2, is that teaching tacts based on conditional discriminations may be more effective in facilitating emergence of complex intraverbals than if the children learn relations that do not involve conditional discriminations.

The results of Experiment 1 replicated those of Lipkens et al. (1993) and May et al. (2013). Like in those studies, the participants demonstrated the emergence of the two intraverbals after learning two contextually-controlled tacts. The results of Experiment 2 were congruent with those of Petursdottir, Ólafsdóttir et al. (2008) and Petursdottir and Haflidadóttir (2009) because they demonstrated also the emergence of the probed intraverbals. More proportion of children demonstrated, however, the emergence of the probed

**Table 4** The discrimination presented in Phase 7 of Condition 1 of Experiment 2, in Spanish, and the English translation (italics)

| Relation | Irrelevant stimuli | | Relevant Stimuli | Response |
|---|---|---|---|---|
| Spanish | | | | |
| P1-A1 | Dime | el país | [Picture 1] | [A1] Pakistán |
| P2-A2 | Dime | el país | [Picture 2] | [A2] Etiopía |
| A1-B1 | Dime | la tribu de | [A1] Pakistán | [B1] Los Kalash |
| A2-B2 | Dime | la tribu de | [A2] Etiopía | [B2] Los Surma |
| *English* | | | | |
| *P1-A1* | *Name* | *the country* | [Picture 1] | *[A1] Pakistan* |
| *P2-A2* | *Name* | *the country* | [Picture 2] | *[A2] Ethiopia* |
| *A1-B1* | *Name* | *the tribe of* | *[A1] Pakistan* | *[B1] The Kalash* |
| *A2-B2* | *Name* | *the tribe of* | *[A2] Ethiopia* | *[B2] The Surma* |

*Note.* The relations are identical in both languages. The picture and the verbal stimulus A1 or A2 control the response. The remaining verbal stimuli are not necessary for responding. Therefore, it is a simple discrimination.

intraverbals in the present study than in those of the two studies cited last. The differences could be related to specific parts of the procedures, as mentioned above. Moreover, we intermixed all taught and probed relations in the probes, whereas in some of the previous studies the learned relations were not intermixed.

The study had limitations. First, the experimental design was a pre–post intervention design with partial control of external variables by conducting the sessions with each child mostly nonconcurrently. Further studies with more elaborated designs are necessary for replicating the results of the present study. Second, two out of seven 5-year-old children did not show the emergence of the probed intraverbals. This fact indicates that some variables involved in the emergence, like the variable or variables that determined the emergence in most children but not in two children, are still to be controlled. A possible variable could be the previous experience with the emergence of related types of intraverbals: It could be that children in Experiment 2 who demonstrated the emergence had learned to attend two stimuli in operants like those used in the present study or other similar ones, and they did so during the present study, in spite that attending to only one stimulus would suffice to reach the learning criterion; participant Blanca, however, could attend only the stimuli required to reach criterion, and that was not sufficient to succeed in the emergence probes. Further studies should respond to the challenge of finding these variables. Those studies can analyze the function of some parts of the procedure. For example, they can analyze the effect of adding phases in which the taught relations are randomly intermixed or the effect of randomly intermixing all taught and probed relations in the probes, cited above.

If the results of the present study are replicated, the study has applications because it suggests ways to teach children with and without learning difficulties in order that they produce the emergence of intraverbals involved in reasoning tasks. The present study shows that the procedures used to produce the emergence of intraverbals were successful, and the procedure in Experiment 1 was more effective than those of Experiment 2. Other studies did not show improvement of emergence after teaching other tacts and intraverbals. The main difference between the procedure of the present study and other procedures used in previous studies is that during the teaching phases of the present study children learned to respond vocally to conditional discriminations related to the intraverbals that were probed for emergence. This variable seems to have a strong influence in the production of emergence of intraverbals. Thus, if emergence of intraverbals is the goal of a specific curriculum, then the procedure of Experiment 1 should be used, because it seems more suited to obtain the emergence. Therefore, teaching conditional discriminations involving the discrimination between the two tact types should suffice for the children to demonstrate the intraverbals.

## Appendix

**Table 5** Correct responses out of two trials in the Preintervention Probe or out of four trials in the postintervention probes, in each relation in each session of Experiment 1

| | Session | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PI | P-A and P-B tacts | | | | | | | | | | | | | | |
| Relation | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Alberto | | | | | | | | | | | | | | | | |
| P-A | 0 | 4 | | | | | | | | | | | | | | |
| P-B | 0 | 4 | | | | | | | | | | | | | | |
| **A-P** | **1** | **4** | | | | | | | | | | | | | | |
| **B-P** | **1** | **4** | | | | | | | | | | | | | | |
| **A-B** | **0** | **4** | | | | | | | | | | | | | | |
| **B-A** | **0** | **4** | | | | | | | | | | | | | | |
| Total | 2 | 24 | | | | | | | | | | | | | | |
| Álvaro | | | | | | | | | | | | | | | | |
| P-A | 0 | 4 | 4 | | | | | | | | | | | | | |
| P-B | 0 | 2 | 4 | | | | | | | | | | | | | |
| **A-P** | **2** | **4** | **4** | | | | | | | | | | | | | |
| **B-P** | **1** | **4** | **4** | | | | | | | | | | | | | |
| **A-B** | **0** | **1** | **4** | | | | | | | | | | | | | |
| **B-A** | **0** | **4** | **4** | | | | | | | | | | | | | |
| Total | 3 | 19 | 24 | | | | | | | | | | | | | |
| Andrés | | | | | | | | | | | | | | | | |
| P-A | 0 | 4 | 4 | | | | | | | | | | | | | |
| P-B | 0 | 2 | 4 | | | | | | | | | | | | | |
| **A-P** | **0** | **4** | **4** | | | | | | | | | | | | | |
| **B-P** | **1** | **4** | **4** | | | | | | | | | | | | | |
| **A-B** | **0** | **2** | **4** | | | | | | | | | | | | | |
| **B-A** | **0** | **3** | **4** | | | | | | | | | | | | | |
| Total | 1 | 19 | 24 | | | | | | | | | | | | | |

*Note.* "PI" indicates "Preintervention Probes." Data of untaught relations are written in bold.

**Table 6** Correct responses out of two trials in the Preintervention Probes or out of four trials in the postintervention probes, in each relation in each session of Condition 1 of Experiment 2

| | Session | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PI | P-A tacts and A-B intraverbals | | | | | | | | | | | | | | |
| Relation | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Bruno | | | | | | | | | | | | | | | | |
| P-A | 0 | 3 | 4 | | | | | | | | | | | | | |
| **P-B** | **0** | **3** | **4** | | | | | | | | | | | | | |
| **A-P** | **0** | **4** | **4** | | | | | | | | | | | | | |
| **B-P** | **0** | **4** | **4** | | | | | | | | | | | | | |

**Table 6** (continued)

| | Session | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PI | P-A tacts and A-B intraverbals | | | | | | | | | | | | | | |
| Relation | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| A-B | 0 | 4 | 4 | | | | | | | | | | | | | |
| **B-A** | **0** | **4** | **4** | | | | | | | | | | | | | |
| Total | 0 | 22 | 24 | | | | | | | | | | | | | |
| Bea | | | | | | | | | | | | | | | | |
| P-A | 0 | 4 | 4 | | | | | | | | | | | | | |
| **P-B** | **0** | **2** | **4** | | | | | | | | | | | | | |
| **A-P** | **0** | **3** | **4** | | | | | | | | | | | | | |
| **B-P** | **2** | **2** | **4** | | | | | | | | | | | | | |
| A-B | 0 | 4 | 4 | | | | | | | | | | | | | |
| **B-A** | **0** | **0** | **4** | | | | | | | | | | | | | |
| Total | 2 | 15 | 24 | | | | | | | | | | | | | |
| Bárbara | | | | | | | | | | | | | | | | |
| P-A | 0 | 4 | 4 | 4 | | | | | | | | | | | | |
| **P-B** | **0** | **1** | **4** | **4** | | | | | | | | | | | | |
| **A-P** | **1** | **4** | **4** | **4** | | | | | | | | | | | | |
| **B-P** | **2** | **3** | **3** | **4** | | | | | | | | | | | | |
| A-B | 0 | 4 | 4 | 4 | | | | | | | | | | | | |
| **B-A** | **0** | **4** | **4** | **4** | | | | | | | | | | | | |
| Total | 3 | 20 | 23 | 24 | | | | | | | | | | | | |
| Blanca | | | | | | | | | | | | | | | | |
| P-A | 0 | 4 | 4 | 4 | | | | | | | | | | | | |
| **P-B** | **0** | **0** | **0** | **0** | | | | | | | | | | | | |
| **A-P** | **0** | **4** | **4** | **2** | | | | | | | | | | | | |
| **B-P** | **1** | **2** | **1** | **0** | | | | | | | | | | | | |
| A-B | 0 | 4 | 2 | 2 | | | | | | | | | | | | |
| **B-A** | **0** | **0** | **1** | **0** | | | | | | | | | | | | |
| Total | 1 | 14 | 12 | 8 | | | | | | | | | | | | |

*Note.* "PI" indicates "Preintervention Probes." Data of untaught relations are written in bold.

**Table 7** Correct responses out of two trials in the Preintervention Probes or out of four trials in the postintervention probers, in each relation in each session of Condition 2 of Experiment 2

| | Session | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PI | P-B tacts and B-A intraverbals | | | | | | | | | | | | | | |
| Relation | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Celia | | | | | | | | | | | | | | | | |
| **P-A** | **0** | **4** | | | | | | | | | | | | | | |
| P-B | 0 | 4 | | | | | | | | | | | | | | |
| **A-P** | **1** | **4** | | | | | | | | | | | | | | |
| **B-P** | **1** | **4** | | | | | | | | | | | | | | |
| **A-B** | **0** | **4** | | | | | | | | | | | | | | |
| B-A | 0 | 4 | | | | | | | | | | | | | | |
| Total | 2 | 24 | | | | | | | | | | | | | | |

**Table 7** (continued)

| | Session | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PI | P-B tacts and B-A intraverbals | | | | | | | | | | | | | | |
| Relation | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Carlos | | | | | | | | | | | | | | | | |
| **P-A** | **0** | **1** | **2** | **4** | | | | | | | | | | | | |
| P-B | 0 | 2 | 4 | 4 | | | | | | | | | | | | |
| **A-P** | **0** | **4** | **4** | **4** | | | | | | | | | | | | |
| **B-P** | **2** | **4** | **4** | **4** | | | | | | | | | | | | |
| **A-B** | **0** | **0** | **1** | **4** | | | | | | | | | | | | |
| B-A | 0 | 4 | 4 | 4 | | | | | | | | | | | | |
| Total | 2 | 15 | 19 | 24 | | | | | | | | | | | | |
| Celso | | | | | | | | | | | | | | | | |
| **P-A** | **0** | **0** | **2** | **2** | **4** | **4** | **4** | **4** | | | | | | | | |
| P-B | 0 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | | | | | | | | |
| **A-P** | **0** | **3** | **1** | **3** | **4** | **4** | **4** | **4** | | | | | | | | |
| **B-P** | **1** | **3** | **4** | **3** | **4** | **4** | **4** | **4** | | | | | | | | |
| **A-B** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | | | | | | | | |
| B-A | 0 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | | | | | | | | |
| Total | 1 | 11 | 15 | 16 | 20 | 20 | 20 | 21 | | | | | | | | |

*Note.* "PI" indicates "Preintervention Probes." Data of untaught relations are written in bold.

## References


Alonso-Álvarez, B., & Pérez-González, L. A. (2006). Emergence of complex conditional discriminations by joint control of compound samples. *The Psychological Record, 56*, 447–463. Retrieved from http://opensiuc.lib.siu.edu/tpr/vol56/iss3/8.

Alonso-Álvarez, B., & Pérez-González, L. A. (2011). Derived control by compound and single stimuli in a matching-to-sample task in children. *Psicothema, 23*, 415–423. Retrieved from http://www.psicothema.com/pdf/3903.pdf.

Alonso-Álvarez, B., & Pérez-González, L. A. (2013). Hierarchy among intersecting equivalence classes formed by unitary and compound stimuli. *European Journal of Behavior Analysis, 14*, 5–17.

Axe, J. B. (2008). Conditional discrimination in the intraverbal relation: A review and recommendations for future research. *The Analysis of Verbal Behavior, 24*, 159–174.

Belloso-Díaz, C., & Pérez-González, L. A. (2015a). Exemplars and categories necessary for the emergence of intraverbals about transitive reasoning in children. *The Psychological Record, 65*, 541–556.

Belloso-Díaz, C., & Pérez-González, L. A. (2015b). *Emergence of symmetrical intraverbals facilitated by learning skills with the intraverbal responses.* Manuscript submitted for publication.

Braam, S. J., & Poling, A. (1983). Development of intraverbal behavior in mentally retarded individuals through transfer of stimulus control procedures: Classifications of verbal responses. *Applied Research in Mental Retardation, 4*, 279–302.

Carp, C. L., & Petursdottir, A. I. (2012). Effects of two training conditions of the emergence of novel intraverbals: An extension of Pérez-González et al. (2008). *The Psychological Record, 62*, 187–206.

Chase, P. M., Johnson, K. R., & Sulzer-Azaroff, B. (1985). Verbal relations within instruction: Are there subclasses of the intraverbal? *Journal of the Experimental Analysis of Behavior, 43*, 301–313.

Cihon, T. M. (2007). A review of training intraverbal repertories: Can precision teaching help? *The Analysis of Verbal Behavior, 23*, 123–133.

Eikeseth, S., & Smith, D. P. (2013). An analysis of verbal stimulus control in intraverbal behavior: Implications for practice and applied research. *The Analysis of Verbal Behavior, 29*, 125.

Greer, R. D., & Ross, D. E. (2008). *Verbal behavior analysis: Inducing and expanding new verbal capabilities in children with language delays*. New York, NY: Pearson.

Greer, R. D., Yuan, L., & Gautreaux, G. (2005). Novel dictation and intraverbal responses as a function of a multiple exemplar history. *The Analysis of Verbal Behavior, 21*, 99–116.

Kisamore, A. N., Carr, J. E., & LeBlanc, L. A. (2011). Training preschool children to use visual imagining as a problem-solving strategy for complex categorization tasks. *Journal of Applied Behavior Analysis, 44*, 255–278.

Lipkens, R., Hayes, S. C., & Hayes, L. J. (1993). Longitudinal study of the development of derived relations in an infant. *Journal of Experimental Child Psychology, 56*, 201–239. 10.1006/jecp.1993.1032.

May, R. J., Hawkins, E., & Dymond, S. (2013). Brief report: Effects of tact training on emergent intraverbal vocal responses in adolescents with autism. *Journal of Autism and Developmental Disorders, 43*, 996–1004.

Partington, J. W., & Bailey, J. S. (1993). Teaching of intraverbal behavior to preschool children. *The Analysis of Verbal Behavior, 11*, 9–18.

Pérez-González, L. A. (2015). *Teaching and inducing verbal capabilities at the core curriculum for an effective intervention for people with autism.* Manuscript submitted for publication.

Pérez-González, L. A., & Alonso-Álvarez, B. (2008). Common control by compound samples in conditional discriminations. *Journal of the Experimental Analysis of Behavior, 90*, 81–101. doi:10.1901/jeab.2008.90-81.

Pérez-González, L. A., Belloso-Díaz, C., Caramés-Méndez, M., & Alonso-Álvarez, B. (2014a). Emergence of complex intraverbals determined by simpler intraverbals. *The Psychological Record, 64*, 509–526.

Pérez-González, L. A., Salameh, J., & García-Asenjo, L. (2014b). *Unidirectional transfer between two types of intraverbals.* Manuscript submitted for publication.

Pérez-González, L. A., & García-Asenjo, L. (2015). *Emergence of intraverbals with antonyms derived from verbal and non-verbal relations.* Manuscript submitted for publication.

Pérez-González, L. A., García-Asenjo, L., Williams, G., & Carnerero, J. L. (2007). Emergence of intraverbals with antonyms as responses in children with pervasive developmental disorders. *Journal of Applied Behavior Analysis, 40*, 697–701.

Pérez-González, L. A., Herszlikowicz, K., & Williams, G. (2008). Stimulus relations analysis and the emergence of novel intraverbals. *The Psychological Record, 58*, 95–129. Retrieved from http://opensiuc.lib.siu.edu/tpr/vol58/iss1/7.

Petursdottir, A. I., Carr, J. E., Lechago, S. A., & Almason, S. M. (2008). An evaluation of intraverbal training and listener training for teaching categorization skills. *Journal of Applied Behavior Analysis, 41*, 53–68.

Petursdottir, A. I., & Haflidadóttir, R. D. (2009). A comparison of four strategies for teaching a small foreign-language vocabulary. *Journal of Applied Behavior Analysis, 42*, 685–690.

Petursdottir, A. I., Ólafsdóttir, A. R., & Aradóttir, B. (2008). The effects of tact and listener training on the emergence of bidirectional intraverbal relations. *Journal of Applied Behavior Analysis, 41*, 411–415. doi:10.1901/jaba.2008.41-411.

Polson, D. A. D., & Parsons, J. A. (2000). Selection-based versus topography-based responding: An important distinction for stimulus equivalence? *The Analysis of Verbal Behavior, 17*, 105–128.

Sautter, R. A., LeBlanc, L. A., Jay, A. A., Goldsmith, T. R., & Carr, J. E. (2011). The role of problem solving in complex intraverbal repertoires. *Journal of Applied Behavior Analysis, 44*, 227–244.

Sidman, M. (1994). *Equivalence relations and behavior: A research history.* Boston: Authors Cooperative.

Skinner, B. F. (1957). *Verbal behavior.* Englewood Cliffs, NJ: Prentice Hall.

Sundberg, C. T., & Sundberg, M. L. (1990). Comparing topography-based verbal behavior with stimulus selection-based verbal behavior. *The Analysis of Verbal Behavior, 8*, 31–41.

Vignes, T. (2007). A comparison of topography-based and selection-based verbal behavior in typically developed children and developmentally disabled persons with autism. *The Analysis of Verbal Behavior, 23*, 113–122.

Watkins, C. L., Pack-Teixteira, L., & Howard, J. S. (1989). Teaching intraverbal behavior to severely retarded children. *The Analysis of Verbal Behavior, 7*, 69–81.