Emergence of the Skills that Define Naming in Children with Autism[1,2]

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Abstract

Individuals with autism lack flexibility to emit novel language. We explored the emergence of the skills that define the *naming* capacity in four young children with autism who received an early intensive behavioral intervention. They learned to tact objects or pictures (i.e., saying the name when seeing the object) then we probed, with no prompts or reinforcement, the emergence of selecting the same objects (pointing to the object or picture when hearing the name); they also learned to select a different set of items and we probed the emergence of tacts. Initially, two children did not demonstrate the emergence of any relation and the other two demonstrated the emergence of the selections. The procedure was repeated 15-21 months later. The first children demonstrated the emergence of the selections and the remaining children demonstrated the emergence of both selections and tacts. The results suggest that both selections and tacts can emerge in children with autism when they are taught with specific behavioral procedures.

Key words: *Naming, tacts, selection, emergence, capacity, verbal behavior, verbal productivity, autism*

Resumen

Las personas con autismo carecen de flexibilidad para emitir lenguaje novedoso. Nosotros exploramos la emergencia de habilidades que definen la capacidad de *naming* en niños con autismo que recibían una intervención conductual intensiva temprana. Aprendieron a tactar objetos o fotografías (i.e., decir el nombre de ellas) y se probaron las selecciones de esos estímulos (señalar al objeto o la fotografía cuando escuchaban el nombre) sin ayudas (prompts) ni reforzamiento. Los niños aprendieron a seleccionar otros ítems y se probaron los tactos de éstos. Al inicio, dos niños no mostraron la emergencia de ninguna

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relación y los otros dos mostraron la emergencia de las selecciones. El procedimiento fue repetido entre 15 y 21 meses después. Los primeros niños mostraron entonces la emergencia de las selecciones y los demás niños mostraron la emergencia de tanto las selecciones como de los tactos. Los resultados sugieren que tanto las selecciones como los tactos pueden emerger en niños con autismo cuando son enseñados con procedimientos conductuales específicos.

Palabras clave: *Naming, tactos, selecciones, emergencia, capacidad, conducta verbal, productividad verbal, autismo*

Children and adults learn specific skills by means of prompts and reinforcement, through the direct intervention of teachers, parents, peers, and other people. The first instances of language are learned one at a time, slowly, by direct intervention of the caregivers. Later on, many language skills come as a result of learning the first instances, without being explicitly taught. The learner can understand novel sentences and can also emit novel utterances. The learning processes underlying the acquisition of the novel skills are known as *emergent processes*. These processes can explain in part, for example, the vocabulary explosion produced after the first year of life (e.g., Horne & Lowe, 1996).

Emergence has been studied mainly with conditional discriminations with selection-based responses. For example, if a typically developing 3-year-old child is taught to select object B1 (instead of B2, B3...) in the presence of object A1, and is taught to select object C1 (instead of C2, C3…) in the presence of B1, then she will select object A1 (instead of A2, A3…) in the presence of C1 (in general, after learning AB and BC, the child will show CA). Children typically show emergence, given certain conditions, with any set of objects, even if prompts or reinforcement are not used: Critical for emergence is that the skills that are probed for emergence are not taught in any way and reinforcement is not used. If the child shows the probed skill after learning the related skills, the probed skills are considered emergent. Emergence of skills with selection-based responses has been broadly demonstrated (e.g., see compilations by Hayes, Barnes-Holmes, & Roche, 2001; Sidman, 1994; and Rehfeldt, & Barnes-Holmes, 2009).

A particularly interesting type of emergence is the emergence that results from teaching name-object relations: (a) saying the name of an object in its presence –which defines the *tact* (Skinner, 1957)- and (b) selecting an object, placed among other objects, when required –which will be shortened here as "*object selection*" or just "*selection*." Initially, children learn to tact objects that are unable to select and learn to select other objects that they are unable to tact. Later on, if a child learns to tact an object, then that child can demonstrate the response of selecting that object, placed among other objects. Moreover, a child can learn to select a different object, placed among other objects, when required and, as a result, she can tact that object. In other words, selections emerge after learning the corresponding tacts, and tacts emerge after learning the corresponding selections. Yet in other words, there is *transfer* from selections to tacts and from tacts to selections. These two types of emergence, which relate the name and the object in two different ways, defines *naming* (e.g. Horne & Lowe, 1996). The naming capacity is documented if the child under evaluation demonstrates the emergence of selections and tacts when learning either corresponding skill. Naming appears around the second or third year of life: Lipkens, Hayes, and Hayes (1993) demonstrated naming with a 19-month old boy using drawings of common objects. Gilic and Greer (2011) found that two out of ten two-year-old children and all three-year old children demonstrated naming. The capability of naming appears to allow children to acquire language incidentally (e.g., Feliciano, 2006; Gilic, 2005; Gilic & Greer, 2011; Greer & Longano, 2010; Greer & Speckman, 2009; Greer, Stolfi, Chavez-Brown, & Rivera-Valdez, 2005; Greer, Stolfi, & Pistoljevic, 2007). Moreover, it

appears as necessary for, or at least strongly facilitates, categorization (Horne, Hughes, & Lowe, 2006; Horne, Lowe, & Harris, 2007; Horne, Lowe, & Randle, 2004; Lowe, Horne, Harris, & Randle, 2002; Lowe, Horne, & Hughes, 2005; Mahoney, Miguel, Ahearn, & Bell, 2011; Miguel, Petursdottir, Carr, & Michael, 2008).

The first studies on naming have explored the acquisition of naming by teaching tacts and probing the selections with a stimulus set and teaching selections and probing tacts with a second stimulus set. In addition, Greer and colleagues have designed a more elaborated procedure to study naming. Moreover, they used this paradigm to induce naming in children who did not initially show this capacity (e.g., Fiorile & Greer, 2007; Gilic, 2005; Gilic & Greer, 2011; Greer, Stolfi, Chavez-Brown, & Rivera-Valdez, 2005; Greer, Stolfi, & Pistoljevic, 2007; Hawkins, Kingsdorf, Charnock, Szabo, & Gautreaux, 2009; Longano, 2008). More recently, a more sophisticated naming capacity has been described as *full naming* (Greer & Ross, 2008; Pérez-González, García-Conde, & Carnerero, 2011) or *pairing naming* (Carnerero & Pérez-González, 2014; Pérez-González, Cereijo-Blanco, & Carnerero, 2014), which consists of demonstrating the emergence of both tacts and selections after observing the presentation of pictures at the same time than the names of the objects in the pictures are listened, without requiring from the learner other behavior than observing. The later studies demonstrated this capacity.

The acquisition of capabilities related to the emergence of novel verbal relations seems crucial along a child's development because they make it possible to behave appropriately in novel situations, solve problems, reasoning, and display other complex skills. In fact, the difference between learning skills directly and demonstrating their emergence is similar to the difference between learning by rote and acquiring knowledge by deriving it from previous knowledge or by directly analyzing the world (see more on this topic in Pérez-González, 2019; and Pérez Fernández, 2015). For these reasons, the acquisition of emergence capabilities seems crucial for children with autism. Moreover, a diagnostic criterion of autism spectrum disorder consists of the existence of restricted, repetitive patterns of behavior, interests, or activities (according to DSM-V –American Psychiatric Association, 2013); therefore, a lack of emergence skills is directly related to that lack of flexibility. This is an important reason for which finding out whether people with autism demonstrate emergence appears to be crucial.

Processes of emergence of equivalence relations have been studied in children with autism. McLay, Sutherland, Church, and Tyler-Merrick (2013) reviewed the literature on this topic and found nine studies about the emergence of equivalence relations with selection-based responses in people with autism (also, García, Gómez, Gutiérrez, & Puche, 2001). Emergence of mands, tacts, and intraverbals have been demonstrated with children with autism (e.g., Carp, Peterson, Arkel, Petursdottir, & Ingvarsson, 2012; Davis, Kahng, & Coryat, 2012; Egan & Barnes-Holmes, 2009; Finn, Miguel, & Ahearn, 2012; Grannan & Rehfeldt, 2012; May, Hawkins, & Dymond, 2013; Nuzzolo-Gomez, & Greer, 2004; Pérez-González, García-Asenjo, Williams, & Carnerero, 2007; Valentino & Shillingsburg, 2011; see literature reviews on emergence of verbal skills by Grow & Kodak, 2010; and by Pérez-González, 2019), as well of selection-based verbal responses (e.g., Alós, Lora, & Moriana, 2008; Alós, Moriana, & Lora, 2011). The emergence of verbal skills was demonstrated with few children (typically, from two to four children per study) and sometimes the emergence was observed in only a portion of the trials, which indicates that the processes involved in the emergence of verbal skills are not well understood. In addition to the cited studies, Carnerero and Pérez-González (2014), Fiorile and Greer (2007), Pistoljevic (2008), and Speckman-Collins, Park, and Greer (2007) demonstrated the emergence of tacts and selections in children with autism.

Some interventions for people with autism focus on the evaluation of emergence and the implementation of procedures for the induction of verbal skills (e.g., Greer & Ross, 2008; Pérez-González & Williams, 2005; Sundberg, & Partington, 1998). Procedures based on emergence processes, however, are not used in many interventions for people with autism. Also, reviews about social skills show that emergence has not been targeted in the studies that tried to establish social skills in children with autism. In that line, Rao, Beidel, and Murray (2008), Reichow and Volkmar (2010), and White, Keonig, and Schaill (2007), in literature reviews of studies to teach social skills to people with autism, did not find studies on emergence (see also comparison of interventions relating to teaching and probing the emergence of speaker and listener skills conducted by Petursdottir & Carr, 2011). These facts can indicate that the amount of studies showing the importance of targeting emergent skills did not reach yet a critical point to be more broadly incorporated to the interventions. The main goal of the present study was to learn if children with autism demonstrated emergence of tacts from selection and vice versa, even though nothing was programmed to facilitate the emergence of these skills in their intervention.

Method

Participants

Four male children, Dick, Pipo, Hugo, and Bert, participated in this study. Three of them were enrolled in special needs schools (two in the United States and one in Mexico) and one was in a home-based program in the United States. Hugo, Bert, and Dick were native English learners; Pipo, from Mexico, was a native Spanish learner. All of them were diagnosed with autism and were described with severe language delays.

The participants had been enrolled in their programs at least one year prior to the onset of this study and received verbal behavior instruction as part of their daily curriculum activities. At some point, they could mand (i.e., request) a few objects and they had acquired some intraverbals, such as responding to, "What is your name?" and, "How old are you?," in addition they acquired some tacts (name) of objects using one- or two-word utterances and selected objects on command. Table 1 summarizes the children' ages as well as the level of their verbal repertoire at the time of their first and second transfer probes. The children were selected to participate in this study because of their initial difficulties to acquire a verbal repertoire.

Table 1. Age (years and months), number of tacts, objects selected on command, and mands of each child at the time of their first and second transfer probe

	Age	Tacts	Objects Selected	Mands
Dick				
First probe	4y 11m	10	24	12
Second probe	6y 2m	+200	+200	+50
Pipo				
First probe	3y 10m	8	10	5
Second probe	5y 7m	20	40	14
Hugo				
First probe	6y 2m	4	9	6
Second probe	7y 6m	18	20	10
Bert				
First probe	6y 4m	0	6	6
Second probe	7y 9m	8	16	10

The two schools were located in the suburbs of metropolitan cities and they served children with autism on a full day program. The child in the home-based program received at least 40 hours per week of instruction. All children participated in intensive programs that had components of the CABAS® system (e.g., Greer, 1996; Greer, McCorkle, & Williams, 1989; Lamm & Greer, 1991; Selinske, Greer, & Lodhi, 1991; Twyman, 1998). The children received individualized instruction. The intervention was implemented by presenting programed trials and every child's response was recorded in order to make programmatic instructional decisions that guaranteed continuous acquisition of skills.

The intervention implemented procedures derived from learning principles such as those used by Lovaas (e.g., Lovaas et al., 1980) plus others designed to teach verbal skills (e.g., Greer & Ross, 2007; Pérez-González & Williams, 2005; Sundberg & Partington, 1998).

Materials

We utilized toys and pictures of common objects (animals, household items, fruits, and toys; the items used with each child appear in Figures 1-4). We used the toys with three children and the pictures with one child (see below).

Procedures

Procedure Overview. We taught two or several tacts first using several objects or picture sets; thereafter, we probed the emergence of the selections with these objects or pictures. Moreover, we taught object or picture selections first with additional sets; thereafter, we probed the emergence of the tacts with these objects or pictures. The procedure was repeated some months later with the skill types that had not emerged initially, with the purpose of studying further the evolution of the independence or transfer between the two skills.

Setting. The study was conducted during the child's daily teaching sessions in their respective special education programs. The experimenters and/or some of the children' instructors carried out the procedures, and the experimenters performed the transfer probes. The instructors were carefully trained to conduct the entire procedure to teach the object selections and the tact repertoires.

Stimuli selection and evidence of missing skills prior to the teaching intervention skills. Typically, we taught the skills when a participant had demonstrated that he/she could learn a skill of that class in a few trials within the context of learning his curriculum; in other words, we taught the selection of new objects after the child had learned other objects. Given the absolute control of all the tacts and selections acquired for each child at any specific date during the intervention program, and the difficulties for the children to learn each one of them, enough evidence existed that the children did not tact or select the objects or pictures of the sets used in the study prior to the onset of the teaching procedure. Therefore, just as in most studies on the emergence of equivalence relations, a pre-intervention probe was considered not necessary (e.g., when Greek letters were used in stimulus equivalence studies, like those used with participant Dick in the present study, no pre—intervention probes were used).

Basic teaching and probing procedures. To teach the selections, the instructor sat across the child and placed the objects on top of the table. To teach the tact, the instructor captured the attention of the child and held up the object in front, by the child's eye level. All the teaching sessions were conducted

presenting blocks of 10 trials. Typically, 10 to 12 blocks were presented on the same day. The instructor praised the child's correct responses and paired with them a tangible item –which served as a reinforcer. The consequence for an incorrect response during the teaching sessions of the selections was to gently bring the child's hand down and to remain quiet for 3 to 5 seconds. The consequence for an incorrect response during tact teaching resulted in 3 to 5 seconds of planned ignoring. There was no correction procedure throughout the process. The child reached criterion when he completed 9 or 10 correct responses in two consecutive 10-trial blocks. After the child obtained criterion, the experimenters conducted 10-trial probes of the corresponding skill. During the probes, there were no differential consequences for correct responding.

Tact teaching. We taught the tact for each object or picture initially one at a time, with the echoic-to-tact procedure (Greer & Ross, 2008; Schwartz, 1994; Williams, Carnerero, & Pérez-González, 2006; Williams & Greer, 1993). The instructor held up the target stimulus and modeled the correct response (e.g., "car"). After the child echoed the name, the instructor provided a generalized reinforcer, such as "Very good!" or "Well done!" An incorrect echoic response consisted of repeating an unintelligible word, or a different word, or no response at all, and resulted in 3-5 seconds of planned ignoring. After three consecutive correct echoic trials, the instructor presented tact trials. Tact trials consisted of presenting the object to the child and allowing the child to emit (without echoic prompt) the name of the object. The child achieved criterion of the specific object after he emitted ten consecutive correct tacts. At this time, the instructor selected a new object for teaching. After the child acquired the two tacts, these were presented together randomly, usually in blocks of 10 trials (with the constraint that an object was not presented more than three times in a row and that each object was presented 5 times in each block of 10 trials). The procedure continued until the child made 9 or 10 correct responses in a session. Several sessions were typically conducted in a day.

Object and picture selection teaching. Two children acquired the object or picture selections with the standard trial and error procedure to teach conditional discriminations, or with the exclusion procedure (e.g., Dixon, 1977; Ferrari, de Rose & McIlvane, 1993; Pérez-González, 2001; Stromer & Osborne 1982). The other two children had difficulties acquiring the object selections, therefore we used basically the Pérez-González and Williams' (2000) procedure, which combines Smeets and Striefel's (1994) and Saunders and Spradlin's (1989, 1990, 1993) procedures. The procedure was demonstrated effective to teach object selections to children with autism. The basic procedure consisted of the following steps: Typically, the locations of the figures or the pictures were kept constant on the table. On each trial, the teacher spoke the name of one item. The putative reinforcer followed a correct selection. Initially, the same spoken name was repeated for a number of trials, until meeting a criterion. Then, the name of the second object was presented. After meeting criterion for a number of trial blocks, the two names were presented randomly. After a criterion of 10 correct responses in 10 trials, the two objects were presented at random locations. The mastery criterion was 9 or 10 consecutive correct responses in two consecutive ten-trial sessions.

Sometimes, three to five objects taught in separate conditional discriminations were merged in a unique conditional discrimination. Then, the objects were presented in a block of 10 trials in approximately the same proportion. The criterion was also 10 consecutive correct responses in a block of 10 trials.

Transfer Probes of Untaught Skills. Probes for tacts and selections were conducted to probe the emergence of untaught skills, after the child had demonstrated proficiency of the taught skill. The transfer probe was performed typically in a 10-trial block, following the same procedures described in the teaching section, but without differential consequences. The whole procedure was repeated immediately by presenting, typically, 10 trials of the taught skill followed by 10 trials of the probed skill.

Response Definition and Interobserver Agreement. There were two target behaviors measured during the transfer probes: Responses to selections and responses to tacts. The response to the object or picture selection consisted of selecting the appropriate object from two or more objects placed on the table, after the child heard the corresponding word spoken by the instructor. The instant of touching one of the objects was accepted as a response (i.e., the child was not given the opportunity to switch to the other object) and this response was followed by the appropriate consequence. The second target behavior, the response to the tact, occurred when the child emitted the name of an object held up by the instructor, aloud and with enough clarity so that two independent observers could hear it.

There were 1,074 trials presented during the transfer probes for both types of behavior –in the selections and in the tacts. On 660 trials (61%) one of the experimenters and an independent observer recorded simultaneously the child's responses. Both observers agreed on all but one response. Thus, the interobserver agreement (agreements / [agreement + disagreements] x 100) was 99,8%.

Results

Dick

The results for Dick are summarized in Figure 1. We did initial probes of tacts and selections with eight pictures of objects unfamiliar to him. These probes showed he had not acquired any of these skills. During the teaching sessions he learned to select two pairs of the pictures and learned to tact the other four pictures. The transfer probe for tacts and selections with the corresponding pictures showed that he transferred from tacts to selections but did not transfer from the selections to the tacts. One year and three months later after this initial probe he learned about 200 tacts and could select over 200 objects; he was probed again for transfer of skills. At this time, he learned the selection of three Greek letters and three tacts of three additional Greek letters. The subsequent probe for the transfer of both skills showed that Dick transferred from selections to tacts and from tacts to selections.

Pipo

The results for Pipo are summarized in Figure 2. During the teaching session he learned to select one pair of objects and eight tacts. The transfer probe showed he did not tact the pair of objects he could select, but he could select three of the four pairs of objects he could tact, demonstrating transfer from tacts to selections. One year and nine months later after the initial probe, he learned to select 9 pictures of objects and 5 pictures of colors. The transfer probe showed he was able to tact all of these pictures.

Hugo

The results for Hugo are summarized in Figure 3. During the teaching sessions, he learned to select nine objects. The transfer probe for tacts showed that he did not tact any of them. He also learned

to tact two objects, and again, the transfer probe for selections showed that he did not select these two objects. One year and four months after the initial probe, we probed the selection with the objects of two new tacts he had acquired (during this time he acquired 18 new tacts) and the selection we had probed for transfer initially. This second transfer probe for selections demonstrated that he transferred from tacts to selections.

Bert

The results for Bert are summarized in Figure 4. During the teaching sessions, he learned to select six objects. The transfer probe for tacts showed he could not tact these six objects. At this time, he had not learned any tact; thus, the transfer probe from tacts to selections could not been conducted. One year and five months later after the initial probe he had acquired eight tacts; we conducted the transfer probe for tacts with two objects used in the initial probe and with two new pairs of objects. He tacted nine times out of 10 the two objects of one discrimination; he tacted nine out of 20 of the second pair of objects; and he did not tact the objects of the third pair. At this later time, he also learned to tact two objects and during the transfer probe for selections he selected correctly nine times out of the 10 trials.

Discussion

The results obtained with all the participants may be summarized as follows: The first time the children were probed, two children showed transfer from tacts to selections, but they did not demonstrate transfer from selections to tacts. At a later time that they were probed, they demonstrated transfer from tacts to selections and from selections to tacts. The first time they were probed, the other two children did not show transfer, neither from tacts to selections nor from objects discriminations to tacts. At a later time, these two children showed transfer from tacts to selections but did not transfer from selections to tacts. There was no exception to these data; data from other children that are not shown here revealed the same trend.

The main goal of the present study was to learn if children with autism demonstrated emergence of tacts from selection and vice versa. The outcomes showed that two children acquired naming and the remaining two children demonstrated one component of it (i.e., emergence of selections), at least with the intervention that these children received; namely, an intervention with many components derived from a functional analysis of verbal behavior. Therefore, the emergence of selections and tacts was demonstrated. Moreover, the children showed more types of emergence in the second probe than in the first, very likely as an un-programmed result of their daily intervention. It is possible that similar children who receive other non-systematic intensive behavioral interventions do not show the same progress. Further research is warranted to answer this question.

The results also provide data that shows that the sequence of the emergence is the same as in typically developing children, in that transfer from tacts to selections occurs first than transfer from selections to tacts (e.g., Gilic & Greer, 2011; Pérez-González et al, 2011, 2014). The results also allow to estimate the age of verbal development of the participants regarding the naming capability: The children who showed the emergence of both selections and tacts in the second probing period reached the level that typically developing children acquire about the third year of life.

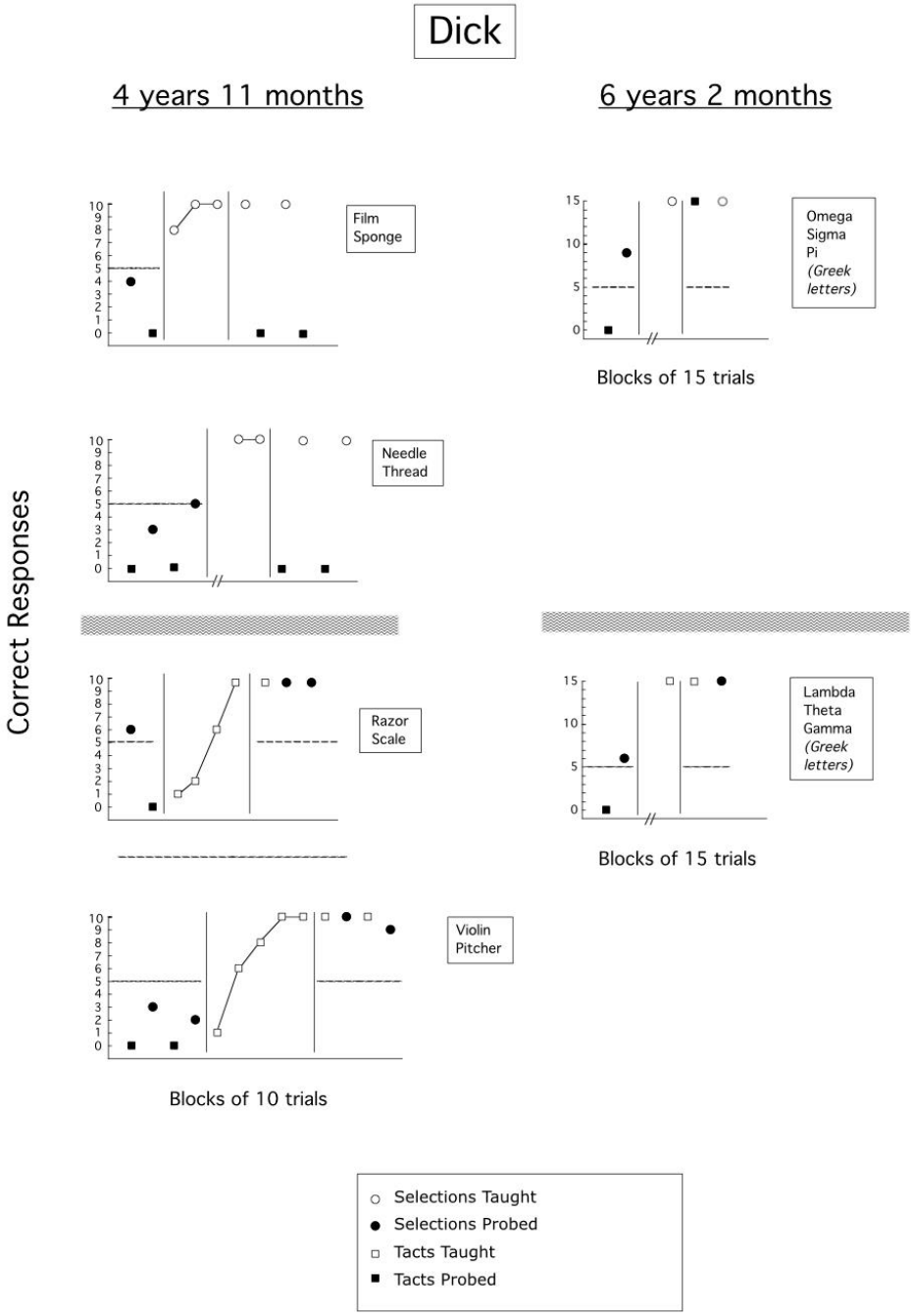

Figure 1. Correct responses in each block of 10 trials in selections and tacts for Dick, when he was 4-years-11-months old (graphs on the left) and when he was 6-years-2-months old (graphs on the right). Dashed lines indicate chance level responding for the selection probes.

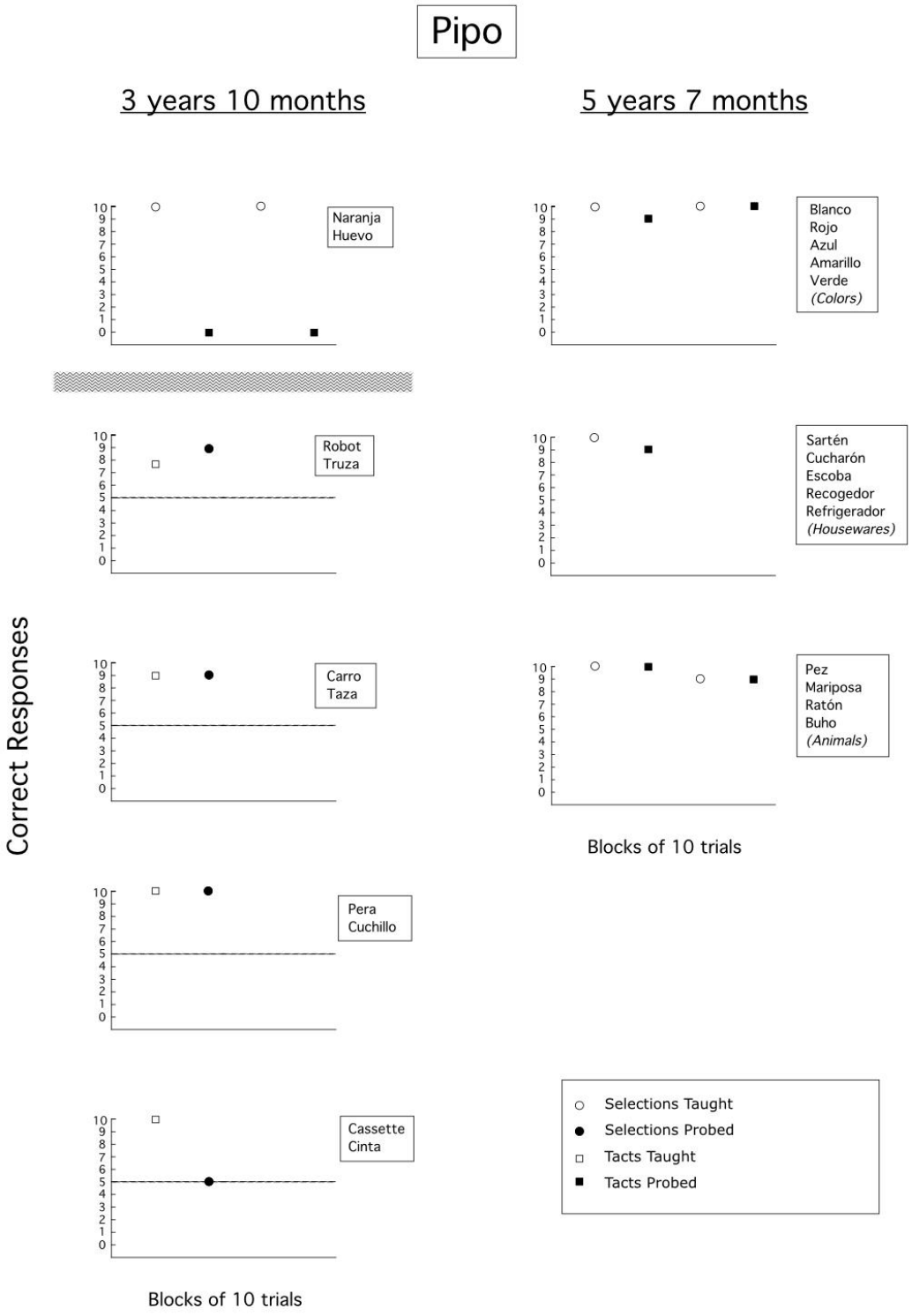

Figure 2. Correct responses in each block of 10 trials in selections and tacts for Pipo, when he was 3-years-10-months old (graphs on the left) and in picture discriminations and tacts when he was 5-years 7-months old (graphs on the right). Dashed lines indicate chance level responding for the selection probes

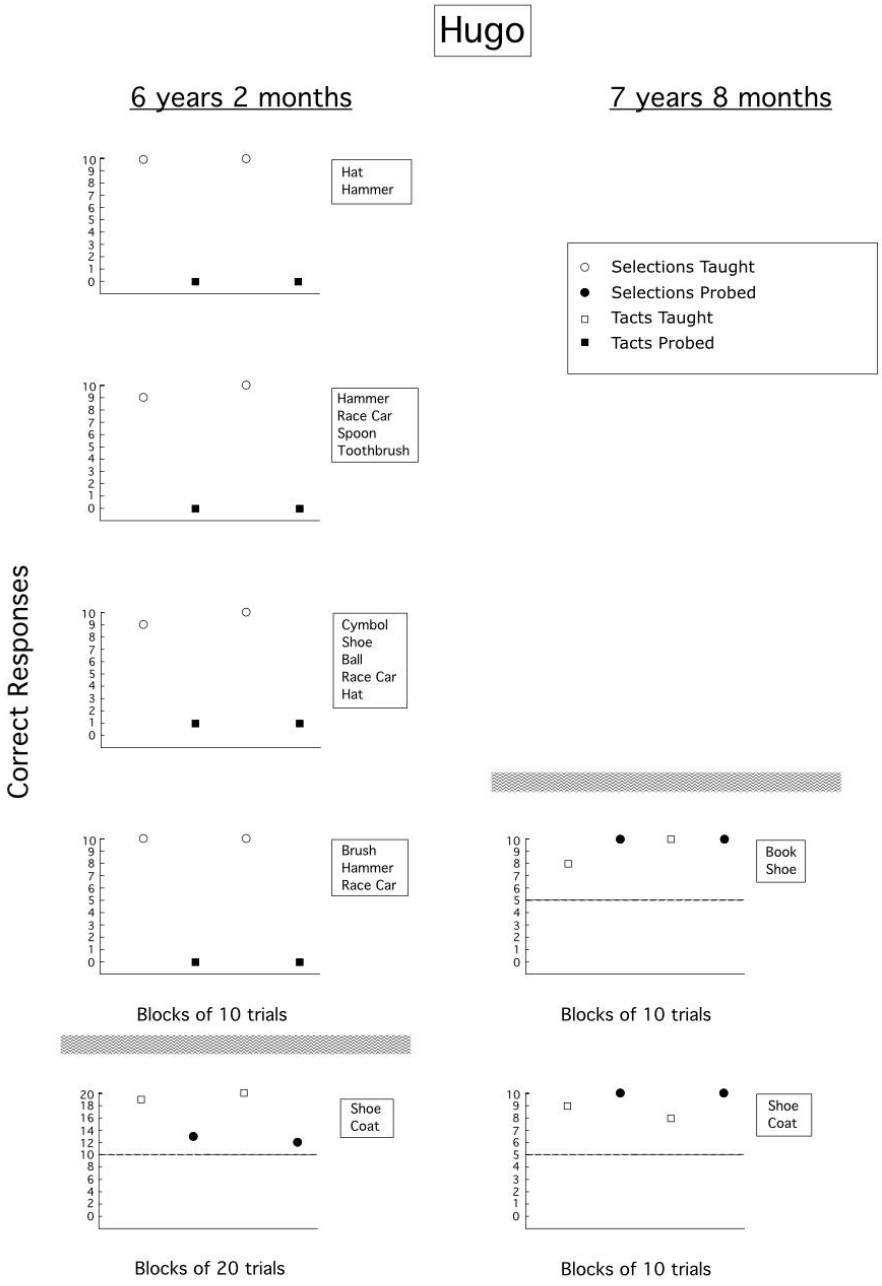

Figure 3. Correct responses in each block of 10 trials (or 20 trials for the lower left graph) in selections and tacts for Hugo, when he was 6-years 2-months old (graphs on the left) and when he was 7-years-6-months old (graphs on the right). Dashed lines indicate chance level responding for the selection probes.

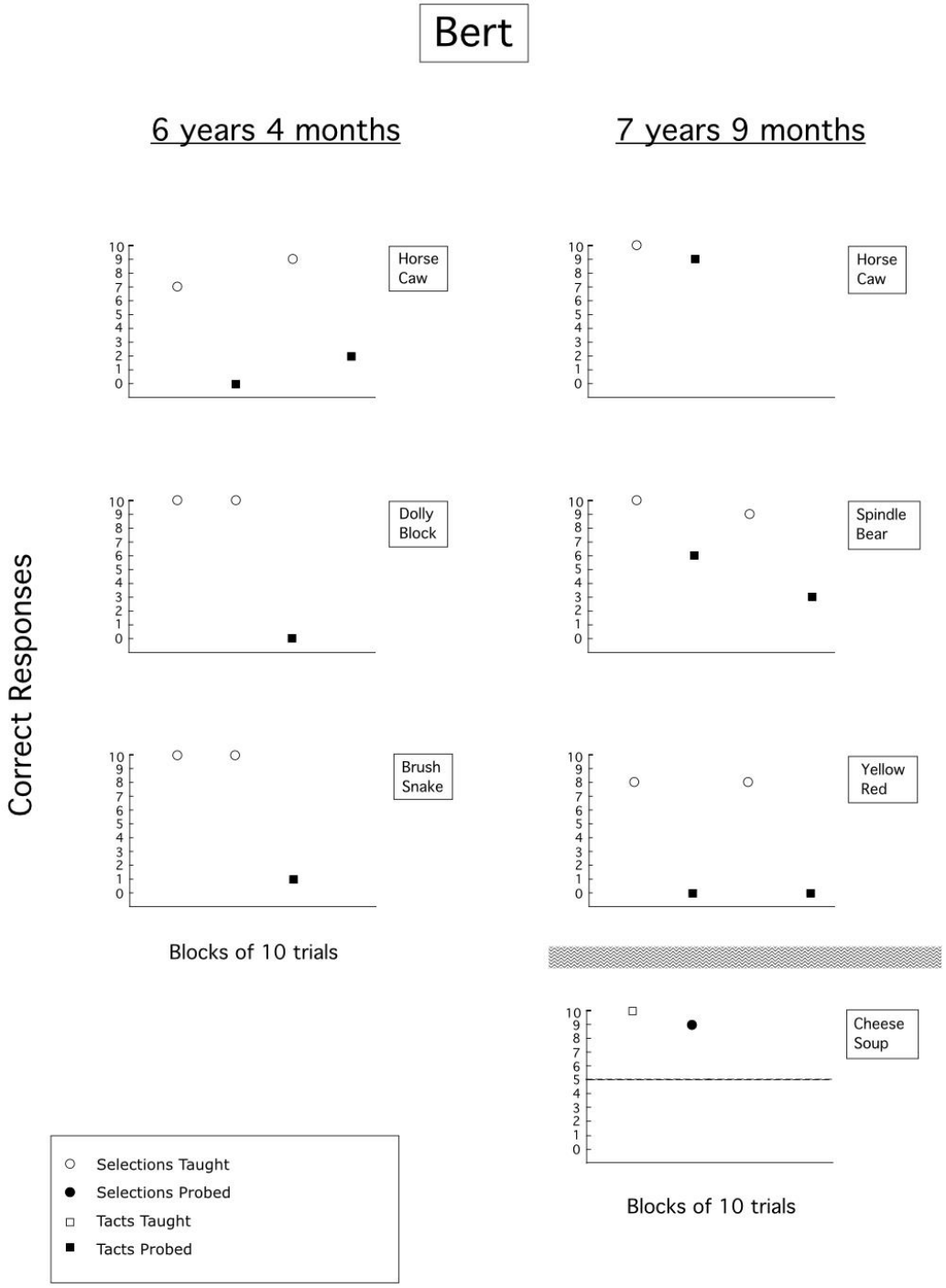

Figure 4. Correct responses in each block of 10 trials in selections and tacts for Bert, when he was 6-years-4-months old (graphs on the left) and in picture discriminations and tacts when he was 7-years-9-months old (graphs on the right). Dashed lines indicate chance level responding for the selection probes.

These results are compatible with the theory that the mutual relationship between selections and tacts that define naming goes through three stages: In the first stage, the children do not tact objects that they select upon hearing their names and they do not select the objects they tact. Thus, children do no transfer from tacts to selections or vice versa; in other words, the repertoires of tacting and discriminating are independent. In the second stage, children select objects upon hearing their names after learning to tact these objects, but they do not tact the objects that they select upon hearing their names. Thus, children transfer from tacts to selections but there is not transfer from selections to tacts. In the third stage, children select objects upon hearing their names after learning to tact these objects and also they tact the objects that they select upon hearing their names. Children transfer from tacts to selections and also transfer from selections to tacts.

The progression from one stage to the next does not happen suddenly. For example, Pipo selected six objects he learned to tact, but he did not select two other objects. These data –together with the data that show that he did not tact the objects that he had learned to select- indicate that he was in the process of reaching the second stage. Another child, Bert, tacted the two objects of a conditional discrimination he had just learned, but he did not tact the four objects of two other conditional discriminations. These data –together with the data that show that he selected the stimuli that he learned to tact- suggest that this child was in the process to reach the third stage at the moment of the probes.

Factors that produce the transfer at each stage

The present results suggest further research to study the specific factors involved in the two types of transfer. One possibility is that for a specific transfer to occur, the child has to have experience tacting and selecting the same objects (e.g., experiencing a relational frame –Hayes, 1991, 1994; Hayes & Hayes, 1989; Hayes et al., 2001), such as it has been demonstrated in the emergence of other verbal skills in children with autism (e.g. Pérez-González et al., 2007). The second possibility is that the cumulative acquisition of selections of objects may suffice to select new objects after learning to tact them (which is also a relational frame); similarly, a high number of tacts may suffice to tact new objects after learning to select them. Several studies (e.g., Fiorile & Greer, 2007; Carnerero & Pérez-González, 2014) have found that teaching the relational frame serves to induce the naming in children who lack it. These data suggest that learning the relational frame could be the factor responsible of the emergence of selections and tacts. Contrary to this assumption is the fact that selections emerge before than the tacts; this fact indicates, at least, that an explanation based on learning the relational frame must need to incorporate additional factors. Moreover, some children in the present experiment transferred from the tacts to the selections without experiencing tacts and objects discriminations with the same stimulus. The current data are insufficient to discard explanations alternative to those based on relational frames. Therefore, more research is necessary to clarify the factors necessary for the acquisition of naming.

Productivity

The transfer from one skill to the other at the third stage is an example of verbal productivity. In fact, learning one skill is sufficient to demonstrate the existence of that skill and the existence of a second one. Thus, the second skill, which emerges without explicit teaching, constitutes an instance of productivity. The productivity was shown here both for the listener behavior –when the child learned the

tact and produced the selection without explicit teaching—and for the speaker behavior –when the child learned the selection and produced the tact without explicit teaching.

Emergence and autism

All four participants diagnosed with autism demonstrated emergence of un-taught skills. These results add empirical evidence that children with autism do not lack the possibility of producing novel verbal skills derived from learning related skills, just as demonstrated in other studies conducted with people with autism. This fact can indicate that people with autism can acquire capabilities to behave with flexibility in novel situations. Therefore, the existence of restricted, repetitive patterns of behavior, interests, or activities can be related, at least in part, to the lack on experiences that facilitate emergence – due, for example, to some rigidity in the procedures used for teaching them. In the case of the emergence of selections and tacts analyzed in the present study, however, no specific procedure was used to facilitate emergence, other than intensively teaching selections, tacts, and other verbal skills.

Selections and naming

Horne and Lowe (1996) have suggested that, in order to learn a conditional discrimination, a child must name in some way the stimuli involved in the conditional discrimination. This hypothesis is known as the naming hypothesis; it has been discussed frequently in the context of the stimulus equivalence literature (for instance, see the articles that followed Horne and Lowe's article in the same issue of the *Journal of the Experimental Analysis of Behavior*). Our data are clear in showing that in the first and the second stages the children learned the conditional discriminations (i.e., selections) even though they were unable to name the stimuli involved in the conditional discrimination. Moreover, the stimuli involved in this type of auditory-visual conditional discrimination seem easier to name than in many other conditional discriminations, because the names of the comparisons are the auditory stimuli that functioned as samples in the conditional discrimination. Thus, a delayed echoic repertoire would suffice to produce the emergence of naming (see a similar analysis in Stromer, Mackay, & Remington; 1996). Moreover, the limited vocal repertoire of the four children with autism who participated in the present experiment makes it difficult to believe that they could covertly name the objects and they did not give the names in the probes during the first and the second stages. Therefore, our data demonstrate that this hypothesis may not be accurate.

Limitations and Applications

The present study has been conducted with only four children. Although this is customary in most studies of this sort, the short number of participants limits the scope of the conclusions and the study needs further replications. A possible limitation was that pre-intervention probes were conducted in only one of the three participants. The probability that any of the four children responded correctly in such probes, had them been conducted, seems remote because all children had enormous difficulties to learn each tact or selection. Moreover, the sudden execution of 9 or 10 correct responses in a 10-trial probe contrasts with the difficulties to teach the related skill, which was never acquired in less than 30

trials or even quite more. Even more, the emergence probes were repeated with several stimulus sets. Therefore, enough evidence exists that the positive results obtained in the emergence probes were due to an emergent process derived from learning the related skill (i.e., the emergence of tacts derived from learning the selections). Further studies, notwithstanding, can include a pre-intervention probe with all participants just as it was made with participant Dick in the present study.

The data of the present research have some implications for teaching of selections and tacts to children with learning disabilities. Probing the naming in the way we did in the present study could answer the question of whether that child is already producing emergent verbal skills. A positive answer would indicate that the intervention goes in the right direction towards the goal of reaching a level of sufficient verbal productivity and capacity to behaving appropriately in novel situations. The data obtained allow to take decisions about the sequence of teaching and probing in order that the child acquires new tacts and selections at a faster pace possible: First, it is likely necessary to explicitly teach the two repertoires to each child –i.e., selections and tacts. Second, once a child demonstrates selections after learning tacts (second stage), it may be possible to teach new tacts and then probe for the selections. In that second stage, the child would demonstrate the acquisition of both repertoires. Third, once a child demonstrates transfer in both directions (third stage), it may be possible to teach either tacts or selections. Teacher decisions may be based on the type of skill each particular child learns faster: If the child learns selections faster than tacts, it seems reasonable teaching the selections and probing the tacts. If the child learns tacts faster than selections, the option should be to teach the tacts and probing the emergence of the selections. Thus, this research reports findings that can be incorporated into a broader curriculum.

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