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Multiple Exemplar Instruction and Derived Relational Responding within Symmetry and Transitivity of Stimulus Equivalence

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〈요 약〉

Effects of Naming and multiple exemplar instruction (MEI) on derivational responding within stimulus equivalence relations were tested within a non-concurrent multiple baselines across the participants with multiple probes design. Four 4-year old children with autism spectrum disorder participated in the study. Three sets of stimuli which consisted of four stimulus equivalence classes were used for participants. Each stimulus equivalence class was comprised of pictures or symbols as visual stimuli, corresponding spoken words as auditory stimuli, and printed textual counterpart of the pictures or symbols as another class of visual stimuli. First, the participants received instruction on listener relations to the visual stimuli (auditory-visual) or speaker relations (visual-auditory). Then derived relational responding within symmetry (visual-auditory or auditory-visual) as Naming and within transitivity (visual-visual) as receptive comprehension of printed words were tested with the same set of stimuli. Seven out of eight participants didn't show the emergent responding in transitivity until they received explicit instruction on responding within symmetry and transitivity relations through MEI with another set of stimuli. The results were discussed in terms of Naming, MEI for establishing reinforcement histories with particular relational frames, derived responding within stimulus equivalence relations as frames.

<Keywords> : Derivational responding, Stimulus Equivalence, Relational frame, Naming

I. Introduction

Within behavior analytic literature, finding sources of emergent verbal behaviors is one of main interests of researchers (Barnes-Holmes, Barnes-Holmes, Roche, & Smeets, 2001; Carr, Wilkinson, Blackman, & McIlvane, 2000; Eikeseth & Smith, 1992; Horre & Lowe, 1996; Horne, Hughes, & Lowe, 2006; Luciano, Becerra, & Valverde, 2007; Sprinkle & Miguel, 2013; Mackay, 1991). Formation of functional equivalence relations among stimuli which don't share physical similarities was one of the topics relevant to the issue. Finding out mechanisms in which a child learn to show derived relational responding within equivalence stimulus-response relations can have significant impacts on implementation of intervention programs for

children with delays in development of verbal behaviors, especially with children who have difficulties in generative verbal behaviors (Luciano, Becerra, & Valverde, 2007;Mackay, 1991; Sidman, Cresson, & Wilson-Morris, 1974; Sidman, Rauzin, et al., 1982; Sidman & Tailby, 1982; Smeets & Barnes-Holmes, 2005; Spradlin, 2003).

A derivational visual-visual matching between a picture and a written word for the picture is an example of behavioral representation of equivalence relations among physically dissimilar stimuli. In the Sidman's study (1971), emergence of derivational responding within equivalent relations was examined using a equivalence class consisted of the pictures, spoken words, and the printed words. A participant, who could point pictures upon hearing the spoken names of them as listener response (auditory-visual stimulus-response relation with pictures) was taught to show the same listener response to the printed words (auditory-visual stimulus-response relation with printed words). Then, the participant demonstrated untaught responses within visual-visual relation as receptive reading. This emergent behavior within equivalent relations can be logically explained as stimulus-response relations in the properties of reflexivity, symmetry, and transitivity (Sidman & Tailby, 1982).

In the aforementioned study, Sidman (1971) demonstrated transfer stimulus-response relations across oral reading of words, auditory comprehension in forms of selecting visual stimuli upon hearing names of stimuli, and reading comprehensions in forms of matching printed words to the pictures. Sidman's demonstration was conducted within stimulus equivalence using conditional discrimination training in a match-to-sample (MET) format. The participant was taught to select B1 not B2 when presented with A1, and then taught selecting C1 not C2 in the presence of B1. Derived stimulus relations, selecting A1 not A2 with the presence of B1 as symmetry, selecting C1 not C2 with the presence of A1 and vice versa as transitivity were emerged. In this case a stimulus equivalency between A1, B1, and C1 was proved. From the perspective of stimulus equivalence theory, these emergent performances in the tests can be logically predicted within these equivalent relations. Sidman and Tailby (1982) later interpreted the emergence of reading comprehension that learning the auditory-visual relations with pictures and printed words for the pictures was sufficient for emergence of visual-visual relations as reading comprehension. Capabilities for derived responding within equivalent relations are considered to be "given" within this perspective.

In the relational frame theory (RFT), symmetry in a stimulus equivalence is referred to as mutual entailment and transitivity as combinatorial entailment and these emergent relational responding to the stimuli are believed to be established as over arching relational frames as higher order responses with reinforcement histories through multiple exemplar experiences within a verbal community ontogenically (Barnes-Holmes, Barnes-Holmes, Roche, & Smeets, 2001; Greer & Specksman, 2009; Greer & Ross, 2008). Hayes and Wilson (1993) referred to responding within relational frames as type of generalized responses. The generalized responses are termed "arbitrarily applicable relational responding within specific patterns as relational frames. Individual verbal behavior is framing relationally." (Hayes, Fox, Gifford, Wilson, Barnes-Holmes, & Healy, 2001, p. 29)

Individuals acquire the frames with a variety of exemplars of the specific frames as higher order responses. Individuals who do not acquire these higher order responses through experience in their environments, they might be able to acquire these frames through instruction in which the core features of the frames are presented exaggerated within variety of exemplars (Geer, 2008; Greer & Keohane, 2005; Greer & Ross, 2008: Greer & Specksman, 2009). Greer et al. (2005) tested effects of Multiple exemplar instruction (MEI) on acquisition of Naming frame as a higher order responses. Naming is an emergence of untaught speaker responses with instruction of listener responses or vice versa (Horne & Lowe, 1996). For example, Naming occurs when a child says "ambulance" when the child sees an ambulance due to prior experience of hearing someone's saying "ambulance" with the presence of an ambulance within his/her sight. (Greer, Stolfi, Chavez-Brown, & Revera-Valdes, 2005). Within perspective of stimulus equivalence, Naming is considered to be untaught generalized responses within symmetry relations between listener responses and speaker responses (Horne, Hughes, & Lowe, 2006; Horne & Lowe, 1996). Within RFT, Naming is a type of joint stimulus control established through multiple exemplar experiences within a frame of coordination of which relation is one of sameness or this is that (Hayes, et al., 2001).

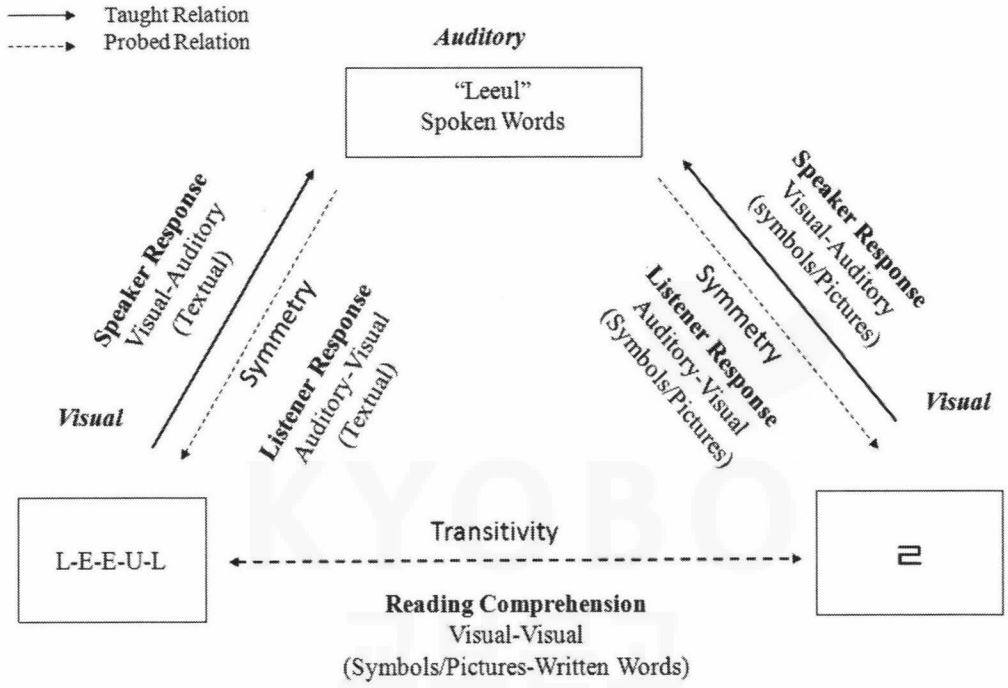
Luciano, Becerra, and Valverde (2007)tested effects of MEI on derived equivalence relations, receptive symmetry with an infant as a participant. First, the participant was trained object-sound relations using unfamiliar objects (i.e., seeing a metal spring -saying "To") and then tested for receptive symmetry relations, sound-object relations (i.e., hearing "To" selecting a metal spring). The participant didn't show the derived receptive symmetry until she received MEI.

In the present study, effects of MEI on acquisition of derived auditory-visual (listener response) or visual-auditory stimulus-response relations (speaker response) within symmetry relations as Naming and on acquisition of untaught visual-visual relations within transitivity relations as reading comprehension were tested with four preschoolers with developmental disabilities. The stimulus equivalence classes were comprised of pictures/symbols as visual stimuli, textual counterparts as another type of visual stimuli (printed words of the pictures or symbols), and spoken words of the pictures/symbols as auditory stimuli.

First, participants were taught listener responses by pointing visual stimuli upon hearing the spoken name of the stimuli (auditory-visual stimulus-response relation) or speaker response (visual-auditory relation) in a MTS format. The participants were tested for derived visual-auditory or auditory-visual symmetry relations as Naming and derived visual-visual transitivity as reading comprehension with the same set of two types visual stimuli (pictures/symbols and the textual counterpart to them) after the instruction. Next, participants received MEI on relational responding within symmetry and transitivity with another set of stimuli. Then repeated probes were conducted for derivational responding in transitivity with the original set of stimuli, Set 1. In order to examine generalized responding in symmetry and transitivity with novel set of stimuli, probes for the target responses followed the listener or speaker instruction with the set of novel stimuli.

The following questions were examined in the present study: (1) teaching one stimulus-response relation

(auditory-visual or visual-auditory) with a stimulus equivalence class comprised of pictures/symbols, spoken words, and printed words as the textual counterpart of the pictures or symbols would induce derived relational responding in symmetry (transfer stimulus function from auditory-visual to visual-auditory relations or vice versa) as Naming and in transitivity an emergent visual-visual relations as in receptive comprehension of printed words, and (2) MEI will induce derivational relational responding in symmetry and in transitivity within a stimulus equivalence. The stimulus-response relations taught and probed were shown in Figure 1.



〈Figure 1〉 One example of the stimulus-response relations taught and probed

II. Method

1. Participants

Four 4-year old children with autism spectrum disorder (ASD) participated in the study. All of the participants failed to show emergent listener or speaker responses as Naming and emergent reading comprehension during the screening procedure for selecting participants. All of the participants vocally request desired items and labelled items with a full sentences and had reliable listener literacy (e.g., following

two-step vocal directions). All of them orally read upper and lower case alphabet letters. Two of the participants didn't have instructional history of reading sight words and the rest of the participants were in early stage of it. No participant had explicit instructional history of matching pictures or symbols to corresponding written words. Description of participants are shown in Table 1.

〈Table 1〉 Description of Participants

Participant/Age	Standard Scores	Verbal Behaviors
A/4 Years	Rossetti-infant Toddler Language Scale -33% delay in Auditory Comprehension -33% Delay in Vocal Communication	-Follow 3-step Vocal Direction -Engaged in Conversation -Reading Letters & Numbers
B/4 Years	Preschool Language Scale-4th -50% delay in Auditory Comprehension -50% Delay in Vocal Communication	-Request/Label in Full Sentences -Decoding Sight Words -Early Reader
C/4 Years	Rossetti-infant Toddler Language Scale -50% delay in Auditory Comprehension -50% Delay in Vocal Communication	-Request/Label in Full Sentences -Decoding Sight Words -Early Reader
D/4 Years	Preschool Language Scale-4th (Evaluated When 4 years Old) -2.4 Age Equivalent Auditory Comprehension -2.7 Age Equivalent Vocal Communication	-Request/Label in Full Sentences -Decoding Sight Words -Early Reader

2. Setting

The study was conducted in a CABAS® (Comprehensive Application of Behavior Analysis in Schooling) preschool which was a publicly funded private school. The school was located in a suburb of a large metropolitan city. Behavior analysis was applied comprehensively to instruction, behavior management, and staff training in the school.

The experimental sessions were conducted in a small tutoring room. Prior to a session, the experimenter set up the experimental materials (i.e., flashcards and an video camera which was for reliability of data collected) in the room. Then the experimenter visited the participant's classroom, pulled the participant out, and took the child to the tutoring room. The session started as soon as the participant sat at a child size table in the room. The size of the room was 3X5 meters and the size of the table was 60X45 centimeters. There were some toys such as Legos® and cars. The participants were given short break during the sessions and the sessions lasted 40 minutes in an average. Only experimenter and the child stayed in the room throughout the sessions except when the second observer was present in order to obtain the inter observer agreements for the data collected during the study. Data was collected as a part of regular instruction in the same way that all other instructions were delivered in the school, hence no special habituation procedures were necessary.

3. Stimuli

Three sets of symbols (i.e., Korean alphabets) and pictures (i.e., rare sea animals or construction tools) which had minimal possibilities of connection to their existing instructional histories of the participants were selected as visual stimuli. Each set had two subsets: symbols or pictures as one subset and the printed names for the symbols or pictures as the other subset. Three or more different visual exemplars were presented for each item in the sets. Each stimulus was presented on a 15X10 centimeter index card in black and white. The target stimuli are shown in Table 2.

〈Table 2〉 Three Sets of Visual Stimuli

Set 1	Set 2	Set 3
ㄱ ㄹ ㅂ ㅅ	squid, manta, eel, conch	snips, pry, cum, wax

4. Independent variables

The independent variable was multiple exemplar instruction (MEI) on relational responding within stimulus equivalence (i.e., symmetry and transitivity relations between symbols/pictures, printed words as counterparts of them, and spoken words) in order to test whether MEI induced generalized responding within symmetry as Naming and within transitivity as an emergent reading comprehension. Instruction as independent variables was delivered in learn units as potential operants where three-term contingencies (i.e., an antecedent, a response, and a consequence) were presented (Greer, 2002).

5. Dependent variables and Response Definition

Three response classes were taught during instruction phases or tested during probe phases using two types of subsets of visual stimuli, a set of pictures/symbols and a set of printed words, textual counterparts for them. The response classes targeted were listener responses, speaker responses, and reading comprehension. A listener response to the pictures/symbols was selecting the pictures/symbols upon hearing the corresponding spoken words, which was auditory-visual stimulus-response relation. A speaker response to the pictures/symbols

was saying the name of the picture/symbols when presented on flash card, which was auditory-visual relation. A listener response or a speaker response to the printed words was same as those with printed pictures/symbols. Reading comprehension was matching two visual stimuli which shared the same spoken words, which was in visual-visual relation. For example, reading comprehension occurred when the participants matched a printed symbol 'ㄱ'to another visual stimuli 'k-i.'

Two types of stimulus-response relations within a stimulus equivalence were targeted during probe sessions. One of them were responding within symmetry between listener responses and speaker responses which is Naming. For example, with a symbol 'ㄱ' in Set 1, participants were taught listener responses (auditory-visual) and then probe sessions were conducted for untaught speaker responses (visual-auditory) which was symmetry to the listener response (auditory-visual). Symmetry with printed words 'ki' was also targeted with the same procedure. If participants demonstrated untaught listener or speaker responding within symmetry using the two types of visual stimuli, Naming with those stimuli was demonstrated. When visual-visual matching between the symbol 'ㄱ' and the printed word 'k-i' occurred, transitivity was demonstrated between the spoken word "Ki," the symbol 'ㄱ,' and the printed words for the symbol 'k-i.' Thus, relational responding within a stimulus equivalence between those stimulus class was proved.

The dependent variables were untaught listener or speaker responses in symmetry as Naming and transitivity as reading comprehension during pre and post listener- or speaker-instruction probes. Targeted response classes with pictures/symbols and with printed words during the probes were: 1) untaught listener (auditory-visual) as symmetry relations to trained speaker responses (visual-auditory) and vice versa and 2) untaught reading comprehension (visual-visual) as responding in transitivity with the two visual stimuli (a pictures/symbols and a printed word) and the spoken word.

6. Data Collection

20 learn units were presented during instruction sessions. Learn units for the listener responses were presented with symbols or pictures printed on flash cards. The experimenter presented one exemplar and one non-exemplar in front of the participants along with a vocal antecedent, "Point to ___ " and waited for 3 seconds for the participant to respond. If the participant pointed to the target exemplar within 3 seconds, the experimenter delivered reinforcers and praise immediately and recorded "+" in the data sheet. If the participant pointed to the non-exemplar or didn't respond within 3 seconds, a correction was provided. First, the experimenter repeated the vocal antecedent and guided the participant to point the target exemplar with a gesture to the target. If the participant pointed to the target with the gestural prompt, the experimenter presented next learn unit after a brief pause. If the participant didn't point to the target with the gestural prompt, the experimenter guided the participant to point to the target with hand-over-hand guidance. The procedure of learn unit presentation for listener textual responses with printed words was same as that with pictures or symbols.

During the instruction for speaker responses, the experimenter presented one of the pictures or symbols in front of the participants. The participants were required to emit a vocal response to the stimulus correctly by labeling the picture or symbol within 3 seconds. If the participants emitted the target vocal response within 3 seconds, the experimenter praised immediately and recorded "+." If the participants didn't emit the target vocal response within 3 seconds, the experimenter provided an echoic and waited 3 seconds for them to respond. The experimenter provided one more echoic if the participant didn't emit the vocal response. The experimenter provided next learn unit after a brief pause. The instructional procedure for the speaker textual responses with printed words was same as that with pictures or symbols.

During the instruction sessions for reading comprehension in MEI, the experimenter presented one exemplar and one non-exemplar (pictures or symbols) as comparisons in front of the participants. Then, the participants were given a sample stimulus (a printed word) to match to the target comparison stimulus (a corresponding picture or symbol) along with a vocal antecedent, "Match." If the participants responded correctly within 3 seconds to the given antecedents, praises were delivered immediately and recorded as correct responses (+), and if the participants responded incorrectly, or did not respond within three second, the experimenter recorded as incorrect responses (-). As a correction procedure for the incorrect response, the experimenter represented the vocal antecedent "Match" with a gesture to the target exemplar. If the participant didn't emit the response, the experimenter prompted the participant to match with hand-over-hand guidance. 20 probe trials were presented during probe sessions. No consequences for correct or incorrect responses were delivered. All other aspects of the probe procedures for listener, speaker responses and reading comprehension were same as those during the instruction.

7. Design and Procedure

Data were collected within a time lagged multiple baseline design (Greer, Yuan, Gautreaux, 2005) across participants with multiple probes for each participant. First, instruction on either listener or speaker responses with one set of pictures/symbols and a set of the textual counterparts was delivered for each participant. Then probes for untaught speaker or listener with pictures/symbols and with the textual counterparts as symmetry relations and reading comprehension as transitivity relations were conducted with the same set of stimuli. The results of the probes for untaught response classes with one set of stimuli (pictures/symbols and the textual counterpart) constituted baseline data. MEI with another set of pictures/symbols and the textual counterparts was provided as treatment for each participant. Next, post-MEI probes were conducted with the original set of stimuli. Onsets of baseline phases and intervention phases were delayed stepwise with the second, the third, and the fourth participant. Throughout the experiment, types of stimuli (i.e., abstract symbols or non-abstract pictures)were counterbalanced across participants throughout the experiment: Participant A and Participant C received pre- and post- instruction probe with

Set 1 and MEI with Set 2; with Participant B and Participant D received pre- and post- instruction probe with Set 2 and received the MEI with Set 1.

1) Pre-experimental probe

Probes were conducted with all of the sets across all of the stimulus-response relations targeted throughout the experiment —listener responses and speaker responses to pictures/symbols and to textual counterparts to them and reading comprehension.

2) Listener or speaker instruction with symbols/pictures and printed words for them (auditory-visual or visual-auditory relations).

Participant A and Participant D received speaker instruction (visual-auditory relation) with Set 1 and with Set 2 respectively. Participant B and Participant C received listener responses (auditory-visual relation) with Set 2 and with Set 1 respectively.

3) Probe for derived relational responding in symmetry as Naming and in transitivity as emergent reading comprehension.

Probe sessions for derived relational responding in symmetry as listener or speaker Naming and for derived relational responding in transitivity as emergent reading comprehension were conducted after they reached to the mastery criteria during instruction on either listener or speaker responses. Participant A and Participant D received probes on derived relational listener responding in symmetry to the speaker. Participant B and Participant C received probes on derived speaker responses within symmetry to the listener responses.

4) MEI and post-MEI probe

Participant A and Participant D received the MEI with Set 2 and received probes on emergent reading comprehension with the original set of stimuli, Set 1. Participant B and Participant C received the MEI with Set 1 and received probes on emergent reading comprehension with the original set of stimuli, Set 2. MEI was delivered in order to teach the participants relational responding within symmetry and in transitivity with another set of stimuli: listener responses and speaker responses to picture/symbols, listener responses to texutual counterparts to them, and reading comprehension. During an MEI session, learn units were delivered interspersed across all response classes. A possible sequence of the delivery of the learn units during the MEI using the stimuli Set 2 was as follows: pointing to a picture of a manta as a listener response, reading the written word "EEL," labeling a picture of a conch as speaker responses, pointing to written word "MANTA" as a listener response, followed by matching a picture of an eel to the corresponding textual stimulus "EEL" as reading comprehension.

5) Post-MEI instruction and probes

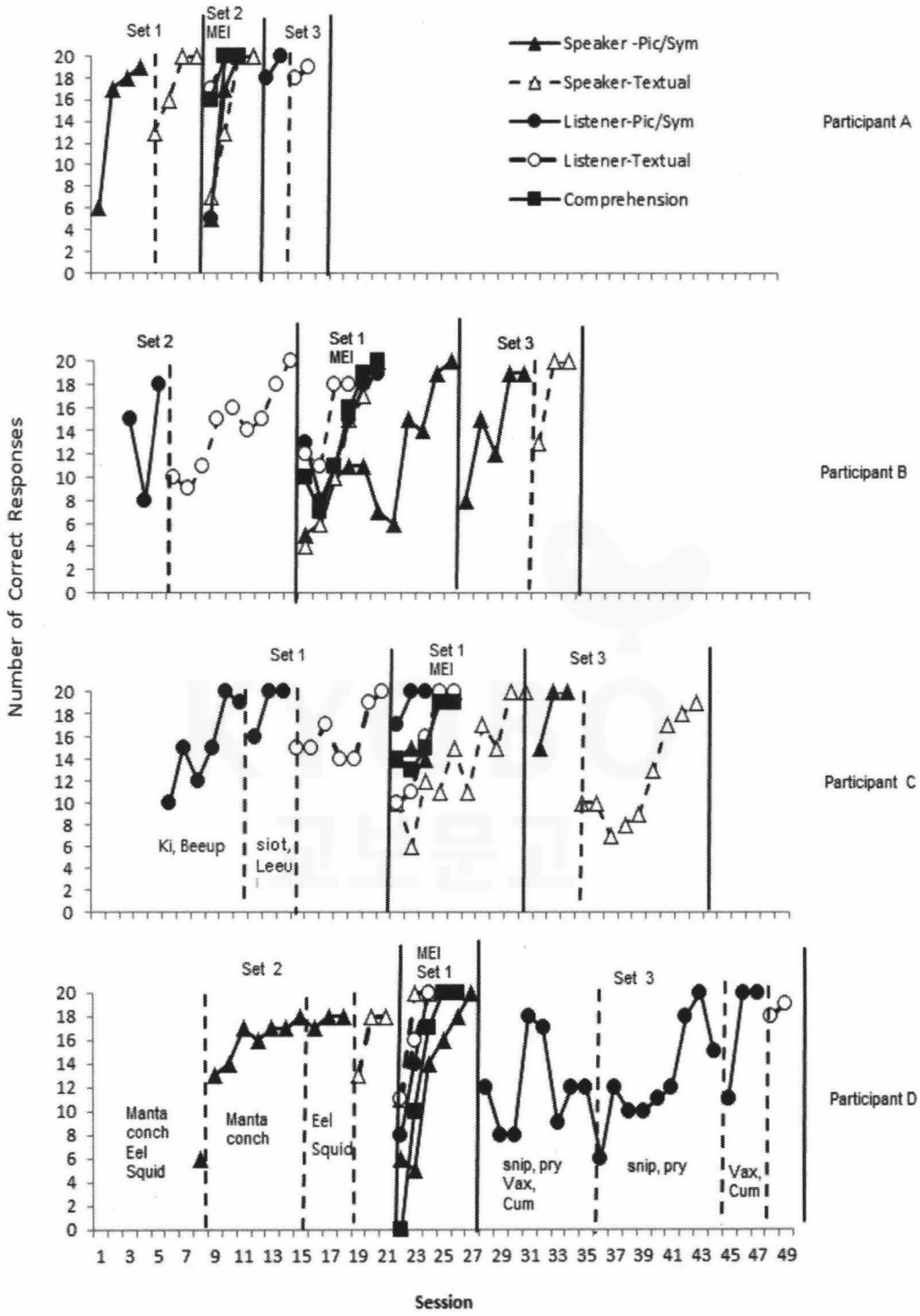
Post-MEI instruction on either listener responses or speaker responses were delivered with a set of novel stimuli, Set 3, to test whether the participants showed Naming and emergent reading comprehension as derived relational responding in symmetry and transitivity with the set of novel stimuli. The stimulus-response on which the participant received instruction were counterbalanced within each participant.

8. Interobserver Agreement

Interobserver agreements (IOAs) were obtained by the second observers who collected data independently while the experimenter worked with the participants or through observation of video tapes afterward. The second observer was a teacher assistant in the participants' classroom. Interobserver agreement was calculated by dividing the number of responses in agreement by the number of agreement plus the number of disagreements and multiplying by 100% (Cooper, Heron, & Heward, 1987). For Participant A, IOA was obtained during the 82% of probe sessions and during the 33% of instruction sessions. Mean of IOA for probe sessions was 98.9, with a range from 95% to 100%; and mean for instruction sessions was 98.5 %, with a range from 95% to 100%. For Participant B, IOA was obtained during the 66% of probe sessions and during the 46.7 % of instruction sessions. The mean IOA for probe sessions was 99.7, with a range from 95 % to 100%, and the mean for instruction sessions was 99.5%, with a range from 87 % to 100%. For Participant C, IOA was obtained during the 78% of probe sessions and during the 25.0% of instruction sessions. The mean of IOA for probe sessions was 98.6, with a range from 95% to 100%, and the mean for instruction sessions was 99.2%, with a range from 90% to 100%. For Participant D, IOA was obtained during the 55% of probe sessions and during the 31.5 % of instruction sessions. The mean of IOA for probe sessions was 100 %, and the mean for instruction sessions was 100%.

Ⅲ. Results

Figure 2 show the sequences in which participants received instruction and the performance of the participants during the instruction.



〈Figure 2〉 Number of Correct responses across responses classes

Table 3 and Figure 3 summarizes results during probes for derived relational responding in symmetry as Naming and in transitivity as emergent reading comprehension shown by the participants

〈Table 3〉 Number of Correct Derived Responses out of 20 Trials during Probe Sessions

Probe Phase	Derived Relations	A Pre/Post	B Pre/Post	C Pre/Post	D Pre/Post
Pre-Instruction	LS	Set 1			Set 2
	Pic/Sym	10			1
	Textual	5			4
	Transitivity	0			4
	SS		Set 2	Set 1	
	Pic/Sym		0	0	
	Textual		0	0	
	Transitivity		1	0	
Post-Instruction	LS	Set 1			Set 2
	Pic/Sym	20			18
	Textual	20			19
	Transitivity	10			0
	SS		Set 2	Set 1	
	Pic/Sym		18	17	
	Textual		6	14	
	Transitivity		5	3	
Post-MEI	LS	Set 1			Set 2
	Pic/Sym	20			20
	Textual	20			20
	Transitivity	20			20
	SS		Set 2	Set 1	
	Pic/Sym		20	20	
	Textual		20	20	
	Transitivity		20	20	
Pre-Instruction Novel Stimuli	LS		Set 3	Set 3	
	Pic/Sym		8	1	
	Textual		3	3	
	Transitivity		5	4	
	SS	Set 3			Set 3
	Pic/Sym	0			0
	Textual	0			0
	Transitivity	6			3
Post-Instruction Novel Stimuli	LS		Set 3	Set 3	
	Pic/Sym		20	20	
	Textual		19	20	
	Transitivity		20	20	
	SS	Set 3			Set 3
	Pic/Sym	17			20
	Textual	20			19
	Transitivity	20			19

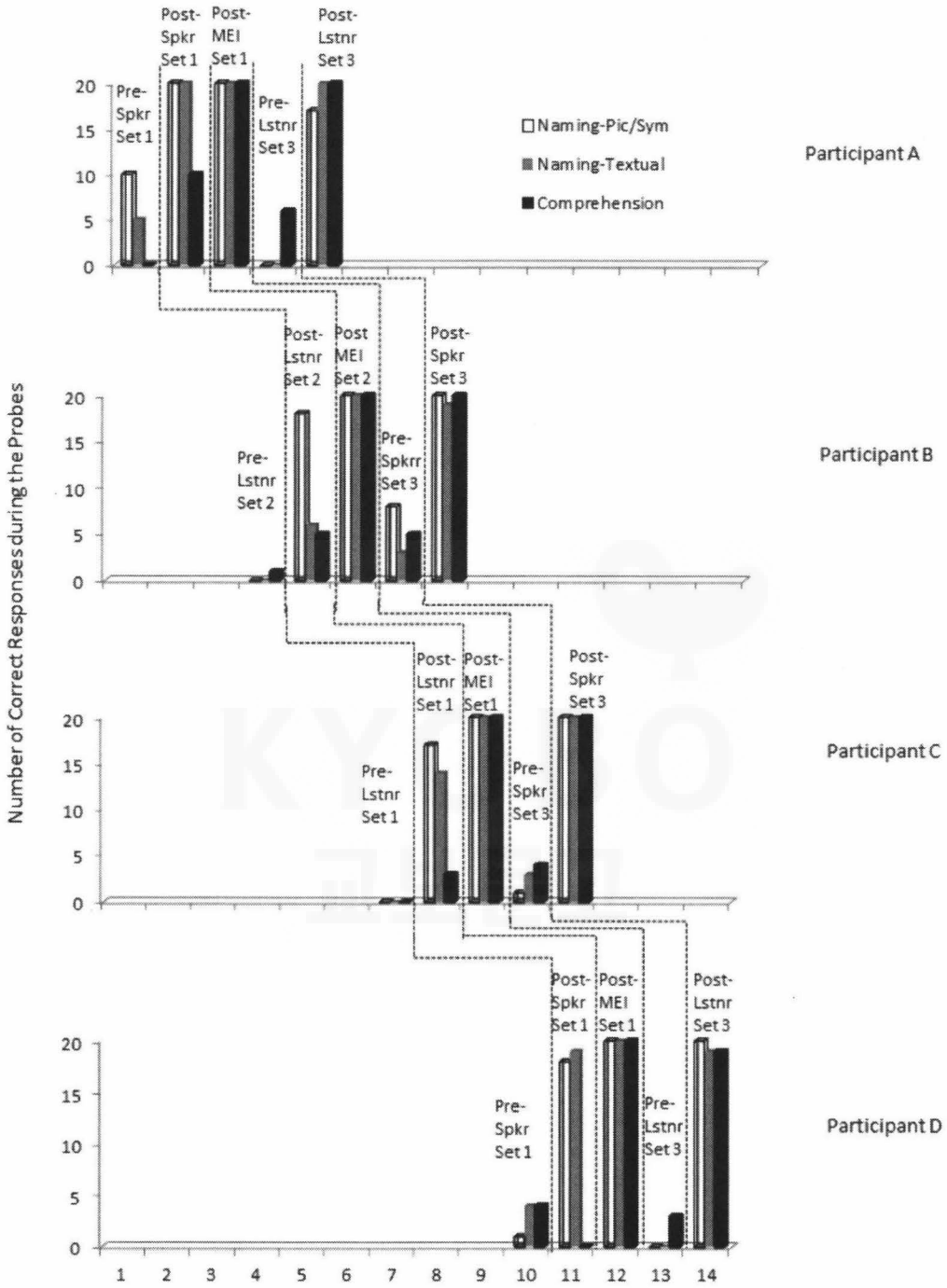
Note. LS refers to Listener Symmetry, SS refers to Speaker Symmetry, and Pic/Sym refers to Picture/Symbol. Participant A and D received speaker instruction and received probes for derived listener symmetry with Set 1 and Set 2 respectively, and Participant B and C, vice versa.

1. Instruction on Either Listener Relations or Speaker Relations and Pre-MEI Probes for Emergent Relational Responding in Symmetry as Naming and in Transitivity as Emergent Reading Comprehension

Participants A and participant D who received speaker instructions showed clear listener Naming with the sets of stimuli: Participant A showed 20 untaught listener responses to the symbols and 20 untaught listener responses to printed words of Set 1. Participant A emitted 10 correct emergent reading comprehension responses with a presence of symmetry relations in the repertoire. Participant D showed 18 correct untaught listener responses and 19 correct untaught listener responses to printed words of Set 2. Participant B and C failed to show clear transformation of function from listener responses to speaker responses to the printed words within symmetry as Naming. Participant B showed 5 correct emergent reading comprehension responses as responding in transitivity. Participant C emitted 3 correct emergent reading comprehension responses. Thus, Participant B and Participant C who received listener instruction failed to show emergent responding in symmetry as Naming and in transitivity as reading comprehension.

2. Post-MEI Probes on Derived Transitivity Relations as Emergent Reading Comprehension with Original Sets and New Sequence of Instruction & Probes on with Novel Sets of Stimuli

All of the participants initially failed to show derived visual-visual transitivity as emergent reading comprehension after they learned symmetry relations across listener responses and speaker responses to the original sets of stimuli. However, they showed derived visual-visual transitivity with the same sets of stimuli after MEI: Participant A showed 20 correct emergent reading comprehension responses to Set 1. Participant C, 18 correct responses with Set 1, Participant B, 20 correct responses with Set 2; and Participant D, 20 correct responses with Set 2. Participant A showed 17 correct untaught speaker responses,20 correct untaught speaker responses to the printed words, and 20 emergent reading comprehension responses to the set of novel stimuli of Set 3. Participant B showed 20 correct listener Naming responses with pictures and symbols, 19 with printed words, and 20 emergent reading comprehension responses. Participant C demonstrated 20 correct listener Naming responses with pictures and symbols, 20 correct responses with printed words, and 20 emergent reading comprehension responses. Participant D demonstrated 20 speaker Naming responses to the pictures and symbols, 19 responses with printed words, and 19 emergent reading comprehension responses. Participant A, Participant C, and Participant D showed clear emergent Naming and emergent reading comprehension with the set of novel stimuli, Set 3, thus demonstrated clear derived relational responding in symmetry and transitivity relations.



〈Figure 3〉 Number of correct derived relational responding within symmetry as Naming and within transitivity as reading comprehension.

IV. Discussion

The results of the study demonstrated that MEI induced derived relational responding in symmetry as speaker Naming and in transitivity as emergent reading comprehension reliably. Thus the results support the stance of RFT in that reinforcement history with specific relational frames as generalized higher-order responses induce derived relational responding within the frames reliably. For two out of four of the participants of the present study failed to show relational responding within transitivity with presence of Naming in their repertoire. This implied that, acquisition of symmetry in audio-visual relations as in Naming with two types of visual stimuli (picture/ symbols and printed words for them) was not sufficient in inducing another equivalence relations in visual-visual, transitivity as emergent reading comprehension. These results don't support Sidman's stance which explained logical basis for emergent responding within symmetry and transitivity of stimulus equivalence relations (1971).

In the present study, participants were taught one stimulus-response relations (auditory-visual or vice versa) to a set of stimuli and were tested for derived symmetry relations and transitivity relations as Naming and emergent reading comprehension. Participant B and Participant C who received listener instructions failed to show clear transformation of stimulus function in symmetry relations as speaker Naming. On the contrary, the participants who received speaker instructions emitted untaught listener responses as Naming as transformation of the stimulus function in symmetry from speaker responses to listener responses. These results imply that auditory comprehension in which a child attends to an item when she or he hears the name of the item likely comes before the child learns oral labeling (Sidman, 1994; Lowe, Harris, & Randle, 2002). These data also provided empirical evidences for the suggestion (Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005) that untaught listener responses might be evoked for typically developing children once oral labeling was acquired.

For the participants who failed to show derived symmetry and transitivity received explicit instruction on relational responding in stimulus equivalence (in symmetry and in transitivity) through MEI. In order to test whether the participants emitted target untaught response classes with a set of novel stimuli, the last phases of experiment were conducted with Set 3. All of the participants emitted clear transformation of stimulus function in symmetry and in transitivity, thus demonstrated Naming and emergent reading comprehension during post-instruction probes.

The results of the present study supported the findings of Greer, Stolfi, Chavez-Brown, and Rivera-Valdes's (2005) study in which MEI for naming frames facilitated emission of a higher order operant. In the study, they tested an effect of MEI on formation of a bidirectional relation across listener responses and speaker responses as joint stimulus controls to sets of printed pictures, a specific frame of relational responding (transforming stimulus function across listener responses to speaker responses). In the present study, sets of corresponding printed words as textual stimuli were added to sets of pictures/symbols, thus the

Naming frame was extended to the sets of textual stimuli, in turn relational frames also extended from symmetry and transitivity.

The results of the present study demonstrate that each frame of relational responding should be considered to be independent. For example, even after the participants acquired a bi-directional relation (symmetry) between the written word 'L-E-E-U-L' and spoken name "leeul" and another bi-directional relation (symmetry) between the symbol 'ㄹ' and the common spoken name "leeul," the participants didn't show emergent equivalent relations (transitivity) between the two subsets of visual stimuli 'L-E-E-U-L' and 'ㄹ.' All the participants needed MEI in order to acquire the specific relational frame, visual-visual relations (transitivity). These results supported the findings of the research on MEI (Greer, Nirgudkar, & Lee Park, 2003; Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005 Greer, Yuan, & Gautreaux, 2005 Luke, Greer, Singer-Dudek, & Keohane, 2011 Nuzzolo-Gomez & Greer, 2004) in which MEI for a specific relational frame facilitated acquisition of the frame by the participants. The multiple exemplar experiences controlled generative behavior within learned relational frames.

For the future study, variables which affect level of explicitly and intensity of MEI required for acquisition of derivational responding within a special relational frame need to be examined systematically. A lack of systematic manipulations to test if Naming affected the emergence of untaught reading comprehension was limitation of the present study. Controlling the differences in the length of instructional history reading sight words or the differences in numbers of mastered sight words among the participants could have resulted in differences in performance of the participants.

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Abstract

다중반응교수가 자극등가의 대칭관계와 타동성관계 안에서 보이는 파생적 언어반응의 출현에 미치는 영향

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본 논문은 자극등가관계 안에서 보이는 파생적 언어반응의 출현에 다중반응교수 (Multiple Exemplar Instruction, MEI)가 보이는 효과를 점검하였다. 다중프로브가 동반된 비 동시 중다 기초선 계획이 이용되었고 네 명의 자폐성 아동들이 참여하였으며 연구 당시 아동들의 나이는 4세였다. 세 셋트의 자극이 이용되었고, 각 셋트에는 네 개의 자극 등가 군이 포함되었다. 각 자극 등가 군에는 시각적 자극인 상징/그림, 또 한 유형의 시각적 자극인 그에 상응되는 인쇄된 단어, 그리고 청각적 자극인 발화된 음성 단어로 이루어 져 있었다. 첫 번째로 하나의 셋트를 가지고 두 유형의 시각적 자극에 대한 청자반응 (청각자극-시각반응) 혹은 화자 반응 (시각자극-청각 반응)에 대한 교수가 이루어 졌고, 둘 째, 교수되지 않은 반응이 자극등가의 대칭관계 (시각자극-청각반응 혹은 청각자극-시각반응) 와 타동성 관계 (시각자극-시각반응)의 파생적 언어반응의 출현을 점검하기 위한 프로브가 실행되었다. 대상자에게서 분명한 파생적 언어반응의 보이지 않아, 세 번째로 다중반응교수(MEI)가 실시되었다. 다중반응교수 동안에 대상자들은 다른 자극 셋트를 가지고 자극등가의 대칭관계와 타동성관계 안에서 반응하는 교수이력을 형성하였다. 네 번째, 다중반응교수 후 원래의 자극 셋트로 돌아가 파생적 언어반응을 다시 프로브 한 결과 모든 대상자가 분명하게 파생적 언어반응을 보였다. 위 반응의 일반화를 점검하기 위해 새로운 자극 셋트로 같은 절차를 거쳐서 파생적 언어반응의 유무를 점검하였고 모든 대상자들이 새로운 자극에 대해서도 분명한 파생적 언어반응을 보여주었다. 위의 결과로 모든 대상자에게서 다중반응교수가 안정적으로 파생적 언어반응이 유도되었다는 것을 알 수 있었다.

주제어: 파생적 언어반응, 자극등가. 상관적 틀, 네이밍

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