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EQUIVALENCE CLASS FORMATION IN ELDERLY PERSONS

Luis Antonio Pérez-González y Vanessa Moreno-Sierra
Universidad de Oviedo

To study equivalence class formation in elderly persons, ten people 13- to 74-years old received training of the conditional discriminations required for equivalence and testing of symmetry, transitivity, and equivalence. First, samples A1 or A2 were randomly presented with comparisons B1 and B2; selections of B1 in the presence of A1 and selections of B2 in the presence of A2 were reinforced. Then, B1 or B2 were the sample and C1 and C2 were the comparisons; selections of C1 in the presence of B1 and selections of C2 in the presence of B2 were reinforced. Later, trials of these baseline discriminations were alternated with other trials in which former samples were the comparisons and former comparisons were the samples (e. g., B1 and B2 alternated as samples and A1 and A2 were the comparisons) but selections were not reinforced —symmetry tests. Also, probes in which A1 or A2 were the samples and C1 and C2 were the comparisons were presented without reinforcement —transitivity test. Finally, sample C1 or C2 and comparisons A1 and A2 were presented in other unreinforced trials —equivalence test. The four 13-to-53-years elderly people and two people older than 64 responded with almost no errors to the tests of symmetry; the remaining 4 people responded initially with errors but finally demonstrated symmetry. All participants, but one, made almost no errors in the probes of transitivity and equivalence. Thus, stimulus equivalence was demonstrated in elderly people. A comparison between the performance in the training and in the tests of transitivity and equivalence showed that elderly people remembered (had contextual recognition) less than younger adults in training trials but remembering was not affected in tests for stimulus equivalence.

La formación de clases de equivalencia en ancianos. Para explorar la formación de equivalencia de estímulos en ancianos, diez personas de diversas edades aprendieron las discriminaciones condicionales necesarias para la equivalencia y se probaron la simetría, la transitividad y la equivalencia. Primero, se presentaron las muestras A1 o A2 con las comparaciones B1 y B2; se reforzaron las selecciones de B1, en presencia de A1, y de B2, en presencia de A2. Después B1 y B2 fueron las muestras y C1 y C2 fueron las comparaciones; se reforzaron las selecciones de C1, en presencia de B1, y de C2, en presencia de B2. Entonces, se alternaron ensayos de estas discriminaciones de línea base con otros ensayos en los que muestras anteriores fueron las comparaciones y comparaciones anteriores fueron las muestras (e. g., B1 y B2 alternaron como muestras y A1 y A2 como comparaciones) pero las selecciones no fueron reforzadas —pruebas de simetría. También se presentaron sin reforzamiento ensayos en los que A1 y A2 fueron las muestras y C1 y C2 fueron las comparaciones —prueba de transitividad. Finalmente, se presentaron la muestra C1 o C2 y las comparaciones A1 y A2 en otros ensayos sin reforzamiento —prueba de equivalencia. Las 4 personas de 13 a 53 años y dos personas mayores de 64 respondieron casi sin errores a las pruebas de simetría; los otros 4 ancianos respondieron inicialmente con errores, pero pasaron las pruebas de simetría. La mayoría de los participantes —todos excepto uno— respondieron sin apenas errores en las pruebas de transitividad y equivalencia. De este modo, se demostró la equivalencia de estímulos en ancianos. Una comparación entre la ejecución durante el entrenamiento y en las pruebas de transitividad y equivalencia mostró que los ancianos recordaron peor (tuvieron peor reconocimiento contextual) que los adultos jóvenes en las discriminaciones de entrenamiento, pero el recuerdo no se alteró en las pruebas de equivalencia..

Correspondencia: Luis Antonio Pérez-González
Departamento de Psicología
Plaza Feijoo, s/n. Universidad de Oviedo
33005 Oviedo (Spain)
E-mail: laperez@sci.cpd.uniovi.es

Conditional-discrimination procedures are very useful to study some complex processes that seem almost exclusive to humans. In a typical conditional discrimination, a simultaneous discrimination between two or more stimuli —the comparisons— has to be done. Depending on the presence of an additional stimulus —the sample—, which changes randomly over trials, the selection of a particular comparison is reinforced. Thus, when sample A1 is presented, the selection of B1 —but not of B2— is reinforced; when sample A2 is presented, the selection of B2 —but not of B1— is reinforced. The discrimination between comparisons B1 and B2 is said to be conditional to the presence of sample A1 or A2.

One characteristic of human performance is that, after being taught several conditional discriminations, a person typically responds in very precise ways when presented to novel conditional discriminations, even if no differential reinforcement is provided for responding. Stimulus equivalence is the most documented of such untrained performances. In a typical experiment on stimulus equivalence, two conditional discriminations are trained: responses to B1 in the presence of A1 and responses to B2 in the presence of A2 are reinforced (the AB conditional discrimination); and responses to C1 in the presence of B1 and responses to C2 in the presence of B2 are also reinforced (the BC conditional discrimination). Then, new conditional discriminations are obtained: (1) If stimuli A1 and A2 alternate as samples over trials and these stimuli are presented also as comparisons, humans typically select comparison A1 in the presence of A1 and comparison A2 in the presence of A2. This unreinforced responding is called reflexivity. (2) If stimuli B1 and B2 alternate as samples over trials, and A1 and A2 are the comparisons, humans typically select A1 in the presence of B1 and A2 in the presence of B2. Because the functions of A stimuli in this discrimination are the same as the functions of B stimuli in AB and the functions of B stimuli are the same as the functions of A in AB, this performance is called symmetry. (3) If stimuli A1 and A2 are presented as samples, and C1 and C2 are the comparisons, a person typically select C1 in the presence of A1 and select C2 in the presence of A2. Given that the selection of C1 in the presence of A1 occurs because the selection of B1 to A1 (in AB) and the selection of C1 to B1 (in BC) have been reinforced, this performance is called transitivity.

Reflexivity, symmetry, and transitivity are the performances that, all together, define stimulus equivalence (Sidman & Tailby, 1982). Presenting C1 and C2 as samples and A1 and A2 as comparisons also produces the selection of A1 in the presence of C1 and of A2 in the presence of C2. Because the functions of A and C as samples and comparisons are the reverse to the functions of these stimuli in the trained discriminations and the training of those stimuli with B is necessary for the untrained performance, the responding of this conditional discrimination is also considered as demonstrating equivalence. After these performances are shown, the functions of A1, B1, and C1 are equivalent, because any of these stimuli can accomplish the function of any other in any conditional discrimination. Then, these stimuli form an arbitrary stimulus class. Stimuli A2, B2, and C2 are also equivalent and, therefore, form another stimulus class. The phenomenon of stimulus equivalence has been broadly documented (see Sidman, 1994 for an extensive description of studies and Pérez-González, 1998, for a source of texts —written in Spanish).

Stimulus equivalence as defined by Sidman and Tailby (1982) is considered so far as a phenomenon almost exclusively human, given that only a non-human animal showed stimulus equivalence —a sea lion (Schusterman & Kastak, 1993). The majority of published studies used college students and children as participants. A few studies on equivalence and related processes, have used normal adults (e. g., Bush, Sidman & de Rose, 1989; Gatch & Osborne, 1989; L. J. Hayes, Thompson & Hayes, 1989; Pérez-González, 1994; Sidman, Kirk & Willson-Morris, 1985; Sidman, Wynne, Maguire & Barnes, 1989; Steele & Hayes, 1991). Thus, the range in ages of the persons who have shown stimulus equivalence goes from very young children to middle-age adults. Usually, children require more elaborate procedures to learn the conditional discriminations, but once they are acquired, the initial probes for equivalence are successful. Little is known, however, about the processes of forming equivalence classes in older people. It would be useful to know whether the elderly differ from younger people in the acquisition of conditional discriminations, the maintenance of acquired discriminations, and the emergence of new relations in novel conditional discriminations. Moreover, it would help to clarify the controversy about what functions related to remembering are altered in the elderly (e. g., Braza Lloret, 1993). The purpose of this research was to study stimulus equivalence formation in the elderly. To compare performance of the elderly with that of younger people, we used the above-explained procedure and probed equivalence with people of a wide range of ages. We looked at the performances during all training and probe procedures. Two experiments were conducted, with slight differences in procedure. The discussion of the target results will be conducted in the General Discussion.

Experiment 1

Method

Participants

To compare results across ages, one girl (NUA, 13-years old, female -f), three young adults (PMA, 21, f; ROA, 44, f; PEO, 53, male -m), and four elderly (BPA, 66, f; RGO, 67, m; ESO, 70, m; CSA, 74, f) participated. RGO suffered a lung emphysema disease that required a permanent supply of oxygen. They were Spanish speakers and members of the family of one of the experimenters. They did not receive any monetary payment to participate; instead, they collaborated with the purpose of helping this experimenter with her studies. They did not know about the purpose of the study.

Procedure

Setting and instructions

The experiment was conducted in a room at the house of the participants in a single session with each participant. Only the participant and the experimenter were present in the room, except for the session with BPA, in which an observer was also present.

Once in the room, the experimenter told the participants that a series of cards with three different figures, one on the top and two on the bottom, were going to be presented; they had to select one of the figures on the bottom. The experimenter also told them that that was all the information they were going to receive about the research and that they had to listen carefully to what the experimenter was going to tell them after each selection. One card with three figures was presented on the table. The experimenter was seated in front of the participant. However, the experimenter was standing behind participants PMA, ROA, RGO, and CSA and the cards were presented from the back of them, so that the participant could not notice any involuntary gesture from the experimenter.

Stimuli and relations

The stimuli were the six visual forms shown in Figure 1. Shapes A1 and A2, as samples, and shapes B1 and B2, as comparisons, defined the AB relations. Shapes B1 and B2, as samples, and shapes C1 and C2, as comparisons, defined the BC relations. The AB and BC relations were the baseline relations. The derived relations BA and CB (symmetry), AC (transitivity), and CA (equivalence) were defined in an analogue way to AB and BC.

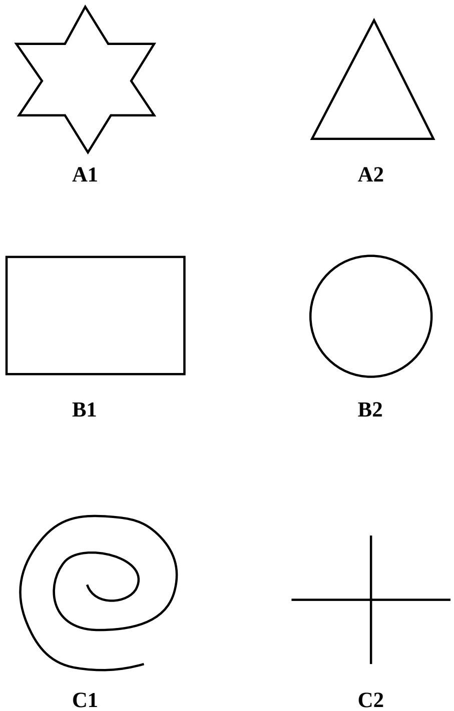

Figure 1. The stimuli used in Experiments 1 and 2. Below each figure there are the notations used by the experimenters; however, the pictures were presented to the participants without the notations.

Specific Procedure

In each trial, one card with the form denoted with a letter (the sample —i. e. , A1) on the top and two forms denoted with another letter (the comparisons —i. e., B1 and B2) on the bottom, one besides the other, was presented to the participant. A selection response was defined as touching one of the bottom figures of the card with one finger after the presentation of it. Selections of the comparison with the same numeral as the sample were considered correct (i. e., B1 when the sample was A1). In the initial training phases, selections of the correct comparison were followed by the experimenter saying «Very good!» or «How smart you are!»; selections of the incorrect comparisons were followed by a brief «No!» The results demonstrated that the first expressions worked as reinforcers and the expression «No!» worked as an aversive stimulus in this context. Some trials after the initial phases (see Phases below) and all selections in the probes of derived relations had not programmed consequences.

A sequence of 48 trials was designed for each phase of training. In each phase, each sample of a relation appeared the same number of times (e. g., in the AB training —see below—, A1 was the sample on 24 trials and A2 was the sample on the other 24 trials), as well as the position of the comparisons (e. g., in the AB training, B1 was on the left and B2 was on the right on 24 trials and B2 was on the left and B1 was on the right on the 24 trials). The order of presentation of each sample was random. In the training phases (the first 4 phases, see below), trials of the same sequence were presented until 12 consecutive correct responses were made; then, the next phase came. In the phases with probes (see below), 12 programmed trials were of AB, 12 programmed trials were of BC, and 24 trials were of the relations being probed; 6 AB trials and 6 BC trials were followed by differential consequences, the remaining trials had not programmed consequences. The phases with probe trials finished after 6 consecutive consistent responses in the probed discriminations —either correct or incorrect, whatever happened first. When the 48-trial series was completed without reaching criterion, the experimenter started again in the first trial. The order and characteristics of the phases were the following:

AB training. Trials of the AB relations were presented. All correct selections were reinforced.

BC training. Trials of the BC relations were presented. All correct selections were reinforced.

AB and BC review. Trials of AB and BC randomly interspersed were presented. All correct selections were reinforced.

AB and BC review -50% reinforcement. It was identical to the AB and BC review, but the correct selections were reinforced only on half of the trials. On the other half, no programmed consequences occurred, regardless of the performance. Before the first trial of this phase, the participant was told that from now on not all responses were going to be followed by feedback.

BA symmetry test. A quarter of trials of AB, a quarter of BC and a half of the BA relations were randomly presented. Differential consequences followed half of the AB and BC trials. No consequences followed the other half of AB and BC trials nor the BA trials.

CB symmetry test. It was identical to the BA symmetry except that trials of CB were presented in the place of BA trials.

AC transitivity test. It was identical to the BA symmetry except that trials of AC were presented in the place of BA trials.

CA equivalence test. It was identical to the BA symmetry except that trials of CA were presented in the place of BA trials

Additional Training

For participant BPA, who did not reach the criterion of 12 consecutive correct responses in 66 trials of the AB and BC review phase, a more-detailed procedure was used: First, the AB, BC, and AB and BC review Phases were conducted. The next phase was identical to the AB training, but sample A1 was presented in every trial. Then, A2 was presented in every trial. The next phase was identical to the BC training, but sample B1 was presented in each trial. The next phase, B2 was presented in each trial. The rest of the experiment followed the same sequence of phases shown above, starting with AB and BC.

Interobserver Agreement

One of the sessions was recorded by an observer and the experimenter. The interobserver agreement (result of dividing the number of agreements by the number of agreements plus the number of disagreements) was 98%. Because of that high level of agreement and given that the response was very discrete, the remaining data were recorded by one experimenter.

Results

Tables 1 and 2 show the trials each participant needed to meet the criterion in each phase. The three youngest participants needed 27 to 45 extra trials to master the AB training Phase (15 to 33 trials before the 12 consecutive correct). Participant PEO —53-years old— needed 24 trials in the BC training Phase, but the adults 21- and 44-years old completed the rest of the phases with no errors. The youngest participant, NUA, needed 6 extra trials in the AB and BC review Phase, 11 in the BA and BC review -50% reinforcement Phase.

The four youngest participants (NUA, PMA, ROA, and PEO) responded in the symmetry, transitivity, and equivalence tests according to the definition of stimulus equivalence —i. e., they selected A1 in the presence of B1 and A2 in the presence of B2 in the BA symmetry test; they selected B1 in the presence of C1 and B2 in the presence of

Table 1

Trials and errors (in brackets) to criterion of seven participants in each phase of Experiment 1. Errors are shown in baseline trials —left— and in test trials —right, in italics. Phase AB-BC (.5) indicates that the probability of differential reinforcement was reduced to .5. An asterisk indicates that error data were lost.

Phase	**NUA 13 f**	**PMA 21 f**	**ROA 44 f**	**PEO 53 m**	**RGO 67 m**	**ESO 70 m**	**CSA 74 f**
AB	40 (16)	45 (13)	38 (11)	27 (*)	59 (17)	41 (18)	87 (17)
BC	12 (0)	12 (0)	12 (0)	24 (*)	23 (3)	50 (10)	40 (12)
AB-BC	18 (1)	12 (0)	24 (1)	12 (0)	21 (4)	19 (1)	86 (28)
AB-BC (.5)	23 (4)	12 (0)	12 (0)	12 (0)	20 (2)	136 (30)	71 (16)
AB-BC *BA*	12 (0)	12 (0)	12 (0)	12 (0)	12 (0)	12 (0)	52 (7+*7*)
AB-BC *CB*	18 (1+*0*)	12 (0)	12 (0)	12 (0)	13 (0+*1*)	12 (0)	72 (9+*13*)
AB-BC *AC*	12 (0)	12 (0)	12 (0)	12 (0)	67 (5+*8*)	12 (0)	35 (5+*2*)
AB-BC *CA*	12 (0)	12 (0)	12 (0)	12 (0)	40 (0+ *4*)	12 (0)	12 (0)

Table 2

Trials and errors (in brackets) to criterion of participan BPA (66-years old, female) in each phase of Experiment 1. Errors are shown in baseline trials —left— and in test trials —right, in italics. Phase AB-BC (.5) indicates that the probability of differential reinforcement was reduced to .5. An asterisk indicates that the criterion was not met in that phase.

Phase	**BPA (66 f)**
AB	77 (33)
BC	82 (23)
AB-BC	66* (13)
a1-B	21 (2)
a2-B	19 (2)
b1-C	12 (0)
b2-C	26 (4)
AB	12 (0)
BC	14 (1)
AB-BC	12 (0)
AB-BC (.5)	14 (1)
AB-BC *BA*	27 (3+*2*)
AB-BC *CB*	70 (5+*4*)
AB-BC *AC*	12 (0)
AB-BC *CA*	12 (0)

C2 in the CB symmetry test; they selected C1 in the presence of A1 and C2 in the presence of A2 in the AC transitivity test; and they selected A1 in the presence of C1 and A2 in the presence of C2 in the CA equivalence test.

The three elder participants who received the standard training procedure (RGO, ESO, and CSA) mastered the four training phases in 123 to 284 trials. Participant RGO —67 years old— performed almost errorless in the BA and CB symmetry test —he made only one error. In the AC transitivity test, he made a total of 13 errors; 6 of which were in the AC trials. He responded correctly in the first three trials, then he responded randomly until he made 8 consecutive responses according to the definition of transitivity. Two errors were made when A1 was the sample, and six errors were made with A2 as sample. In the CA equivalence test, he made four errors. The first three responses were correct, then he responded above chance and then he made the 6 consecutive correct responses of the CA test.

Participant ESO —70 years old— responded with no errors to the BA and CB symmetry test, to the AC transitivity test, and to the CA equivalence test. Participant CSA —74 years old— selected B1 to A1 and B2 to A2 in the first BA symmetry trials. Then, she selected the alternative comparison in the next BA trial and switched comparison selection until she made 6 consistent responses, according to the symmetry. She took 52 trials (with 14 errors) to reach the criterion of 6 consecutive consistent responses in the BA symmetry. In the next phase, with the CB symmetry, she made 22 errors. She required a total of 72 trials. In the AC transitivity test, she made a total of 7 errors and needed 35 trials to reach the criterion. After these 23 extra trials, she selected C1 in the presence of A1 and C2 in the presence of A2 during 6 consecutive trials. Five of the seven errors were in AB —2 errors— and BC —3 errors— baseline trials. In the CA equivalence test, she selected A1 in the presence of C1 and A2 in the presence of C2 in all trials. She also did not make any errors in the baseline trials.

Participant BPA —66 years old— needed 77 and 82 trials to master the AB and BC training Phases. She received a total of 66 trials in the next phase with AB and BC trials. As she had not reach the criterion, she received the remedial procedure described previously; in it, she needed a maximum of 26 trials to reach criterion in a Phase (in the B2-C Phase). During the phase of the BA symmetry test, she made 5 errors, 2 of which were in BA trials. In the next CB symmetry test phase, she made 9 errors, 4 of which were in the CB trials. In the AC transitivity test and in the CA equivalence test, she performed without errors.

Discussion

During Experiment 1, the test phases were conducted with unlimited trials, until the participant reached a criterion of 6 consecutive consistent responses in the tested discriminations. There is some probability that the repeating of same type of trials in the phase could have provided some feedback for correct responding in the people who failed in the initial trials. Also, there were a number of errors in the baseline discriminations during the testing phases. This could be prevented with a more extensive training. The procedure of Experiment 2 was directed to provide more training previous to the test and presented the test phases for a fixed number of trials.

Experiment 2

Method

Participants

Two elderly females (JPA, 65-years old, and MSA, 73-years old) participated. They were Spanish speaking members of the family of one of the experimenters. They did not receive any monetary payment to participate; instead, they collaborated with the purpose of helping this experimenter with her studies.

Procedure

All the procedures were identical to those of Experiment 1, except the following (see Table 3): During the first phase, only the A1 stimulus was the sample. Then, only A2 was the sample. In Phase 3, A1 and A2 alternated as samples. During Phase 4, only the B1 stimulus was the sample. Then, only B2 was the sample. In Phase 6, B1 and B2 alternated as samples. In Phase 7, AB and BC trials were intermixed. In the next phases, the probability of reinforcement was gradually reduced to .5 (Phase 8), .33 (Phase 9), and .25 (Phase 10). All training phases finished after 12 correct consecutive responses.

During the phases with tests, 4 AB and 4 BC baseline trials were intermixed with 8 test trials. Two AB and two BC trials had differential consequences. These phases concluded irrespective of responding. When a test phase was conducted with one or zero errors in the eight test trials the test was considered to be passed.

With participant JPA, the BA and CB tests were conducted in Phases 11 and 12; then, the AB and BC phases were repeated

Table 3
Trials and errors (in brackets) to criterion in each phase of the two participants of Experiment 1. Errors are shown in baseline trials —left— and in test trials —right, in italics. The number in brackets after Phase AB-BC indicates the probability of differential consequences. An asterisk indicates a test phase, that finished after 16 trials irrespective of responding.

Phase	**JPA (65 f)**		**MSA (73 f)**	
	Session 1	**Session 2**	**Session 1**	**Session 2**
1. a1-B	15 (1)		13 (1)	
2. a2-B	19 (8)		13 (1)	
3. AB	129 (42)		79 (27)	
4. b1-C	12 (0)		13 (1)	
5. b2-C	12 (0)		12 (0)	
6. BC	80 (30)		25 (12)	
7. AB-BC	72 (15)	38 (4)	147 (46)	33 (11)
8. AB-BC (.5)	12 (0)	21 (2)	21 (1)	27 (2)
9. AB-BC (.33)	15 (2)	16 (1)	23 (3)	31 (4)
10. AB-BC (.25)	12 (0)	13 (1)	19 (2)	13 (1)
11. AB-BC *BA*	16* (2+*3*)	16* (1+*0*)	16* (2+*2*)	16* (0+*1*)
12. AB-BC *CB*	16* (2+*3*)	16* (0+*1*)		16* (0+*1*)
13. AB-BC	14 (2)	12 (0)		12 (0)
14. AB-BC (.5)	14 (1)	18 (1)		12 (0)
15. AB-BC (.33)	25 (2)	21 (1)		18 (1)
16. AB-BC (.25)	41 (8)	18 (1)		18 (1)
17. AB-BC *AC*	16* (2+*4*)	16* (0+*0*)		16* (0+*0*)
18. AB-BC *CA*	16* (1+*4*)	16* (0+*1*)		16* (0+*0*)

again (Phases 13 to 16), and the AC and CA tests were made. On the next day (Session 2), the entire procedure, starting in Phase 7, was repeated again. With participant MSA, the BA symmetry test was conducted in Phase 11; in the second session, given that she had errors in all phases of Session 1, including in the phase with the BA probe, Phases 7 to 10 were repeated, the BA and CB symmetries were tested, Phases 7 to 10 were repeated again, and the AC transitivity and the CA equivalence tests were given. The cards were presented to both participants from behind them.

Results

The results are shown in Table 3. Participant JPA made 42 errors in the AB phase with A1 and A2 alternating as samples (Phase 3) and 30 errors in the BC phase with B1 and B2 alternating as samples (Phase 6). She made 15 errors in the first phase with AB and BC trials (Phase 7). During the rest of the phases, she made less than 10 errors. In the first BA and CB symmetry tests, she responded correctly to 5 of the 8 trials. In the AC transitivity and CA equivalence test, she responded correctly to 4 of the 8 trials (random responding). The next day (in Session 2), the BA and CB symmetry tests were conducted again. She responded correctly to the 8 BA symmetry trials and to 7 of the 8 CB symmetry trials. She also responded correctly to the 8 AC transitivity trials and to 7 of the 8 equivalence trials.

Participant MSA made 27 errors in the AB phase with A1 and A2 alternating as samples (Phase 3) and 12 errors in the BC phase with B1 and B2 alternating as samples (Phase 6). She made 46 errors in the first phase with AB and BC trials (Phase 7). During the rest of the phases, she made 3 or less errors. In the BA symmetry test, she made 2 errors in BC baseline trials and 2 errors out of 8 BA trials. In Session 2, she made 11 errors in the BA and BC baseline trials. The rest of the session was made with almost no errors: in the BA and CB symmetry test, she responded correctly to 7 out of 8 trials. She responded correctly to all the AC transitivity and CA equivalence trials.

Discussion

The specific procedure designed to decrease the errors was not useful with the two participants, since they made as many errors as the participants in Experiment 1. Both had between 12 and 42 errors in the AB and BC phases (Phases 3 and 6). The remaining results were comparable to those of Experiment 1.

General Discussion

The ten participants in the study demonstrated symmetry, transitivity, and equivalence. Symmetrical relations emerged without errors in 11 BA and CB tests in the 4 participants younger than 65 years and one 70-year old participant. Only participant CSA —74-years old— made more than four errors in a test of symmetry (7 errors in BA and 9 errors in CB). Transitive and equivalence relations emerged without errors in 7 participants, including 3 of the 5 participants older than 65.

Equivalence in elderly people

The six participants older than 64 learned the baseline conditional discriminations and showed the performance that defines stimulus equivalence. There were, however, clear differences between the performances of the younger and the older people: First, the four people younger than 64 performed with almost no errors during virtually all the training and tests phases —they made most errors in the first training phase (AB); participant PEO (53-years old) mastered the baseline conditional discriminations and demonstrated equivalence in a total of as few as 123 trials. In contrast, the six participants older than 64 had considerable more difficulties to master the baseline conditional discriminations. Second, none of the people younger than 64 made an error in the symmetry, transitivity, and equivalence tests. In contrast, the elder people made errors in the first trials of the test for symmetry, transitivity or equivalence. (See a comment about the only exception below).

The number of errors in the trials of the trained relations and in the trials of the equivalence relations during the test phases may be related to one another: Participant ESO —70-years old—, who received 124 trials with no errors before the equivalence tests, passed all test without errors. Also, participant MSA —73-years old— made errors in the baseline conditional discriminations and made 2 errors in the 8 trials of the BA symmetry test in the first session. Then, the session was ended and the next day she received additional training starting in the AB-BC phase. That resulted in less errors in the trained relations and in passing the symmetry test with only one error and the transitivity and equivalence without errors. Thus, when the baseline relations were well acquired, there were few errors in the tests.

These data showed that elderly people learned the conditional discriminations at a slower pace than younger people. Some derived relations emerged after some errors, but, during test phases, when there were errors in the derived relations, there were errors also in the baseline relations (figures right and left to the plus sign in Tables 1 to 3). This result shows that the tests may have disrupted the baseline discriminations. When the baseline relations were mastered, the derived relations emerged. Thus, it seems that elderly people can have more difficulties than younger people in learning new relations, but, once these are learned, the new relations emerge.

Equivalence in elderly people and other studies on equivalence

The demonstrations of equivalence with these 10 people with ages ranging from 13 to 74 years replicates many previous studies with children and younger adults. This result extends the knowledge of the process of stimulus equivalence and the uniqueness of this concept in the science of behavior to adults over 64 ages of age. In the present study, a variety of small differences in procedure were used. All of them produced virtually the same results. That fact (far from weakening the results) enhances the importance of the results by demonstrating procedural generality of the process (Sidman, 1960).

Some particular data have been observed before. For example, Sidman and Tailby (1982) observed that a child who did not pass a test of equivalence also did not pass a test for transitivity. Sidman an Tailby suggested that the lack of symmetry could prevent the equivalence to emerge, since symmetry was postulated as a component necessary for equivalence. Participant JPA failed the BA and CB tests for symmetry; then, she failed the tests for transitivity and equivalence. On the second session, she passed the test for symmetry and, then, the tests for transitivity and equivalence. Also, participant MSA —the other participant of Experiment 2— passed the tests of symmetry and the tests for transitivity and equivalence. However, these data suggest a relation also between symmetry and transitivity —if symmetry is shown, then, transitivity also will be shown. This relation does not derive from Sidman and Tailby's analysis.

The procedure used with these adults resulted in training considerably faster than other procedures. Thus, this specific procedure can serve for researchers who want to conduct an equivalence study very fast, either for interest in equivalence or for using equivalence as baseline for studying more complex phenomena.

The results of the present research are consistent with those derived from the relational frame theory (S. C. Hayes, 1991; 1994). According to that analysis, once a discrimination between stimuli have been learned by a person, new discriminations with novel stimuli having the same relations —a relational frame— are going to be learned faster. Here, the two-sample two-comparison conditional discriminations of training and tests have the same relational frame. One of the specific suggestions of the theory is that once conditional discriminations have been trained and relations such as reflexivity, symmetry, and transitivity have been trained or successfully tested in a person, the training with novel stimuli results in the emergence of the derived relations —because they have the same relational frame. The results with elderly people in the present experiment suggest that elderly people learn novel relations between novel stimuli with more difficulties than younger adults, but, once the baseline discriminations are mastered, the derived relations emerge. The errors in the first conditional discriminations can be due to the novelty of the task; however, once the novel relations have been learned, the relations among all the members of the class emerged. That could have been produced by the enormous experience of elderly people in other tasks requiring stimulus equivalence. Thus, these results are consistent with the relational frame theory.

Stimulus equivalence in elderly people and remembering

Studies about memory and intelligence in the elderly show that elderly people have difficulties to remember novel information and solving new problems (e. g., learning computer tasks); however, when they deal with tasks directly related to their experience (e. g., they read news related to facts with which they are very familiar —such as local politics) they show a similar proficiency to that demonstrated by younger people (cf. Braza Lloret, 1993). The results from the present research suggest that adding new elements in a network of stimulus relations can be somewhat difficult, but once the basic relations have been learned, new relations with the remaining stimuli in the network automatically emerge. Thus, studies about remembering (memory) in elderly people and the present research have many procedures and outcomes in common. Then, the vast field of research on stimulus equivalence can be useful also to study this phenomenon.

Author's note

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Requests of copies either in English or Spanish of this article and correspondence have to be made to the first author, La Granja, 33720 Boal, Asturias (Spain); e-mail laperez@sci.cpd.uniovi.es.

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