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Contextual control, compound stimuli and numbers

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Abstract

The purpose of this research was to teach the discrimination between “equal” and “different” for the quantities and written form of various numbers. In the procedure used, a contextual control for conditional discriminations that included compound stimuli was presented. A five year old girl learnt that the choice of one of the four comparisons (number one, number two, quantity one, quantity two) depended on the presentation of a contextual stimulus (equal or different) and a conditional stimulus composed of two words (one-quantity, one-number, two-quantity, two-number). So that if “equal to one in numbers” was presented, the girl had to select the written form of that number; she also learnt that with the instruction “equal to one in quantity”, the girl had to indicate the quantity. In the same way, when “different to one in quantity” or “different to one in number” was presented, in the first case, the girl had to select a different quantity, and in the second case, a different spelling. Once the eight possible combinations of stimuli were learnt, the contextual stimuli were presented for two new numbers. The results showed the transference of learning without deliberate teaching for two new numbers which included compound stimuli.

Participant

Azahara was 5 years and 8 months' old at the time of the study. The girl presented normal cognitive development and exhibited no behavioural disorders. She was attending infant school, and this study was carried out as an extra-curricular reinforcement programme.

First-order conditional discrimination with compound stimuli

A1 D1 B1 B2 C1 C2 +	A1 D2 B1 B2 C1 C2 +	A2 D1 B1 B2 C1 C2 +	A2 D2 B1 B2 C1 C2 +
One Number 1 2 * ** +	One Quantity 1 2 * ** +	Two Number 1 2 * ** +	Two Quantity 1 2 * ** +

E1 D1 F1 F2 G1 G2 +	E1 D2 F1 F2 G1 G2 +	E2 D1 F1 F2 G1 G2 +	E2 D2 F1 F2 G1 G2 +
Three Number 3 4 *** **** +	Three Quantity 3 4 *** **** +	Four Number 3 4 *** **** +	Four Quantity 3 4 *** **** +

Second-order conditional discrimination with compound stimuli

X1 A1 D1 B1 B2 C1 C2 +	X1 A1 D2 B1 B2 C1 C2 +	X1 A2 D1 B1 B2 C1 C2 +	X1 A2 D2 B1 B2 C1 C2 +
Equal One Number 1 2 * ** +	Equal One Quantity 1 2 * ** +	Equal Two Number 1 2 * ** +	Equal Two Quantity 1 2 * ** +

X2 A1 D1 B1 B2 C1 C2 +	X2 A1 D2 B1 B2 C1 C2 +	X2 A2 D1 B1 B2 C1 C2 +	X2 A2 D2 B1 B2 C1 C2 +
Different One Number 1 2 * ** +	Different One Quantity 1 2 * ** +	Different Two Number 1 2 * ** +	Different Two Quantity 1 2 * ** +

RESULTS In the initial tests for first-order conditional discriminations, Elena completed all the tests correctly. At the baseline of the second-order conditional discriminations (XA-B, X(AD)-B/C, X(ED)-F/G), she correctly answered 8 of 16 trials. It indicates that differentiation between equal vs different was not established for spellings and amounts. However, in the final evaluation for “X(AD)-B/C” and “X(ED)-F/G”, she completed all the tests correctly. The girl learnt a contextual control task which involved compound stimuli for numbers one and two, showing transfer of functions of the contextual stimuli (two new numbers: three and four). In order to learn the second-order conditional discrimination with compound stimuli (phases 17 to 23), she needed a total of 97 trials and of these only two were incorrect.

	Phases	Prompt	Reinfor-cement	Criterion	Trials
1	A-B	no	Test	8	8/8
2	A-C	no	Test	8	8/8
3	E-F	no	Test	8	8/8
4	E-G	no	Test	8	8/8
5	D-B1/C1	no	Test	8	8/8
6	D-B2/C2	no	Test	8	8/8
7	D-F1/G1	no	Test	8	8/8
8	D-F2/G2	no	Test	8	8/8
9	(AD)-B/C	no	Test	8	8/8
10	(ED)-F/G	no	Test	8	8/8
11	XA-B	no	Test	16	8/16
12	X(AD)-B/C	no	Test	16	8/16
13	X(ED)-F/G	no	Test	16	8/16
14	BC-RX	no	Test	8	8/8
15	FG-RX	no	Test	8	8/8

	Phases	Prompt	Reinfor-cement	Criterion	Trials
16	(AD)-B/C	no	.5	12	12
17	X1(A1D)-B1/C1	no	1	12	12
18	X2(A1D)-B2/C2	yes	1	12	20
19	X(A1D)-B/C	no	1	12	13
20	X1(A2D)-B2/C2	no	1	12	12
21	X2(A2D)-B1/C1	yes	1	12	12
22	X(A2D)-B/C	no	1	12	12
23	X(AD)-B/C	no	1	16	16
24	X(AD)-B/C	no	Test	12	16/16
25	(ED)-F/G	no	.5	8	8
26	X(ED)-F/G	no	Test	16	16/16
	Total				293

DISCUSSION

The procedure used was effective for teaching a contextual control task for_conditional discriminations (see Sidman, 1986). Specifically, the discriminations used in this research included compound conditional stimuli (Alonso-Álvarez, 2010; Alonso-Álvarez & Pérez-González, 2006; Pérez-González & Alonso-Álvarez, 2008). First, the girl learned to choose the written form or quantity of the numbers one and two before the words “equal” or “different”. Then, her performance was evaluated for two new numbers: three and four. The girl performed correctly in behavioural interactions not taught explicitly; a phenomenon referred to in specialised literature as transfer of contextual functions (Pérez-González, 1994; Pérez-González & Martínez, 2007; Pérez-González & Serna, 2003; Serna & Pérez-González, 2003). Alós & Lora (2007) used this procedure to teach numbers to a child with intellectual disability. The child had to choose one of two numbers “1” or “2” in response to the instructions: “equal to one”, “different to one”, equal to two”, “different to two”. The incorporation of the compound stimuli had several differential effects with respect to the programme described by these authors. Firstly, the number of combinations of stimuli increased to eight compared with the four combinations in the previous study. Secondly, the number of comparisons or discriminative stimuli to choose from increased from two to four. Thirdly, the girl has to consider four stimuli (one contextual, two which create the conditional stimuli and one discriminative) to choose the correct answer while she had to consider just three stimuli in the previous investigation. Fourthly, the girl learnt to use the words “equal” or “different” for two properties (written form and quantity) of four numbers. Fifthly, this procedure contributed positively to the generalisation and transfer of learning involving two properties of the numbers.

Various aspects of this research may be highlighted. Firstly, from an applied standpoint, it describes a procedure for teaching a complex task. Secondly, from an experimental standpoint, it presents an initial study of the contextual control of conditional discriminations incorporating compound stimuli. Thirdly, it describes a systematic and detailed procedure that may also be used to teach these repertoires to persons with learning difficulties, e.g. autism or intellectual disability.