TEACHING COIN SUMMATION TO THE MENTALLY RETARDED¹

MARGARET L. LOWE AND ANTHONY J. CUVO

REHABILITATION INSTITUTE
SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE

A procedure to teach four mild and moderately retarded persons to sum the value of coin combinations was tested. Subjects were first taught to count a single target coin, and then to sum that coin in combination with coins previously trained. Five American coins and various combinations were trained. Modelling, modelling with subject participation, and independent counting by the subject constituted the training sequence. The subjects improved from a mean pretest score of 29% to 92% correct at posttest. A four-week followup score showed a mean of 79% correct. A multiple-baseline design suggested that improvement in coin-counting performance occurred only after the coin was trained. The results indicate that this procedure has potential for teaching the retarded to sum combinations of coins in 5 to 6 hr of instruction.

DESCRIPTORS: monetary skills training, coin summation, modelling, multiple baseline, retardates

The principle of normalization (Wolfensberger, 1971) advocates the attainment of as normal an existence as possible for the handicapped. Evidence of normalization can be seen in the placement of institutionalized persons into small, home-like community living facilities and in sheltered or competitive employment.

Concomitant with community placement, the handicapped need to be trained in essential daily living skills. Perhaps one of the most important of these is the use of money. For rehabilitation clients and children in special-education classes to live more normally, they must acquire this skill, without which many reinforcing opportunities in the environment would not

be available, thus increasing the probability that the newly independent person might retreat to the safe confines of the institution.

Pictorial representations of coins and bills, usually with equivalent amounts, are commonly used teaching materials (LeBlanc, Vogeli, Barnhart, Grimsley, and Scott, 1973; O'Neil, Keiter, and Benson, 1971). In an extension of this method, Wunderlich (1972) tested a matching-to-sample procedure to teach mentally retarded children to discriminate between (a) five American coins, and (b) combinations of coins that did and did not equal individual sample stimuli consisting of a nickel, dime, quarter, and half-dollar.

Bellamy and Buttars (1975) taught monetary counting skills to mentally retarded adolescents. Students were first taught a sequence of rote counting skills and then these skills were applied to identifying and counting coins. Modelling was used as a training technique; the program required approximately 100 hr of instructional time.

Although there are few tested procedures to teach monetary skills, general training principles have been explicated (Denny, 1966). Modelling by an experimenter (*e.g.*, Ross, 1969) and the

¹This paper was based on a thesis submitted by the first author to the Graduate School of Southern Illinois University at Carbondale in partial fulfillment of the M.A. degree. This research was supported by a grant from the Southern Illinois University at Carbondale Office of Research and Projects. The authors would like to thank Dr. Albert Shafter of the A. L. Bowen Children's Center, Harrisburg, Illinois, and the Jackson Community Workshop and Activity Center, Murphysboro, Illinois, for making subjects and facilities available. Reprints may be obtained from Anthony J. Cuvo, Rehabilitation Institute, Southern Illinois University at Carbondale in partial fulfillment 62901.

subject imitating concurrently with the experimenter modelling (*e.g.*, Ross, Ross, and Evans, 1971) have both been demonstrated to occasion a response successfully and are applicable to teaching monetary skills. The present program was devised to teach mentally retarded persons with rudimentary arithmetic skills to sum various combinations of American coins.

METHOD

Subjects

Two male adolescents and two female young adults served as subjects. Their mean chronological age was 14.8 yr, their mean IQ was 57, and their mean arithmetic grade level was 1.8. The four subjects were selected on the basis of their demonstrated ability to count by ones and fives to 100 and to recall the names and values of five American coins when they were presented to them, and their inability to sum coin combinations, each of whose total was less than \$1.00.

Materials

Five nickels, five dimes, three quarters, one half-dollar, and four pennies were used as stimulus materials in the training program. A 21.6 cm by 27.9 cm scoreboard, equally divided into 10 numbered boxes, was used to provide feedback with respect to response accuracy.

Design

A multiple-baseline design across coin-counting responses was used. Subjects were administered the Coin Summation Test as a pretest, after teaching them to count each of five American coins, including combinations, and four weeks after the final training session, as a followup. The test administered after training the penny, the final coin trained, served as an immediate posttest. Thus, a test sampling the content of all skills trained, or to be trained, was administered seven times to examine the efficacy of the training procedures for each coin independently.

Major Dependent Variable—Coin Summation Test

The principal dependent measure was a test of 51 coin combinations to be summed. Each sum was less than \$1.00. There were 22 combinations composed of silver coins (*i.e.*, nickel, dime, quarter, half-dollar) only. There were 29 additional combinations that included one to four pennies, as well as silver coins. The four silver coins were represented as equally as possible across the 51 combinations. For the 22 sets of silver coins, the values in the ten's digit column were about equally represented (*e.g.*, twenties, thirties, . . . nineties); the items included an approximately even number of fives and zeros in the one's digit place. For combinations incorporating pennies, all possible values in both the ten's and one's place were represented as equally as possible. Four different randomized sequences of the dependent measure were employed. The constraint was imposed that the same randomization not be used on two consecutive occasions for the same subject.

The test was administered by arranging the silver coins in a vertical column in order of ascending value. Pennies were placed above the silver coins. The coins were placed down arbitrarily with respect to whether the obverse or reverse of the coin was visible, or to the angular orientation of the figure on the coin. Coins were spaced approximately 2.5 cm apart, in the column. For example, 93¢ was presented with the nickel placed closest to subjects, and the dime, quarter, half-dollar, and three pennies, respectively, placed above the nickel in a vertical column.

Subjects were required to count the coins overtly in any manner. Response scoring was based on the subtotals of the coins in the column. In the example above, the correct subtotals were, "5, 10, 40, 90, 91, 92, 93¢".

In scoring the test items, the counting of each coin was considered independently. Subjects would have been credited with a correct response for each of the seven coins in the example cited.

If subjects erred on counting a particular coin of a combination, but increased the value correctly for other coins, all those properly counted were scored correctly, even though the total was in error. Thus, correctness was determined by properly increasing the cumulating value for coin combinations, and not for correctly stating the sum of the combination. If subjects gave a total without counting each coin aloud, they were encouraged to count each coin independently. If they persisted in giving only a total, the correctness of the total determined the scoring of all coins in the combination: all coins were scored as correct if the total was right and all coins were scored wrong if the total was incorrect.

The subtotals comprising a coin combination were specific integers. For each coin in the combination, one and only one response—the correct subtotal—was scored as correct. The experimenter's data sheet for the Coin Summation Test included the subtotals, as shown in the above example, for each of the 51 test items. The experimenter circled correct responses and made specific note of incorrect ones. All subjects could clearly articulate the coin values. Thus, the response recording method was relatively simple and objective. Subjects were not given feedback concerning response accuracy during administration of the Coin Summation Test. They were not stopped or corrected when they made errors. If subjects failed to respond to a problem after encouragement, all coins of the combination were considered incorrect. The first author administered and scored the Coin Summation Test on each occasion and conducted all training sessions. She was fully aware of the purpose of the study.

Procedure

Training was conducted for approximately 30 min, four times per week, in rooms provided by the subjects' facilities. No more than one session was conducted per day.

Participants were first trained to count each coin singly, and then in combination with other

coins previously learned. The coins were presented for training in the sequence of nickel, dime, quarter, half-dollar, and penny. This training hierarchy was adopted because it was assumed that skill acquisition would be facilitated by students first learning coins that were to be counted in sequences of five (*i.e.*, silver coins), with the later inclusion of single units (*i.e.*, the penny).

Counting Single Coins

The first step for each coin was to present it and its specific counting method to subjects. The coin was placed in front of subjects without concern for its obverse/reverse orientation or the angular position of the figure. Subjects were asked to state the coin's value in order to verify that it had been learned. For the silver coins, each was equated with the number of fives in its value. Subjects were taught to place next to the coin one finger for each time that that coin was divisible by five, while counting by fives until the coin's value had been attained. Employing this procedure, the nickel was counted by placing the index finger next to it and saying, "five". The dime was counted by placing the index finger next to it and saying, "five", and then placing down the middle finger and saying, "ten". The quarter was counted by placing each of the five consecutive fingers on one hand, beginning with the thumb, next to the coin one at a time and counting by fives as each finger was placed down (*i.e.*, 5, 10, . . . 25). The half-dollar was counted by placing all 10 fingers next to the coin one at a time, and counting by fives as each finger was placed down (*i.e.*, 5, 10, . . . 50). Counting commenced with the thumb on the right hand and progressed through its successive fingers, and then to the thumb of the left hand and its successive fingers.

Subjects were instructed to count the coins by a three-step procedure. The experimenter first modelled counting the coin once by using the method just described. Next, subjects imitated the counting procedure concurrently with the experimenter modelling once again. If an error

occurred, subjects were manually guided through the appropriate counting method until the procedure was performed correctly. Finally, participants were required to perform the counting procedure independently once.

The procedure for counting the penny varied slightly. Subjects were taught simply to count each penny by ones, while pointing to it with the index finger. The same series of modelling, modelling with subject's imitation, and independent counting by the participant was employed.

Summing Coin Combinations

After training subjects to count a single coin, they were taught to sum the value of that coin in combination with other coins previously taught. Throughout training, all coin combinations were placed vertically in front of subjects, as described for the Coin Summation Test. This arrangement was adopted to allow subjects to count the coins in the sequence in which they were trained. Subjects were allowed to manipulate the coins at all times, changing their orientations as they wished.

Teaching subjects to count coin combinations was accomplished in the same way as teaching single coins. The experimenter first modelled summing coin combinations, then subjects imitated along with the experimenter, and, finally, participants counted independently. The method for counting coin combinations was to apply the counting procedure successively for individual coins in the combination and cumulating the total. For each coin in the combination, the finger-counting procedure was begun anew with the index finger of the counting hand. For example, the nickel in combination with the dime was taught by the experimenter first modelling the procedure of placing the index finger next to the nickel and saying, "five", the index finger next to the dime and saying, "ten", and placing the middle finger next to the dime also, and saying, "fifteen". Next, the subject was asked to perform this procedure along with the experimenter once. If an error occurred, the subject was manually guided through the counting procedure until it

was performed correctly. Finally, the subject was required to perform the procedure independently once. Summation of all other combinations of two or more coins followed the same counting procedure.

When a coin combination included pennies, all silver coins were counted by fives first, then the pennies were added by counting by ones. For example, a dime and two pennies were counted, "5, 10", as the index and middle fingers were placed next to the dime, and then "11, 12", as the index finger was placed over each penny respectively.

Practice Trials

After completing each stage in the sequence, subjects practised counting those coin combinations. For practice trials, subjects were asked to sum combinations of coins placed before them as during training. If subjects were correct on a trial, they were given a new coin set to count. If incorrect, they were asked to count that set with the experimenter and if necessary manually guided through the procedure. The failed item was re-introduced three trials later. Subjects were required to count 10 consecutive coin sets to demonstrate mastery of the procedure at that stage.

A 10-box scoreboard was used to provide feedback to subjects on the number of consecutively correct problems. A miniature candy bar was placed on the appropriate number on the scoreboard. The candy was returned to zero whenever an error occurred. The candy was given to subjects after the tenth consecutive correct response was made.

Spontaneous correct contracting of the counting steps during the practice trials was permitted, but not encouraged. For example, the response was considered correct if subjects, when presented two quarters and one dime, said, "Two quarters are 50 . . . That's 50 . . . 55, 60", instead of counting the dime first and then each of the quarters.

For all responses, subjects were considered correct only when they placed the specified num-

ber of fingers next to each coin while counting appropriately. The exception to this rule was spontaneous correct contracting. When an error occurred, subjects were stopped immediately, and the prescribed correction procedure was instituted.

Postcheck

Four weeks after the final training session for each subject, the Coin Summation Test was readministered to assess skill maintenance.

RESULTS

It was of interest to determine whether subjects improved in coin-summing performance after participating in the present training program. Table 1 shows that the group mean proportion correct on the Coin Summation Test was 0.29 at pretest and 0.92 at posttest. Thus, coin-summing performance improved substantially. Table 1 also shows that each subject had a marked increase in this behavior, contributing to the group effect.

Also, the data were examined to determine whether the newly acquired coin-summation skill was maintained four weeks after training. The group mean followup score was 0.79. Although there was an average decrement of 0.13 from the posttest score for the group, Table 1 shows that there were wide individual differences in skill maintenance.

The Coin Summation Test was administered

repeatedly in order to examine the effect of training on each of the five target coins and their combinations, and to assess possible generalization of training across coins. As can be seen in Figure 1, the dimes, quarters, and half-dollars were counted correctly on an average of 0.34 of the pretest trials. The pretest level of counting nickels and pennies was somewhat higher, with nickels counted correctly approximately 0.62 and pennies about 0.47 of the trials. Figure 1 shows that significant improvement in coin-counting performance occurred only after the target coin had been trained, and the increased performance was maintained throughout original training.

The data were analyzed for the number of errors committed by each subject before attaining the criterion of 10 consecutive correct practice trials. One subject made 28 errors across the 11 practice trials and had particular difficulty counting combinations with two quarters and pennies. The total errors made by the other three subjects ranged between one and seven.

The mean number of sessions to complete training for all subjects was 11.5 or approximately 5 to 6 hr. Additional time was required to administer the pretest and posttest.

DISCUSSION

The results indicate that the present instructional program was effective in teaching coin-summation skills to the mentally retarded. As

Table 1

Subject characteristics and proportions correct on Coin Summation pre-, post-, and followup tests.

<i>Subjects</i>	<i>CA</i>	<i>MA</i>	<i>IQ</i>	<i>Wide Range Achievement Test— Arithmetic Grade Equivalent</i>	<i>Pretest</i>	<i>Posttest</i>	<i>Followup Test</i>
John	13.17	8.33	67	1.6	0.10	0.86	0.74
Steve	10.50	6.26	60	1.9	0.49	0.96	0.69
Diane	17.50	6.25	39	1.4	0.04	0.90	0.92
Shirley	18.25	10.25	62	2.2	0.55	0.96	0.80
Group Mean	14.85	7.77	57	1.8	0.29	0.92	0.79

Fig. 1. Mean proportion correct on Coin Summation Test administered as a pretest, after each coin was trained, and as a followup for four subjects trained.

a group, and individually, the subjects showed a substantial increase in this skill after completing a relatively brief training program.

There was generally satisfactory maintenance of the skill one month after training. It is recommended, however, that the present instructional program be modified to incorporate a maintenance phase following original training. Programming for maintenance ideally would include the practice of newly acquired skills in daily living.

Experimental control was demonstrated by the multiple-baseline design, which showed that

the mean score for counting a target coin increased significantly only after the counting method for that particular coin had been taught. This suggests that the specific training methods were responsible for the increase in counting performance.

Occasioning independent responding by a sequence of experimenter modelling, and modelling with subject imitation, with manual guidance when necessary, seems to teach effective coin summing. Three of the four subjects made surprisingly few errors during the practice trials. These procedures may have general utility for

teaching a wide variety of skills to the mentally retarded and other rehabilitation clients. Additionally, a finger-counting procedure is commonly employed to teach arithmetic in the special-education classroom. Thus, the procedure is compatible with current educational practices and may benefit from positive transfer from arithmetic skills already acquired.

REFERENCES

- Bellamy, T. and Buttars, K. L. Teaching trainable level retarded students to count money: Toward personalized independence through academic instruction. *Education and Training of the Mentally Retarded*, 1975, 10, 18-26.
- Denny, M. R. A theoretical analysis and its application to training the mentally retarded. In N. R. Ellis (Ed.), *International review of research in mental retardation*, Vol. 2. New York: Academic Press, 1966. Pp. 1-27.
- LeBlanc, J. F., Vogeli, B. R., Barnhart, T. E., Grimsley, E. E., and Scott, J. L. *Silver burdett mathematics*. Morristown, New Jersey: General Learning Corporation, 1973.
- O'Neil, M. J., Keiter, J. L., and Benson, K. S. *Math 3*. Boston: Economy Company, 1971.
- Ross, S. A. Effects of intentional training in social behavior on retarded children. *American Journal of Mental Deficiency*, 1969, 73, 912-919.
- Ross, D. M., Ross, S. A., and Evans, M. A. The modification of extreme social withdrawal by modelling with guided participation. *Journal of Behavior Therapy and Experimental Psychiatry*, 1971, 2, 273-279.
- Wolfensberger, W. Will there always be an institution? II: The impact of new service models. Residential alternatives to institutions. *Mental Retardation*, 1971, 9, 31-37.
- Wunderlich, R. A. Programmed instruction: Teaching coinage to retarded children. *Mental Retardation*, 1972, 10, 21-23.

Received 30 June 1975.

(Final acceptance 23 March 1976.)