The Effect of the Concrete to Abstract Teaching Sequence on Acquisition and Retention of Place Value Skills

by

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The development of meaning and understanding within the learner's capacity to perform has become a recent goal for school mathematics (Underhill, Uprichard, & Heddens, 1980). According to Ashlock (1986), students frequently do not have prerequisite understandings and skills needed to learn new ideas and procedures. He states that teachers who introduce paper-and-pencil procedures to students who still need to work problems with concrete aids are encouraging students to memorize a complex sequence of mechanical acts. Such memorization lends itself to faulty algorithms and frustration for the student and teacher.

Reisman (1982) concurs with Ashlock and further suggests that students must develop a basic understanding of mathematical relationships before they can succeed at arithmetic computations. Gaps in mathematical foundations occur when relations underlying computational algorithms are not fully understood. One strategy that promotes conceptual understanding of mathematical skills involves using a teaching sequence that begins with the manipulation of objects, then uses pictures for instruction, and finally uses the abstract symbols (i.e., numbers) in isolation (Underhill, et al., 1980).

The purpose of this article is to share results obtained when the concrete to abstract teaching sequence was implemented for place value instruction. Student performance was evaluated in terms of skill acquisition, retention, and generalization to a new setting.

METHOD

Subjects. The three subjects in this study were males categorized as learning disabled and enrolled in grades 2, 1, and 4 respectively. They were referred to the Multidisciplinary Diagnostic and Training
Program's (MDTP) classroom at the University of Florida, which they attended for five weeks and then returned to their home schools. All three participants exhibited varying degrees of difficulty with mathematics skills. The subjects were determined eligible for the study based on a 10-item place value pretest. Criterion for study participation was a score of 70% or less.

Design. The primary purpose of the study was to test the effectiveness of three learning activities at the concrete, semiconcrete, and abstract instructional levels on the acquisition, retention, and generalization of place value skills. A multiple baseline design (Baer, Wolf, & Risley, 1968) was used.

Procedure. Three experimental conditions were included in the study: baseline, treatment, and posttreatment (see Figure 1). Baseline and treatment conditions were implemented in the MDTP classroom. The posttreatment condition was implemented in the participants' home schools.

Baseline. During the baseline condition, one-minute timings were administered to each subject on a daily basis. The same instructor met daily with each subject. The same teacher dialogue was used to initiate the timing on each occasion (i.e., "I want you to tell me how many ones or tens the underlined number represents.") Figure 2 illustrates the probe sheet used to conduct the timings. Teacher feedback regarding student performance was withheld. Baseline data were gathered for a minimum of three days (Tawney & Gast, 1984).

Treatment. During the treatment condition, the three subjects were taught place value using a concrete, semiconcrete, and an abstract teaching sequence. Three activities were presented for each step in this sequence. Materials used for concrete instructional activities included one-inch plastic

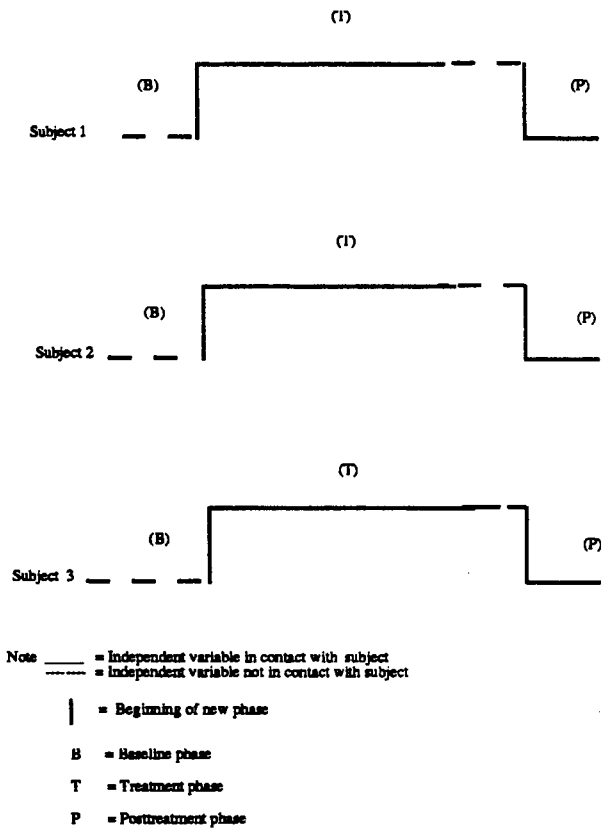


Figure 1 Diagram of Experimental Conditions

cubes, teacher-made place value strips, and teacher-made place value cards. Worksheets with pictures of place value sticks and cubes were used for semi-concrete instruction. Abstract level instruction was conducted using worksheets without pictorial representations. All nine activities were presented using a direct instruction model and the following steps:

(1) provide an advance organizer,
(2) demonstrate and model the skill,
(3) provide guided practice, and
(4) provide independent practice.

A teacher script was used and instructional time was limited to 15 minutes each day. At the completion of each 15-minute instructional period, a one-minute timing was administered to each participant using the baseline probe sheet.

Students progressed through the nine activities at their own rate. In order to insure student comprehension before moving to a new activity, a criterion was set for acceptable performance. If the criterion was not met, the activity was repeated. The duration of the treatment phase ranged from 9 to 15 days for the three subjects.

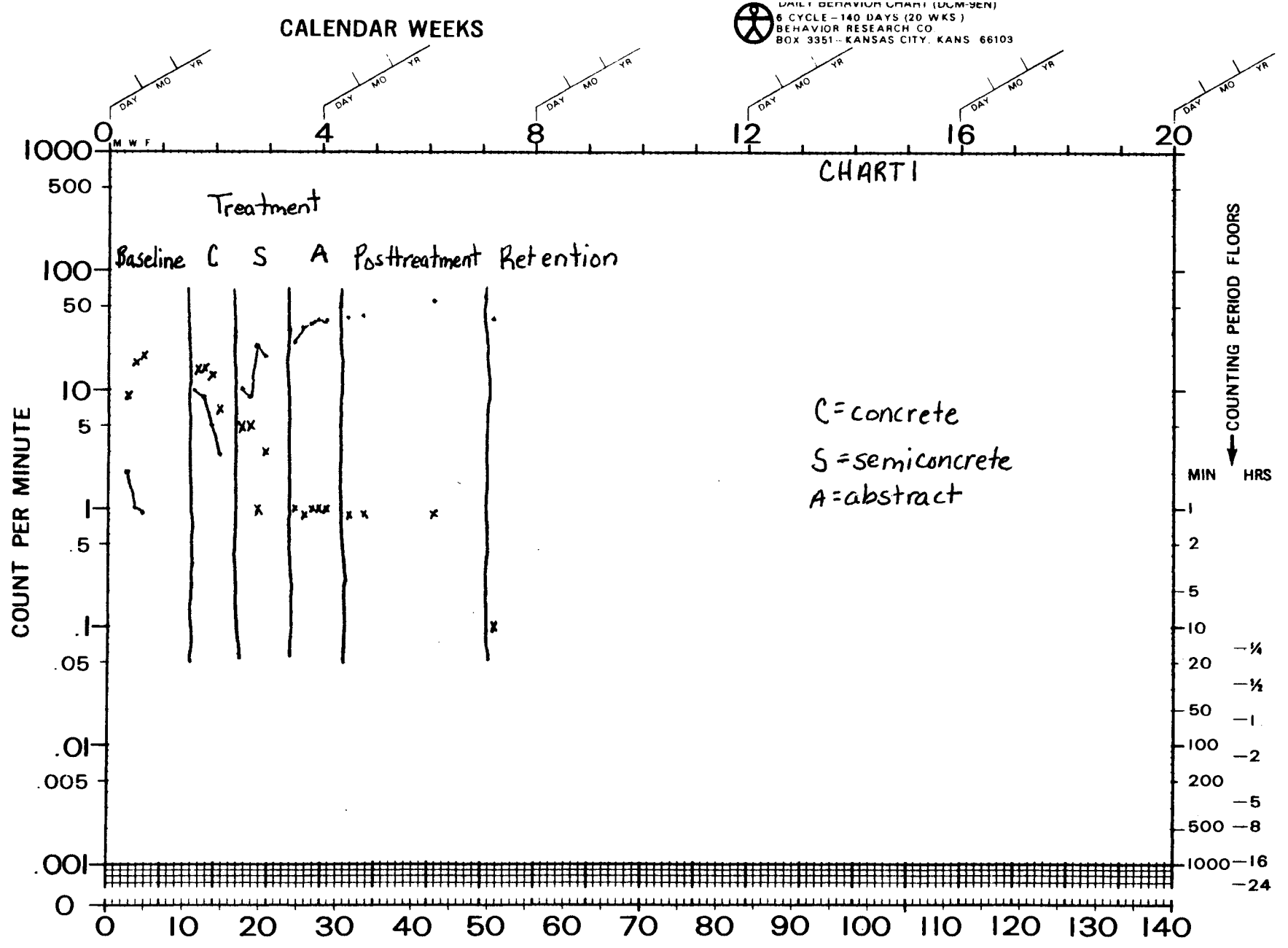
Posttreatment. Immediately following the last instructional activity each student was given a posttest identical to the pretest. Direct instruction on the mathematical skill was discontinued and the students returned to their home schools. The baseline probe sheet was used to administer periodic one-minute timings for two weeks to serve as maintenance checks. Maintenance checks were then discontinued for one week. Then, a retention probe sheet (an alternate form of baseline probeline sheet) was used to conduct one one-minute timing. An alternate form of the posttest was also administered.

RESULTS

As shown in Table 1, all three participants made dramatic gains on the criterion-referenced pretest-posttest measures. More importantly each participant retained the newly acquired skill. Data from the one-minute timings are displayed in Charts 1--3. During the baseline condition all three participants exhibited more error responses than correct responses. During the treatment condition, correct responses increased while error responses decreased. For subject 1 and 3, however, this improvement was not evident from the timings until introduction of semiconcrete instruction. This improvement was maintained during the posttreatment condition. An additional timing also demonstrated retention.

DISCUSSION

The daily and pretest-posttest measures suggest that the treatment was effective for all three participants. Additionally, the data demonstrate skill maintenance and retention. Since the posttreatment measures occurred in the students' home school, generalization to a new setting was also demonstrated. The concrete to abstract teaching sequence was easy to implement, yet significant in its effect. Replication across skills and subjects would add to the existing data base.

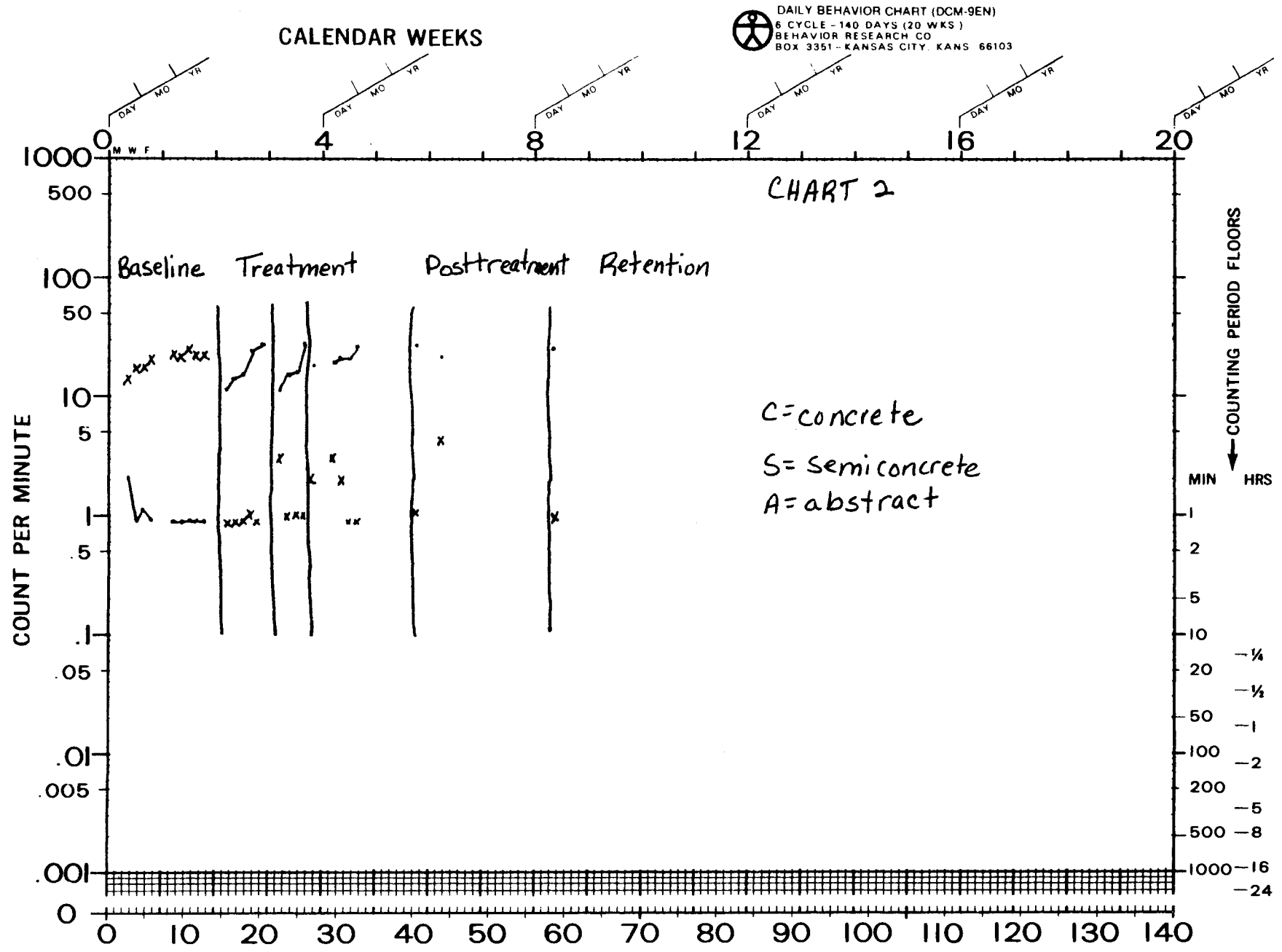


Subject 1 | | | see/say place

SUPERVISOR | ADVISER | MANAGER | BEHAVER | AGE | LABEL | COUNTED

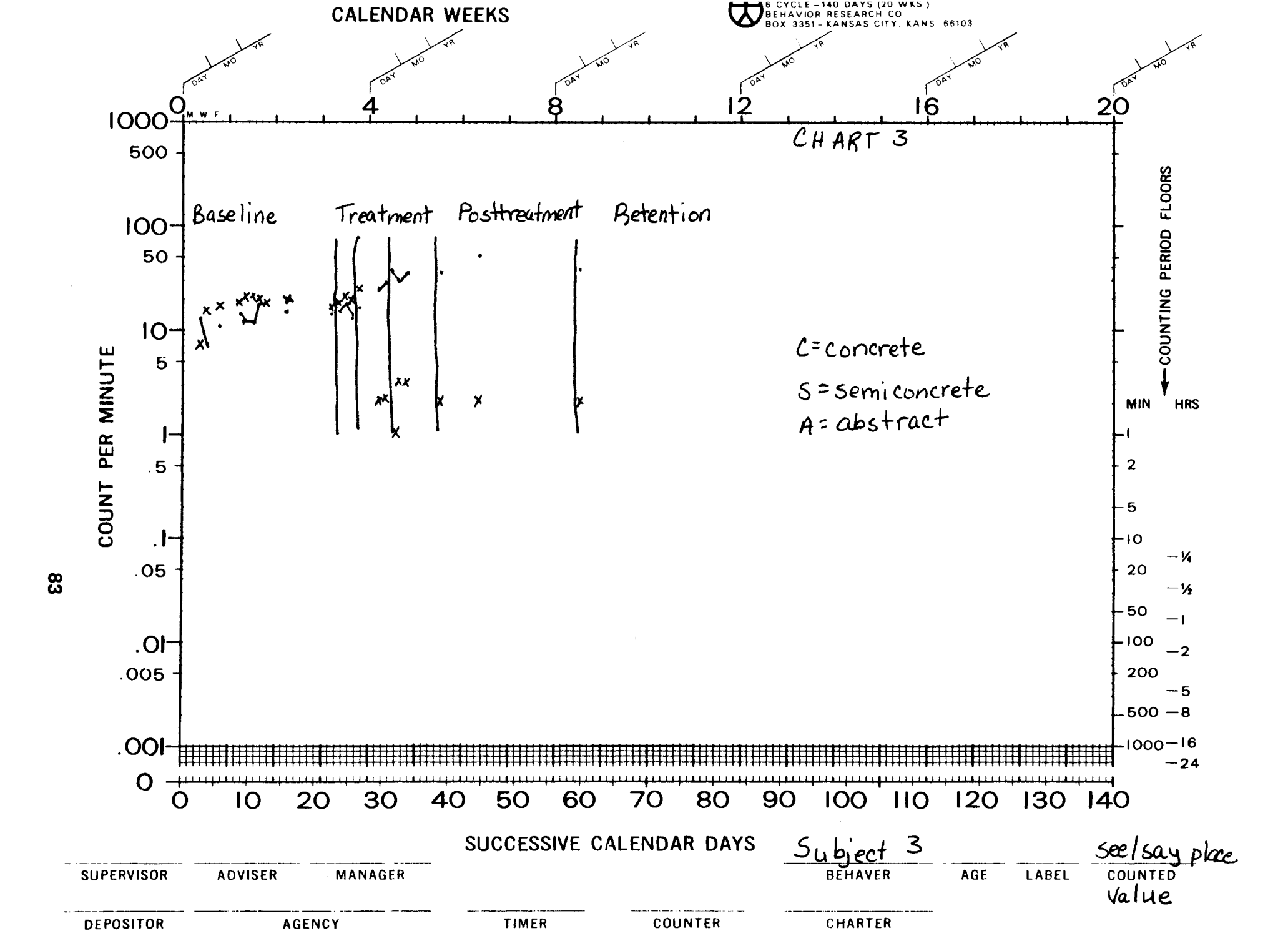
Value

DEPOSITOR | AGENCY | TIMER | COUNTER | CHARTER



SUPERVISOR ADVISER MANAGER

Subject 2 BEHAVER AGE LABEL See/Say place COUNTED value


CALENDAR WEEKS
6 CYCLE – 140 DAYS (20 WKS)
BEHAVIOR RESEARCH CO
BOX 3351 – KANSAS CITY, KANS 66103
DAY MO YR
0 4 8 12 16 20
M W F
CHART 3
Baseline
Treatment
Posttreatment
Retention
C = concrete
S = semiconcrete
A = abstract
COUNT PER MINUTE
1000 500 100 50 10 5 1 .5 .1 .05 .01 .005 .001 0
COUNTING PERIOD FLOORS
MIN HRS
1 2 5 10 20 50 100 200 500 1000
¼ ½ 1 2 5 8 16 24
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
SUCCESSIVE CALENDAR DAYS
Subject 3
see/say place
SUPERVISOR
ADVISER
MANAGER
BEHAVER
AGE
LABEL
COUNTED
Value
DEPOSITOR
AGENCY
TIMER
COUNTER
CHARTER

41	26	64	31	61	85	27	11
48	23	52	58	43	71	90	66
87	32	15	19	15	82	39	17
64	65	37	92	16	84	43	46
12	93	81	57	68	99	92	17
18	43	46	12	93	81	18	91
24	68	13	47	71	29	56	28
17	69	14	24	30	50	31	68
45	17	91	33	54	98	47	51

Figure 2 See-Say Place Value Probe

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