

**THE ACQUISITION AND MAINTENANCE
OF READING SKILLS BY
INTELLECTUALLY HANDICAPPED
DEAF STUDENTS**

**K. Richard Young
Richard P. West**
Utah State University

Adrian Crawford
Utah School for the Deaf

A major goal in the education of severely multiply handicapped students is the acquisition of behavior that will enable independent living (Perske & Smith, 1977). Learning to read words commonly encountered in the community is an important step toward independence. Brown (1973) stated that "basic reading skills are crucial to survival in a community setting" (p. 8). One of these basic reading skills is recognizing and comprehending the meaning of words on street signs (stop, walk, don't walk), building signs (danger, men, women, open, push, exit, entrance), and warning signs (poison, do not enter, private). The ability to read those words is a survival skill in our word-dependent community.

Children with adequate hearing typically learn to read words through the "oral method." They see the written word and say the word. Multiply handicapped, profoundly deaf adolescents require a different instructional approach emphasizing signs, fingerspelling, and gestures. When a deaf child reads a written word, he shows that he recognizes it with appropriate hand shape and hand movements (see-to-sign approach).

Students are taught to recognize words and to know their meanings, but this is not enough. They must continue to display these skills over time. This may be referred to as maintenance or retention. Haring (1978) defined maintenance as the ability of the learner to "perform the behavior accurately and fluently after some interval [time] without practice" (p. 16). Despite its obvious importance, only a small percentage of applied research has formally investigated the maintenance of behavior over time (Hayes, Rincover, & Solnick, 1980). Whitman and Scibak (1981) reviewed 280 behavioral studies with mentally retarded students and found that only 21 percent (59 of the studies) assessed maintenance. Hayes et al. (1980) and Whitman and Scibak (1981) concluded that additional research is needed to identify strategies that teachers could use to facilitate the maintenance of behavior they teach to handicapped students.

Haring (1978) stated that retention improved as children became more fluent in reading sight words (up to 60-80 words per minute), however, he reported no data. White and Haring (1981) suggested that maintenance of behavior would result when students respond fluently. Again, no data were presented. Liberty (1974) demonstrated a correlation between students' high fluency levels and skill maintenance. A study by Young, West, Howard, and Whitney (in press) also supports the relationship between fluency and maintenance of behavior. In that study, students were taught to dress themselves at frequencies that were fluent and appropriate to the situation. The frequencies were established after sampling the performance of nonhandicapped same age peers, and handicapped peers who were rated as competent in the dressing skills. Response levels continued at treatment levels both in accuracy and frequency, even thirty or more days following the suspension of training. Other research strongly suggests that overlearning (Krueger, 1929) and repetition (Ausubel & Youssef, 1965; Eaton & Swenson, 1972; Gilbert, 1957; Stinnet & Prehm, 1969) improves retention of learned skills. However, relatively few researchers have addressed the presumed relationship between fluent responding and retention or maintenance of performance over time.

The study reported here builds upon previous research dealing with fluency and retention, by investigating the effect of increasing the frequencies of multiply handicapped deaf students' reading recognition and comprehension tasks on the maintenance of the tasks. The study also examined the effects of direct instructional techniques and precise measurement strategies (which emphasized frequency of responding or fluency) on the ability of multiply handicapped deaf students to perform a see-to-sign reading task at frequencies of 85 signs per minute and demonstrate their understanding of the meaning of the words (see-to-match task). The study also measured the maintenance of the learned words following four months without instruction.

METHOD

Participants and Settings

We conducted this study in a classroom serving multiply handicapped deaf students at the Utah School for the Deaf. One female and one male student participated in the study.

The first student was 16 years old at the time of the study. She has a severe

congenital, bilateral sensorineural hearing loss associated with brain damage. She is mentally retarded (intellectual functioning in the trainable range, with an IQ of 35). Her score on the Stanford Achievement Test, reading subtest, was 1.1 grade level.

The second student was a 15 year old male with a severe congenital bilateral sensorineural hearing loss. He has a history of emotional and behavioral problems, including aggressive and destructive behaviors, high levels of distractibility, and lack of attention to social or environmental stimuli. He had an IQ of 53. He scored at the 1.1 grade level on the reading section of the Stanford Achievement Test. Both students were nonvocal and communicated by sign language; both were ambulatory, and neither suffered from deficiencies in finger or hand dexterity.

Procedures

Word Lists. We constructed two lists with five terms (words or phrases) on each list. We selected the terms from master lists prepared by the school. School officials considered these terms to be important for independent community living. Before the study began, both students learned to sign terms from the master list. The students had also learned some of these terms during previous years. The teacher reported that the students had not retained most of the terms. However, none of the terms that had been previously taught on the lists were used in this study.

We constructed two lists by randomly assigning words and phrases that were unfamiliar to the students to each of the two lists. The words and phrases in each list and the number of signs needed to represent each word or phrase are presented in Table 1. We used the terms on the two lists in two different reading tasks: a reading recognition task (see-to-sign) and a reading comprehension task (see-to-match).

Reading Recognition Task. For the reading recognition (see-to-sign) task, we constructed a practice sheet for each word list. The practice sheet for Word List I is displayed in Figure 1. The terms were listed in random order, with each term appearing six times on the practice sheet. A comparable practice sheet was constructed for Word List II. Starting at any point on the practice sheet and repeating the five terms ensured that the students would encounter each of the terms with equal probability and in no predictable sequence.

Table 1

Word Lists and the Number of Signs

Word List I	Number of Signs
bus stop	2
gentlemen	1
ladies	1
no smoking	2
taxi	1
Word List II	Number of Signs
down	1
fire alarm	2
handicap	1
up	1
wash hands	2

The teacher gave a practice sheet to each of the students and asked the student to read each word or phrase and make the sign as rapidly as possible. The student was given one minute in which to perform the task. If the students reached the bottom of the page, s/he started over at the top. At the end of the one-minute timing, the teacher counted the number of terms signed correctly and incorrectly (the dependent variables) and charted the frequencies on the Standard Celeration Chart. This procedure was repeated for the second practice sheet.

We established an aim of 85 signs per minute for the see-to-sign reading task. We decided on this aim after sampling the performance on the same task of five deaf students, of the same age as the participants in the study, whom the teachers believed were excellent readers. These students performed on grade level, and did not manifest any reading problems. They performed the see-to-sign task and the median response frequency of the five students was selected as the aim.

The intervention consisted of 20 minutes of direct instruction and practice per day, five days per week. The direct instruction involved the presentation of a card by the teacher to the student. Upon the card, the teacher had written a term (word or phrase). Initially, the teacher presented the card, signed the word and had the student sign the word. After the first session, the teacher presented the card, the student looked at it and signed the term written on it. The teacher then showed another card with another term written on it. The procedure continued until all terms from the word list were completed. During instruction, the students were given immediate positive feedback for correct responses, and all errors were

Figure 1

The Practice Sheet for Word List I
Used in the See-to-sign Reading Task

Name _____ Date _____ Count: Correct _____ Error _____ Time: _____ Min.

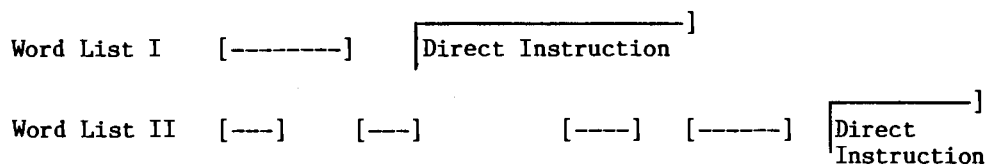
Word List I

- | | | | | | |
|------------|------------|------------|------------|------------|------|
| bus stop | gentlemen | ladies | no smoking | taxi | (5) |
| ladies | taxi | bus stop | gentlemen | no smoking | (10) |
| gentlemen | bus stop | no smoking | taxi | ladies | (15) |
| taxi | ladies | gentlemen | bus stop | no smoking | (20) |
| bus stop | no smoking | taxi | ladies | gentlemen | (25) |
| no smoking | gentlemen | ladies | bus stop | taxi | (30) |

START AT THE TOP

Figure 2

Illustration of the Multiple Probe Design*



* Baseline and baseline probes are indicated by a dotted horizontal line. A vertical line indicates the introduction of an independent variable. A solid horizontal line indicates an independent variable is operative. The independent variable is indicated just below this line.

corrected by stopping the student, telling him/her that the response was incorrect, modeling the correct response, and requiring the student to make the correct sign.

The students also practiced reading (see-to-sign) the words directly from the practice sheet used in the daily timings. After 20 minutes of instruction and/or practice on signing the terms, the teacher gave the students the practice sheets and asked them to read and sign as many terms as they could during two one-minute timings. The data from these daily, one-minute timings were used to evaluate the students' progress and the effects of the independent variable (direct instruction). The teacher also showed the students their data on the Standard Celeration Charts and praised their efforts and performance improvements.

When the students' performance reached 85 terms per minute on List I, five other terms that the students had learned prior to the study (don't walk, exit, girls, library, restaurant) were added to List I and referred to as List Ib. The teacher felt that this would be a further test of reading mastery. The students practiced list Ib until they could respond with 85 terms correct per minute. List IIb was also created, but was used only with the second student because of lack of time at the end of the school year.

Reading Comprehension Task. For the reading comprehension(see-to-match) task, the teacher prepared two 5 x 8 inch cards for each of the terms on the list. Upon each card, the teacher drew a picture depicting the meaning of one of the terms or something closely related to the meaning of the term. Each term had two different 5 x 8 picture cards. For example, the term "fire alarm" was printed on two 3 x 5 word cards and two pictures were drawn on 5 x 8 cards, one of a fire and one of an alarm in a school building. The teacher placed the cards with the terms printed on them in slots on a 3 x 3 slot board. She then displayed the picture cards on a table in front of the student and instructed him/her to place the pictures under the appropriate word or phrase cards. Direct instruction procedures(the independent variable) were used to teach the see-to-match task. These procedures included: explaining(via sign language) the relationship between the word cards and their corresponding picture cards, modeling the performance of the matching task, having students practice matching, and providing positive, corrective feedback. After a ten-minute practice session, the students performed the task during a one-minute

timing. The teacher counted the number of correct and incorrect responses during the timing and charted the frequencies on the Standard Celeration Chart. The aim for the see-to-match comprehension task was 25 matches per minute. We determined this aim by timing the same students on this task that assisted us in establishing the aim for the see-to-sign task. The aim was set at the median performance level of the "capable" hearing impaired students.

Experimental design. We utilized a multiple probe variation of the multiple baseline design to establish experimental control for both the see-to-sign and the see-to-match tasks (Horner & Baer, 1978). Gast, Skouge, and Tawney (1984) described the multiple probe design:

The multiple probe design is similar to the multiple baseline design in that the independent variable is systematically and sequentially introduced to one behavior(or in one setting or with one subject) at a time. Unlike the multiple baseline design, baseline data are not collected on a continuous basis on behaviors that have not yet been introduced to the intervention. Rather, probe trials (i.e., trials that are operationally identical to preintervention baseline trials) are conducted intermittently on behaviors "to be trained." These probe trials, which may be interspersed within instructional sessions or across observational periods, provide the applied researcher with data that can be used to evaluate whether a student is improving prior to the introduction of the independent variable (p. 269).

The requirements of demonstrating experimental control with both variations of the multiple probe design are identical to those required with multiple baseline designs. That is, if subject responding remains at or near preintervention (baseline) levels across intermittently conducted probe trials and/or probe sessions, and a targeted behavior improves only after the independent variable has been applied, a functional relationship between the independent variable

and behavior change has been demonstrated (p. 207).

Horner and Baer (1978) stated that the multiple probe design may be used "when continuous measurement during extended multiple baselines proves impractical, unnecessary, or reactive" (p.193). In the present study, we expected performance to improve only after training and considered prolonged baseline sessions for the second word lists to be impractical; therefore, the multiple probe design was employed. When baseline conditions were initiated for Word List I, we conducted one initial probe on the terms from List II. We also conducted additional intermittent probes on the second list throughout the first baseline condition (for List I). As soon as we started training(intervention) on List I, a continuous baseline was initiated for Word List II. Figure 2 illustrates the multiple probe design using the notation system described by Johnston and Pennypacker (1980).

RESULTS AND DISCUSSION

The data in Charts 1 through 8 indicate that the direct instruction procedures were effective in helping the students learn to correctly perform the reading recognition (see-to-sign) and the reading comprehension (see-to-match) tasks. The frequencies on the see-to-sign task achieved during training conditions were maintained even after a four-month period without training. However, the students' frequencies on the see-to-match task did not maintain at the same high level of fluency that was attained during training.

The data displayed on the charts show changes between baseline and intervention phases. In all instances, errors were higher than correct responses during baseline; but when the authors introduced the instructional and practice procedures, errors immediately dropped below the frequency of correct responses, and ultimately decreased to zero. Direct instruction also produced continuous increases in the level of correct responding. The target behaviors all accelerated at or above 1.3 per week.

These data are important because they demonstrate that intellectually handicapped deaf students can perform functional academic skills at high frequencies and that the learned behavior will maintain over time. According to the teachers' reports, the students in this study had never before maintained reading skills after training had ceased.

Based on the results of this study, we suggest that teachers employ direct instruction strategies, a variety of practice exercises, and set high aims for multiply handicapped students. The high frequencies produced by these techniques will probably result in greater retention. The maintenance data suggests a relationship between fluency and retention, although this study was not designed to show such a functional relationship.

There is a logical argument for the possible existence of a functional relationship. In order to maintain over time it must be reinforced. If a child is not proficient at performing the behavior, the probability of the behavior occurring diminishes and the opportunity for that behavior to come in contact with reinforcement also diminishes. Many educational programs for severely handicapped students teach them to perform a new behavior correctly for a few trials, but fail to strengthen the behavior to the point that it can be performed in a fluent, effortless manner. Training on the particular skill is terminated and teachers move on to new skills. The newly acquired, but nonfluent, behavior does not occur in the natural environment and, therefore, has no opportunity to be reinforced and strengthened by the natural environment. The behavior eventually extinguishes and requires retraining. Fluency development increases the probability that the child's newly learned behaviors will generalize to nontraining conditions and be maintained over time by coming in contact with natural communities of reinforcement. Even though the data are not conclusive, we believe that instructional programs for the severely handicapped should not be considered complete until the teacher moves the student from the acquisition stage of learning through fluency development to proficiency.

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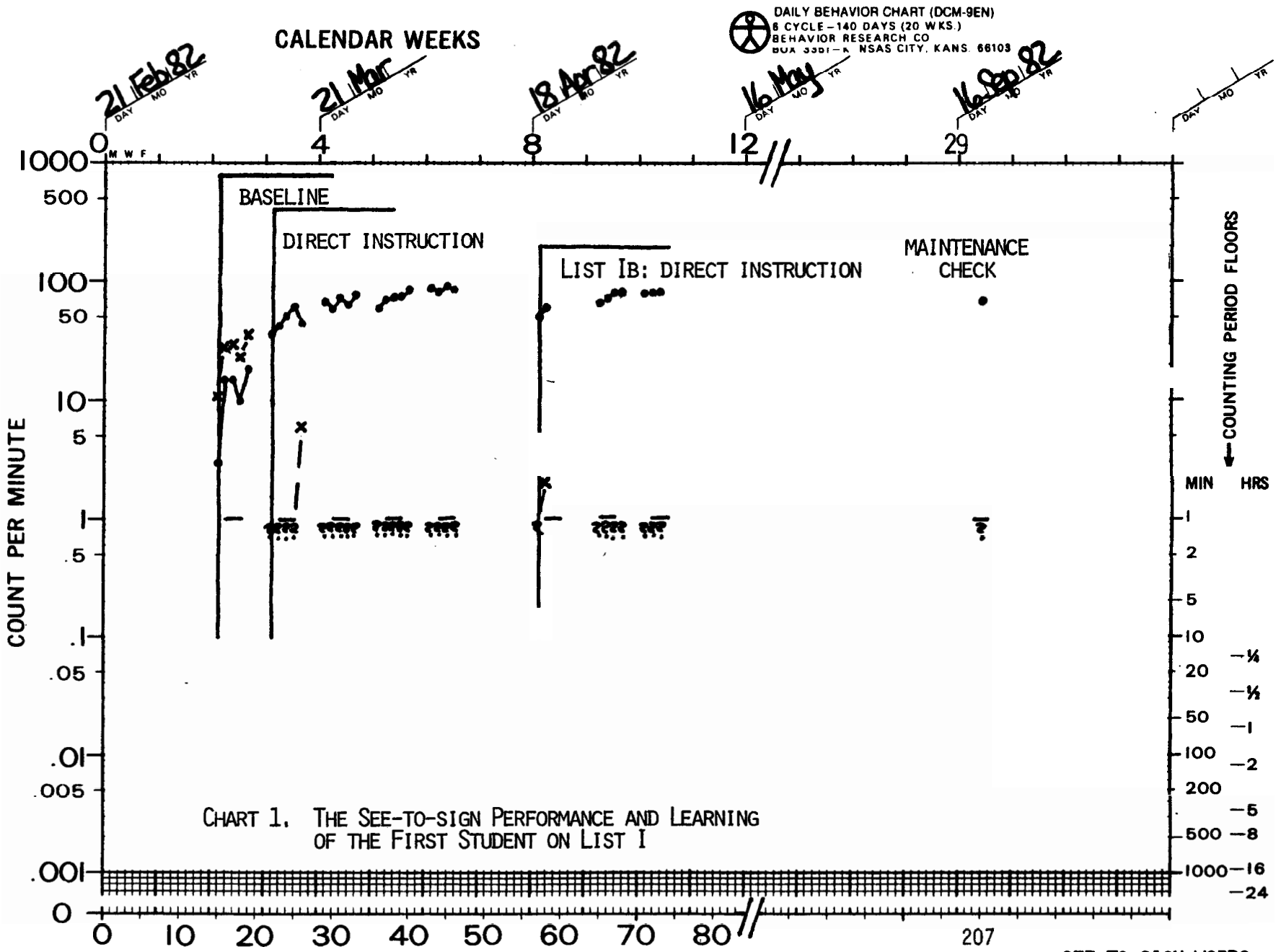


CHART 1. THE SEE-TO-SIGN PERFORMANCE AND LEARNING OF THE FIRST STUDENT ON LIST I

WEST SUPERVISOR	YOUNG ADVISER	CRAWFORD MANAGER	SUCCESSIVE CALENDAR DAYS		FIRST STUDENT BEHAVIOR	16 AGE	SEE-TO-SIGN WORDS ON LIST I
UTAH SCHOOL FOR THE DEAF DEPOSITOR			CRAWFORD TIMER	CRAWFORD COUNTER	CRAWFORD CHARTER		COUNTED

DAILY BEHAVIOR CHART (DCM-9EN)
 5 CYCLE - 140 DAYS (20 WKS.)
 BEHAVIOR RESEARCH CO
 BOX 3351 - KANSAS CITY, KANS 66103

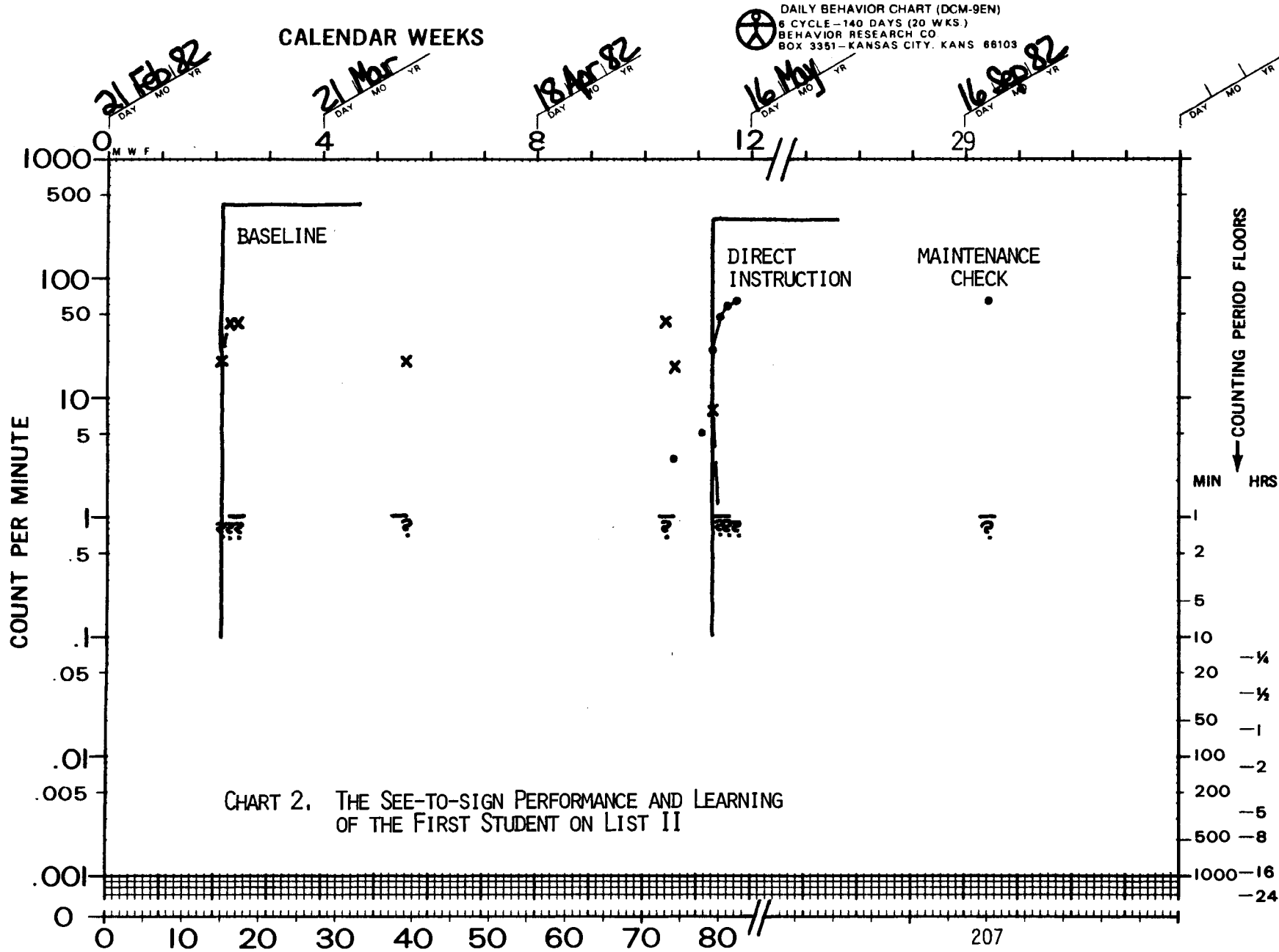


CHART 2. THE SEE-TO-SIGN PERFORMANCE AND LEARNING OF THE FIRST STUDENT ON LIST II

WEST	YOUNG	CRAWFORD	SUCCESSIVE CALENDAR DAYS		FIRST STUDENT	16	SEE-TO-SIGN WORDS ON LIST II
SUPERVISOR	ADVISER	MANAGER	CRAWFORD	CRAWFORD	BEHAVIOR	AGE	COUNTED
UTAH SCHOOL	FOR THE DEAF		CRAWFORD	CRAWFORD	CRAWFORD		
DEPOSITOR	AGENCY		TIMER	COUNTER	CHARTER		

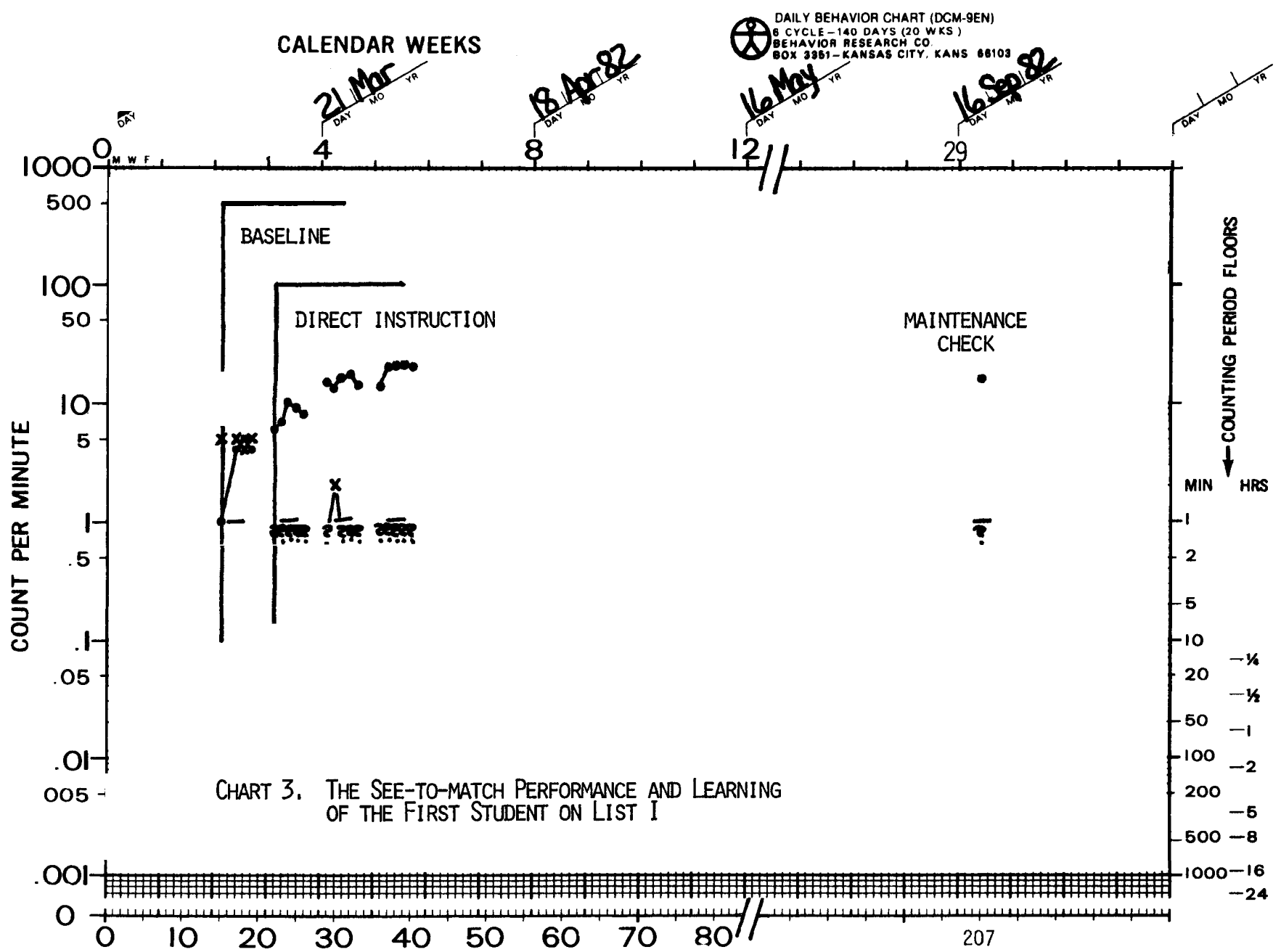


CHART 3. THE SEE-TO-MATCH PERFORMANCE AND LEARNING OF THE FIRST STUDENT ON LIST I

<u>WEST</u>	<u>YOUNG</u>	<u>CRAWFORD</u>	<u>SUCCESSIVE CALENDAR DAYS</u>	<u>FIRST STUDENT</u>	<u>16</u>	<u>SEE-TO-MATCH WORDS</u>
SUPERVISOR	ADVISER	MANAGER		BEHAVER	AGE	ON LIST I
<u>UTAH SCHOOL FOR THE DEAF</u>	<u>FOR THE DEAF</u>	<u>AGENCY</u>	<u>CRAWFORD</u>	<u>CRAWFORD</u>	<u>CRAWFORD</u>	<u>COUNTED</u>
DEPOSITOR			TIMER	COUNTER	CHARTER	

DAILY BEHAVIOR CHART (DCM-9EN)
 8 CYCLE - 140 DAYS (20 WKS.)
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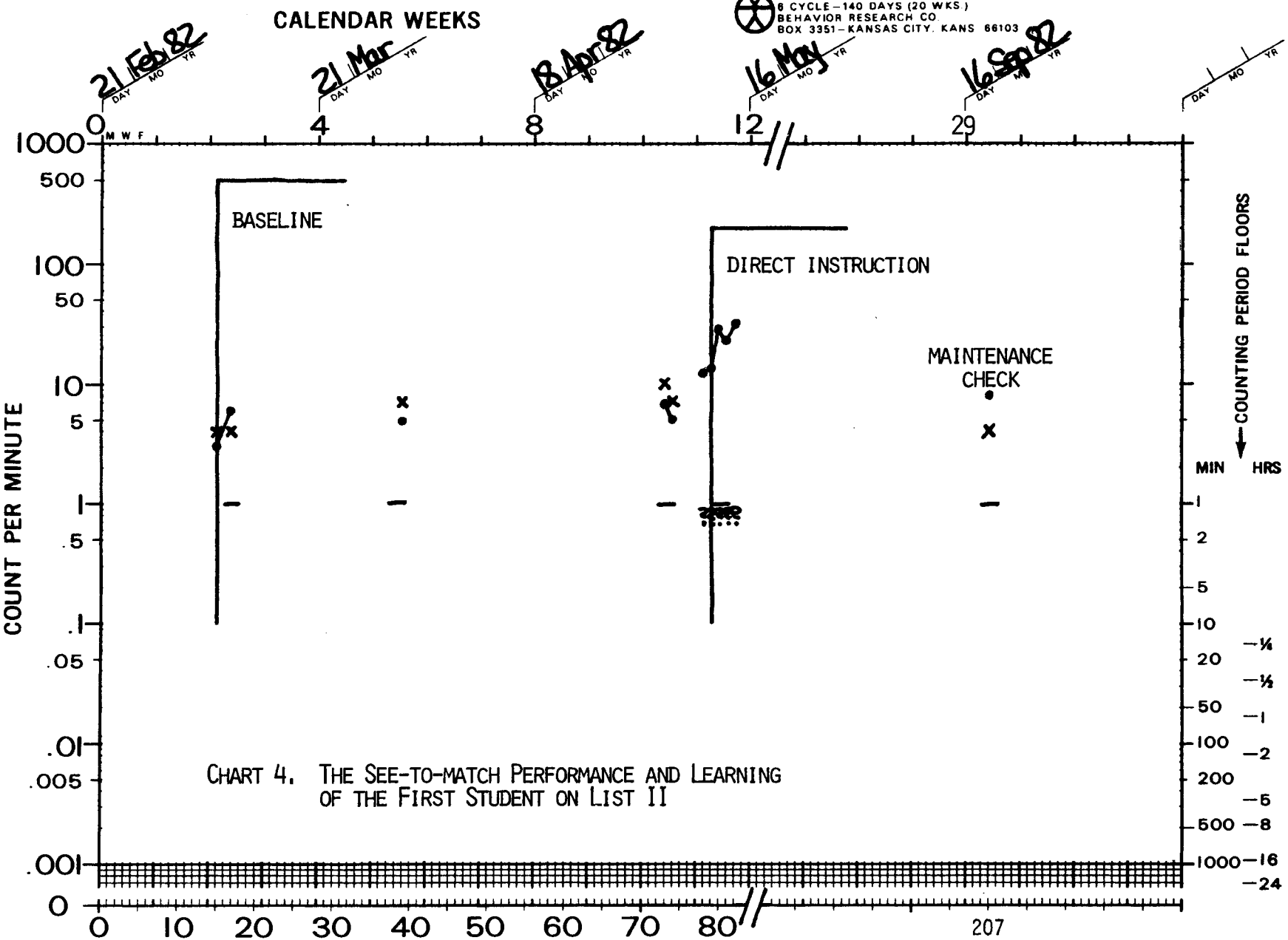


CHART 4. THE SEE-TO-MATCH PERFORMANCE AND LEARNING OF THE FIRST STUDENT ON LIST II

WEST	YOUNG	CRAWFORD	SUCCESSIVE CALENDAR DAYS	FIRST STUDENT	16	SEE-TO-MATCH WORDS
SUPERVISOR	ADVISER	MANAGER		BEHAVIOR	AGE	ON LIST II
UTAH SCHOOL	FOR THE DEAF		CRAWFORD	CRAWFORD	CRAWFORD	COUNTED
DEPOSITOR	AGENCY		TIMER	COUNTER	CHARTER	

DAILY BEHAVIOR CHART (DCM-9EN)
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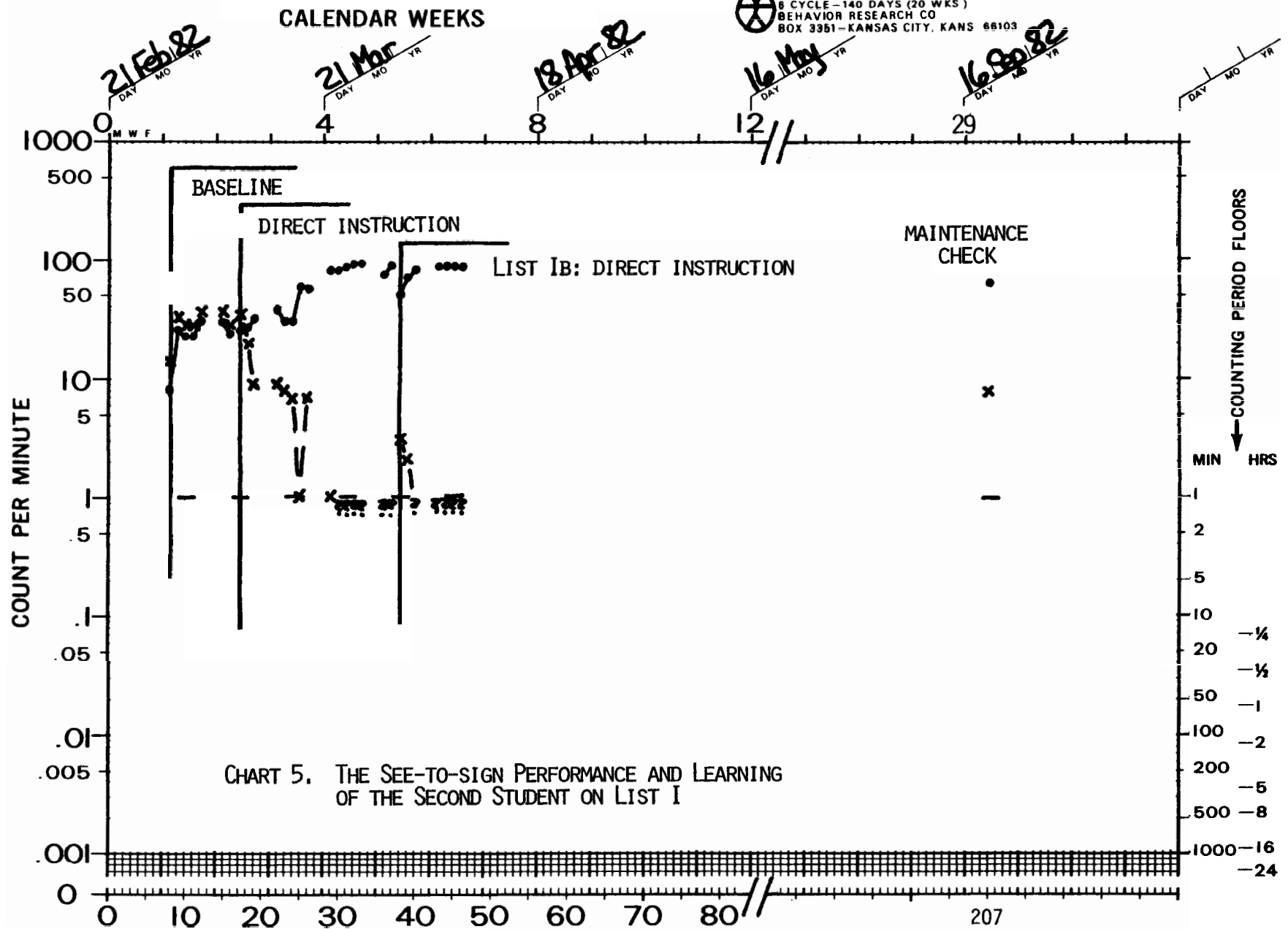
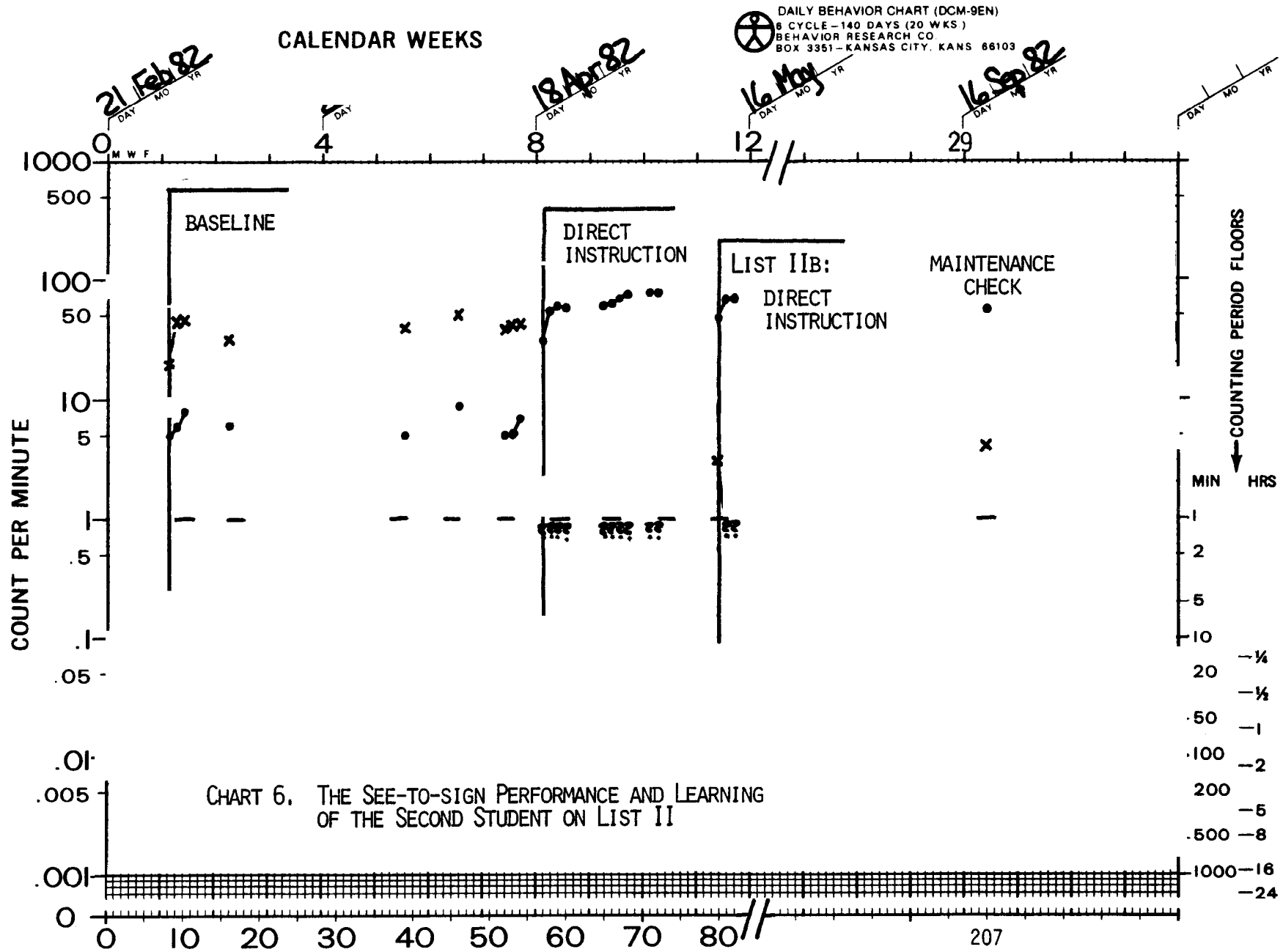


CHART 5. THE SEE-TO-SIGN PERFORMANCE AND LEARNING OF THE SECOND STUDENT ON LIST I

<u>WEST</u>			<u>YOUNG</u>			<u>CRAWFORD</u>			<u>SUCCESSIVE CALENDAR DAYS</u>			<u>SECOND STUDENT</u>		<u>SEE-TO-SIGN WORDS</u>		
SUPERVISOR			ADVISER			MANAGER						15		ON LIST I		
												BEHAVER		AGE		
<u>UTAH SCHOOL</u>			<u>FOR THE DEAF</u>			<u>CRAWFORD</u>			<u>CRAWFORD</u>			<u>CRAWFORD</u>		<u>COUNTED</u>		
DEPOSITOR			AGENCY			TIMER			COUNTER			CHARTER				



<u>WEST</u>	<u>YOUNG</u>	<u>CRAWFORD</u>	<u>SUCCESSIVE CALENDAR DAYS</u>	<u>SECOND STUDENT</u>	<u>15</u>	<u>SEE-TO-SIGN WORDS</u>
SUPERVISOR	ADVISER	MANAGER		BEHAVIOR	AGE	ON LIST II
UTAH SCHOOL FOR THE DEAF	FOR THE DEAF		CRAWFORD	CRAWFORD		COUNTED
DEPOSITOR	AGENCY		TIMER	COUNTER		

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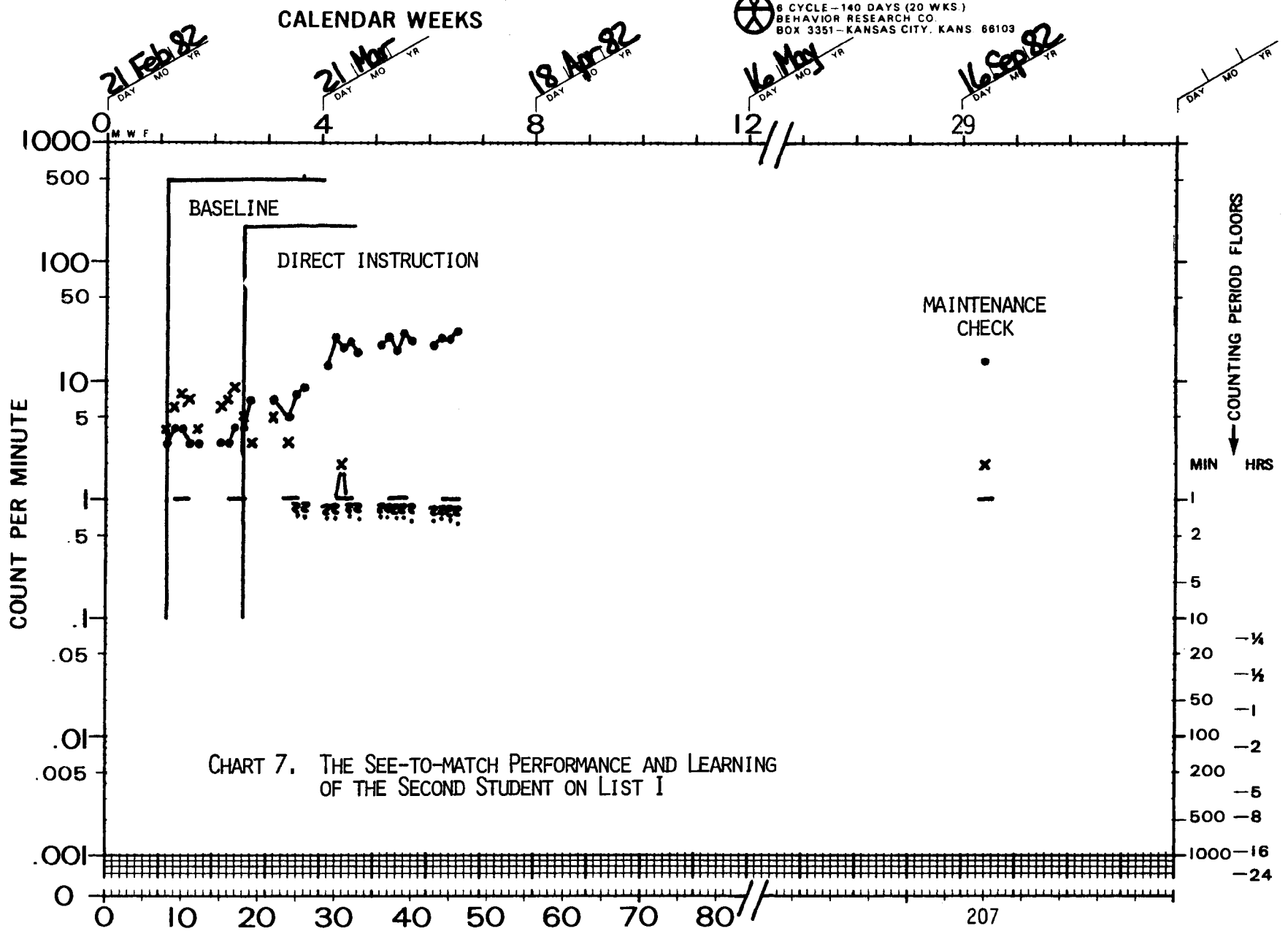


CHART 7. THE SEE-TO-MATCH PERFORMANCE AND LEARNING OF THE SECOND STUDENT ON LIST I

WEST	YOUNG	CRAWFORD	SUCCESSIVE CALENDAR DAYS		SECOND STUDENT	15	SEE-TO-MATCH WORDS ON LIST I	
SUPERVISOR	ADVISER	MANAGER			BEHAVIOR	AGE	LABEL	COUNTED
UTAH SCHOOL FOR THE DEAF	CRAWFORD	CRAWFORD	CRAWFORD	CRAWFORD	CRAWFORD			
DEPOSITOR	AGENCY	TIMER	COUNTER	CHARTER				

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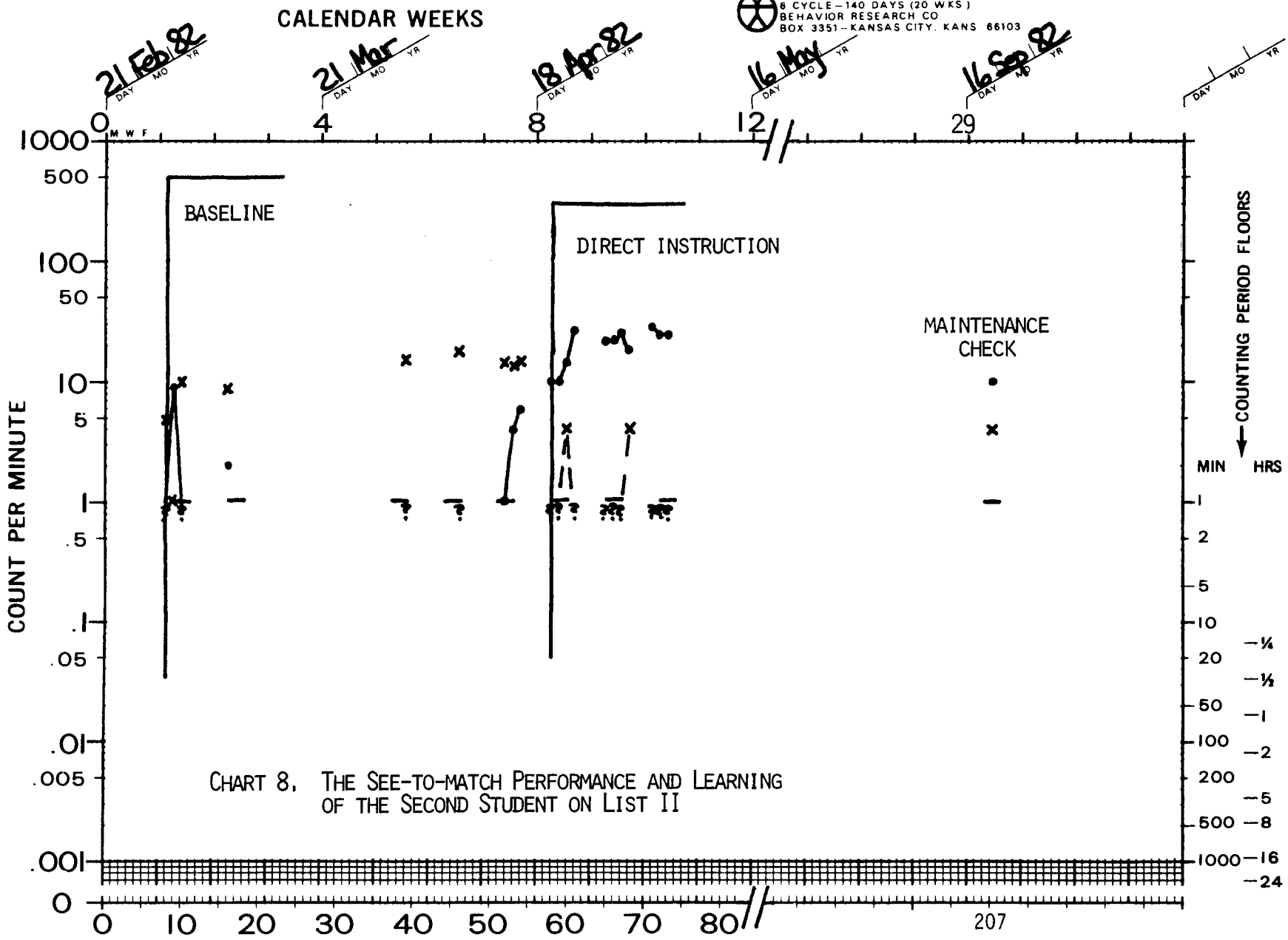


CHART 8. THE SEE-TO-MATCH PERFORMANCE AND LEARNING OF THE SECOND STUDENT ON LIST II

WEST SUPERVISOR	YOUNG ADVISER	CRAWFORD MANAGER	SUCCESSIVE CALENDAR DAYS	SECOND STUDENT BEHAVIOR	15 AGE	SEE-TO-MATCH WORDS ON LIST II
UTAH SCHOOL FOR THE DEAF DEPOSITOR	AGENCY	CRAWFORD TIMER	CRAWFORD COUNTER	CRAWFORD CHARTER		LABEL COUNTED

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K. Richard Young is an associate professor and Richard P. West is an assistant professor of Special Education at Utah State University, UMC-65, Logan, UT 84322. At the time of the study, Adrian Crawford was a teacher at the Utah School for the Deaf. She has since relocated.

AIM*STAR WARS

[Setting AIMS that COMPETE]

Owen R. White
University of Washington

Episode II: Return of the Learner

In Part I of this serial we made friends with young Eric, Learner Knight, and followed the exploits of Uncle Owen as he struggled to discover the secret of the Learner Force that Eric had mastered. Owen had decided that aims should allow a learner to (A)dvance to a level of (I)ndependence with a skill and