To Err is Divine

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Introduction

Within the precision teaching population, a great deal of attention has been focused on the attainment of functional fluency and mastery levels of performance. Evidence currently exists which suggests that low performance frequencies in simpler skills will result in lower performance levels in more demanding tasks (Barrett, 1979). Binder has related performance quantity to endurance (1980). Performance quantities related to success and failure within the school curriculum have also been documented (Wood, Burke, Kunzelmann and Koenig, 1978). Standards for performance quantities have been established on numerous pinpoints in various curricular areas (Precision Teaching Project, Sacajawea, 1980; Haughton, 1981).

Of major concern to the practitioner has been the provision of curricular and other environmental arrangements which accelerate acquisition of fluency and mastery attainment. For years the potential contributory effects of high error rate on learning were overlooked. Errors were things to be avoided. The two-line learning picture dramatically and graphically represented the possible honeymoon relationship of initial high rates of errors and correct learning (All, 1977). Evidence that errors could indeed function as learning opportunities and accelerate correct learning began to surface (Neely, 1978); Sokolove, 1979). Strategies for generating initially high rates of errors were suggested as a means of placing children into more efficient and effective learning environments (Lindsley, 1979, 1980).

Although the positive relationship of error generation and accelerated correct learning was manifest, placement of students into such environments was difficult at best. The suggestion was raised that our own personal histories of punishment for error production precluded error production strategies (Lindsley, 1980). Clark (1979) discovered that rate of error making and error learning were related to curricular area and the degree of detail in selected pinpoints. High rates of error learning were produced in Chappell's second grade classroom as the children leaped ahead into a previously untaught math curriculum (Stromberg, 1980).

Efforts have been made to design environments within the classroom which are conducive to error generation as a strategy to rapidly accelerate correct learning. However, the results have been spotty. Presently, learning picture summaries are characterized by a predominance of flat and low error frequencies. The jaws and crossover jaws pictures remain a rare animal in the classroom.

The Study

The investigators attempted to place the students into curricular environments which would produce and support initially high generation of errors. steep error learning, and rapidly accelerating correct learning. The student population consisted of undergraduate college students enrolled in general psychology, secondary educational psychology, and elementary educational psychology classes at Wayne State College. Based upon their ACT test scores, these students can confidently be classed as "normal" for these

populations (See Note 1). Students were provided lists of facts relevant to the curriculum, and were instructed to make flash cards. Daily 1-minute timings were conducted throughout the duration of the course. Students would be shown the front of the card, and would respond by saying the information on the back of the card. Frequencies for corrects and errors were recorded on the Daily Standard Behavior Chart. Error-making was encouraged by the instructor. This was done by:

* Establishing a high (40/minute) criterion level for correct performance;

* Publicly praising students who initially generated high error rates during class timings;

* Employing high initial error generators as models for the class;

* Modelling high error generation during acquisition phase when the instructor learned the students' names;

* Repeatedly stating during the acquisition phase that students must make many errors or skips if they expect to reach the criterion level within the allotted period of time;

* Snapping fingers at a rate of approximately 60 per minute during the class timings;

* Consequating only correct answers; errors were systematically not attended;

* Setting grade criteria which specified only the number correct during a 1-minute timing; no accuracy level was specified and no penalties were assessed for errors.

Results

Charts 1 through 3 display frequency distributions reflecting the proportion of error generation to correct frequencies for each group of students at the beginning and end of the curricular unit. All groups produced more errors than corrects when starting each group of flash cards. The highest proportion of errors to corrects was evidenced in the general psychology class during the "psychology facts #2" card packet (X5.5), while the smallest proportion of errors to corrects was observed in the secondary educational psychology class (X1.9). In all cases, terminal performance levels show dramatic division of errors and multiplication of correct frequencies. The failure of median error frequencies to fall below the record floor on the final test was not interpreted by the researchers as having major import in view of the extremely high rate of correct performance levels, and the more than satisfactory ratio of corrects to errors.

Learning picture summaries were also constructed for each group. Collectively, they displayed a disproportionately large quantity of learning pictures representative of high error learning. Chart 4 displays quantities and proportions of the various pictures. In each instance, the vast majority can be classified as derivatives of "jaws" including "crossover jaws" (See Note 2).

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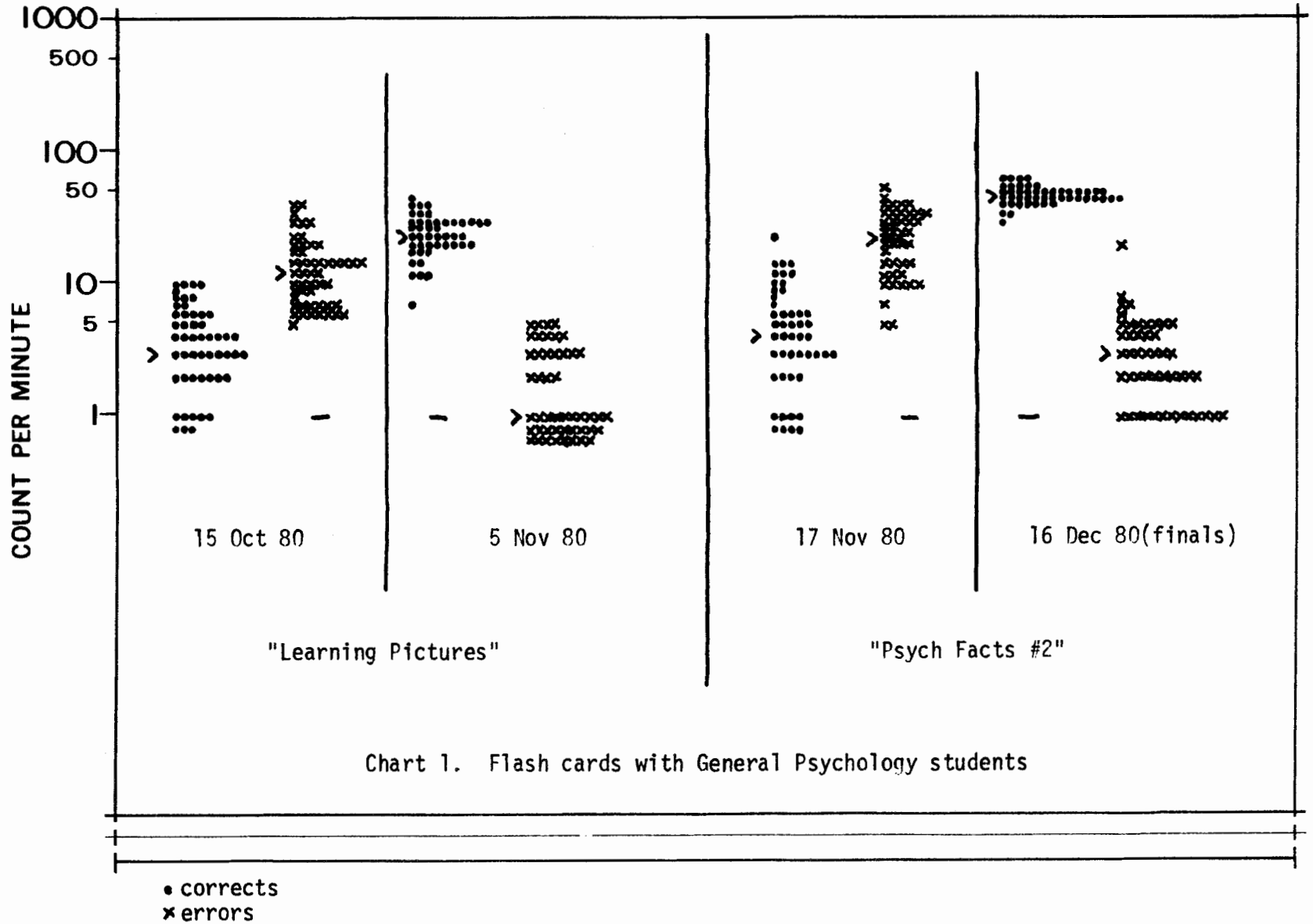

Chart 1. Flash cards with General Psychology students

BOWER ORGEL BOWER

GENERAL PSYCHOLOGY STUDENTS SEE AND SAY

FLASH CARDS

WAYNE STATE COLLEGE WAYNE, NEBRASKA

DAILY CHART TRACER (CT-8)

Bower, Bob and Orgel, Robert. To err is divine. *Journal of Precision Teaching*, Volume II, Number 1, April, 1981.

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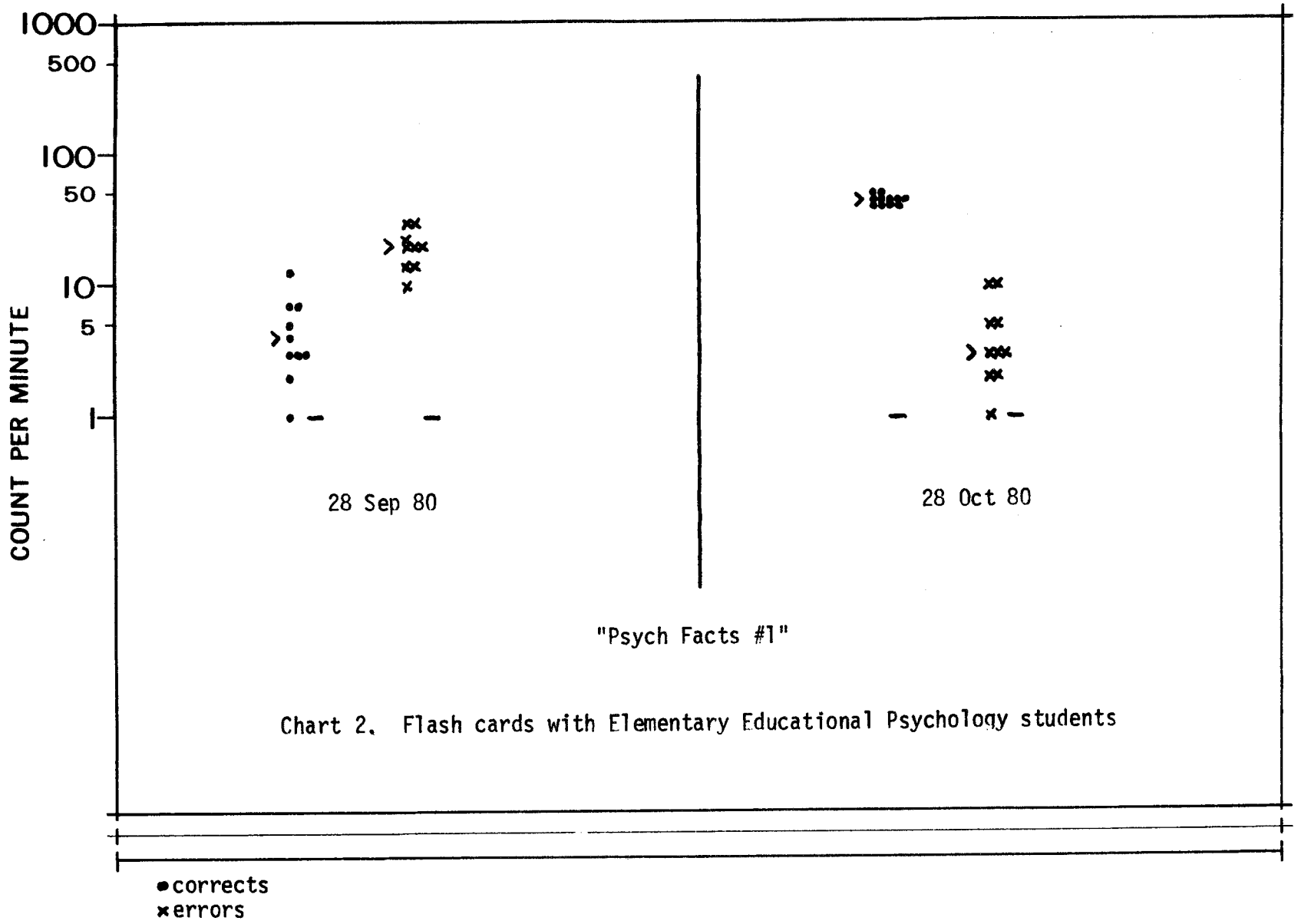

Chart 2. Flash cards with Elementary Educational Psychology students

BOWER ORGEL BOWER — ELEMENTARY EDUCATIONAL PSYCHOLOGY STUDENTS — SEE AND SAY

WAYNE STATE COLLEGE WAYNE, NEBRASKA — FLASH CARDS

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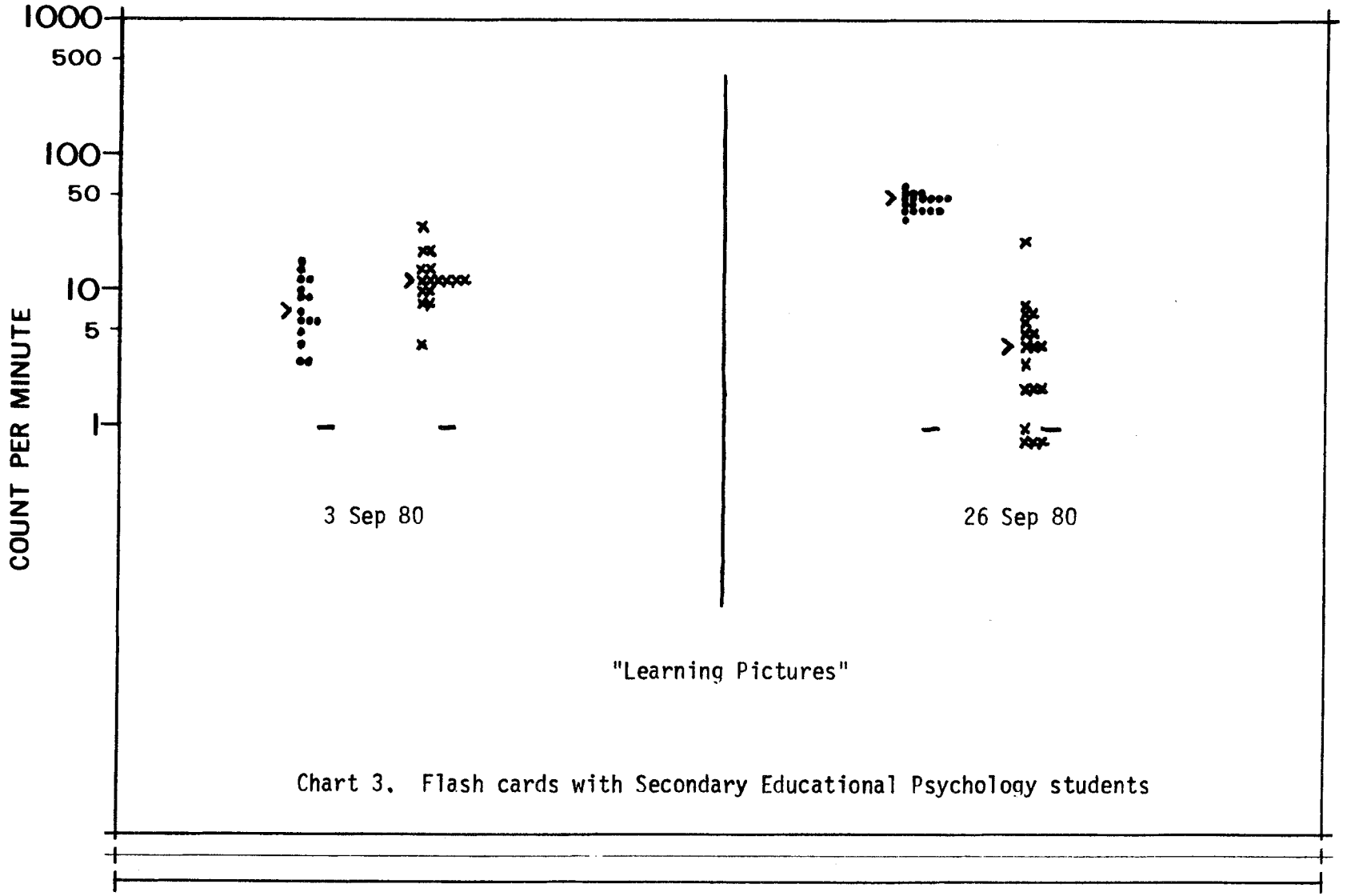

Chart 3. Flash cards with Secondary Educational Psychology students

•corrects
×errors

BOWER ORGEL BOWER

SECONDARY EDUCATIONAL PSYCHOLOGY STUDENTS

SEE AND SAY

WAYNE STATE COLLEGE WAYNE, NEBRASKA

FLASH CARDS

Bower, Bob, and Orgel, Robert. To err is divine. *Journal of Precision Teaching*, Volume II, Number 1, April, 1981.

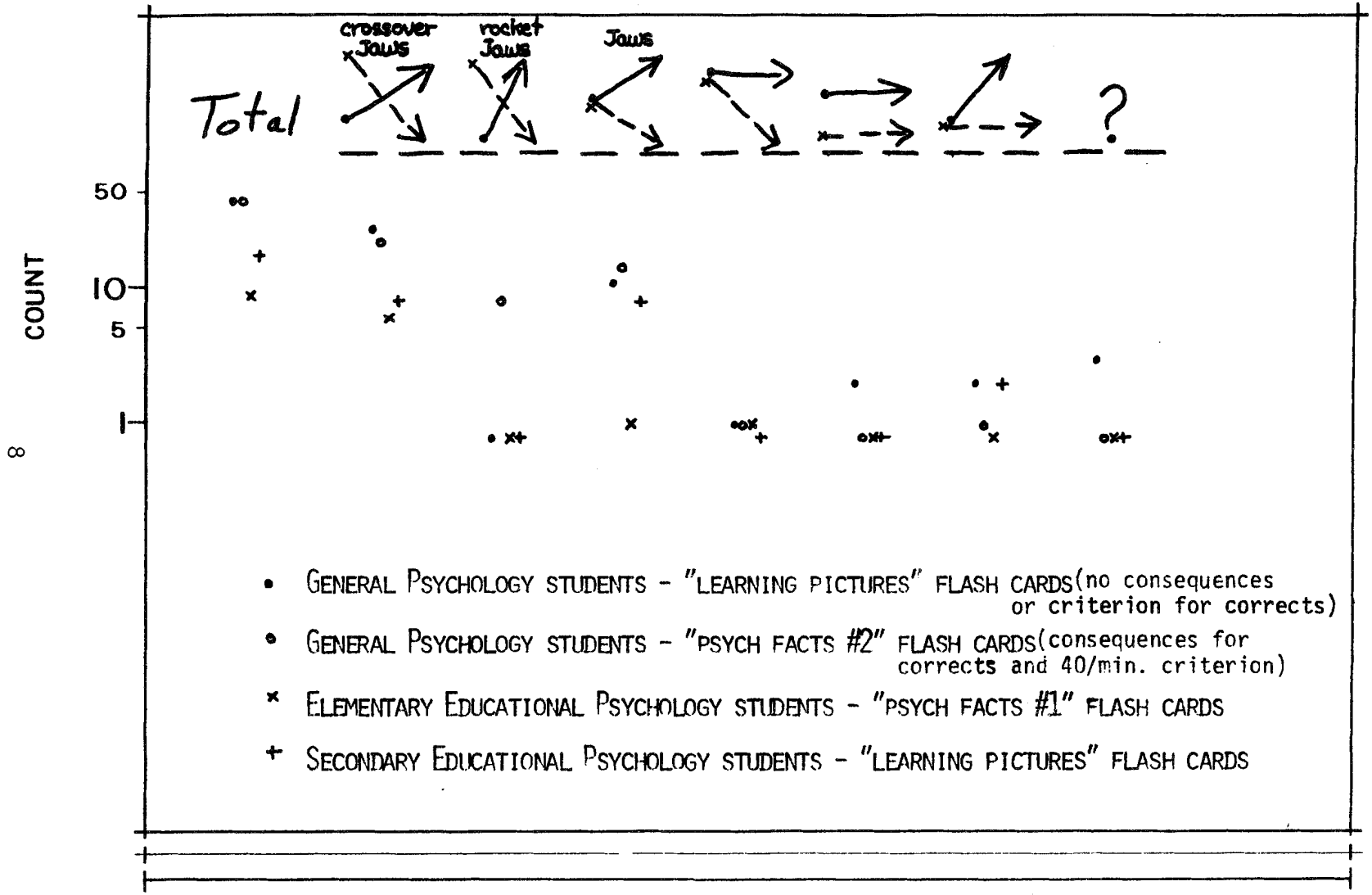

Chart 4. Student Learning Pictures

BOWER ORGEL BOWER STUDENTS LEARNING PICTURES

WAYNE STATE COLLEGE WAYNE, NEBRASKA

DAILY CHART TRACER (CT-8)

Bower, Bob, and Orgel, Robert. To err is divine. *Journal of Precision Teaching*, Volume II, Number 1, April, 1981.

The failure of researchers to systematically generate high rates of error and error learning has recently been noted by Lindsley (1981). While attempts have been made by Precision Teachers to deemphasize errors, terminal criteria are usually specified as a ratio of corrects to incorrect responses. This practice may not be necessary, however, when correct aims are set closer to their limit, and the order in which the cards (or exercises) is varied as a generalized part of the procedure. The data seems to indicate that under these conditions there is a satisfactory terminal accuracy ratio, along with a higher propensity for error generation and steep celeration. While these findings are still tentative, they do merit, we believe, further investigation. They point to the possibility that attention to errors may significantly retard the rate at which people learn, especially among populations with a long history of being punished for mistakes. Well designed curricula and learning environments along with sufficiently high aims for correct response frequencies may make attending to errors both unnecessary and counterproductive.

Precision Teachers, uncertain of the outcomes and fearful of negative consequences, often lack the curricular courage to set high aims and demand steep celerations. We thus decided that it was important to ask the students how they felt about being placed in learning situations which initially produce high rates of errors and require high rates of terminal performance. An evaluation tool designed by Lindsley (1979) provides clues to the students' feelings and perceptions. Upon completion of the course, students anonymously responded to a questionnaire which requested answers on a multiply-divide scale. The instrument included the following questions:

> "In this course, I liked the flash cards _____ as compared with other methods of testing and learning in other college courses."
>
> "In this course, I felt _____ free as in other college courses."
>
> "In this course, I had _____ fun as other college courses."

The distributions of these answers are found on Chart 5. Generally, the students liked the flash card learning and testing method twice (X2) as much as more traditional methods. Although placed in relatively high error learning situations, the students perceived the course to be freer (X2-X4). Confirming a previous finding by Calkin (1979), freedom and fun are functionally different categories. The students did not perceive the course to be more fun. The last two questions refer to the course as a whole, not exclusively to flash cards. However, inferences concerning flash cards may be drawn from these responses. Flash card drill occurred during each class meeting and was a heavily weighted factor in the grading procedures.

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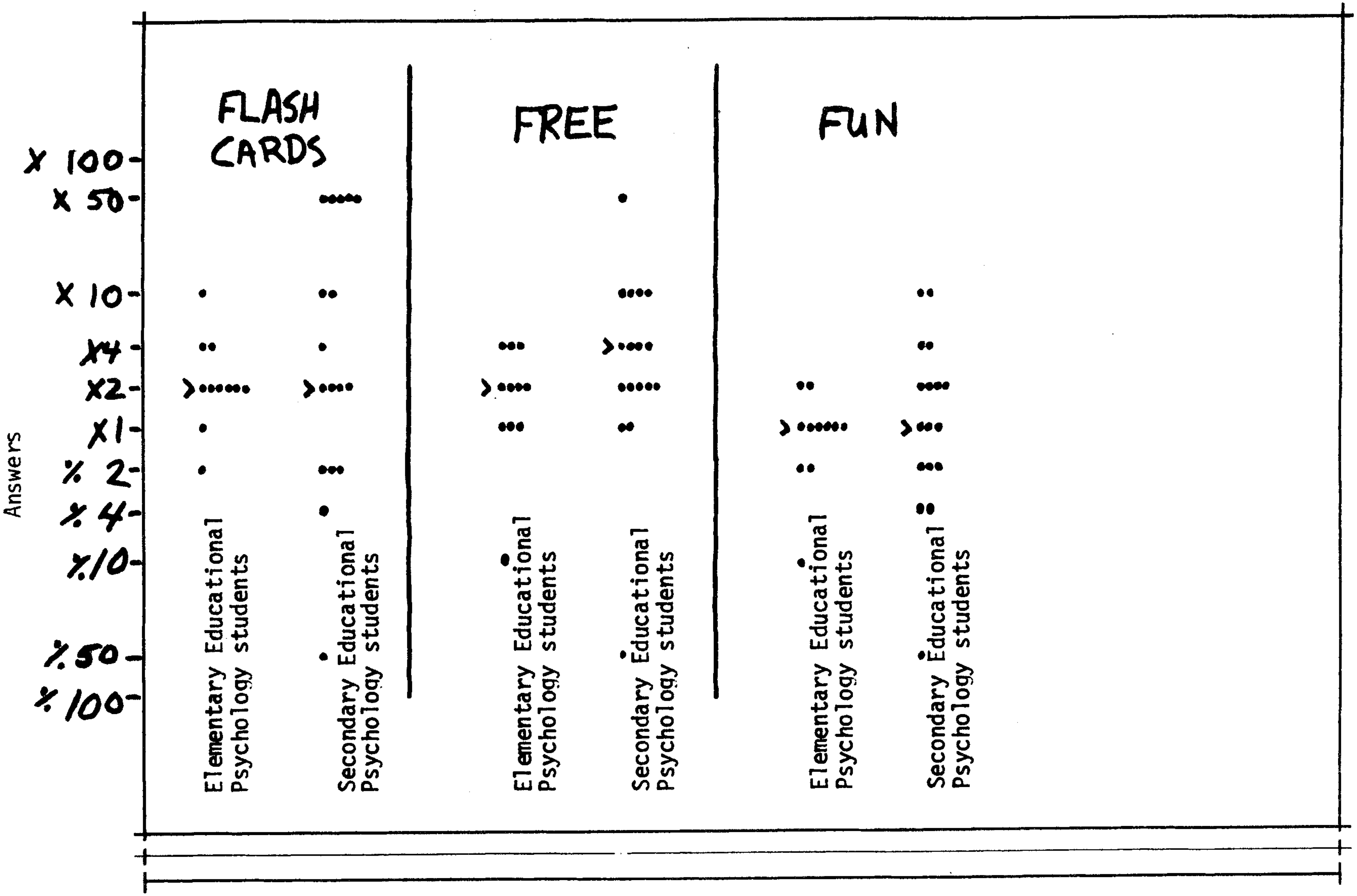

Chart 5. Students' answers to evaluation questions

BOWER | BOWER

WAYNE STATE COLLEGE | WAYNE, NEBRASKA

ELEMENTARY AND SECONDARY EDUCATIONAL PSYCHOLOGY STUDENTS

WRITE ANSWERS TO EVALUATION QUESTIONS

NOTES

Note 1. General Psychology - Freshmen - 1980-81 ACT Class Profile. "Typical student in this group had an ACT composite score of 18.5 and a H.S.A. of 2.9 out of 4.0. This compares to national scores of 18.9 and 3.0 respectively."

Elementary and Secondary Educational Psychology - Seniors - 1977-78 ACT Class Profile. "Typical student in this group had an ACT composite score of 18.9 and a H.S.A. of 2.9 out of 4.0. This compares to national scores of 18.5 and 3.0 respectively."

Note 2. Special attention should be paid to the third learning picture on Chart 4 named "rocket jaws" by the authors. This learning picture is characterized by extremely rapid acceleration (usually greater than X8/week) followed by a distinct celeration turn down until testing. In most cases 80% or better of criterion was learned in three days to one week. This phenomenon is currently being studied by the authors, and will be discussed in an upcoming article.

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PERFORMANCE AND LEARNING WORLD RECORDS

Performance Records

Tanya Kelb (Belleville, Ontario)	See-think 1470 words per minute (silent reading)
Vicky Vachon (Belleville, Ontario)	See-write 146 subtract facts of 18 per minute

Learning Records

Mary Hurst and Patsy (Potosi, Missouri)	See-say 10 survival words over and over for 1 minute--corrects x20 and incorrects /15 for 8 data days

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A SUGGESTION

Many precision teachers count and chart "digits" when teaching math facts. Betty Duvall, a teacher in Great Falls, Montana and author of the Can Do program, suggests that "answers" is a more useful movement. When "answers" is counted, performance aims for addition, subtraction, multiplication and division facts can be standardized at about 90 answers per minute.