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ABSTRACT
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Abstract

The present study assessed the effects of a distinct visual stimulus
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Although much is known about chained schedule performance in animals
(Kelleher, 1966) and operant chaining techniques have been successfully
used in teaching verbal behavior to children (Risley, 1966; Wheeler &
Sulzer, 1970), little research has attempted to delineate specific stimulus
functions in the learning of heterogeneous verbal response sequences by
children. The present study attempted to objectify some stimulus functions
in verbal training procedures through the use of controlled visual and
auditory stimuli. The primary concern was to assess the effect of external
visual stimuli (lights) on the development of a verbal chain, and to examine
relative efficiency, error rate, and training effectiveness of the two methods
of training.

Method

Subjects

Three girls attending the summer session of the University School
kindergarten at Southern Illinois University served as subjects. Chrono-
logical ages were 6-7, 5-9, and 6-0. Peabody (Dunn, 1959) mental ages
were, respectively, 6-4, 8-2, and 6-4. All were given portions of a standard
articulation test (Goldman & Fristoe, 1969) containing those phonemes used
in the nonsense syllables. None made any articulation errors on the test.

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Apparatus and Materials

The subjects' view of the apparatus is shown in Figure 1. Subjects
sat at a table facing a 9 X 10--inch panel containing five small white

Insert Figure 1 about here

lights, one centered near the top of the panel, and the other four arranged
in a row across the lower half of the panel. The four lower lights, referred
to as the component lights, could be continuously dimmed by means of a rheo-
stat. The single top light, referred to as the top master light, was always
used at full strength. To the left of the panel was a candy dispenser con-
taining a variety of small edibles, to the right of the panel was a small
speaker, and mounted on top of the panel was a microphone.

Auditory stimuli used were nine four--component chains of nonsense
syllables (Blasdell & Jensen, 1970), shown in Table 1. Syllables were pre--
recorded by a trained speaker, a radio announcer, keeping sound intensity and

Insert Table 1 about here

intonation as constant as possible. Syllables could be played through the
child's speaker by means of a Bell & Howell Language Master in any order,
with any inter--syllable interval, and with any number of repetitions of
individual syllables.

Procedure

After initial instructions, one shaping session, and several adaptation
sessions, experimental sessions were begun. No instructions were given during
experimental sessions. The experimental conditions consisted of two methods
of training a verbal response sequence of four nonsense syllables to be emitted
in response to the onset of the top master light on the panel in front of the
subject. The two methods differed only in whether or not the four component
were used. Each subject received each training method four times, the order

of presentation being partially counterbalanced across subjects. Order of presentation is shown in Table 2. For each subject, each new training method

Insert Table 2 about here

was accompanied by a new set of nonsense syllables. Thus, each subject was exposed to eight different nonsense syllable chains during experimental sessions

Method 1, No Lights (NL). With this training method, the top master light came on to signal the start of each trial. Simultaneous with the onset of the light, the first syllable of the chain was delivered through the speaker. None of the component lights in the bottom row were used in the NL condition. Following correct imitation of each syllable, the next syllable in the chain was delivered until all four syllables had been correctly imitated. Reinforcement was programmed to follow the last syllable in the chain, regardless of errors made. Failure to repeat any syllable correctly resulted in a re-presentation of that syllable until it was correctly imitated, followed by the presentation of the next syllable or reinforcement.

Once there had been five trials in which the above procedure was followed, fading of the auditory stimulus was begun until the response occurred immediately following the onset of the top master light alone. Fading was accomplished by delaying the presentation of auditory prompts to allow the subject to anticipate the prompt. Fading started with the final syllable in the chain and moved backwards through the first as the latter members of the chain were successfully anticipated.

Method 2, With Lights (WL). This condition utilized the four component lights in establishing the chain. The stimulus chain was presented as in the NL condition, and reinforcement contingencies and terminal behavior were the same. However, as each syllable was delivered auditorily, a corresponding component light was illuminated, going from left to right for each syllable.

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Here, correct imitation of each syllable resulted in the illumination of the
next light and delivery of the next auditory stimulus. Auditory fading was
carried out exactly as in NL, but the component lights occurred without any
delay until correct emission of each syllable in response to the onset of
the proper component light alone occurred for two trials in succession. Then
fading of the component lights was done simply by not turning them on, or,
if the subject failed to respond, by gradually dimming the lights.

During all phases of the experiment, each syllable in the chains was
scored right or wrong, prompted or not prompted. A syllable was scored correct
if two out of the three phonemes in the syllable were reproduced correctly,
and only the first occurrence of a response in a trial was scored. Six
reliability checks covering 508 syllables yielded an overall agreement of
97%, with reliabilities for individual sessions ranging from 93% to 99%.

Results and Discussion

Addition of the lights in the WL condition failed to speed acquisition
of the criterion behavior, as shown in Figure 2. Two subjects met criterion

Insert Figure 2 about here

on every chain trained and failed to exhibit systematic differences in number
of trials to criterion under the two training methods. The third subject
reached criterion only two out of four times in the WL condition and only once
out of four times in the NL condition.

However, the addition of lights did have an effect on number of errors
made on individual syllables, number of times subjects missed a syllable
once it had previously been anticipated during fading, and total number of
syllables anticipated. As can be seen in Figure 3, the first two subjects
made consistently fewer errors when trained with lights than without, and

once these two subjects had successfully anticipated a syllable, they seldom

needed another auditory prompt on that syllable in the WL condition. The

third subject failed to show these effects because of her failure to learn

Insert Figure 3 about here

most of the chains and her low overall rate of anticipations. As can be seen

in Figure 4, all three subjects anticipated the auditory prompt more often

during the WL conditions.

Insert Figure 4 about here

Although the use of added visual stimuli in the WL condition failed to

speed acquisition of the terminal behavior, the effect of the lights on errors

and anticipations is of interest. The present task was well within the cap-

abilities of two of the subjects, and the ease of the task may explain the

ineffectiveness of the lights in speeding acquisition. For subjects who

might find such a task more difficult, the decrease in errors and the increase

in anticipations accompanying training with lights might become very impor-

tant in determining whether such subjects would learn at all.

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Footnote

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Table 1

Response Chains Used in the Study

Chain/Component	1st	2nd	3rd	4th
A	tud*	gop	nʌk	pim
B	mˑp	kit	pud	tok
C	bɔn	tuk	dit	mʌp
D	kig	pʌd	gon	bug
E	dʌt	mob	tug	nin
F	puk	nip	kʌg	dod
G	kʌn	gin	muk	bop
H	nok	dʌp	kim	gub
I	tip	gum	nʌg	pot

*Letters here are International Phonetic Alphabet symbols

Table 2

Sequence of Training Methods and Syllable

Chains for each Subject

Subject

Phase	1	2	3
Introductory	NL B*	NL A	NL B
1	NL E	WL E	NL E
2	WL C	NL D	WL D
3	WL D	WL C	NL C
4	NL A	NL B	WL A
5	NL F	WL F	NL F
6	WL G	NL G	WL G
7	WL H	WL H	NL K
8	NL I	NL I	WL I

*NL B indicates No Lights condition, syllable chain B, etc.

Figure Captions

Figure 1. Subject's view of apparatus. From left to right are a candy
dispenser, the box containing the stimulus lights, with a microphone
mounted atop the box, and the speaker through which the auditory stimuli
were delivered.

Figure 2. Trials per session and trials to criterion when reached. An $\underline{X}$
above a bar indicates criterion was reached during that session. Letters
at the bottom of each bar indicate syllable chain for that session. Open
bars are the number of trials until the fading of the auditory prompt
was complete, and blackened portions are trials with no auditory prompts
until fading of the component lights was complete.

Figure 3. Incorrect responses and failures to anticipate a syllable after
it had been correctly anticipated once as percent of total trials by
individual component. Letters above each segment of figure indicate
syllable chain used.

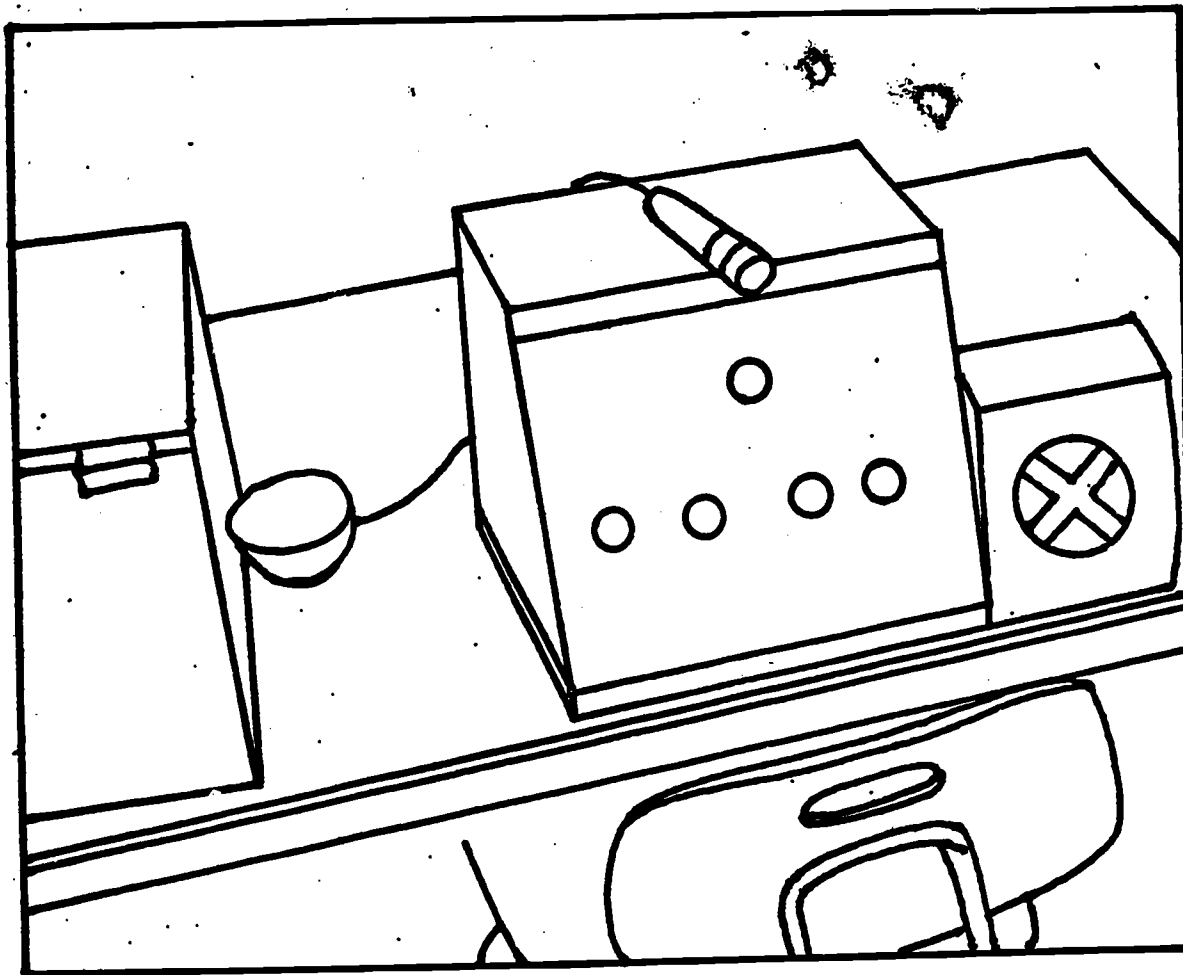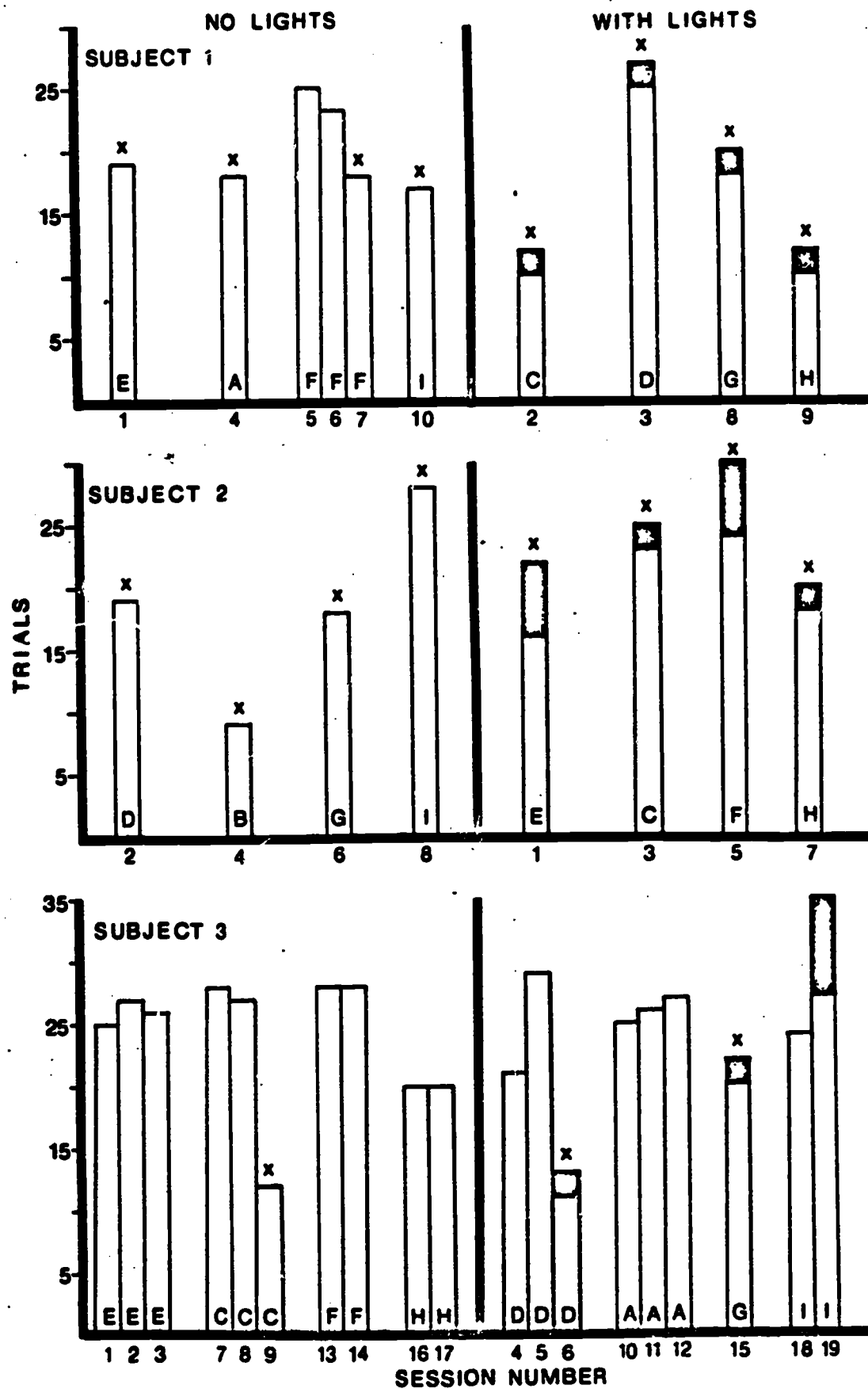Figure 4. Percent of total syllables anticipated correctly for each chain
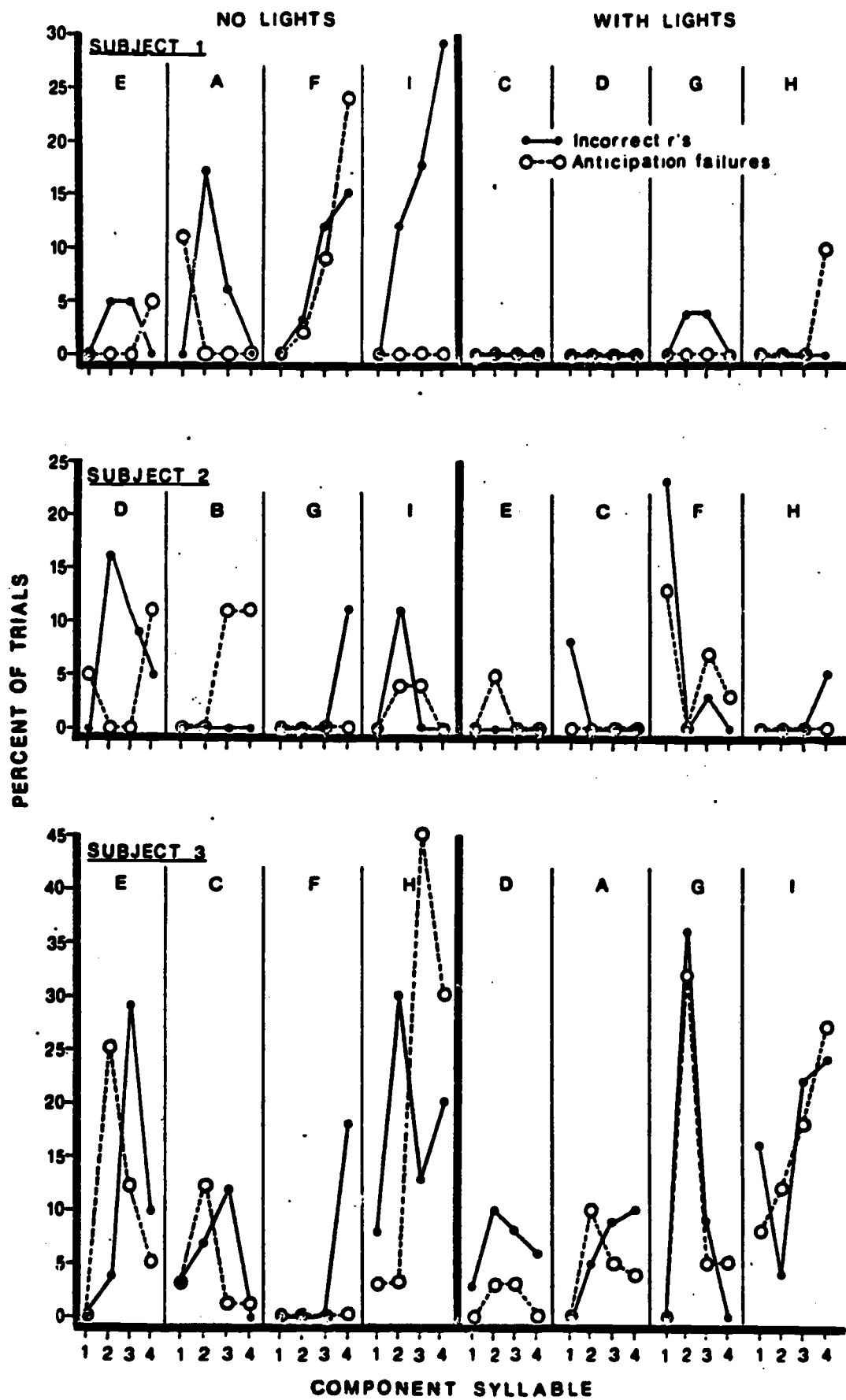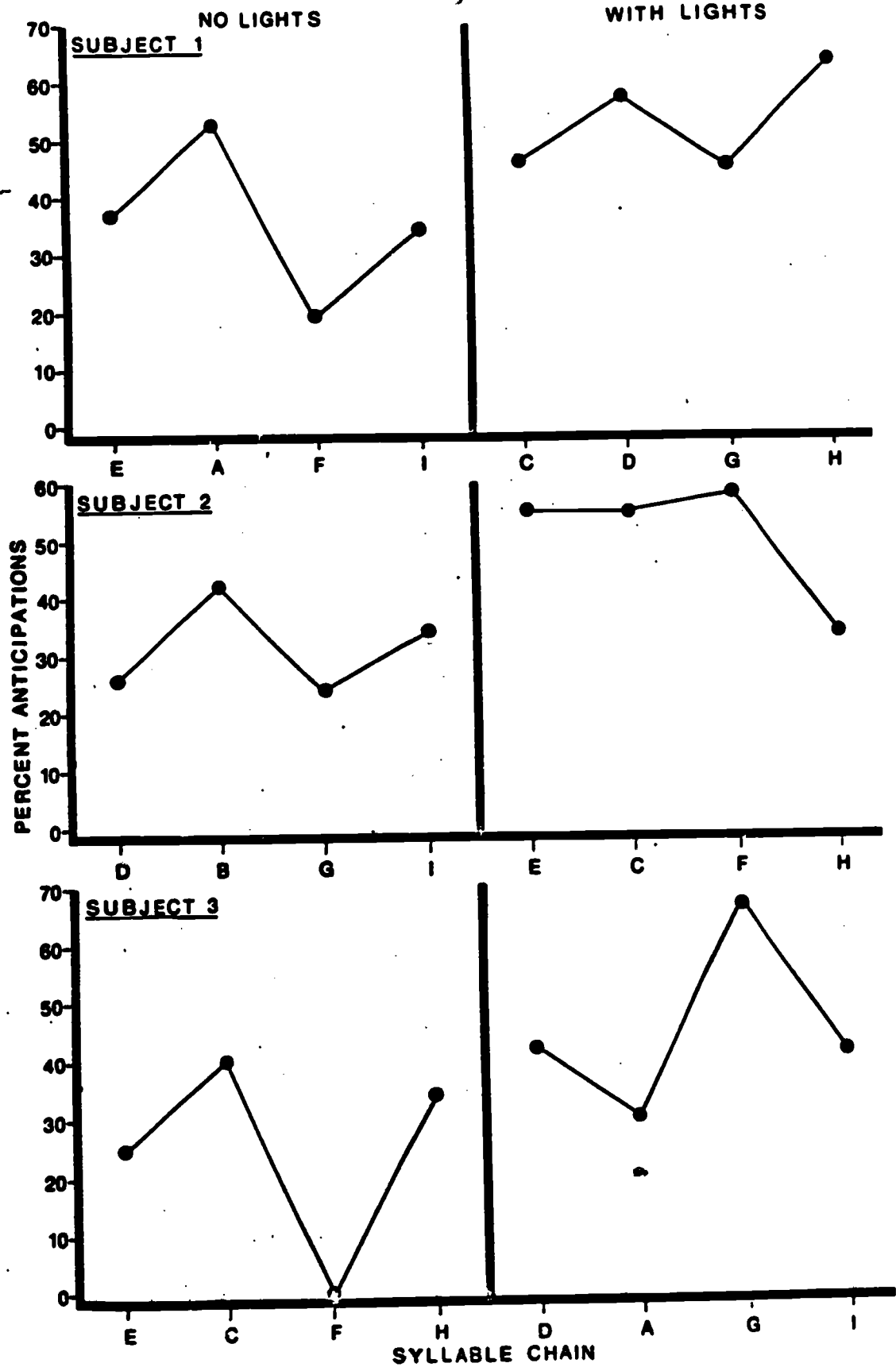trained.

FIGURE 1

FIGURE 2

NO LIGHTS · WITH LIGHTS

FIGURE 3

FIGURE 4