THE EFFECTS OF MANIPULATING OBJECTS IN MODELING FILMS ON IMITATIVE RESPONSE TOPOGRAPHIES

by

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Imitative responding has been the focus of considerable theoretical and research attention. Many studies have dealt with variables which are associated with response matching following the observation of a modeling sequence. However, recent research strategies have restricted the availability of stimuli to which an imitater could respond and limited the responses under direct observation. In addition, previous research has not analyzed modeling sequences by examining which components of a modeled stimulus sequence are functionally related to subsequent behaviors. The present study varied several components of a modeled stimulus sequence and permitted topographical variety within the imitative response class to be emitted in a subsequent testing environment.

Five-year old black boys individually observed one of the following four modeling films: 1) a film depicting a model swinging a yellow baseball bat (the Yellow Film), 2) a film depicting a model swinging (in baseball fashion) a short pink cloth-wrapped stick (the Pink Film), 3) a film depicting a model pantomiming baseball swings (the Pantomime Film), and 4) a film showing a model engaging in various gymnastic exercises (the Jumping Jack Film). After watching the films, each child entered a testing room where two types of objects were available: Bat objects (a Yellow, a Blue and a short Black bat) and Nonbat objects (a Wooden stick, a short

Pink stick, and a Pail and shovel). During the 10 minute observation session observers, behind one-way mirrors, recorded the amount of time a child made contact with each object and the number of swings made with an object. Also recorded were the latencies to contacting the objects and the latencies to swinging behaviors.

The results indicated that the objects in the testing room exerted considerable control over swinging behaviors. All groups swung Bats more frequently than Nonbats. The mean number of swings for the Jumping Jack Film group and the Pantomime Film group were similar and relatively low. However, the Pantomime Film group made their initial swing during the session much earlier than did children who saw the Jumping Jack Film. The mean number of swings for both the Yellow Film group and the Pink Film group were significantly greater than the means for the other two groups. However, while the mean number of swings for the Yellow Film group and the Pink Film group was comparable, the median number for the Yellow Film group was considerably greater than that of the Pink Film group. Thus, the Yellow Film appeared to have the greatest influence on swinging behaviors, followed in order by the Pink Film, the Pantomime Film and the Jumping Jack Film. All groups who had observed swinging behaviors contacted earlier and played longer with the Bats than with the Nonbats.

A theoretical system was presented to account for the order of the Film effects and the Objects effects. The

system described three components of a modeling film: the behavior modeled, the object used in the film, and the interaction between the behavior and the object (i.e., the use of the objects). Estimations were made for each component's control over the imitative response class under study. The combined estimations permitted the placement of each Film along a continuum (arbitrarily labelled "familiarity"). The objects used in the testing environment were also placed on a continuum (again labelled "familiarity") which orders the degree of control of each object over the response class of swinging. For example, the Bat objects are more "familiar" than the Nonbats. The system also suggests that children will imitate familiar rather than unfamiliar behaviors and will imitate with familiar objects. The results of the study were compatible with the outlined system.

ACKNOWLEDGMENTS

I would like to express my appreciation to the members of my advisory committee, Dr. Marilyn T. Erickson, Dr. Aaron J. Brownstein, Dr. Richard L. Shull, Dr. Rosemery O. Nelson, and Dr. Robert J. Jones. I also wish to thank Dr. William A. Powers for his assistance in the statistical analyses of the data. I would especially like to express my gratitude to Dr. Erickson, for her guidance, support and patience which have helped to make graduate school so meaningful.

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INTRODUCTION

All of us have encountered many occasions when the behavior of another person has influenced our own behavior. For example, while dancing or playing sports, the manner in which a partner moved has partially determined our own behavior. Skinner (1957) has discussed the numerous effects that one person's verbal behavior has on the same response class in another person (e.g., echoic behavior, intraverbal behavior, etc.). In each case, the performance of one individual is functionally related to the prior behavior of another person. Imitation is another example of this type of interaction.

What makes imitation unique is the similarity between the behaviors of a model and the observer. Imitation has been the focus of considerable empirical and theoretical discussion. One reason for this attention is the apparent importance of imitation to the development of children's behavioral repertoires. For example, psychoanalytic theory (Freud, 1935) stressed the importance of "identification" (i.e., imitation) in the development of internalized standards for appropriate behaviors. Others (Bandura, 1962; Mowrer, 1960) have noted the importance of imitative behaviors in the development of various social roles and expectations.

Imitative performance has also been postulated to play a major role in language acquisition (Mowrer, 1960; Sherman, 1971; Whitehurst and Vasta, 1975).

Some authors (e.g., Bandura, 1969) have suggested that imitative behaviors cannot be derived solely from operant or classical conditioning learning principles. Others (Miller and Dollard, 1941; Gewirtz and Stingle, 1968; and Skinner, 1953) have stressed that imitation may be understood in terms of operant conditioning learning principles (e.g., reinforcement, shaping, generalization, etc.). Consistent with this latter position, Skinner (1953) has stated, "The similarity of stimulus and response in imitation has no special function (p. 121)." The position adopted in this paper is similar to that of Skinner's in that the behavior of a model is viewed as having an influence on the performance of a variety of response classes, one of which will include topographically similar responses.[1]

Past research has suggested a number of variables which have been demonstrated to influence the likelihood that a particular topography will be observed. These variables include: a) history of reinforcement for imitative behavior (Bry and Nawas, 1972), b) history of

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[1]A review of this position is presented in an unpublished manuscript by Bondy (1974).

reinforcement for the response to be imitated (Gewirtz, 1971), c) variables indicating current reinforcement contingencies (e.g., observed reinforcement of the model, Bandura, 1969), d) method of model presentation (Steinman, 1970), e) time between modeling sequence and subsequent observer performance (Litrowrik, 1972), and f) similarity of contextual stimuli between the modeling sequence and subsequent environments.

One factor which has received little attention is the possible role that specific "enabling" stimuli in a testing environment have in determining which member of a response class is emitted. The testing environment is here defined as all the objects and events which occur in the situation in which imitative responding will be measured. Enabling stimuli are those objects with which people interact (i.e., ball throwing, bat swinging, doll punching, etc.). Contextual stimuli include more general cues such as the color of the testing room, people present in the testing environment, etc. It would be difficult to determine which are the stimulus functions of portions of a modeling sequence without knowing how the objects within a testing environment will influence the topographical selection within response classes. Many stimulus functions may be imbedded in a modeling sequence. For example, the activity level of a model may serve as an elicitor of many motor responses, or, viewing a particular manipulandum may serve to alter the

"attentional set" of an observer (i.e., "local enhancement", Thorpe, 1963).

Past research on imitative performance has restricted the range of behaviors which may be influenced by a modeling sequence. Previous researchers have also excluded from their studies possible additional factors within a modeling sequence which may influence subsequent behaviors.

The purpose of the present study was to examine the interaction between past histories of exposure and reinforcement with different modeling sequences. More specifically, the study permitted several members of a response class to be observed following a modeling sequence, and also varied the specific objects used in the modeling sequences.

To aid in the assessment of which topographies of a response class are influenced by a modeling sequence, several enabling objects and multiple dependent measures were used in the present study. The dependent measures were interrelated such that if a particular modeling sequence had a strong effect upon the response class under study, each of the measures would be influenced in a predictable manner. For example, for the response class of swinging behaviors, a strong modeling effect would be reflected by a greater number of swings and a shorter latency to the initial swing. Furthermore, since several objects were available, specific changes in other dependent measures could be used to detect response preferences

between the objects. For example, a subject would spend more time with a preferred object and interact with that object prior to other objects.

One of the expectations of the present study was that children who observed a model using a known object in a usual manner would subsequently choose that same object from an array and use it during an imitative performance. Another expectation was that children who observed a model engaging in a familiar behavior with an unusual object would, when given an array of objects, choose objects which had been previously associated with that behavior in the child's history prior to the experiment. These expectations were based upon the hypothesis that children's past experience's will interact with a modeling sequence to yield imitative performances, although not necessarily in a topographically identical manner.

It was assumed in the present study that the subjects had had previous experience concerning the response class under study, namely swinging behaviors. It was further assumed that these behaviors had been primarily associated with culturally standard objects, i.e., baseball bats. The selection of the objects included in the testing environment was based upon these assumptions.

METHOD

Subjects

38 Black boys (mean age = 5.5 years, range = 4.3 to 5.11 years) served as subjects. The children were selected from three day care centers in Greensboro, North Carolina. Forty children were initially selected. However, two subjects did not comply with the general requirements and were dropped from the study. Additional children were not available at the day care centers. The children were asked if they would like to play some games with the experimenter and were permitted to leave the experimental area at any time.

Observers and Reliability

The principal observer observed each child, and two other observers attended a random selection of the sessions for the purpose of assessing inter-observer agreement. The observers were graduate students from the University of North Carolina at Greensboro. The observers were not aware of the experimental group to which any particular child was assigned. Prior to data collection the observers were trained while observing a nonexperimental subject who engaged in the experimental behaviors until an inter-observer agreement criterion of 85% was established (approximately 30 minutes). Observation data were collected

via a continuous-time event recorder (an Esterline-Angus Model AW recorder). This recording device also permitted the determination of the latency to the onset of any contact or to any swing by a child. The observers recorded the amount of time each child was in contact with the various experimental objects. In addition, the observers recorded the number of swings (two-handed and uni-directional) with each object.

Materials

The testing environment consisted of a 10' X 10' screened-off "room" within each day care center. The room was portable and brought to each center. A distinctive curtain material provided common contextual cues between the modeling sequence background and the testing environment. Two one-way mirrors were located on one of the walls to permit observation of the children. The room also contained the following objects:

Object 1 - A yellow, plastic 76.2 cm. (30") baseball bat (the Yellow bat).

Object 2 - A blue, plastic 76.2 cm. (30") baseball bat (the Blue bat).

Object 3 - A black, plastic 38.1 cm. (15") baseball bat (the Black bat).

Object 4 - A wooden, rectangular 76.2 X 2.0 X 2.0 cm. (30 X 3/4 X 3/4 in.) stick (the Wooden stick).

Object 5 - A pink, cloth-wrapped 38.1 cm., 0.7 cm. diameter (15", 1/4" diameter) stick (the Pink stick).

Object 6 - A red plastic pail and a red plastic shovel (the Pail).

The first three objects (i.e., Yellow bat, Blue bat, and Black bat) constituted an object category labelled Bat, while the other objects (i.e., Wooden stick, Pink stick, and Pail) were labelled as Nonbats.

Four modeling films were used. Each was filmed (in color) with a Kodak X33 Super-8 movie camera and lasted for two minutes. One 23 year old adult served as the model in all films. In Film 1 (the Jumping Jack Film) the model engaged in jumping jack exercises (i.e., jumping up and spreading his legs while raising his hands over his head, etc.) and other exercises (i.e., trunk twists, shoulder rolls). In Film 2 (the Pantomime Film) the model pantomimed swinging a baseball bat (i.e., he held his hands and moved his arms as if swinging a baseball bat, while standing in a "batter's" positions, etc.). In Film 3 (the Yellow Film) the model swung the Yellow bat. In Film 4 (the Pink Film) the model swung the Pink stick (in baseball fashion). The rate of swinging was kept constant for all three swinging films.

Dependent Measures

Four dependent measures were used. Observers recorded the length of time each child made contact with each of the objects available in the testing environment (Contact Time). The number of swings which occurred with each object were also recorded (Swings). In addition, the latency to the first contact (Latency to Contact) and the latency to the first swing (Latency to Swing) with each object were determined from the data recordings.

To facilitate evaluation of the experimental effects, the data were combined in several ways for analysis. For the Latency to Contact measures one category, labelled "Any", was defined as the time a subject took to contact the first object, regardless of which object was contacted. Two other categories for the Latency to Contact measure included the time to the first contact with a Bat object (labelled "Bat") and the time to the first contact with a Nonbat object (labelled "Nonbat").

For the Latency to Swing data, the category "Any" refers to the amount of time until the initial swing with any of the five swingable objects. "Bat" refers to the time to the initial swing with a Bat object, while "Nonbat" refers to the time to the initial swing with a Nonbat object.

For the Contact Time data, the category, "Nocontact" time, refers to the amount of time spent not in contact with any of the available objects. The average time spent with

Bat objects was labelled "Bat", while the average time spent with the Nonbat objects was labelled "Nonbat".

For the data concerning the number of Swings, two categories were defined. One category was the average number of swings with Bat objects (labelled "Bat"), and the other category (labelled "Nonbat") was the average number of swings with the Nonbat objects.

Procedures

Children were randomly assigned to view one of the four films. Each child was asked by the experimenter to view a film made of a "friend" playing a game. Ten children viewed the Jumping Jack Film, ten children viewed the Yellow Film, nine children viewed the Pantomime Film, and the remaining nine children viewed the Pink Film. After viewing the films, the children were brought to the testing room where they were asked to wait and play with whatever was available while the experimenter found a game they could play together. The boys were told that they could do whatever they wished but that they should remain in the room. Each child was observed for a ten-minute period, after which the experimenter returned to play with the subject. During this play period, the experimenter informally interviewed each subject to assess whether the subject recalled the specific content of the film he had observed.

RESULTS

Inter-observer agreement was computed on the dependent measures of Contact Time and on the number of Swings for 26% of the subjects. Reliability for Contact Time was determined by the sum of the time in agreement divided by the sum of the time in agreement and disagreement. For the number of Swings, reliability was determined by the sum of the number of swings in agreement divided by the sum of the number of swings in agreement and disagreement. Inter-observer reliability was assessed between the principal observer and the other two observers. The reliability for all six objects between one pair of observers was 92.3% for Contact Time (range: 76.3% to 96.6%) and 92.5% for the number of Swings (range: 88.9% to 95.8%). The reliability between the second pair of observers was 93.5% for all six objects for Contact Time (range: 85.3% to 95.7%) and 94.0% for the number of Swings (range: 89.3% to 96.8%).

Table 1 presents the means for each dependent measure for each group. A multivariate analysis of variance (Manova) for a repeated measures design was used to evaluate the overall effects of the experimental manipulations. In order to maintain a balanced design, the object Pail was not included, since no Swings were expected to occur with this object. (The data concerning interaction with the Pail

TABLE 1

Group mean, standard deviation (S.D.), and median scores for each dependent measure with each object.

Latency to Contact (in seconds)	FILM GROUPS											
	JUMPING JACK			YELLOW			PINK			PANTOMIME		
	mean	S.D.	median	mean	S.D.	median	mean	S.D.	median	mean	S.D.	median
Bluebat	137	127	93	55	84	24	140	224	9	132	186	37
Yellowbat	48	57	26	36	35	27	105	151	26	56	59	32
Blackbat	124	174	50	41	30	40	285	232	328	117	179	52
Woodenstick	156	184	77	224	202	156	324	249	146	160	166	132
Pinkstick	72	90	35	65	50	46	297	258	149	63	68	48
Pail	33	42	9	114	170	35	292	271	239	157	182	70
Contact Time (in seconds)												
Bluebat	93	46	73	144	80	141	224	188	191	125	66	117
Yellowbat	107	69	87	177	68	169	166	190	117	136	126	96
Blackbat	68	61	53	101	87	84	61	56	27	91	68	57
Woodenstick	73	59	38	62	56	41	63	51	11	108	123	58
Pinkstick	90	76	61	31	17	28	57	88	10	114	100	99
Pail	120	83	107	74	49	74	79	99	28	90	112	41

TABLE 1 (continued)

Latency to Swing (in seconds)	FILM GROUPS											
	JUMPING JACK			YELLOW			PINK			PANTOMIME		
	mean	S.D.	median	mean	S.D.	median	mean	S.D.	median	mean	S.D.	median
Bluebat	304	217	247	140	194	54	237	265	100	204	221	66
Yellowbat	176	218	71	115	171	34	195	227	67	171	232	61
Blackbat	311	244	221	75	76	48	382	210	445	221	212	136
Woodenstick	555	128	600	369	250	500	520	155	600	416	208	600
Pinkstick	554	96	600	333	269	380	426	238	600	511	181	600
Swings												
Bluebat	7.6	9.6	2.5	44.5	41.5	38.0	47.7	54.3	14.0	14.8	16.2	5.0
Yellowbat	15.0	27.4	1.5	43.8	37.8	39.0	76.6	137.2	6.0	13.8	17.3	7.0
Blackbat	3.4	5.4	1.0	29.8	32.9	15.5	3.3	4.3	1.0	4.1	4.3	2.0
Woodenstick	0.2	0.4	0.0	12.6	21.9	1.0	2.6	6.9	0.0	1.1	1.5	0.0
Pinkstick	0.5	1.2	0.0	3.5	5.6	0.5	2.7	4.2	0.0	0.2	0.4	0.0

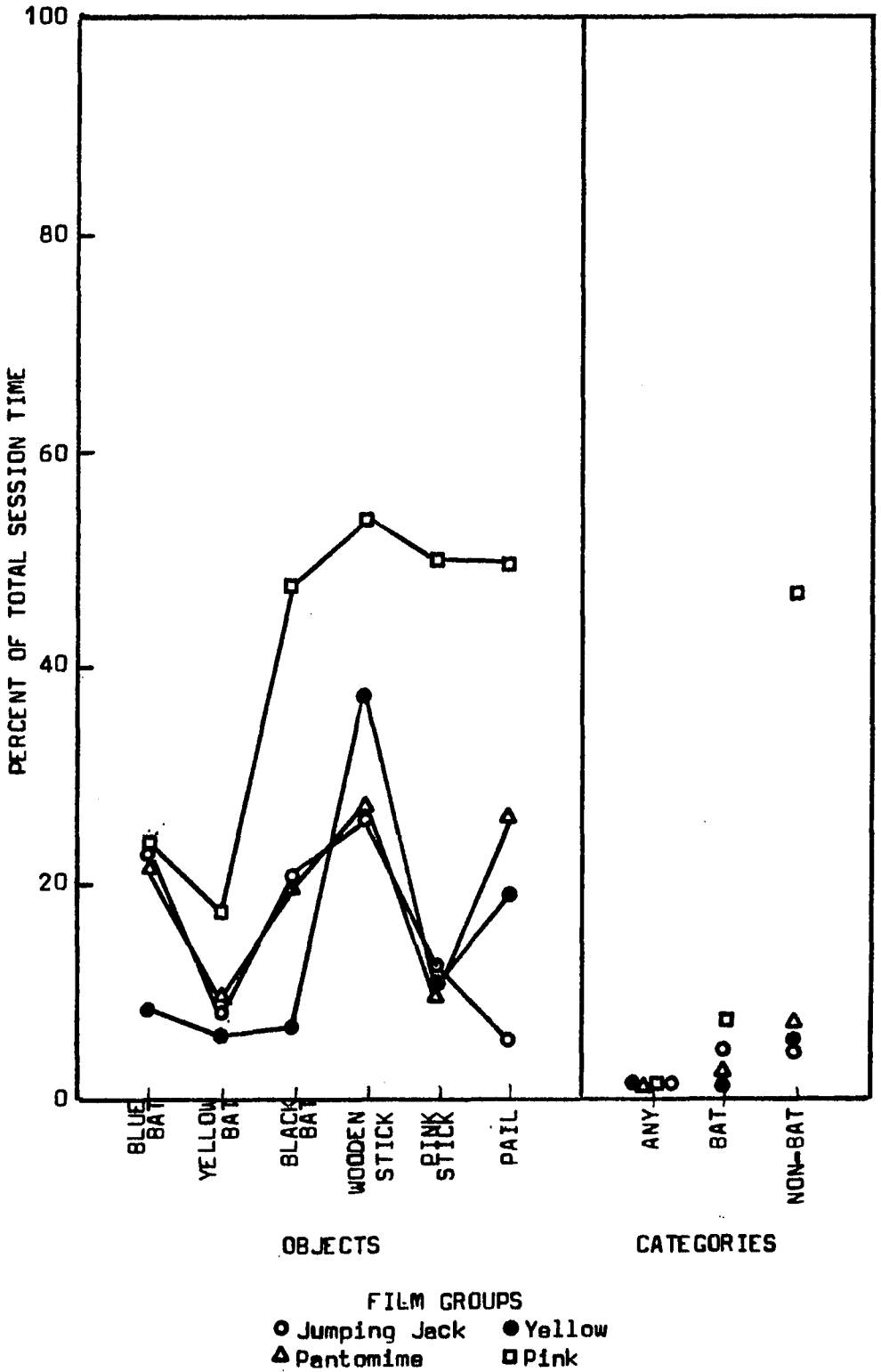
were analyzed in subsequent Anova's within each dependent measure.) The Manova for overall Film and Object effects was statistically significant (Approximate F = 6.65, df = 16,406, $p < .001$, and Approximate F = 4.56, df = 12,484, $p < .001$, respectively); no significant Film X Object interaction effect was found. (The individual scores for each dependent measure are presented in Appendix A. Summary tables for the various statistical analyses are presented in Appendix B.)

The univariate analysis of variance (Anova) for each of the four dependent measures was computed using both means and medians. In the mean analyses the upper limit of the observation period (600 seconds) was assigned to both Latency to Contact and Latency to Swing if a child did not interact with a particular object. Since means were likely to be greatly affected by extreme scores, median distribution-free tests of Anova hypotheses (Wilson, 1956) were also used to evaluate each dependent measure.

Figure 1 presents the mean of each group for Latency to Contact with each object. Also presented are the data for the categories Any, Bat and Nonbat. The data appear to indicate that the Jumping Jack Film group distributed their selection of objects fairly equally between Bats and Nonbats. The Pantomime Film group's Latency measure appears to closely resemble that of the Jumping Jack Film group, with the exception of a longer latency to contacting the Pail.

Figure 1

The mean Latency to Contact scores (percent of total session time) for each group with each object, and the categories Any, Bat and Nonbat.


100
80
60
40
20
0
PERCENT OF TOTAL SESSION TIME
BLUE BAT
YELLOW BAT
BLACK BAT
WOODEN STICK
PINK STICK
PAIL
ANY
BAT
NON-BAT
OBJECTS
CATEGORIES
FILM GROUPS
Jumping Jack
Yellow
Pantomime
Pink

The Yellow Film group clearly selects Bats prior to Nonbats, as does the Pink Film group. However, the Latency to Contact scores for the Black Bat, and the Nonbats for the Pink Film group appear substantially longer than all the other scores. All groups appear to contact their first objects with similar latencies.

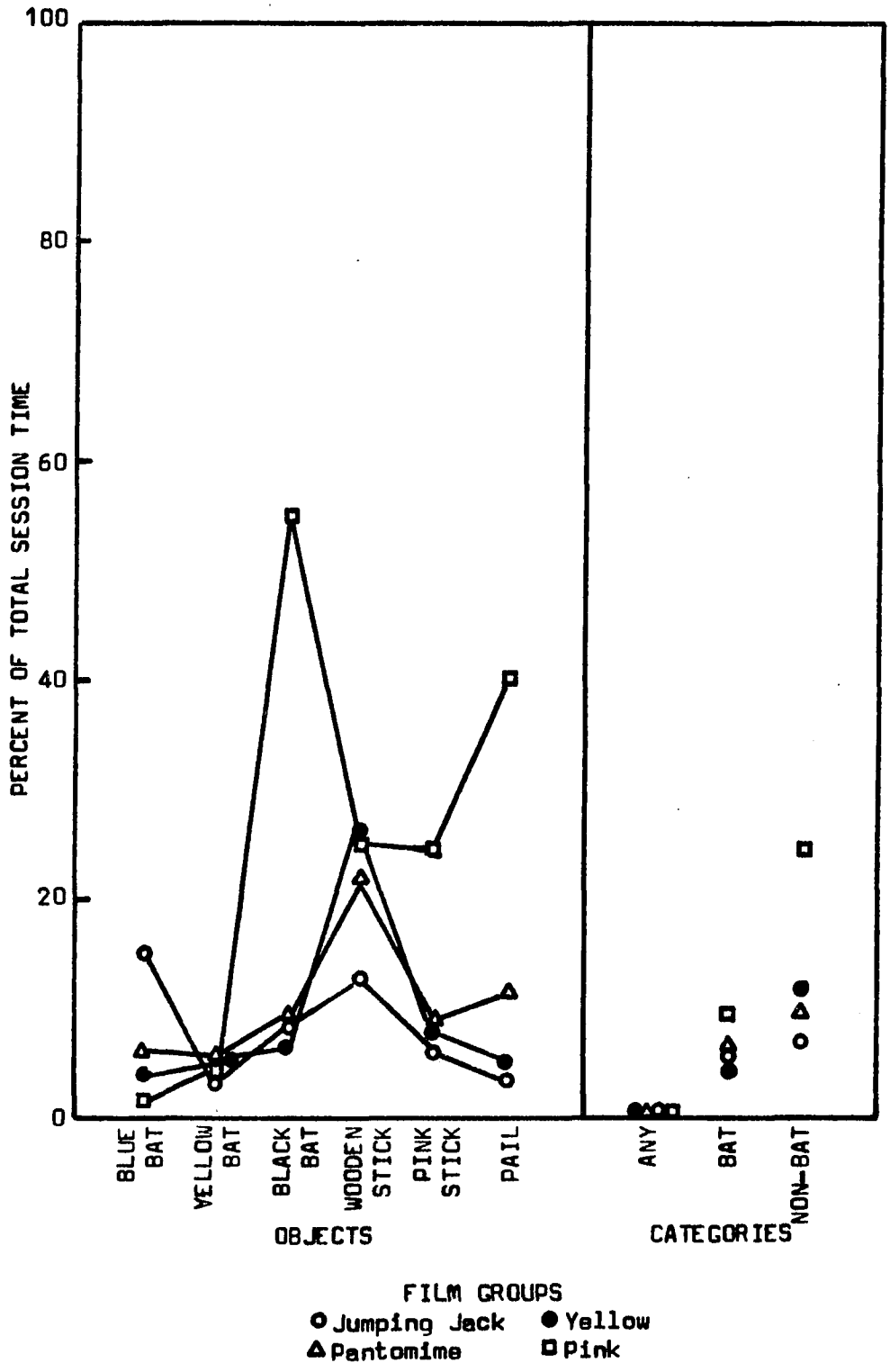
The means Anova for the Latency to Contact measure indicated both a significant Film effect ($F = 3.37$, $df = 3,34$, $p < .05$) and Object effect ($F = 6.09$, $df = 4,136$, $p < .001$). No significant Newman-Kuels effects were found for this Anova. A Newman-Kuels comparison made between groups for the category, Any, also revealed no significant differences. When the data were combined into Bats and Nonbats, a Newman-Kuels analysis revealed that the Pink Film group showed longer latencies to contacting the Nonbats than the other three groups ($q > .95$, $df = r, 34$).

Figure 2 presents the group median scores for each object for the dependent measure Latency to Contact, along with the categories Any, Bat and Nonbat. Figure 2 appears to be similar to Figure 1. However, only the median latency scores for the Pink Film group with the Black Bat and Pail seem to be extremely different from all other scores.

The median Anova for Latency to Contact indicated a significant Film effect ($X^2 = 7.81$, $df = 3$, $p < .05$) and a significant Object effect ($X^2 = 21.68$, $df = 5$, $p < .005$). A group medians comparison between Bats and Nonbats for each

Figure 2

The median Latency to Contact scores (percent of total session time) for each group with each object, and the categories Any, Bat and Nonbat.


100
80
60
40
20
0
PERCENT OF TOTAL SESSION TIME
BLUE BAT
YELLOW BAT
BLACK BAT
WOODEN STICK
PINK STICK
PAIL
ANY
BAT
NON-BAT
OBJECTS
CATEGORIES
FILM GROUPS
Jumping Jack
Yellow
Pantomime
Pink

dependent measure is presented in Table 2. Comparisons between Bats and Nonbats revealed that all groups contacted Bats prior to Nonbats ($X^2 = 7.02$, df = 1, $p < .01$).

Figure 3 presents the group means for Contact Time with each object. Also shown are the group values for the average Contact Time with Bats and Nonbats, and the category Nocontact Time. The data appear to show that the Jumping Jack Film group spent as much time with Bats as Nonbats. The Pantomime Film group tended to spend slightly more time with Bats than Nonbats. The Pink Film group and the Yellow Film group both seemed to spend more time with the Yellow and Blue baseball bats than the other two groups, but relatively less time with the Nonbat objects.

The means Anova for Contact Time revealed a significant Object effect ($F = 4.64$, df = 4,136, $p < .002$). A Newman-Kuels analysis revealed no specific Object differences. Newman-Kuels analysis indicated that the Pink Film group spent significantly more time with Bats than did the Jumping Jack Film group ($q > .95$, df = 4,34) and that there was a trend for the Yellow Film group to spend more time with Bats than the Jumping Jack Film group ($q > .93$, df = 3,34). In addition, no significant differences were found for the category, Noncontact Time.

Figure 4 presents the group median scores for each object for Contact Time, as are the categories Nocontact Time, Bat and Nonbat Times. Figure 4 appears to be very

Table 2

The number of scores below the median for the Latency to Contact data for the categories Bat and Nonbat.

	Jumping Jack	Yellow	Pantomime	Pink	Totals
Bats	13	8	12	14	47
Nonbats	14	16	16	21	67
Totals	27	24	28	35	114

Figure 3

The mean Contact Time scores (percent of total session time) for each group with each object, and the categories Nocontact time, Bat and Nonbat.

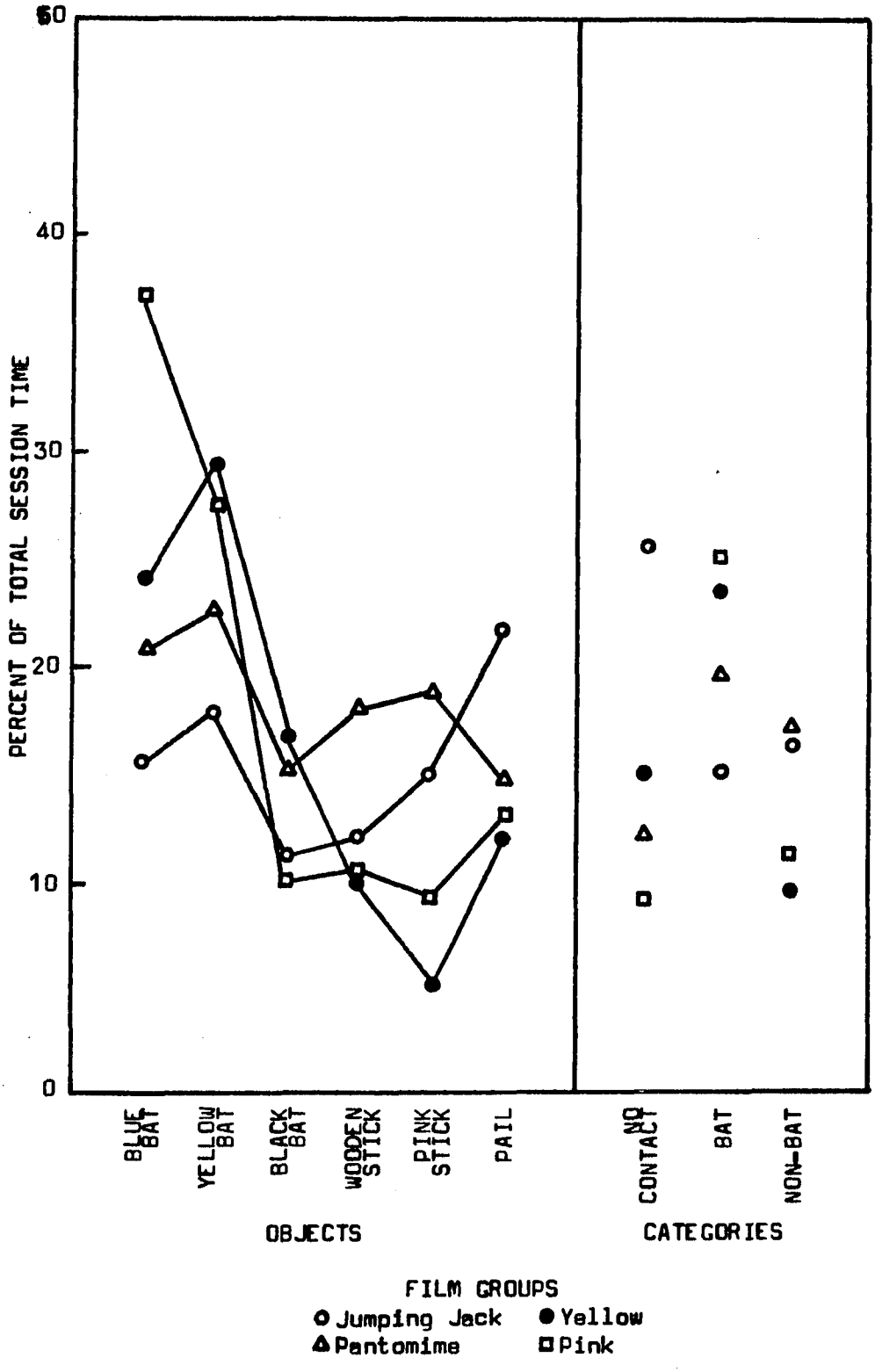
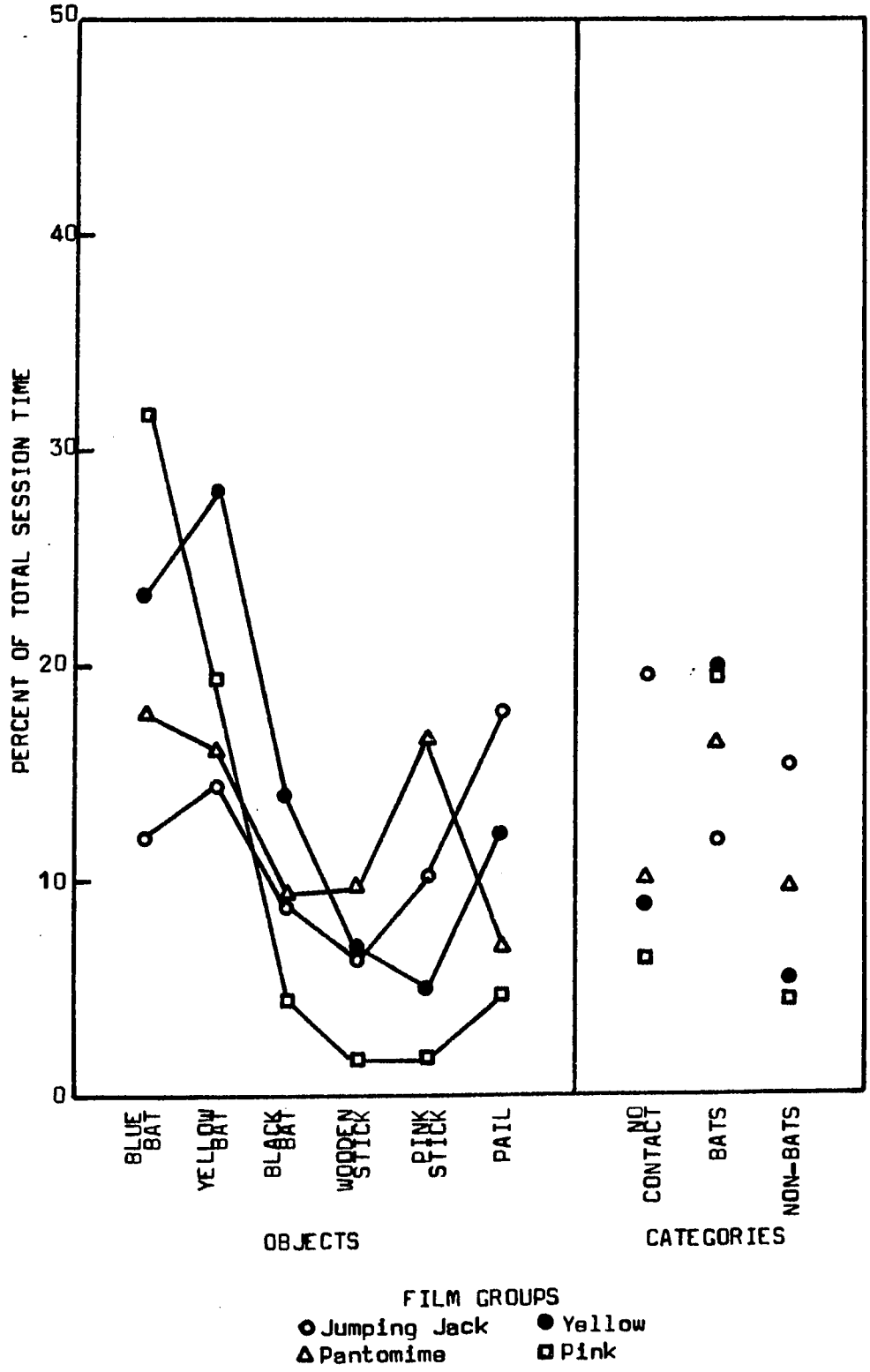

60
40
30
20
10
0
PERCENT OF TOTAL SESSION TIME
BLUE BAT
YELLOW BAT
BLACK BAT
WOODEN STICK
PINK STICK
PAIL
NO CONTACT
BAT
NON-BAT
OBJECTS
CATEGORIES
FILM GROUPS
Jumping Jack
Yellow
Pantomime
Pink

Figure 4

The median Contact Time scores (percent of total session time) for each group with each object, and the categories Nocontact, Bat and Nonbat.


50
40
30
20
10
0
PERCENT OF TOTAL SESSION TIME
BLUE BAT
YELLOW BAT
BLACK BAT
WOODEN STICK
PINK STICK
PAIL
NO CONTACT
BATS
NON-BATS
OBJECTS
CATEGORIES
FILM GROUPS
Jumping Jack
Yellow
Pantomime
Pink

similar to Figure 3. The median Anova for Contact Time indicated a significant Object effect (X^2 = 24.00, df = 5, p <.001). Analysis of Bats versus Nonbats (Table 3) showed that the three groups who observed the films involving Swinging behaviors spent significantly more time with the Bats than with the Nonbats (X^2 = 11.86, df = 1, p < .001).

Figure 5 shows the group mean scores for each object for Latency to Swing, with the mean group scores for the categories Any, Bat and Nonbat. Inspection of Figure 5 reveals that each group appears to follow a similar, general pattern. Each group swung each of the Bats prior to the Nonbats. Furthermore, it appears that the score for Latency to Swing any object is longer for the Jumping Jack Film group than for the other groups.

The means Anova for the Latency to Swing data revealed significant Film effects (F = 3.02, df = 3,34, p < .05) and Object effects (F = 20.76, df = 4,136, p <.001). Newman-Kuels analysis of the Object effect indicated that the children took significantly longer to swing the Wooden or Pink Sticks than the Yellow or Blue Bats (q > .95, df = r, 136). Newman-Kuels analysis of the categories indicated that the Latency to Swing scores for the Nonbats was significantly longer than the Latency to Swing measures for the Bats (q > .95, df = r, 136). Furthermore, analysis of the Any category showed that the Jumping Jack Film group took

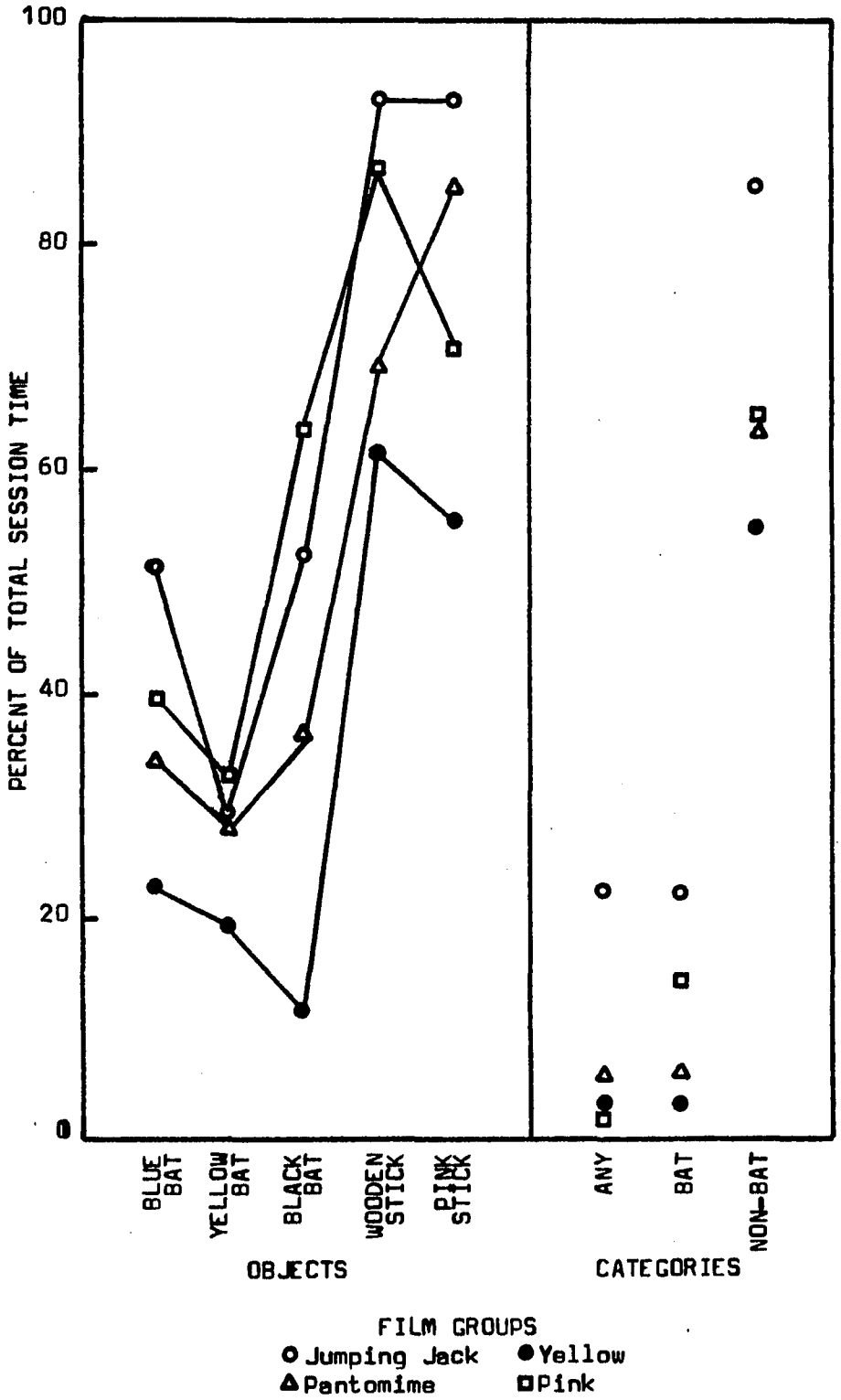
Table 3

The number of scores below the median for the Contact Time data for the categories Bat and Nonbat.

	Jumping Jack	Yellow	Pantomime	Pink	Totals
Bats	16	7	10	11	44
Nonbats	14	21	16	19	70
Totals	30	28	26	30	114

Figure 5

The mean Latency to Swing scores (percent of total session time) for each group with each object, and the categories Any, Bat and Nonbat.


100
80
60
40
20
0
PERCENT OF TOTAL SESSION TIME
BLUE BAT
YELLOW BAT
BLACK BAT
WOODEN STICK
PINK STICK
ANY
BAT
NON-BAT
OBJECTS
CATEGORIES
FILM GROUPS
Jumping Jack
Yellow
Pantomime
Pink

significantly longer to make their initial Swing than the other three groups ($q > .95$, df = r, 34).

Figure 6 presents the group median scores for Latency to Swing, as are the median scores for the categories Any, Bat and Nonbat. Figure 6 is essentially similar to Figure 5. The median Anova for Latency to Swing indicated a significant Film effect ($X^2 = 12.61$, df = 3, $p < .01$) and Object effect ($X^2 = 41.47$, df = 4, $p < .001$). All groups (Table 4) swung Bats earlier in the session than Nonbats ($X^2 = 37.13$, df = 1, $p < .001$).

Figure 7 shows the group mean number of Swings for each object, and included are the data for the categories Bat and Nonbat. Figure 7 shows that the Pink Film group made many swings with the Yellow and Blue bats, but very few swings with the other objects. The Yellow Film group made many more swings with the Bats than Nonbats. The Pantomime Film group and the Jumping Jack Film group both appear to have made far fewer swings with the Yellow Bat and Blue Bat than the other groups, and very few swings with the Black Bat or the Nonbats. All groups can be seen to have swung Bats more frequently than Nonbats.

The means Anova for Swings demonstrated a significant Film effect ($F = 3.47$, df = 3,34, $p < .05$) and a significant Object effect ($F = 6.46$, df = 4,136, $p < .01$). No specific Newman-Kuels differences were found for the Film or Object

Figure 6

The median Latency to Swing scores (percent of total session time) for each group with each object, and the categories Any, Bat and Nonbat.

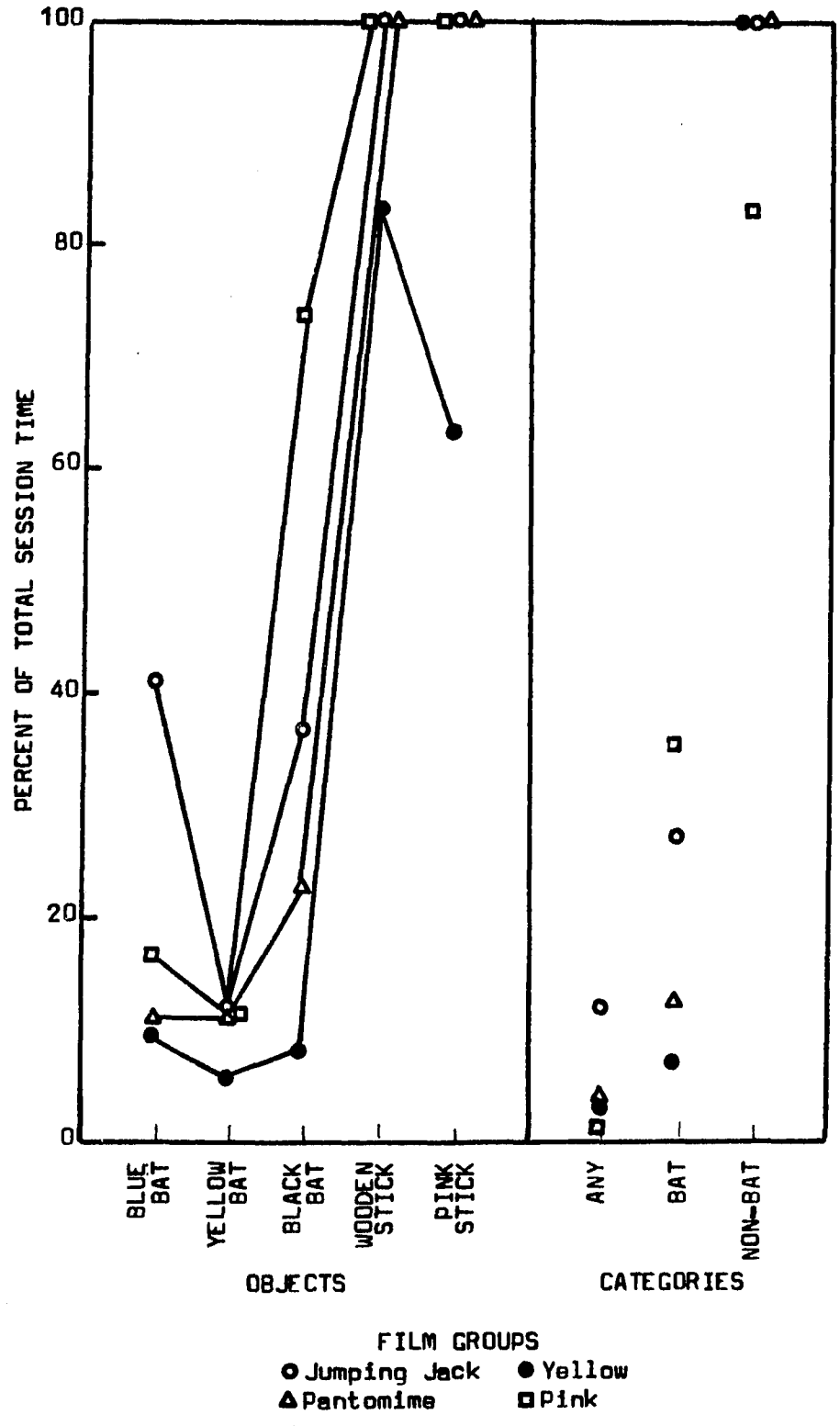

100
80
60
40
20
0
PERCENT OF TOTAL SESSION TIME
BLUE BAT
YELLOW BAT
BLACK BAT
WOODEN STICK
PINK STICK
ANY
BAT
NON-BAT
OBJECTS
CATEGORIES
FILM GROUPS
Jumping Jack
Yellow
Pantomime
Pink

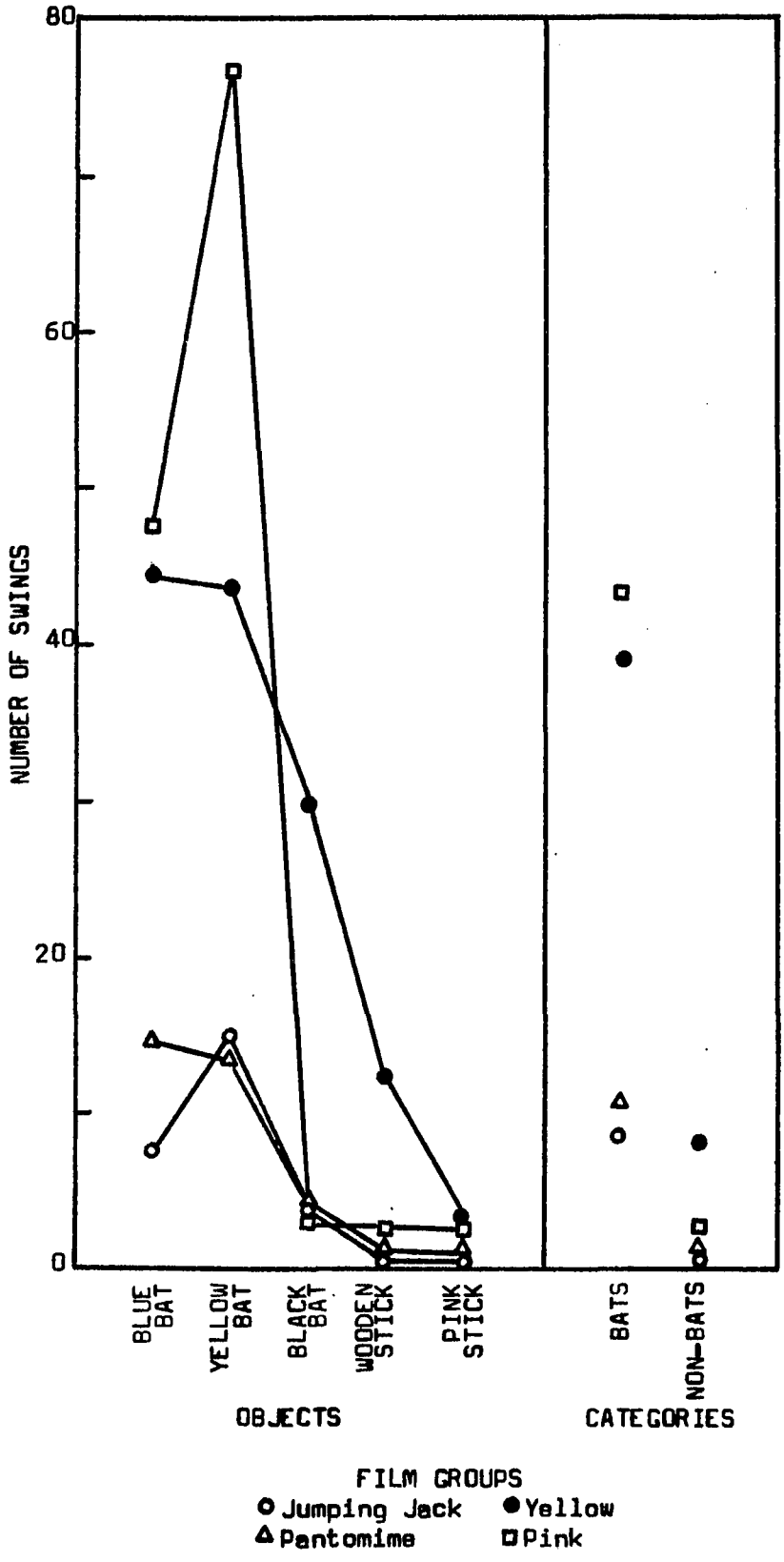
Table 4

The number of scores below the median for the Latency to Swing data for the categories Bat and Nonbat.

	Jumping Jack	Yellow	Pantomime	Pink	Totals
Bat	18	26	19	15	78
Nonbat	1	9	4	3	17
Totals	19	35	23	18	95

Figure 7

The mean number of Swings for each group with each object, and the categories Bat and Nonbat.


80
60
40
20
0
NUMBER OF SWINGS
BLUE BAT
YELLOW BAT
BLACK BAT
WOODEN STICK
PINK STICK
BATS
NON-BATS
OBJECTS
CATEGORIES
FILM GROUPS
Jumping Jack
Yellow
Pantomime
Pink

effects. However, it was found that both the Yellow Film group and the Pink Film group tended to swing Bats more often than did the Jumping Jack Film group or the Pantomime Film group ($q > .93$, df = r, 34).

Figure 8 presents the group median number of Swings for each object, along with the median scores for the categories Bat and Nonbat. Figure 8 appears to indicate that only the Yellow Film group engaged in a substantial amount of Swinging behavior. The performance of the Pink Film group does not appear extremely distinct from that of the Pantomime Film or Jumping Jack Film groups, as it does in Figure 7.

The median Anova for the number of Swings indicated both significant Film ($X^2 = 16.26$, df = 3, $p < .001$) and Object effect ($X^2 = 36.42$, df = 4, $p < .001$). All groups (Table 5) swung Bats significantly more than Nonbats ($X^2 = 33.68$, df = 1, $p < .001$).

The results of the post-session interviews indicated that all children were able to describe or demonstrate the model's behavior and the appropriate objects when observed. Only one child gave evidence of mislabelling the model's performance. This child was in the Pink Film group and described the model's behavior as "chopping wood" although he was able to correctly select the object used by the model.

In summary, the statistical findings reveal that the children who saw the three films which demonstrated swinging behaviors tended to pick up bats earlier and spend more time

Figure 8

The median number of Swings for each group with each object, and the categories Bat and Nonbat.

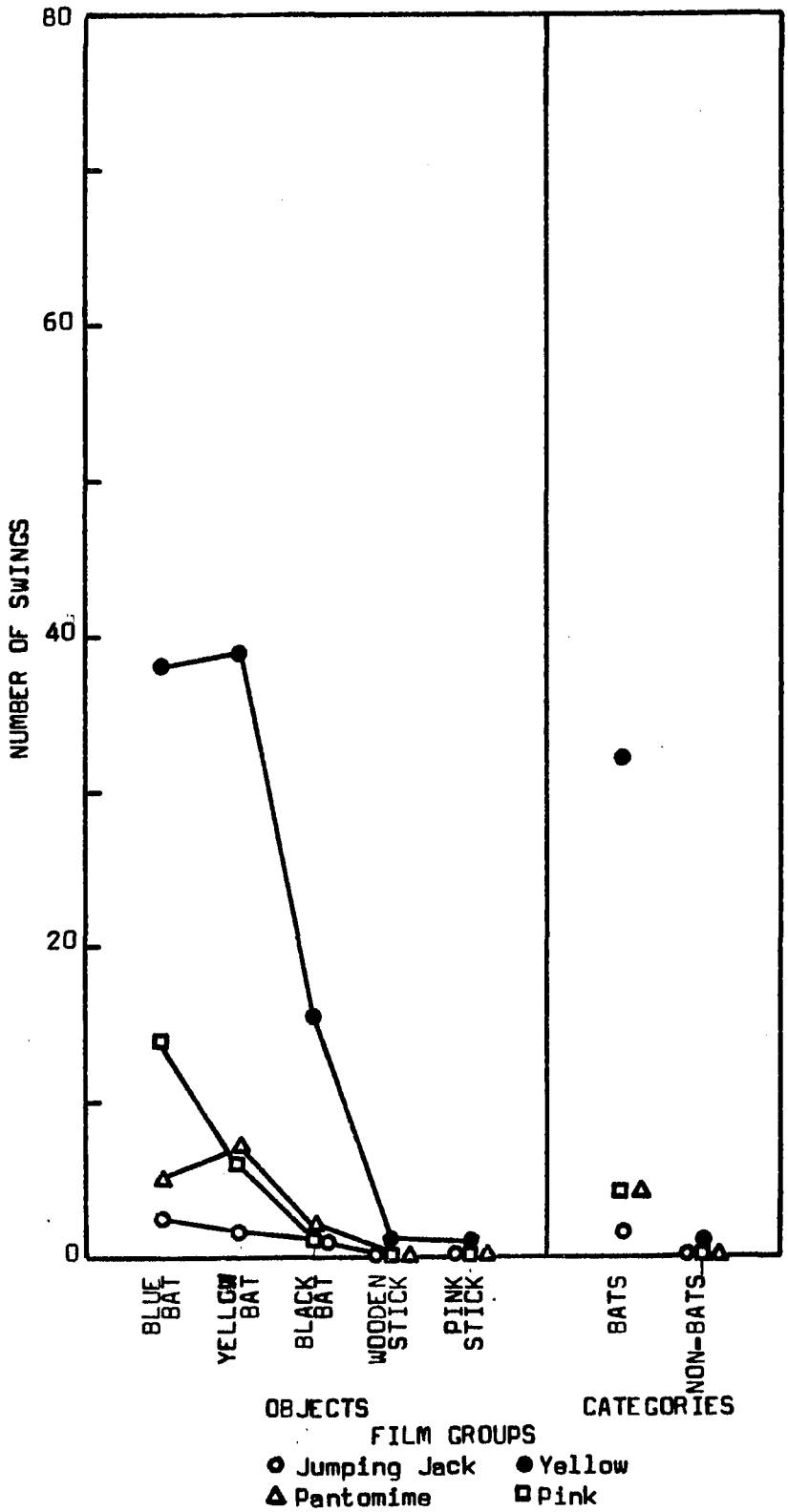

80
60
40
20
0
NUMBER OF SWINGS
BLUE BAT
YELLOW BAT
BLACK BAT
WOODEN STICK
PINK STICK
BATS
NON-BATS
OBJECTS
CATEGORIES
FILM GROUPS
Jumping Jack
Yellow
Pantomime
Pink

Table 5

The number of scores below the median for the number of Swings data for the categories Bat and Nonbat.

	Jumping Jack	Yellow	Pantomime	Pink	Totals
Bat	15	3	8	11	37
Nonbat	19	11	15	13	58
Totals	34	14	23	24	95

in contact with Bats than with Nonbats. In contrast, the Jumping Jack Film group tended to distribute their time of contact equally between Bats and Nonbats. The three groups which observed swinging behavior tended to make their first swing earlier in the session than did the boys in the Jumping Jack Film group.

The analysis of the number of Swings with each object indicated that all groups swung the Bats more frequently than Nonbats. The analysis of group means showed that the Pink Film group swung as often as did the Yellow Film group. However, the median analysis demonstrated that the median score for Swings of the Yellow Film group was much higher than the median score for the Pink Film group with Bats.

DISCUSSION

The comparison of the responses by the Yellow Film group and the Jumping Jack Film group revealed findings which replicated the basic findings of many modeling studies (Bandura, 1969). Children who viewed a model swing a Yellow baseball bat were much more likely to engage in similar responses than were children who viewed a baseball-irrelevant film. However, by providing several objects for the children to interact with, it was possible to observe how a modeling sequence could affect other responses. As the median and means analysis of the number of Swings indicated, children in the Yellow Film group were equally likely to swing the Yellow or the Blue normal-sized baseball bats, but made fewer swings with a small Black bat and still fewer swings with the Wooden stick and the Pink stick. Therefore, the data seem to reflect a generalization gradient of the control over swinging responses by the other objects.

The use of multiple dependent measures permits an analysis of various measures of response strength influenced by each film. For example, not only did the Yellow Film group swing objects more frequently than did the Jumping Jack Film group, but they also swung objects earlier in the

session, contacted Bats earlier in the session and spent considerably more time with Bats than with Nonbats. In other words, the distinction between the behaviors of these two groups is apparent on all dependent measures (i.e., each assumed measure of swinging response strength).

The inclusion of several objects for all groups allows one to begin to answer how a subject's past experiences may interact with modeling procedures. The Latency to Swing data demonstrated that all groups swung Bats before Nonbats. Furthermore, a review of the individual data showed that only one subject (in the Pink Film group) swung a Nonbat prior to a Bat. This subject was the child who, as previously described, mislabelled the model's behavior. Therefore, for all groups, the objects available exerted considerable control over the order of objects swung by the children.

A comparison of the Pantomime Film group's performance with that of the Jumping Jack Film group reveals several interesting relationships. Analysis of the number of Swings data shows an obvious lack of difference between the number of Swings made by the two groups or their distribution of swings. However, children in the Pantomime Film group made their initial swing much earlier in the session than did the Jumping Jack Film group. Therefore, while the Pantomime modeling film did not seem to influence

one measure of swinging response strength, i.e., magnitude, it apparently did influence another measure, i.e., latency to the first swing.

The performance of the Pink Film group was particularly important in several ways. The means analysis indicated that subjects in the Pink Film group swung more frequently than did members of the Jumping Jack Film group. Inspection of the Swinging data shows that the Pink Film group's distribution of swings was different from the Yellow Film group's distribution although their overall number of swings was similar. The Pink Film group frequently swung the Yellow and Blue bats but did not engage in substantial swinging behaviors with the Black bat, as had the subjects of the Yellow Film group. Furthermore, analysis of the various measures of swinging response strength all fail to show any significant influence on the Pink Film group's interaction with the Pink stick relative to the other groups.

From a comparison between the mean and median analysis of the number of Swings, one can deduce that the overall high number of swings with Bats for the Pink Film group was due to relatively few members of the group. This relationship suggests that the overall effect of the Pink Film was not as powerful as the effect of the Yellow Film on swinging behavior.

Another indication of the Pink Film's influence on the swinging data can be seen in the Latency to Swing data. The latency to the initial swing during the session was markedly shorter for the Pink Film group than for the Jumping Jack Film group. Thus, the Pink Film appeared to have affected at least two measures of swinging response strength, i.e., magnitude and latency.

One surprising finding was the Latency to Contact data for the Pink Film group. The Latency to Contact scores for the Pink Film group are substantially longer for the Nonbats and the Black bat than the other group's scores. However, while the Pink Film group took longer to contact these objects, they did not spend significantly less time over the course of the session with these objects relative to the other groups. The longer Nonbat latencies for the Pink Film group cannot be attributed to unusually short latencies with Bats because other groups (e.g., the Yellow Film group) displayed equally short Bat latencies without demonstrating extremely long Nonbat latencies.

The overall pattern of responses for the Pink Film group demonstrated that these subjects did not imitate in a mimicking fashion (i.e., exact topographical matching) of the behavior of the model (i.e., swinging a Pink stick). Instead, these children tended to imitate the performance they had observed (i.e., swinging) with the normal-sized baseball bats.

There are several possible hypotheses which might account for this shift between the object viewed in a modeling sequence and the object subsequently used by a subject. One hypothesis may be labelled as "abstraction," whereby a subject responds to some "abstract" property of a stimulus array. Whitehurst and Novak (1973) use the term "abstraction" in the following manner: "...selective imitation involves the abstraction of structural elements..." (p. 333). If the idea of abstraction is applied to the present study, then it could be argued that the Yellow Film group and the Pink Film group responded toward the normal-sized baseball bats in a similar fashion because each group had responded to an abstraction common to both films. This abstract property might be the swinging behavior regardless of the object.

Another possible hypothesis, which can be called "covert labelling," is described by Bandura (1969) who discussed various imitative sub-processes. That is, subjects in both the Yellow Film group and the Pink Film group may have covertly labelled each modeling film in a similar manner, i.e., "He's playing baseball". Subsequent behavior by the two groups in the experimental room would then be under the control of the common covert label and thus be similar.

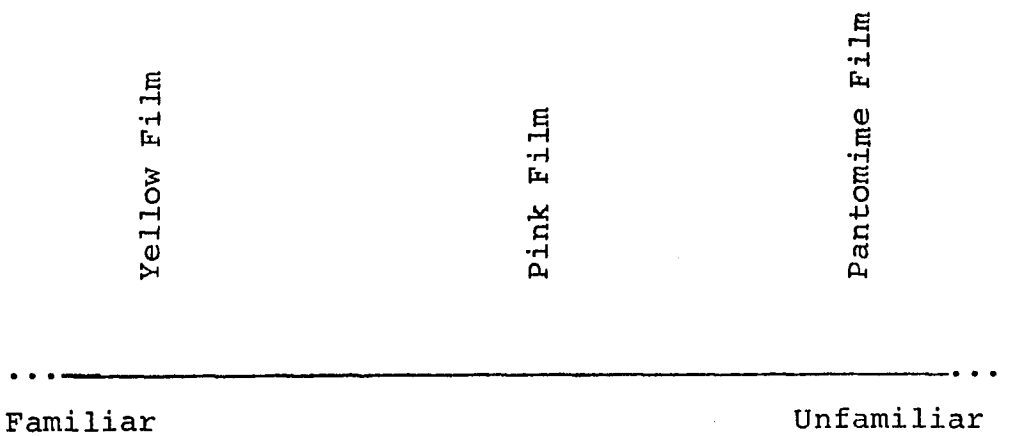
There is no obvious reason why the subjects who viewed the Pantomime Film would not respond to either a similar "abstraction" or use a similar "covert label" as would the other two groups. However, the performance of the Pantomime Film group is clearly different from that of the Yellow Film or Pink Film groups. Therefore, a different system seems necessary to explain each of the groups' behavior.

Another plausible account, to be outlined here, requires four interrelated hypotheses. Two of the hypotheses involve ordering the films and objects along a dimension relating each to the behavior under study, swinging responses. The other two hypotheses describe children's behavior following modeling sequences. In general, this heuristic account attempts to specify the way in which imitative behavior is controlled by a person's history with the modeled behavior, the objects used in the modeled behavior, and a combination of behaviors and objects.

The Film continuum may be constructed by placing each of the three swinging films along a complex (or compound) stimulus dimension which, for convenience, is labelled "familiarity" (see Table 6). Three principal components of each film which determine its relative placement are 1) the model's behavior, 2) the object used by the model, and 3) the interaction of the behavior with that object (i.e., the use of the object). In the present study, the Yellow Film

Table 6

Relative placement of each Film along a Familiarity dimension.



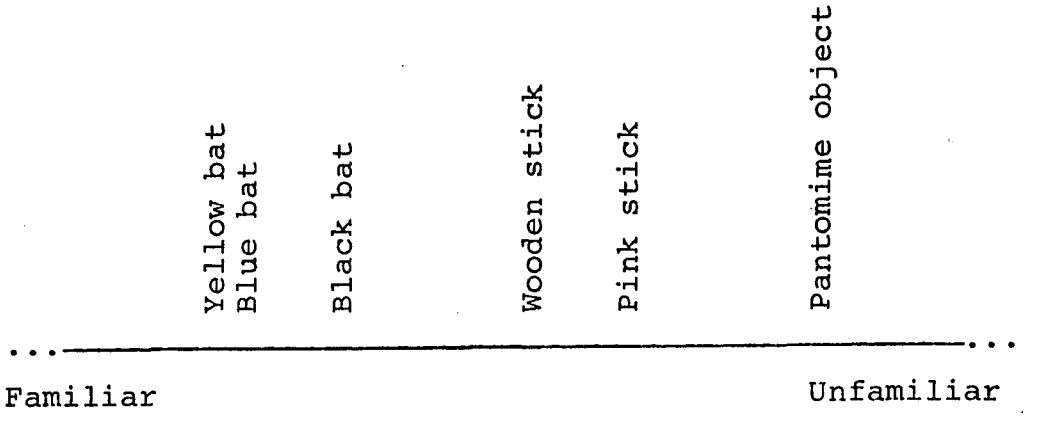
would lie at the "most familiar" end of the continuum because the model's behavior (i.e., swinging), the object of the model's behavior (i.e., the Yellow bat) and the use of the object (i.e., swing the Yellow bat) are all familiar to the subjects. The Pink Film would be placed at some distance from the Yellow Film toward the "unfamiliar" end of the continuum. This placement is due to the model's behavior (i.e., swinging) being familiar, the object of the model's behavior being unfamiliar (i.e., the Pink stick), and the use of the object (i.e., swing the Pink stick) being unfamiliar. The placement of the Pantomime Film would be farthest out toward the unfamiliar end of the continuum. While the behavior of the model is familiar, the object of the behavior (i.e., the object "nothing"), and the use of the object (i.e., swing "nothing") are both very unfamiliar for these subjects. The Jumping Jack Film may be thought of as lying on an orthogonal dimension, since these behaviors are irrelevant to swinging.

The objects with which the subjects interact may also be viewed as lying on a continuum of familiarity (see Table 7). Both the Yellow and Blue bats are likely to be the most familiar, while the Black bat, due to its shorter size, can be placed somewhat toward the unfamiliar end of the dimension. The Wooden stick, while having the length of the first two bats, differs in color, texture and shape and

Table 7

Relative placement of the Objects

along a Familiarity dimension.



would thus be placed still closer to the unfamiliar end of the continuum. The Pink stick would be placed closer to the unfamiliar end of the continuum because it differs from the bats in length, color, texture and shape. Farthest out on this continuum could be placed a Pantomime Object, which we can assume has a low degree of control over the children's swinging behaviors. (No pantomime swings were exhibited by any of the children.)

A brief discussion of the term "familiarity" is now appropriate. In general, familiarity is an estimation of control over a particular behavior. The more familiar something is, the greater the potential control over some performance. The determination of the familiarity of a film is relatively complex due to the previously mentioned factors. The familiarity of the swingable objects used in the present study is associated with the stimulus control each object exerts over swinging behavior prior to the modeling procedure. One estimate of this control can be made by analyzing the performance of the Jumping Jack Film group, for which the Yellow and Blue bats had some moderate amount of control over swinging, while the Black bat had less control, and the Wooden stick and the Pink stick extremely little control.

One of the hypotheses concerning the children's behavior is that children tend to imitate familiar rather than unfamiliar behavior. The second hypothesis is that children

tend to imitate with familiar objects. To "imitate familiar behaviors" means to imitate behaviors that already are under existing stimulus control, that is behaviors (or the behavioral units) which are within the subject's reportoire. Support for this conceptualization of imitation can be found in the theoretical writings of Skinner (1953) and Gewirtz (1971), in the observational accounts of infant imitation by Piaget (1952), and in the experimental findings of Garcia et al. (1971). The second hypothesis is one which will be shown to be supported by the data found in the present study.

These two hypotheses, along with the continua described, would predict that the Yellow Film would have the greatest effect of the three films and have its greatest effect on the most familiar objects, i.e., the Yellow and Blue bats. This prediction appears to be supported by the data within each of the dependent measures and in the relative distributions of the data within each dependent measure. The present heuristic system would predict the Pink Film to have the next strongest effect, although again, the effect would be strongest with the most familiar objects. This prediction appears to be largely supported by the high number of swings displayed by a few group members, yet predominantly with the familiar objects, the Yellow and Blue bats. The present

account would also predict a weak effect by the Pantomime Film, but with a distribution of behavior similar to the other groups. This prediction appears to be supported by the low effect on magnitude of swings, but an obvious effect on the latency to the first swing. It is also interesting to note that while the Latency to Swing scores for the Pantomime Film group were substantially lower than those of the Jumping Jack Film group, they were slightly higher than for the other two swinging film groups. This ordering of latencies is also in line with the general system outlined. Furthermore, the distribution of swings by the Pantomime Film group followed the pattern of the other groups, namely more swings with the more familiar objects.

At the present time, it is not clear why one effect of the Pink Film was to generate long latencies to interacting with the Nonbats and the Black bat. Additional research might be designed to determine the specific factors responsible for this effect and to determine its generality to other behaviors and objects. Such factors might include the influence that exposure to a novel stimulus has on responding to other novel stimuli.

The results of the present study support the viewpoint that one's past history of exposure and reinforcement interacts with observing modeling sequences in a predictable manner. However, future research, experimentally manipulating

specific histories, will contribute greatly to our understanding of modeling effects.

The present study also points out the importance of using multiple objects with which to assess imitative behaviors. Future research should begin to specify the stimulus dimensions along which imitative generalization will occur. Studies which look at a number of nonmimicry responses will be necessary to achieve this goal. Futhermore, the advantages of using multiple dependent measures may help specify the exact response properties (including topography) which can be influenced by modeling procedures.

SUMMARY

Imitative responding has been the focus of considerable theoretical and research attention. Many studies have dealt with variables which are associated with response matching following the observation of a modeling sequence. However, recent research strategies have restricted the availability of stimuli to which an imitater could respond and limited the responses under direct observation. In addition, previous research has not analyzed modeling sequences by examining which components of a modeled stimulus sequence are functionally related to subsequent behaviors. The present study varied several components of a modeled stimulus sequence and permitted topographical variety within the imitative response class to be emitted in a subsequent testing environment.

Five-year old black boys individually observed one of the following four modeling films: 1) a film depicting a model swinging a yellow baseball bat (the Yellow Film), 2) a film depicting a model swinging (in baseball fashion) a short pink cloth-wrapped stick (the Pink Film), 3) a film depicting a model pantomiming baseball swings (the Pantomime Film), and 4) a film showing a model engaging in various gymnastic exercises (the Jumping Jack Film). After watching the films, each child entered a testing room where two types

of objects were available: Bat objects (a Yellow, Blue and short Black bat) and Nonbat objects (a Wooden stick, a short Pink stick, and a Pail and shovel). During the 10 minute observation session, observers, behind one-way mirrors, recorded the amount of time a child made contact with each object and the number of swings made with an object. Also recorded were the latencies to contacting the objects and the latencies to swinging behaviors.

The results indicated that the objects in the testing room exerted considerable control over swinging behaviors. All groups swung Bats more frequently than Nonbats. The mean number of swings for the Jumping Jack Film group and the Pantomime Film group were similar and relatively low. However, the Pantomime Film group made their initial swing during the session much earlier than did children who saw the Jumping Jack Film. The mean number of swings for both the Yellow Film group and the Pink Film group were significantly greater than the means for the other two groups. However, while the mean number of swings for the Yellow Film group and the Pink Film group was comparable, the median number for the Yellow Film group was considerably greater than that of the Pink Film group. Thus, the Yellow Film appeared to have the greatest influence on swinging behaviors, followed in order by the Pink Film, the Pantomime Film and the Jumping Jack Film. All groups who had observed swinging behaviors contacted earlier and played longer with the Bats than with the Nonbats.

A theoretical system was presented to account for the order of the Film effects and the Objects effects. The system described three components of a modeling film: the behavior modeled, the object used in the film, and the interaction between the behavior and the object (i.e., the use of the objects). Estimations were made for each component's control over the imitative response class under study. The combined estimations permitted the placement of each film along a continuum (arbitrarily labelled "familiarity"). The objects used in the testing environment were also placed on a continuum (again labeled "familiarity") which orders the degree of control of each object over the response class of swinging. For example, the Bat objects are more "familiar" than the Nonbats. The system also suggests that children will imitate familiar rather than unfamiliar behaviors and will imitate with familiar objects. The results of the study were compatible with the outlined system.

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TABLE A.1

The individual scores for the Jumping Jack Film group for each dependent measure with each object.

	1	2	3	4	5	6	7	8	9	10
Latency to Contact (in seconds)										
Bluebat	26	394	83	313	28	6	217	172	29	103
Yellowbat	5	20	9	159	40	20	24	162	32	13
Blackbat	106	17	122	254	13	600	2	28	40	59
Woodenstick	12	442	186	571	100	13	23	77	56	76
Pinkstick	1	1	161	290	22	11	60	4	126	48
Pail	37	4	136	6	3	2	11	3	74	56
Contact Time (in seconds)										
Bluebat	195	69	126	66	122	69	42	126	40	77
Yellowbat	101	129	238	249	73	44	16	110	40	74
Blackbat	73	58	12	38	48	-0-	101	227	34	87
Woodenstick	124	30	95	16	151	37	189	39	19	29
Pinkstick	145	5	7	59	152	41	63	188	20	222
Pail	89	303	97	152	99	72	64	115	143	169
No Contact	139	19	116	20	94	411	119	128	381	101

TABLE A.1 (continued)

Latency to Swing (in seconds)	1	2	3	4	5	6	7	8	9	10
Bluebat	117	399	92	316	600	28	600	178	600	106
Yellowbat	600	23	64	162	78	22	28	169	600	15
Blackbat	600	39	124	257	600	600	42	184	600	65
Woodenstick	600	600	172	578	600	600	600	600	600	600
Pinkstick	600	600	600	301	600	600	600	600	600	437
Swings										
Bluebat	3	19	2	24	0	1	0	4	0	23
Yellowbat	0	26	5	97	1	1	2	1	0	17
Blackbat	0	16	1	12	0	0	2	1	0	2
Woodenstick	0	0	1	1	0	0	0	0	0	0
Pinkstick	0	0	0	4	0	0	0	0	0	1

TABLE A.2

The individual scores for the Yellow Film group for each dependent measure with each object.

	1	2	3	4	5	6	7	8	9	10
Latency to Contact (in seconds)										
Bluebat	1	2	65	28	24	109	24	7	5	287
Yellowbat	24	22	3	37	112	1	4	41	89	30
Blackbat	12	113	9	15	37	47	42	55	65	12
Woodenstick	6	187	273	55	209	80	103	600	124	600
Pinkstick	18	160	43	48	89	42	51	33	155	10
Pail	33	5	34	8	35	34	90	600	185	114
Contact Time (in seconds)										
Bluebat	165	48	231	116	179	244	197	100	60	100
Yellowbat	177	104	260	165	113	90	260	123	288	188
Blackbat	21	45	46	64	121	142	107	334	24	104
Woodenstick	77	183	25	96	127	52	26	0	30	0
Pinkstick	32	25	32	17	62	10	26	13	29	67
Pail	124	147	91	84	138	63	28	0	10	55
No Contact	65	50	27	57	204	24	41	45	169	207

TABLE A.2 (continued)

	1	2	3	4	5	6	7	8	9	10
Latency to Swing (in seconds)										
Bluebat	1	76	76	31	26	121	28	428	12	600
Yellowbat	27	28	20	39	151	5	13	178	90	600
Blackbat	14	138	279	18	46	50	44	67	66	27
Woodenstick	8	600	600	60	600	89	400	600	128	600
Pinkstick	21	600	600	50	600	43	52	600	160	600
Swings										
Bluebat	46	5	40	99	3	138	46	36	32	0
Yellowbat	32	16	26	132	2	46	49	52	83	0
Blackbat	11	3	1	51	3	73	28	102	20	6
Woodenstick	2	0	0	72	0	26	4	0	22	0
Rinkstick	2	0	0	11	0	4	1	0	17	0

TABLE A.3

The individual scores for the Pantomime Film group for each dependent measure with each object.

	1	2	3	4	5	6	7	8	9
Latency to Contact (in seconds)									
Bluebat	519	17	26	29	60	434	69	1	37
Yellowbat	116	5	65	1	188	1	20	32	73
Blackbat	28	69	102	10	179	600	2	52	14
Woodenstick	20	180	163	132	174	600	42	78	49
Pinkstick	12	50	18	223	15	137	48	61	3
Pail	93	336	155	42	6	600	55	70	56
Contact Time (in seconds)									
Bluebat	73	117	121	98	88	164	107	295	63
Yellowbat	127	162	26	96	8	432	72	248	53
Blackbat	173	120	134	32	57	0	212	37	54
Woodenstick	48	14	214	30	407	0	129	74	58
Pinkstick	272	99	26	231	226	6	14	17	131
Pail	67	19	8	322	267	0	64	41	10
No Contact	60	139	66	17	6	4	31	73	263

TABLE A.3 (continued)

	1	2	3	4	5	6	7	8	9
Latency to Swing (in seconds)									
Bluebat	600	24	34	146	66	438	481	9	41
Yellowbat	126	61	68	3	600	6	36	36	600
Blackbat	153	74	136	114	242	600	15	55	600
Woodenstick	600	600	165	600	253	600	117	205	600
Pinkstick	352	600	600	600	600	600	51	600	600
Swings									
Bluebat	0	2	43	26	2	40	5	14	2
Yellowbat	1	7	12	24	0	56	2	22	0
Blackbat	2	1	11	8	2	0	9	4	0
Woodenstick	0	0	1	0	3	0	4	2	0
Pinkstick	1	0	0	0	0	0	1	0	0

TABLE A.4

The individual scores for the Pink Film group for each dependent measure with each object.

	1	2	3	4	5	6	7	8	9
Latency to Contact (in seconds)									
Bluebat	92	509	1	600	2	1	43	9	4
Yellowbat	8	477	57	5	15	252	26	8	92
Blackbat	7	328	96	600	474	386	65	6	600
Woodenstick	78	70	146	600	600	600	125	93	600
Pinkstick	16	57	48	600	600	529	149	71	600
Pail	4	3	37	600	600	539	239	2	600
Contact Time (in seconds)									
Bluebat	110	8	165	0	598	482	181	242	216
Yellowbat	117	24	73	595	9	7	138	124	405
Blackbat	152	119	27	0	24	20	83	124	0
Woodenstick	32	400	101	0	0	0	26	11	0
Pinkstick	50	281	124	0	0	10	39	8	0
Pail	305	85	91	0	0	28	13	185	0
No Contact	72	22	79	5	2	37	216	64	4

TABLE A.4 (continued)

	1	2	3	4	5	6	7	8	9
Latency to Swing (in seconds)									
Bluebat	100	600	5	600	4	3	216	600	8
Yellowbat	67	600	60	6	600	256	38	40	92
Blackbat	12	600	101	600	476	388	214	445	600
Woodenstick	600	600	148	600	600	600	328	600	600
Pinkstick	16	59	218	600	600	534	600	600	600
Swings									
Bluebat	9	0	60	0	98	161	14	0	87
Yellowbat	1	0	23	395	0	2	6	7	256
Blackbat	4	0	4	0	6	14	1	1	0
Woodenstick	0	0	22	0	0	0	1	0	0
Pinkstick	2	7	13	0	0	2	0	0	0

Appendix B

Table B1

Anova for Latency to Contact data for the objects Yellow, Blue, and Black bats, Wooden and Pink sticks.

Source	SS	df	MS	F
Film	606025	3	202008	3.37*
Sub (Film)	2040454	34	60013	
Object	469092	4	117273	6.09**
Object X Film	294594	12	25450	1.27
Sub Error	2620624	136	19269	

*p<.05

**p<.001

Table B2

Newman-Kuels analysis on Films effect for Latency to Contact data.

	Yellow	Pantomime	Jumping Jack	Pink	r	$q(.95)\sqrt[2]{MSe/\tilde{n}}$
$\bar{X}$ seconds =	84	105	107	230		
		21	23	146	4	305
			2	125	3	277
				123	2	229

$\sqrt[2]{MSe/\tilde{n}} = 79.6$ df=r,34

Table B3

Newman-Kuels analysis on Objects effect

for Latency to Contact data.

	Yellow b.	Blue b.	Pink s.	Black b.	Wooden s.	r	$q(.95)\sqrt[2]{MSe/\tilde{n}}$
$\bar{X}$ seconds =	60	115	121	138	214		
		55	61	78	154	5	176
			7	23	99	4	166
				17	93	3	151
					72	2	126

$\sqrt[2]{MSe/\tilde{n}}$ = 45.1 df=r,136

Table B4

Anovas for the categories Any, Bat, and Nonbat for the Latency to Contact data.

Any

Source	SS	df	MS	F
Film	17	3	5.7	0.10
Error	1875	34	55.2	

Bat

Source	SS	df	MS	F
Film	6548	3	2183	0.64
Error	115804	34	3406	

Nonbat

Source	SS	df	MS	F
Film	410098	3	136699	6.41*
Error	724413	34	21306	

*$p < .002$

Table B5

Newman-Kuels analysis for the category Nonbat,

for the Latency to Contact data.

	Jumping Jack	Yellow	Pantomime	Pink	r	$q(.95)\sqrt{MSe/\tilde{n}}$
$\bar{X}$ seconds =	27	34	41	278		
		7	14	251*	4	182
			7	244*	3	165
				237*	2	137

$\sqrt{MSe/\tilde{n}} = 47.4$ df=r,34

*p<.05

Table B6

Distribution-free Anova of scores below the median for the Latency to Contact data.

	Jumping Jack	Yellow	Pantomime	Pink	Total
Blue b.	6	3	4	3	16
Yellow b.	2	2	4	4	12
Black b.	5	3	4	7	19
Wooden s.	7	9	6	9	31
Pink s.	4	2	3	7	17
Pail	3	4	7	15	19
Total	27	24	28	35	114

χ^2 (total) = 43.69

χ^2 (object) = 21.68**, df=5

χ^2 (films) = 7.81*, df=3

χ^2 (interaction) = 14.20, df=15

*p<.05

**p<.005

Table B7

Distribution-free Anova for scores below the median for the Latency to Contact data for the categories Bat and Nonbat.

	Jumping Jack	Yellow	Pantomime	Pink	Total
Bat	13	8	12	14	47
Nonbat	14	16	16	21	67
Total	27	24	28	35	114

χ^2 (total) = 16.97

χ^2 (bats) = 7.02**, df=1

χ^2 (films) = 7.81*, df=3

χ^2 (interaction) = 2.14, df=3

*p<.05

**p<.01

Table B8

Anova for Contact Time data for the objects Yellow, Blue, and Black bats, Wooden and Pink sticks.

Source	SS	df	MS	F
Film	25517	3	8505	2.50
Sub (Film)	115770	34	3405	
Object	220876	4	55219	4.64**
Object X Film	149699	12	12475	1.05
Sub Error	1619027	136	11904	

**p<.002

Table B9

Newman-Kuels for Object effect

for the Contact Time data.

	Pink s.	Wooden s.	Black b.	Blue b.	Yellow b.	r	$q(.95)\sqrt{MSe/\tilde{n}}$
$\bar{X}$ seconds =	72	76	80	145	146		
		4	8	73	74	5	139
			4	69	70	4	131
				65	66	3	119
					1	2	99

$\sqrt{MSe/\tilde{n}} = 35.5$

Table B10

Anovas for the categories No Contact, Bat, and Nonbat for the Contact Time data.

No Contact

Source	SS	df	MS	F
Film	51696	3	17232	1.93
Error	303237	34	8918	

Bat

Source	SS	df	MS	F
Film	21167	3	7055	3.20*
Error	74912	34	2203	

Nonbat

Source	SS	df	MS	F
Film	15754	3	5251	1.20
Error	148379	34	4364	

*$p < .05$

Table B11

Newman-Kuels analysis for the category Bat,

for the Contact Time data.

	Jumping Jack	Pantomime	Yellow	Pink	r	$q(.95)\sqrt[2]{MSe/\tilde{n}}$
$\bar{X}$ seconds =	89	117	140	150		
		28	51	61*	4	59
			23	33	3	53
				10	2	44

$\sqrt[2]{MSe/\tilde{n}} = 15.3$ df=r,34

*p<.05

Table B12

Distribution-free Anova for scores below the median for the Contact Time data.

	Jumping Jack	Yellow	Pantomime	Pink	Total
Blue b.	5	2	1	2	10
Yellow b.	4	0	4	4	12
Black b.	7	5	5	5	22
Wooden s.	6	6	5	7	24
Pink s.	6	10	4	7	27
Pail	2	5	7	5	19
Total	30	28	26	30	114

χ^2 (total) = 49.51

χ^2 (object) = 24.00*, df=5

χ^2 (films) = 0.87, df=3

χ^2 (interaction) = 24.64, df=15

*$p<.001$

Table B13

Distribution-free Anova for scores below the median for the Contact Time data for the categories Bat and Nonbat.

	Jumping Jack	Yellow	Pantomime	Pink	Total
Bat	16	7	10	11	44
Nonbat	14	21	16	19	70
Total	30	28	26	30	114

χ^2 (total) = 19.75

χ^2 (bats) = 11.86*, df=1

χ^2 (films) = 0.87, df=3

χ^2 (interaction) = 7.02, df=3

*$p<.001$

Table B14

Anova for the Latency to Swing data.

Source	SS	df	MS	F
Film	863336	3	287778	3.02*
Sub (Film)	3236033	34	95177	
Objects	2987171	4	746792	20.76**
Objects X Film	323780	12	26982	0.75
Sub Error	4890225	136	35957	

*p<.05

**p<.0001

Table B15

Newman-Kuels analysis for Film effect

for the Latency to Swing data.

	Yellow	Pantomime	Pink	Jumping Jack	r	$q(.95)\sqrt{MSe/\tilde{n}}$
$\bar{X}$ seconds =	206	304	351	379		
		98	145	173	4	384
			47	75	3	341
				24	2	288

$\sqrt{MSe/\tilde{n}} = 100$ df=r,34

Table B16

Newman-Kuels analysis for Object effect

for the Latency to Swing data.

	Yellow b.	Blue b.	Black b.	Pink s.	Wooden s.	r	$q(.95)\sqrt[2]{MSe/\tilde{n}}$
$\bar{X}$ seconds =	163	221	244	455	465		
		58	81	292*	302*	5	242
			23	234*	244*	4	228
				211*	221*	3	208
					10	2	174

$\sqrt[2]{MSe/\tilde{n}} = 62$ df=r,136

Table B17

Anovas for the categories Any, Bat, and Nonbat for the Latency to Swing data.

Any

Source	SS	df	MS	F
Film	78471	3	26157	3.00*
Error	296147	34	8710	

Bat

Source	SS	df	MS	F
Film	67551	3	22517	1.28
Error	599107	34	17620	

Nonbat

Source	SS	df	MS	F
Film	179465	3	59822	1.09
Error	1871460	34	55042	

*p<.05

Table B18

Newman-Kuels analysis for the category Any,

for the Latency to Swing data.

	Pink	Yellow	Pantomime	Jumping Jack	r	$q(.95)\sqrt[2]{MSe/\tilde{n}}$
$\bar{X}$ seconds =	19	22	36	128		
		3	17	109	4	116
			14	106*	3	105
				92*	2	87

$\sqrt[2]{MSe/\tilde{n}} = 30.3$ df=r,34

*p<.05

Table B19

Distribution-free Anova for scores below the median for the Latency to Swing data.

	Jumping Jack	Yellow	Pantomime	Pink	Total
Blue b.	5	8	6	6	25
Yellow b.	8	9	7	6	30
Black b.	5	8	6	3	23
Wooden s.	1	4	3	1	9
Pink s.	0	5	1	2	8
Total	19	35	23	18	95

χ^2 (total) = 60.02

χ^2 (object) = 41.47**, df=4

χ^2 (films) = 12.61*, df=3

χ^2 (interaction) = 5.93, df=12

*p<.01

**p<.001

Table B20

Distribution-free Anova for scores below the median for the Latency to Swing data for the categories Bat and Nonbat.

	Jumping Jack	Yellow	Pantomime	Pink	Total
Bat	18	26	19	15	78
Nonbat	1	9	4	3	17
Total	19	35	23	18	95

χ^2 (total) = 52.10

χ^2 (bats) = 37.13**, df=1

χ^2 (films) = 12.61*, df=3

χ^2 (interaction) = 2.36, df=3

*p<.01

**p<.001

Table B21

Anova for the number of Swings data.

Source	SS	df	MS	F
Film	20355	3	6785	3.47*
Sub (Film)	66401	34	1953	
Object	36663	4	9166	6.49**
Object X Film	21972	12	1831	1.30
Sub Error	192184	136	1413	

*p<.05

**p<.0001

Table B22

Newman-Kuels analysis for Film effect

for the number of Swings data.

	Jumping Jack	Pantomime	Pink	Yellow	r	$q(.95)\sqrt[2]{MSe/\tilde{n}}$
$\bar{X}$ =	5.3	6.8	26.6	26.8		
		1.5	21.3	21.5	4	55.3
			19.8	20.0	3	49.1
				0.2	2	41.5

$\sqrt[2]{MSe/\tilde{n}} = 14.4$ df=r,34

Table B23

Newman-Kuels analysis for Object effect

for the number of Swings data.

	Pink s.	Wooden s.	Black b.	Blue b.	Yellow b.	r	$q(.95)\sqrt{MSe/\tilde{n}}$
$\bar{X}$ =	1.7	4.2	10.5	28.5	36.9		
		2.5	8.8	26.8	35.2	5	47.7
			6.3	21.3	32.7	4	44.9
				18.0	26.4	3	40.9
					8.4	2	34.2

$\sqrt{MSe/\tilde{n}} = 12.2$ df=r,136

Table B24

Anovas for the categories Bat and Nonbat

for the number of Swings.

Bat

Source	SS	df	MS	F
Film	9285	3	3094	3.24*
Error	32425	34	954	

Nonbat

Source	SS	df	MS	F
Film	376	3	125	2.17
Error	1961	34	58	

*$p < .05$

Table B25

Newman-Kuels analysis for the category Bat,

for the number of Swings.

	Jumping Jack	Pantomime	Yellow	Pink	r	$q(.93)\sqrt{MSe/\tilde{n}}$
$\bar{X}$ =	8.7	10.9	39.4	42.7		
		2.2	30.7*	34.0*	4	34.0
			19.5	31.8*	3	30.7
				3.3	2	24.6

$\sqrt{MSe/\tilde{n}} = 10.0$ df=r,34

*p<.07

Table B26

Distribution-free Anova for scores below the median for the number of Swings data.

	Jumping Jack	Yellow	Pantomime	Pink	Total
Blue b.	4	1	2	3	10
Yellow b.	5	1	3	3	12
Black b.	6	1	3	5	15
Wooden s.	10	5	6	8	29
Pink s.	9	6	9	5	29
Total	34	14	23	24	95

χ^2 (total) = 59.24

χ^2 (object) = 36.42*, df=4

χ^2 (films) = 16.26*, df=3

χ^2 (interaction) = 6.54, df=12

*p<.001

Table B27

Distribution-free Anova for scores below the median for the number of Swings data for the categories Bat and Nonbat.

	Jumping Jack	Yellow	Pantomime	Pink	Total
Bat	15	3	8	11	37
Nonbat	19	11	15	13	58
Total	34	14	23	24	95

χ^2 (total) = 52.57

χ^2 (bats) = 33.68*, df=1

χ^2 (film) = 16.26*, df=3

χ^2 (interaction) = 2.63, df=3

*$p<.001$