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## **Inertial effects in television viewing.**

Rosemarie Miskiewicz  
*University of Massachusetts Amherst*

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INERTIAL EFFECTS IN TELEVISION VIEWING

A Thesis Presented

By

ROSEMARIE MISKIEWICZ

Submitted to the Graduate School of the  
University of Massachusetts in partial fulfillment  
of the requirements for the degree of

MASTER OF SCIENCE

MAY 1980

Psychology

INERTIAL EFFECTS IN TELEVISION VIEWING

A Thesis Presented

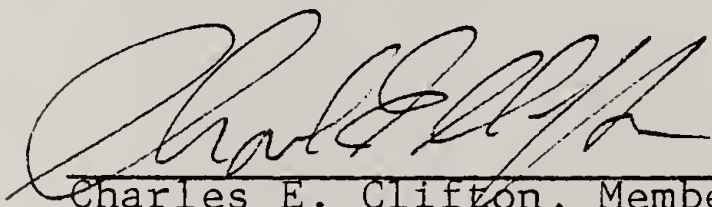
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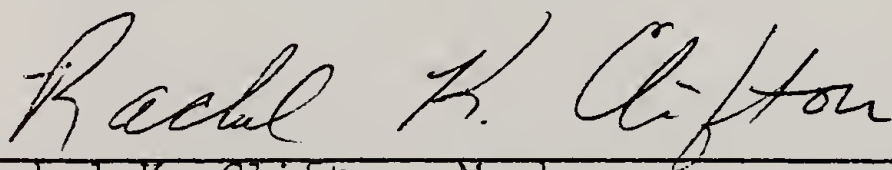
Approved as to style and content by:



Daniel R. Anderson, Chairperson of Committee



Charles E. Clifton, Member



Rachel K. Clifton, Member



Bonnie R. Strickland, Department Head  
Psychology

## ACKNOWLEDGEMENTS

Many thanks are extended to the members of my thesis committee: to Rachel Clifton, for her support and insightful comments; to Chuck Clifton, for his invaluable contributions to the theoretical aspects of the thesis; and particularly to my chairperson and advisor, Dan Anderson, not only for his assistance and guidance throughout the preparation of the thesis, but also for his persistent support, patience, and confidence in my abilities and potential.

Special thanks are extended to Rex Bradford for his invaluable assistance in the computer programming aspects of the data analysis.

Several people participated in the data collection stage of the thesis project, and their contribution is gratefully recognized: Rex Bradford, Diane Field, Betty Lorch, Nanciann Machnik, and Jeanne Sanders.

Collection of the data used in the project was supported by funds from Children's Television Workshop.

## ABSTRACT

Visual attention of 300 three- and five-year-old children viewing 15 hour-long Sesame Street programs in the presence of an audiovisual slide distractor was examined to establish the existence and nature of attentional inertia, defined as the increased tendency to continue looking at TV the longer one has been viewing. Three major analytic approaches were employed: 1) plotting the conditional probability function,  $p(\text{look}_{\underline{t+i}}/\text{look}_{\underline{t}})$ , where  $\underline{t}$  = look length; 2) seeking inertial effects between looks and between pauses by examining the relationship between adjacent look and pause lengths; and 3) seeking inertial effects across episodes by examining the relationship between look and pause lengths before and after bit and slide boundaries. Using TV attention data, slide attention data, and pauses in attention both to the TV and slides, a sufficient body of evidence was accumulated to conclude that attentional inertia does exist. With regard to the nature of attentional inertia, the consistent carry-over effects across bit and slide boundaries demonstrated that attentional inertia is not strictly episode-bound. All results revealed inertial effects that were episode-free in nature. However, no results were obtained that eliminated the possibility that both episode-bound and episode-free inertia may be functioning simultaneously in visual attention. No age effects



ABSTRACT, Continued

were found, and curvilinear functions were consistently obtained, suggesting that inertial effects do not continue indefinitely but eventually reach and maintain a plateau. The significance of the attentional inertia phenomenon to TV viewing and to behavior in general was discussed.

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# C H A P T E R I

## INTRODUCTION

Television is widely believed to have a hypnotic-like effect. In a popular magazine, T. Berry Brazelton (1972) remarked somewhat melodramatically that as his children

sat in front of a set that was blasting away, watching a film of horrors of rapidly varying kinds, the children . . . were hooked. If anyone interrupted, tapped a child on the shoulder to break through his state of rapt attention, he almost would start and might even break down in angry crying. (p. 47)

Although one seldom "breaks down in angry crying" when tapped on the shoulder while engrossed in a TV program, it is not uncommon to "start" when suddenly distracted from the TV screen. Children in the studies on TV viewing by Anderson and his colleagues have often clearly manifested this hypnotic-like effect of TV:

In our viewing room, a child typically looked at the TV for only a short period of time before looking away (54% of all looks were less than three seconds long), but if a child continued beyond about ten seconds, we often observed the child's body relax, head slouch forward, and mouth drop open. This posture might then be maintained continuously for several minutes, ending abruptly as if the child were "released" by some change on the TV. (Anderson, Alwitt, Lorch, & Levin, 1979)

It is not uncommon to find adults in a similar state while watching TV, staring intently (or vacantly) at the TV



screen, oblivious to activities around them and to questions directed at them. This aspect of TV viewing was investigated in the present study.

Television viewing has been investigated from several perspectives. During the 1950s, the introduction of this new medium into people's lives was studied largely due to concerns about its possible harmful effects, such as reducing social interaction and encouraging passivity and escapism (Himmelweit, Oppenheim, & Vince, 1958; Schramm, Lyle & Parker, 1961). In the 1960s the focus of research was switched to the content of TV, particularly to the effects of TV violence on aggressive behavior (Friedrich & Stein, 1973; Surgeon General's Advisory Committee on Television and Social Behavior, 1972). Research in the 1970s has looked at possible harmful effects of other TV content on behavior, such as advertising and social stereotypes, and at the potentially beneficial effects of prosocial and educational content (Ball & Bogatz, 1970; Bogatz & Ball, 1971; Friedrich & Stein, 1975; Stein & Friedrich, 1975).

Recently, a new research direction has emerged in which the nature of TV viewing itself is the focus of attention. Researchers have been examining patterns of TV viewing, asking such questions as when children begin watching TV, how program preferences, comprehension, and amount of viewing change with age, and what auditory and visual characteristics of TV capture and hold attention (Anderson et al.,



1979; Anderson & Levin, 1976; Collins, Wellman, Keniston, & Westby, 1978; Levin & Anderson, 1976; Wartella & Ettema, 1974; Watt & Krull, 1974; Stein, Note 1). This perspective has led investigators to study TV as a unique medium, as they did in the 1950s, rather than focus on its content. Now, however, the goal is to gain an understanding of the formal qualities of this medium and to determine how these qualities influence interaction with the medium itself.

One aspect of TV viewing which Anderson and his colleagues have investigated is the pattern of attention to TV within viewing sessions. Logically, three factors can produce fluctuations in visual attention to TV: environmental distraction, program content, and characteristics of the viewer. Anderson and his colleagues have examined how visual attention to TV changes over time without direct reference to fluctuations in program content or environmental distractions. This analysis is central to the present study and will therefore be discussed in detail, paraphrasing the discussion by Anderson et al. (1979).

#### The Attentional Inertia Curve

Consider the progression of any given look at the TV, regardless of when during the viewing session the look began. Independent of changes in program content or environmental distractions, the likelihood of the look continuing could stay the same, decrease, or increase as the look pro-

gresses through time. Three simple hypotheses can be posited which correspond to these three possible outcomes. The distraction hypothesis states simply that the viewer continues to look at the TV until distracted or until the program content becomes boring. Since both the distractor and the boring incident are independent of the look length, the likelihood of either of them occurring remains constant throughout the look. According to the distraction hypothesis, then, the conditional probability of continuing to look at some later time,  $\underline{t} + \underline{i}$ , given that the look has progressed to time  $\underline{t}$ , will be a flat function. The fatigue hypothesis states that the viewer's attention becomes fatigued as the look continues through time, so that the probability of continuing to look at the TV decreases as the look length increases. The inertia hypothesis states that the viewer is more likely to continue looking at the TV the longer the look has lasted (the "locking in" phenomenon). A plot of  $\underline{p}(\text{look}_{\underline{t}+\underline{i}}/\text{look}_{\underline{t}})$ , according to this third hypothesis, will be an increasing function. These three hypotheses are illustrated in Figure 1. Other hypotheses could be suggested which are variations or combinations of these three simple ideas, but the central issue is how the temporal course of a look influences the probability of the look continuing.

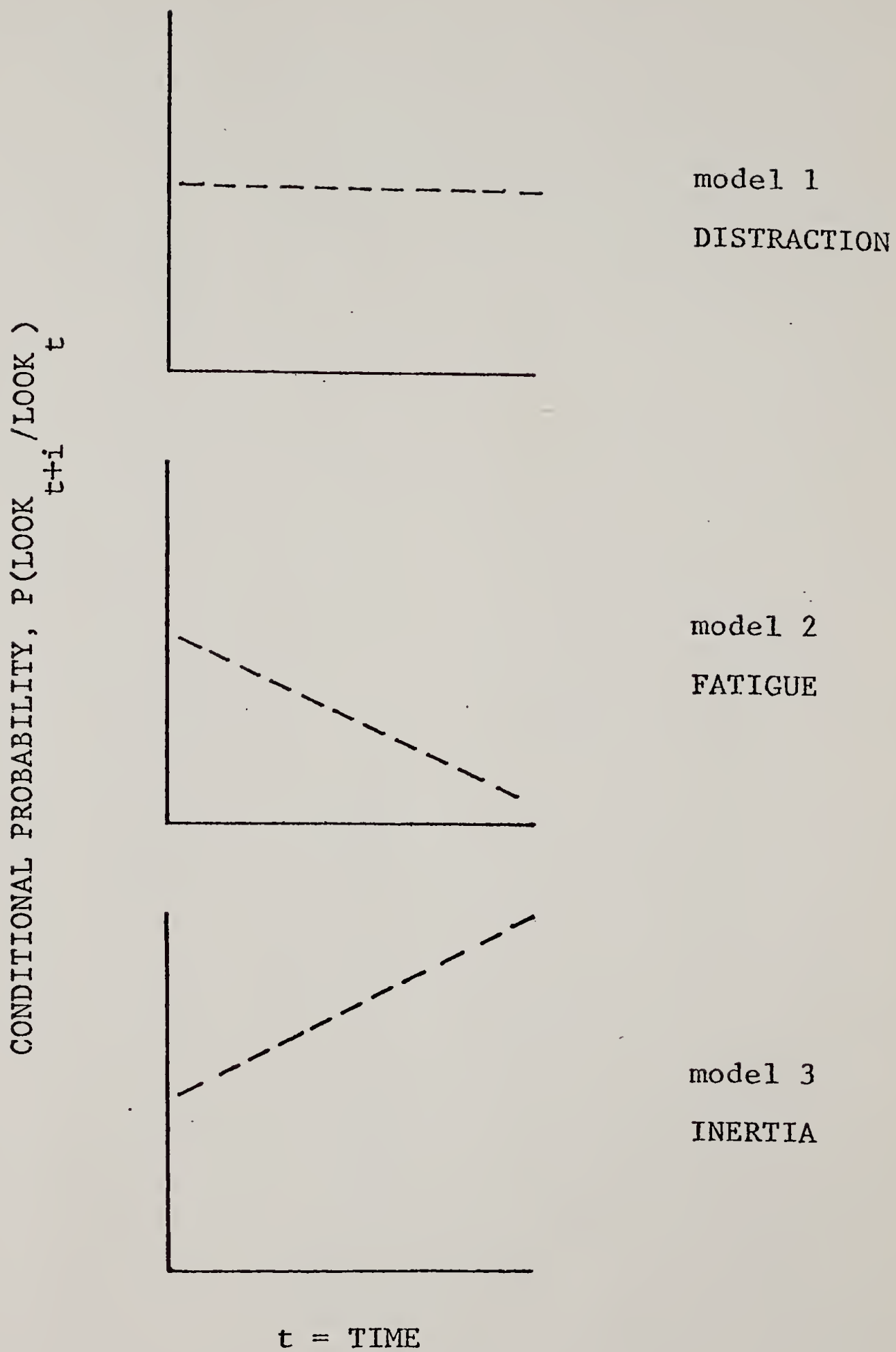


Fig. 1. Three simple models of looking at TV.

Using three-second intervals, Anderson, Levin, and Sanders (Note 2) calculated the conditional probability of continuing to look at the TV as a function of time since the look began. The analyses were based on visual attention data from three studies. In the first study (Levin, Note 3), sixty 3-, 4-, and 5-year-old children from Springfield, Massachusetts, individually watched nearly three hours of heterogeneous children's programs. Each child viewed the programs over three sessions in a comfortably furnished room equipped with toys and snacks and in the presence of a parent. Visual attention was measured by having an observer, looking through a one-way mirror, depress a switch each time the child looked at the TV and release the switch each time the child looked away. Times of onset and offset of visual attention were automatically stored in a computer, thus providing a continuous record of each child's attention to the TV.

To illustrate the analysis, consider the calculation of the first three points in the function. There was a total of 26,664 looks at the TV over all 60 subjects and over all three sessions. Of those looks, 12,162 continued beyond three seconds. The probability of continuing to look beyond three seconds, given that the look started, was  $12,162 \div 26,664$ , or .456. To calculate the conditional probability of continuing to look beyond six seconds, given that the look had lasted three seconds, first consider that

only 12,162 looks entered the interval from three to six seconds. Of these looks, 7806 continued beyond six seconds; therefore,  $p(\text{look}_6/\text{look}_3) = 7806 \div 12,162$ , or .642. In an identical manner,  $p(\text{look}_9/\text{look}_6) = 5763 \div 7806 = .738$ . The complete function is illustrated by the solid line in Figure 2. The curve clearly implicates the inertia hypothesis; the longer the children maintained a look at the TV, the more likely it was that they would continue to look. If a look lasted longer than about 15 seconds, the children had a strong tendency to become progressively "locked in" to the TV screen.

In order to demonstrate that the group function in Figure 2 was not an artifact of averaging individual curves, the data of each child were also plotted separately. Each individual function showed the inertial pattern. Examples of individual curves are given by the solid lines in Figure 3.

An analysis of the visual attention data from a second study (Anderson & Levin, 1976), in which 72 children from Amherst, Massachusetts, ranging in age from 12 to 48 months, individually viewed an hour-long Sesame Street program again showed inertial tendencies in both group and individual conditional probability curves. In a third study (Anderson et. al., Note 2), the visual attention data from six college students who individually watched  $4\frac{1}{2}$  hours of self-chosen prime-time TV programs were also examined. The students



Fig. 2. Conditional probability of continuing to look at the TV as a function of time since the look began (solid line), and the conditional probability of looking back at the TV as a function of time since the pause began (dashed line), based on sixty preschool children who individually viewed nearly three hours of TV programs (Levin, Note 3).



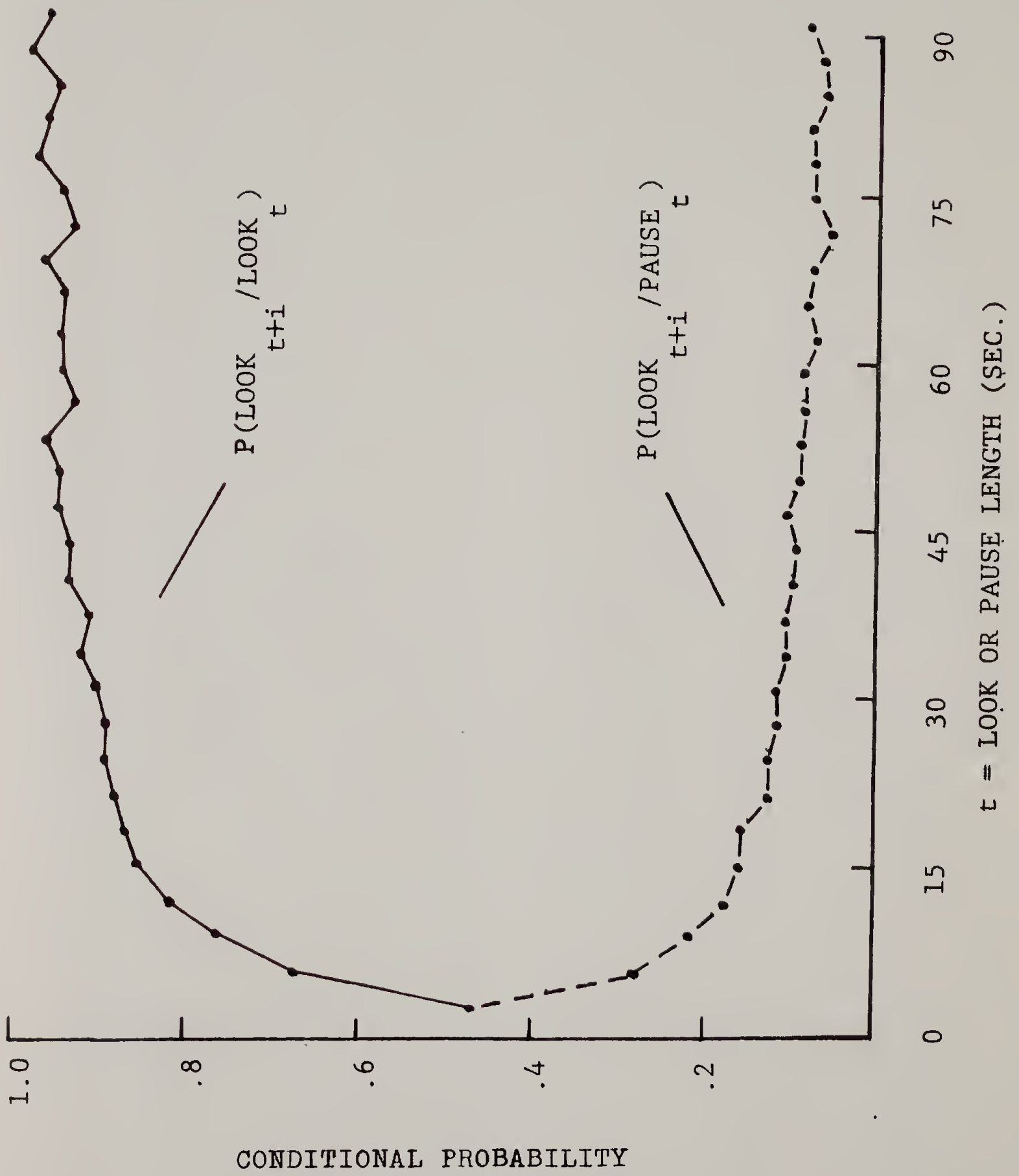


Fig. 2.

Fig. 3. Individual conditional probability functions for four children included in the data represented in Figure 2.

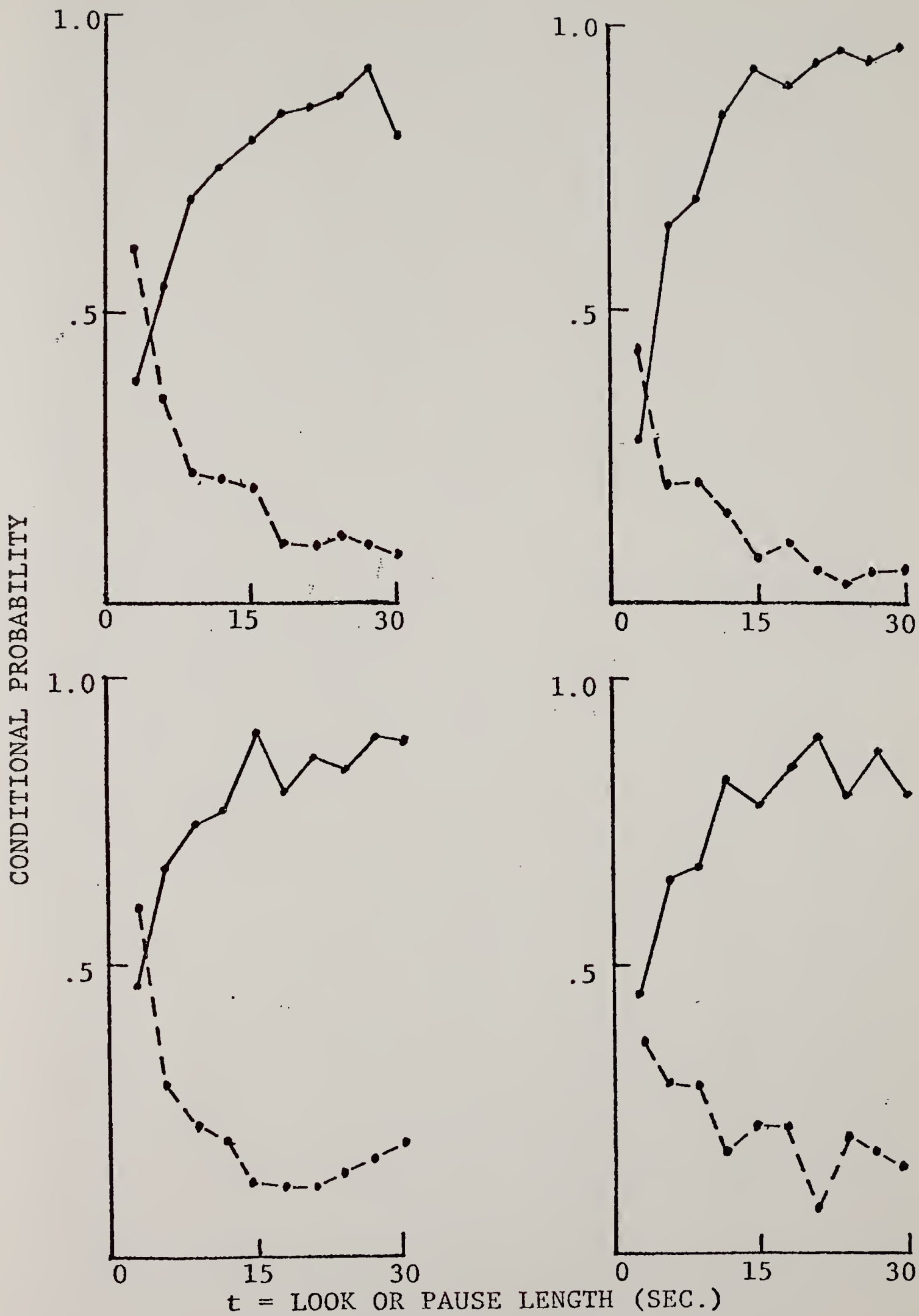


Fig. 3.

were permitted to read novels, eat, or do homework while the TV was on. The individual functions of  $p(\text{look}_{\underline{t+i}}/\text{look}_{\underline{t}})$  again revealed inertial patterns. The attentional inertia pattern thus describes the visual attention of individuals ranging in age from 1 to 23 years who watched a wide variety of TV programming.

In an analogous manner, Anderson et al. (Note 2) calculated the conditional probability of initiating a look at the TV as a function of time since the end rather than the beginning of a given look, for each set of data discussed above. A flat function would be predicted if the viewer looks at the TV only because some characteristic of the TV program attracts attention, since changes in program characteristics are independent of the non-look length. If, however, the viewer has a strategy of periodically "checking" the TV screen, an increasing function would be predicted. A decreasing function would be predicted if the "inertia" found in looking at the TV also described the viewer's behavior between looks; that is, the longer the viewer does not look at the TV, the less likely that is that a look at the TV will be initiated. The group and individual graphs of  $p(\text{look}_{\underline{t+i}}/\text{not look}_{\underline{t}})$ , shown by the dashed lines in Figures 2 and 3 respectively, show very clearly that the longer the pause in looking has been in progress, the less likely it is that the viewer will look back at the TV. Either the viewer becomes "locked in" to

a non-TV-viewing activity, or the attractiveness of the TV diminishes the longer the viewer looks away.

No other investigations or demonstrations of this "locking in" phenomenon, which will be referred to as "attentional inertia", have been previously reported. The present study continued investigation of this phenomenon to determine what, if anything, it is reflecting. The possibility exists that this demonstration of attentional inertia is simply an artifact of the particular analysis used, a problem that is discussed in detail later. However, some underlying cognitive process could be producing the phenomenon; the fact that an increasing (inertial) conditional probability curve is obtained despite continual fluctuations in TV content and environmental distractions suggests that some characteristic of the viewer may be responsible for the phenomenon.

#### Episode-bound Theory of Attentional Inertia

No theory has yet been suggested in the literature to explain this inertial effect of TV viewing. Two alternative mechanisms might be postulated (Anderson, Note 4). The first mechanism, which will be referred to as "episode-bound inertia," is a process whereby cognitive involvement by the viewer produces the progressive "locking in" to the TV screen. The concept of episode-bound inertia follows indirectly from Darren Newton's work on attribution theory

and the perception of ongoing behavior (Newtson, 1973; Newtson, 1976; Newtson & Enquist, 1976; Newtson, Note 5). Newtson proposed and demonstrated that continuous behavior is perceived in discrete units of action, and that the size of these units increases over time. His theory states that:

the perceiver actively participates in the organization of observed behavior into meaningful actions and thus actively controls his information from that behavior. ...As the perceiver observes another's actions, he gains some information from each meaningful act, as each action rules out some interpretations of the intentions and dispositions of the actor. That is, each action may be considered a question or hypothesis with a limited number of alternative outcomes possible. The completion of such an action unit defines the outcome of that particular hypothesis. As alternatives are gradually ruled out, the perceiver should become progressively more certain of his understanding of the action. In terms of information theory, each unit eliminates progressively more uncertainty... [O]ne would [thus] expect a decrease in unitization rate over time. As more information from a sequence is gained, observed behavior should become more predictable over longer periods. (Newtson, 1973, pp. 28, 36)

In other words, a perceiver of ongoing behavior "asks a question" each time a new action begins, and the question is "answered" when that action is completed. At first, the actions perceived (and, therefore, the questions asked) are small. As information is gained, larger units of action are perceived; that is, bigger questions are asked.

To relate this theory to TV viewing is straightforward: the "perceiver" is the TV viewer, and the "ongoing behavior"



is the TV content. To explain how an inertial effect would be predicted by such an account of TV viewing requires an additional assumption. This assumption is that while the viewer is asking a question (that is, while he is within an action unit), there is a strong tendency to continue looking at the TV until the question is answered (that is, until the action unit is complete). In other words, an arousal system is hypothesized whereby cognitive involvement (the "asking of a question") by the viewer results in excitation of the act of looking, so that the probability of a look terminating within an action unit is very small. The end of an action unit, however, is a likely "exit point" from an ongoing look, because the viewer's question has been answered, and, as a consequence, the accompanying arousal will have subsided.

Now consider the progression of a single look at the TV. At the beginning of the look, the viewer has little information about the action being viewed, so that small action units will be perceived, according to Newton's theory. Potential "exit points" from the look will therefore be frequent, producing a low probability of the look continuing. As the look progresses, the viewer gains more information about the action on the TV screen, and, as a result, larger action units will be perceived. The potential "exit points" from the look will therefore be few and far between, producing a high probability of the look continuing. Thus,

as a given look progresses, the probability of maintaining the look will increase, resulting in a progressive "locking in" to the TV screen.

### Episode-free Theory of Attentional Inertia

A second, much simpler mechanism can be postulated which requires no reference to episodes or cognitive involvement. This alternative mechanism, which will be referred to as "episode-free inertia," is simply a process whereby continued looking results in excitation of the act of looking. In other words, an arousal system is hypothesized in which continued looking results in an arousal buildup which, in turn, increases the tendency to continue looking. Such an underlying mechanism would predict an increasing (inertial) conditional probability curve; as the duration of a given look increases, the excitation level is hypothesized to increase, resulting in a greater probability of maintaining the look.

Episode-free inertia is hypothesized to function regardless of the meaningfulness of the stimulus being viewed or of the degree of cognitive involvement by the viewer. Observations such as mindless watching of program after program on TV without particular interest in any of them, sitting through a series of commercials despite the intention to leave the TV set and do something else during that time, or vacant staring at the blank TV after the sta-

tion has gone off the air all suggest that meaningful stimuli and cognitive involvement may not be necessary for the production of attentional inertia.

### Comparison of the Episode-bound and Episode-free Theories of Attentional Inertia

Both the episode-free inertia theory and the episode-bound inertia theory successfully account for the attentional inertia phenomenon, but the inertia is produced by a different factor in each case. According to the episode-free inertia theory, attentional inertia results simply from the act of continued looking; no cognitive involvement is required. According to the episode-bound inertia theory, the production of attentional inertia is dependent upon a progressive increase in the viewer's cognitive involvement with the action being viewed (that is, bigger and bigger questions must be asked).

Note also that each of the two mechanisms functions within different boundaries. Episode-bound inertia refers to inertial effects only within episodes, while episode-free inertia refers to inertial tendencies within individual looks without regard to episodes. However, one could use these same two mechanisms to make predictions about inertial tendencies across looks and across episodes by postulating a carry-over effect in which some attentional arousal may

carry over from look to look and from episode to episode. Such predictions are outlined in a later section.

### Combination Theory of Attentional Inertia

In a recent attempt to explain a seemingly unrelated phenomenon, infants' visual habituation to static stimuli, Jeffrey (1976) employed concepts similar to "arousal" and "cognitive involvement" to account for the pattern of fixation durations prior to habituation. Because Jeffrey's theory not only includes mechanisms similar to the two proposed above but also outlines how these two mechanisms may both be involved in visual attention, his account of the habituation process will be presented in detail.

A backward habituation curve, illustrated in Figure 4, is derived by plotting average fixation times per trial backward from the habituation trial, which is the trial on which the criterion for habituation was reached. Thus, the habituation trial rather than the first trial of the experiment is the anchor point of the graph. (In habituation studies, a trial is either time dependent, lasting a set length of time, or behavior dependent, beginning when the infant looks at the stimulus and ending when the infant looks away.) Jeffrey employed his serial habituation model to account for the pattern of fixation times in the backward habituation curve. This model postulates that: 1) stimuli differ in their salience, where salience is defined as the

Fig. 4. Backward habituation curve to faces for four-month-old infants. (Taken from Cohen, 1976, p. 229).



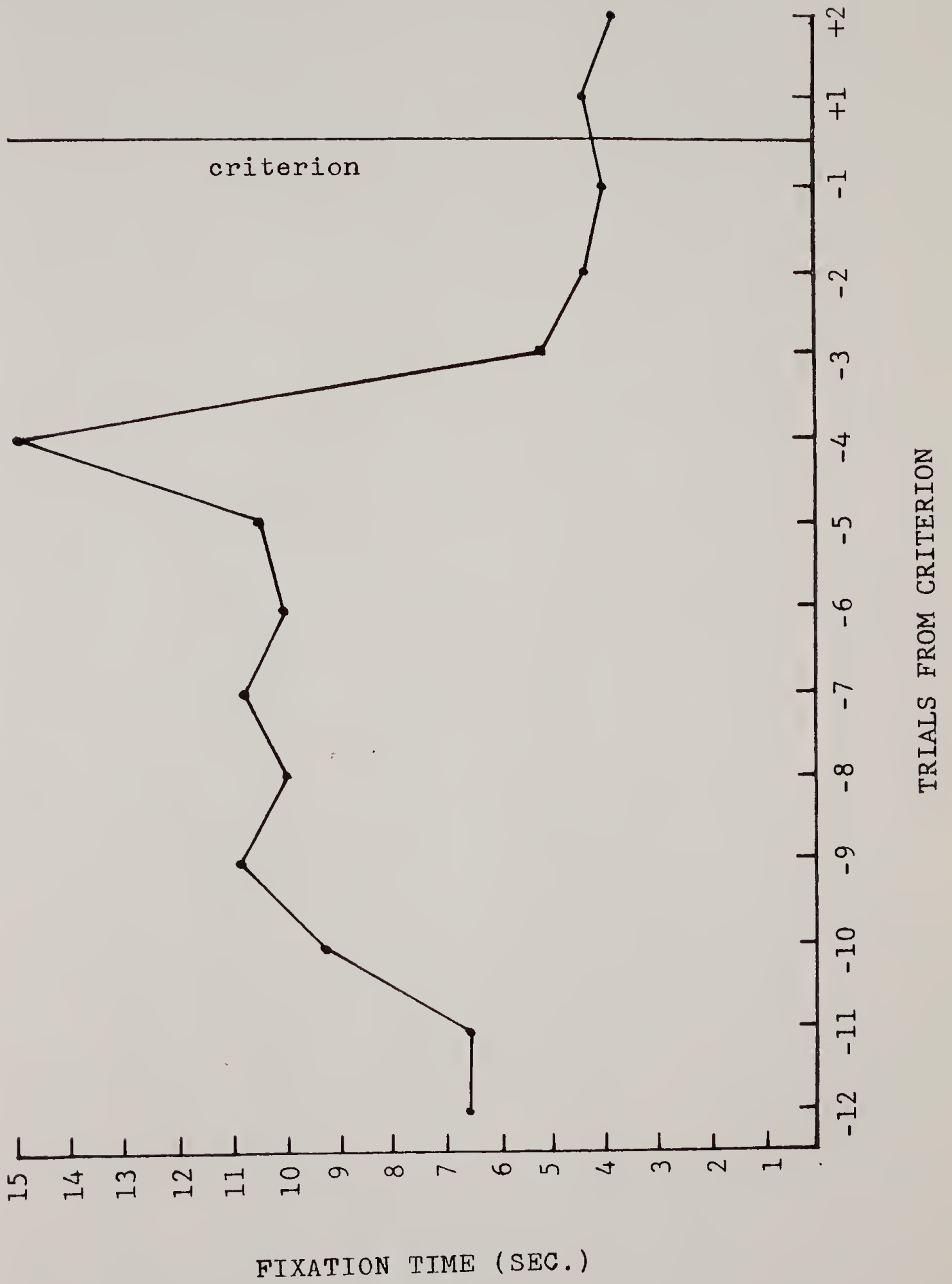


Fig. 4.



likelihood of eliciting an observing response; 2) with attention to a salient cue, its salience wanes and attention shifts to the next most salient cue; and, 3) with such continued habituation, the salience of all cues observed will be reduced, and the rate at which cues are scanned, as well as the number of cues scanned, will increase. Applying this model to the backward habituation curve, Jeffrey states:

[T]he habituation curve may be separated into two phases. I would propose that two different types of habituation are associated with these two phases.

The first phase of the curve might be presumed to reflect a targeting reflex. This is Konorski's (1967) term and it accentuates the arousal and receptor orienting aspect of what is typically called the orienting reflex [Sokolov, 1963]. I propose that the targeting reflex is elicited by rather simple but salient stimulus properties such as sharp brightness or hue difference contours and movement. It is reasonable to assume that such a reflex would be related motivationally to basic alimentary and defensive systems. ... I presume that the targeting reflex system would be involved in what Cohen [1973] has called the attention getting aspect of a stimulus. Furthermore, when a simple stimulus is presented there is nothing but the targeting reflex to habituate, and therefore the individual [backward] habituation curve would approximate the classic group [forward] curve for habituation.

With a complex stimulus, however, I propose that a second system takes over before the targeting reflex habituates. It is this second system that accounts for the second phase of an infant's fixation behavior. I would call this second system an information processing system and now suggest that the serial habituation process operates primarily in this second phase. I also believe that in this second phase the arousal system and the degree of arousal may be different from that involved in the targeting reflex in that the

information processing arousal system is not related to alimentary or defensive needs but to the extraction of information from the environment (Hunt, 1963).

Fixation times would be expected to increase during the information-processing phase of the habituation curve because as the serial habituation hypothesis dictates, the subject begins responding to more than one cue. In doing so, time is permitted for spontaneous recovery of cue salience, and the more cues observed, the more recovery time there is. Thus, it seems quite likely that there would be an increase in fixation time. Furthermore, given serial attention to multiple cues, wherever habituation is taking place, it must be spread out over a wider range of pathways and points. (Jeffrey, 1976, pp. 290-292)

To apply Jeffrey's theory to TV viewing, one must first deal with the fact that Jeffrey is concerned with the temporal pattern of visual attention to a single static stimulus, while TV consists of a series of continuously moving, changing stimuli. It does not seem unreasonable to consider a TV episode analogous to a single static stimulus for the purpose of comparing Jeffrey's theory with the two theories of TV viewing proposed earlier. Jeffrey's theory deals with patterns of visual attention only within the boundary of a given static stimulus, just as the episode-bound theory deals with inertial effects only within the boundary of a given TV episode.

Consider the first phase of habituation proposed by Jeffrey. Jeffrey refers to the arousal system involved in this phase as a "targeting reflex system" and likens it to Sokolov's orienting reflex, in which the highly

salient cues of a stimulus (such as corners, edges, hues) elicit attention or arouse the visual receptors. This arousal system requires no cognitive involvement to be activated; an automatic excitation of the targeting reflex system occurs with the introduction of any visual stimulation. In this sense the first phase of the habituation process is similar to the episode-free inertia proposed above.

However, Jeffrey does not propose any inertial tendencies due to this arousal system. On the contrary, he states that this targeting reflex will rapidly habituate due to the simplicity of the cues eliciting attention during this phase. Recall, however, that Jeffrey is dealing with attention to a single static stimulus. Consider what would happen if several dynamic stimuli were presented in rapid succession, which is the case with TV. When the first stimulus is presented on the TV screen, the targeting reflex system is activated, so attention is elicited and the viewer looks at the TV. This attention rapidly habituates; the targeting reflex system is deactivated, so attention is no longer captured, and the viewer begins to look away from the TV. Presentation of the next stimulus, however, arouses the targeting reflex system once again; attention is again captured but not maintained due to rapid habituation. Thus, the viewer's attention is captured but rapidly lost once again. One would expect the targeting reflex system to



be reset continually and rapidly, producing either short but frequent looks at the TV, or one continual look at the TV if the stimuli are presented rapidly enough to prevent complete habituation of attention to the most salient cues of one stimulus before the next stimulus is presented. By itself such a system would predict a flat conditional probability curve.

However, such a system can produce an inertial effect if an additional assumption is introduced. As the targeting reflex system is continually and rapidly reset, it may become more primed for action the more often it is reset, resulting in an arousal buildup over time. Such an arousal buildup could lead either to a lower threshold of activation so that subsequent stimuli are attended to more rapidly, or to a longer duration of activation so that attention to subsequent stimuli is habituated less rapidly, or to both. Either situation would produce attentional inertia when moving, changing stimuli are observed. As stimuli are presented in rapid succession, arousal of the targeting reflex system increases, so that the probability of maintaining a look increases as the number of successive stimuli previously viewed increases (that is, as the look length increases). This account is similar to the episode-free inertia theory proposed earlier, which simply states that continued looking results in excitation of the act of looking, and this excitation is manifested by a progressive

"locking in" to the TV screen. Although quite an extrapolation from Jeffrey's theory is necessary to draw a parallel between his theory and that of episode-free inertia, doing so does demonstrate that the two theories are not incompatible; rather, Jeffrey's theory can be regarded as an elaboration of the episode-free inertia theory.

Now consider the second phase of the habituation curve as proposed by Jeffrey. He refers to the system underlying this second phase as an "information processing system" and states that the arousal system of this phase is related to "the extraction of information from the environment." Cognitive involvement, in other words, is the motivating force during this second phase of habituation, just as cognitive involvement is the factor that produces attentional inertia in the episode-bound inertia theory.

A second similarity between Jeffrey's theory and the episode-bound inertia theory is the proposal of an arousal system produced by "the extraction of information from the environment" during this second phase of habituation. Recall that the episode-bound inertia theory employs the idea of an arousal system which maintains an ongoing look until a given action unit is complete. Jeffrey later justifies his proposal of an arousal system during this second phase of habituation with the following statement:

Given the extent to which we are now willing to recognize the motivational and reinforcing aspects of information processing it also seems

reasonable to suggest that as the organism discovers the richness of the stimulus complex some arousal would occur. Our observations certainly suggest that there is some excitement that occurs in active processing .... (Jeffrey, 1976, p. 292)

Jeffrey thus adds support to the assumption underlying the episode-bound inertia theory that a state of arousal is produced by the viewer's cognitive involvement during an action unit, which maintains an ongoing look until the action unit is complete. This arousal is, in a sense, the conceptual opposite of habituation. It is the maintenance of attention produced by nonrepetitive, complex stimulation, rather than the diminution of attention by repetitive, simple stimulation.

Jeffrey's account of this information-processing phase has a third similarity to the episode-bound inertia theory. His description of the process underlying this second phase is analogous to Newtonson's account of the process underlying the perception of ongoing behavior, on which the episode-bound inertia theory is based. In both accounts, it is argued that initially the viewer deals with only small units of that which he is viewing, but with time gradually deals with larger units. Recall Newtonson's statement that as a behavior sequence progresses, the viewer gains more information about the behavior and therefore perceives it in larger units. The prediction of increased look lengths across a given episode by the episode-bound inertia theory is based



on this trend of perceiving larger units of action as the episode progresses.

Now consider Jeffrey's account of the process underlying the second phase of the habituation curve. Jeffrey states that during the progression of this second phase, "as the serial habituation hypothesis dictates, the subject begins responding to more than one cue." Recall that more than one cue will be responded to on later trials because: 1) attention to a cue results in habituation of attention to that cue, shifting attention to the next most salient cue, and 2) with time, more and more cues will lose their salience, so that the number of cues scanned will increase. The first point can be interpreted to mean that during later trials the subject gains more information about the stimulus, since attention is shifted to new cues as old cues lose their salience. The second point can be interpreted to mean that during later trials the subject begins "chunking" the information perceived about the stimulus, since the number of cues scanned simultaneously increases on later trials. Like Newton's theory, Jeffrey's theory employs the idea that over time: 1) increased information is gained about that which is viewed; and, 2) the stimulus is perceived in larger and larger chunks.

Jeffrey then explains how this tendency to respond to more than one cue on later trials during this second phase leads to a prediction of increased fixation times.

As more cues are scanned, "time is permitted for spontaneous recovery of cue salience, and the more cues observed, the more recovery time there is." In other words, the more cues that are being perceived, the more chance there is for one of the cues to become salient once again and to hold the subject's attention for a longer time. As a result, longer fixation times are expected as this information-processing phase progresses. This account is central to Jeffrey's theory, because it predicts the increase in fixation time prior to the habituation trial, which has otherwise baffled investigators. This prediction of increased fixation times across trials (that is, as a given stimulus is repeatedly viewed) during the second phase of the habituation curve also provides a fourth similarity between Jeffrey's theory and the episode-bound inertia theory. Recall that the episode-bound inertia theory predicts increased look lengths as a given TV episode is viewed. Thus, both Jeffrey's theory of the second phase of the habituation curve and the episode-bound theory of attentional inertia employ similar motivating forces (cognitive involvement and an accompanying arousal system) and similar underlying processes (the perception of larger units over time) which results in similar predictions (increased look lengths over time).

Jeffrey's proposal of two different arousal systems, the "targeting reflex system" and the "information-processing arousal system," to explain the habituation curve leads

one to propose that both episode-free and episode-bound inertia may be involved in TV viewing. Episode-free inertia may account for inertial effects manifested when little or no cognitive involvement occurs (when simple stimuli which do not provide the opportunity for much cognitive involvement are viewed, or when complex stimuli are viewed passively, with little processing effort), and episode-bound inertia may account for inertial effects manifested when cognitive involvement does occur. This proposal of both mechanisms being involved in TV viewing will be referred to as the "combination theory of attentional inertia."

#### Potential Carry-over Effects

Although episode-free inertia is hypothesized to function only within the bounds of a given look and episode-bound inertia is hypothesized to function only within the bounds of a given episode, inertial effects across looks (not only looks within a given episode, but any looks) and across episodes may be predicted by postulating a carry-over effect in which some attentional arousal may carry over from look to look and from episode to episode. First consider how predictions based on the episode-free inertia theory can be made about inertial effects across looks as an entire viewing session progresses, without reference to episodes or cognitive involvement. When the viewer takes a short look at the TV, attentional arousal caused by continued

looking will be low, so that little arousal will be available to carry over to the next look. One would thus expect a short look at the TV to be followed by another short look and a long pause in attention to the TV to separate these short looks. When the viewer takes a long look at the TV, attentional arousal due to this extended looking will be high, and some of this arousal may linger after the look has ended and "spill over" into the next look, making it a long look, as well, and making the pause between the looks short. Thus, an inertial effect across looks can be predicted by the episode-free inertia theory in which short looks tend to be followed by short looks and long pauses, and long looks tend to be followed by long looks and short pauses.

This same argument can be used to make a prediction of inertial effects across episodes. First recall that the mechanism of episode-bound inertia is hypothesized to function only within a given episode. That is, the viewer perceives the behavior in larger and larger units as the episode progresses, so that longer and longer looks at the TV are taken. As soon as a new episode begins, the viewer again perceives the action in small units, and the looks at the TV become shorter. Thus, the episode-bound inertia theory does not permit the prediction of any inertial effects between episodes.<sup>1</sup> The combination theory of inertia, however, does not eliminate the possibility that a carry-over



effect from episode to episode may exist due to episode-free inertia. If the viewer was perceiving large action units by the end of an episode and was taking long looks at the TV as a result, the arousal created by all this looking, according to the episode-free inertia theory, should be high. Some of this arousal may "spill over" into the next episode, even though the arousal due to cognitive involvement may terminate completely at the end of an episode, as the episode-bound theory predicts. Similarly, if a viewer experienced little cognitive involvement during an episode and was still perceiving small action units as a result, little looking at the TV would occur near the end of the episode, so that little arousal would be available to carry over to the next episode. In conclusion, it does seem reasonable to predict inertial effects across looks and across episodes if the assumption of a carry-over effect of attentional arousal is included in the theory of episode-free inertia.

#### Possible Sources of an Artifactual Inertia Curve

Although an underlying process such as episode-free and/or episode-bound inertia can be proposed to account for the attentional inertia phenomenon, the possibility still remains that the empirical demonstration of attentional inertia outlined earlier is nothing more than an artifact of the particular analysis used. The problem is similar

to the one encountered when interpreting a group learning curve (Zeaman & House, 1963). It seems reasonable to interpret the group learning curve as demonstrating that the learning process of an individual is continuous. However, the same curve can be obtained by averaging discrete, one-trial learning curves of subjects, each of whom attained the learning criterion on a single but different trial. On each subsequent trial, more subjects will have already reached the learning criterion. Because the analysis involves averaging learning scores across subjects at each trial, a gradually increasing group learning curve is obtained even though learning actually occurred all on one trial for each subject. A similar averaging problem exists in interpreting forward group habituation curves (Cohen & Gelber, 1975). Because the attention of each subject habituated on a different trial, and since attention scores are averaged across subjects at each trial, a gradually decreasing group habituation curve is obtained, even though the attention of each subject habituated in a single trial.

This problem of averaging scores across subjects exists in the conditional probability curve described earlier, although in a slightly different form (Clifton, Note 6). Consider the possibility that each subject has a constant but different probability of continuing to look at the TV screen, regardless of TV content. In other words, some people are typically long-lookers (high probability of con-



tinuing to look at any given time) and others are typically short-lookers (low probability of continuing to look at any given time). If this is the case, then fewer and fewer short-lookers will be represented in the conditional probability curve as longer look lengths are considered. As a result, an increase in the probability of continuing to look is expected as longer look lengths are considered, since mostly long-lookers (high probability of continuing to look at any given time) will be represented in the data used to calculate the data points for longer looks. However, the conditional probability curves of individual subjects are virtually identical to group conditional probability curves.

A second problem analogous to the first one should be mentioned. Consider the possibility that each look has a constant but different probability of continuing, regardless of who is doing the looking or what TV content is being viewed. If this is the case, looks with a low probability of continuing will have a smaller representation in the calculation of data points as longer look lengths are considered, simply because by definition these low-probability looks are not likely to continue very long. Prediction of an increasing (inertial) conditional probability curve follows from this situation as in the one proposed earlier, since the probability of continuing to look will increase as look length increases. It is unlikely, however, that

each look has a constant probability of continuing, independent of who is doing the looking and what is being viewed. Therefore, it seems reasonable to disregard this second potential source of an artifactual curve because of its implausibility.

A third and plausible artifactual explanation of the curve exists, as well. Each episode in the TV program (for example, each bit on Sesame Street) may have a constant but different probability of maintaining a look, regardless of who is doing the looking. In other words, some episodes may be more interesting than others. In such a case, a smaller and smaller proportion of the less-interesting episodes will be represented in the curve as longer look lengths are considered, producing an increasing (inertial) conditional probability curve.

To illustrate how this third situation successfully generates the attentional inertia curve, consider the hypothetical situation in which one subject views five successive two-minute episodes, each of which has a constant but different probability of maintaining a look. The first artifactual problem mentioned can be disregarded in this case, because only one subject is being considered. Suppose the five episodes have a 1.0, .8, .6, .4, and .2 probability of maintaining a look, respectively, and that the probability of looking back at the TV once a look has stopped is .9 for all five episodes. For any given episode, the proba-

bility of a look continuing will be constant for any interval of time considered within that episode. For each episode, then, looks with varying lengths can be generated by using a random numbers table and by considering the given probability of maintaining a look for that episode.

First consider the episode with a probability of 1.0 of maintaining a look, and assume the subject looks at the TV as soon as the episode begins. Because the probability of maintaining a look is 1.0 for this episode, the look will continue to the end of the episode, at which point a new episode begins, which happens to have a probability of .8 of maintaining a look. For each three-second interval within this episode, the probability of a look continuing will be .8. Therefore, a look can be said to continue through a given three-second interval if any of the digits 0 through 7 are met in the random numbers table; otherwise, the look will be said to stop and not continue through that three-second interval. The probability of looking back at the TV once a look stops is .9 for all five episodes. When a look stops for one three-second interval, then, a new look can be said to begin and continue through the next three-second interval if any of the digits 0 through 8 are met in the table; otherwise, no look is generated for that interval as well.

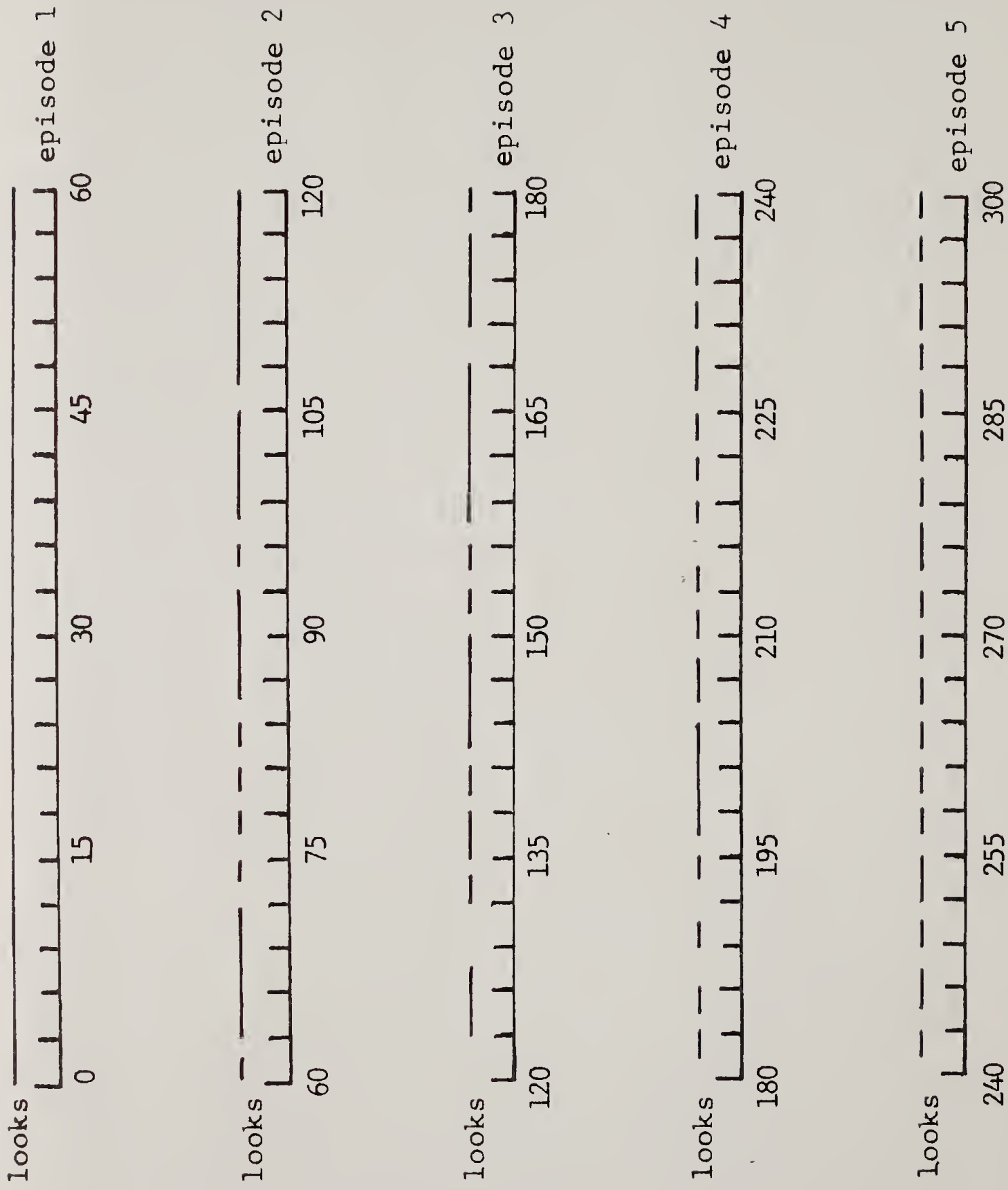
The looks and pauses generated by following this Monte-Carlo procedure for all five two-minute episodes are presen-

ted in Figure 5. Note that the looks become shorter as the probability of maintaining a look associated with a given episode decreases. As a result, fewer low-probability episodes will be represented in the data used to calculate data points as longer look lengths are considered, so the probability of a look continuing is expected to increase as look length increases. Figure 6, a plot of the conditional probability curve devived from these data, confirms this prediction. (Due to the small number of instances of looks lasting 15 seconds or longer, the probabilities of these looks continuing are not plotted.)

In summary, an artifactual increasing (inertial) curve can be produced by two potential properties of the data. First, each subject may have a constant but different probability of continuing to look regardless of TV content, so that an increasingly greater proportion of long-lookers will be represented as the curve is plotted. This situation will be termed the "heterogeneous subjects" condition to distinguish it from the possible "homogeneous subjects" condition, in which the probability of a subject continuing to look may be identical across all subjects. Second, each episode may have a constant but different probability of maintaining a look regardless of who is doing the looking, so that an increasingly greater proportion of highly-interesting episodes will be represented as the curve is plotted. This situation will be termed the "heterogeneous episodes"

Fig. 5. Looks at the TV generated using a Monte-Carlo simulation.





GENERATED LOOKS

Fig. 5.

TIME (SEC.)

Fig. 6. Conditional probability function for the data represented in Figure 5.

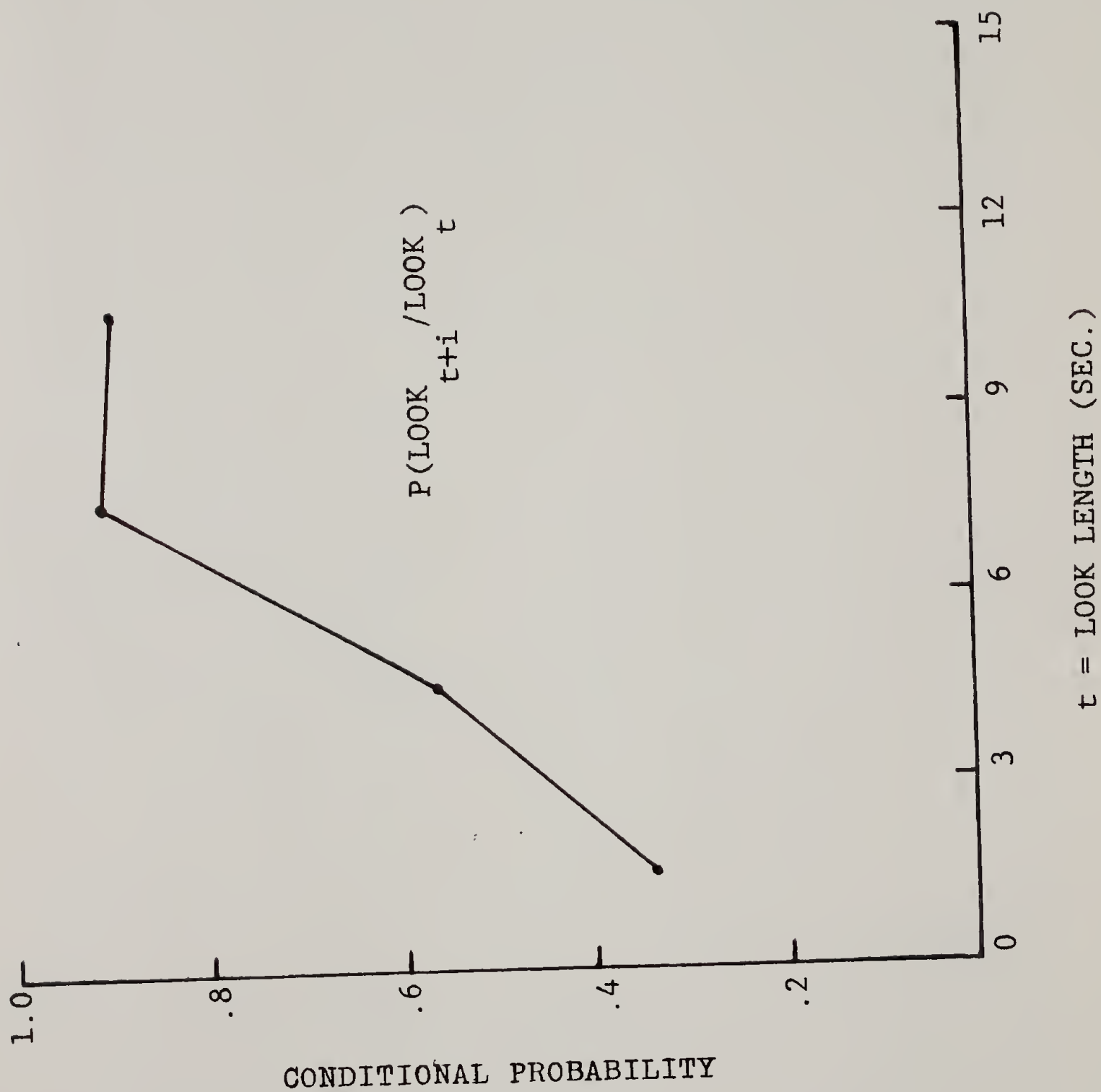


Fig. 6.

condition to distinguish it from the possible "homogeneous episodes" condition, in which the probability of an episode maintaining a look may be identical across all episodes. Thus, subjects may be heterogeneous or homogeneous, and episodes may be heterogeneous or homogeneous, with respect to their tendency to maintain a look at the TV at any given time. As a result, four different situations may exist, all four of which produce artifactual curves, and three of which produce an increasing (inertial) curve.

First consider the situation in which both subjects and episodes are homogeneous with respect to their tendency to maintain a look. A flat conditional probability curve would be predicted from such a situation. Because there are no subject differences or episode differences in regard to the probability of maintaining a look, there is no reason to expect the probability of maintaining a look to change as look length increases. To illustrate this, consider the hypothetical situation in which the probability of a look continuing through any given interval is a constant,  $p$ . Now consider the progress of a given look through successive intervals. Once the look begins, the probability of the look continuing through the first interval is  $p$ , as defined above. The probability of the look continuing through the second interval is  $p^2$  (that is,  $p$  times the probability that the look lasted through the previous interval, namely,  $p$ ). The probability of the look continuing through the

third interval is  $p^3$  (that is,  $p$  times the product of the probabilities that the look lasted through the previous two intervals, namely,  $p$  and  $p$ ). In general, the probability of the look continuing through the  $n$ th interval is  $p^n$ .

Now, to plot the conditional probability curve,  $p(\text{look}_{\underline{t+i}}/\text{look}_{\underline{t}})$ , one needs to determine the probability of the look continuing through a given interval, given that the look actually did continue through all previous intervals. For the first interval, this conditional probability is:

$$\frac{p(\text{look continuing through first interval})}{p(\text{look beginning once it already began})} = \frac{p}{1} = p.$$

For the second interval, this conditional probability is:

$$\frac{p(\text{look continuing through second interval})}{p(\text{look continuing through first interval})} = \frac{p^2}{p} = p.$$

In general, for the  $n$ th interval, the conditional probability is:

$$\frac{p(\text{look continuing through } n\text{th interval})}{p(\text{look continuing through } (n-1)\text{th interval})} = \frac{p^n}{p^{n-1}} = p.$$

Thus, the conditional probability remains constant (namely,  $p$ ) as look length increases. However, the conditional probability curve actually derived from the data is not flat but increasing, so it seems unlikely that both subjects and episodes are homogenous with respect to the probability of maintaining a look. Thus, this situation can be disregarded.

Next consider the situation in which all subjects differ with respect to their tendency to maintain a look (hetero-



geneous subjects) but all episodes have the same constant probability of maintaining look (homogeneous episodes). This situation exists if there are differences in attractiveness of the TV for each subject and/or differences in the distractibility of each subject, resulting in different probabilities of continuing to look for each subject. The fact that the individual inertia curves derived from the data are increasing functions eliminates this possibility of artifact.

A third possible situation is that all subjects have the same constant probability of maintaining a look at the TV (homogeneous subjects) but all episodes differ in their probability of maintaining a look (heterogeneous episodes). That is, there may be no subject differences in attraction to or distraction from the TV, but TV episodes may differ in their interest level. However, there is evidence that subject differences do exist. Levin and Anderson (1976), observing 3-, 4-, and 5-year-old children watch one hour of children's TV programs on three separate days, found that individual differences in look duration, as well as look frequency, overall percent attention to the TV, and talking about the TV during the program were all reliable from session to session, even when the effects of age were partialled out (average partial correlation was .49,  $p < .001$ ). Subjects to seem to differ in their patterns of TV viewing, including look duration (the tendency to maintain

a look), so this third possibility can also be eliminated.

Finally, a fourth possible situation is that both subjects and episodes are heterogeneous with respect to their tendency to maintain a look at the TV at any given time. The present data do not rule out this possibility, and it seems very reasonable that there are both subject and episode differences with respect to maintaining a look at the TV.

To summarize, all but one of the four possible situations outlined above can be eliminated immediately, based on data already available. Only the heterogeneous-subjects, heterogeneous-episodes situation remains as a possible source of an artifactual increasing conditional probability curve. As long as any possibility remains that the curve is artifactual, due to the heterogeneous nature of episodes or subjects or both, the inertia curve cannot be interpreted unequivocally as reflecting an underlying cognitive process.

#### Purpose of the Present Study

Four theories of the attentional inertia phenomenon in TV viewing were posited: 1) it does exist but is strictly episode-bound (episode-bound inertia theory); 2) it does exist and is not episode-bound (episode-free inertia theory); 3) it does exist and consists of two components, one that is episode-bound and another that is not (combination inertia theory); and, 4) it is artifactual and does not really exist. The present study was an attempt to determine which of these

four theories is the most plausible, based on analyses of extensive TV viewing data already collected. In addition to the conditional probability analysis outlined earlier, two major approaches were used to evaluate the relative merits of these four theories: 1) seeking evidence for inertial effects between looks and between pauses without regard to episode boundaries; and, 2) seeking evidence for inertial effects across episodes. Within the second major approach, several different although nonindependent analyses were carried out. Any demonstration of inertial effects between looks and between pauses was taken as additional evidence that attentional inertia does exist, but failed to differentiate between the episode-bound, episode-free, and combination inertia theories. Any demonstration of inertial effects across episodes was interpreted as refuting the episode-bound inertia theory, but failed to differentiate between the episode-free and combination inertia theories.

The specific purpose of the present study was twofold: 1) to determine whether attentional inertia is artifactual, and 2) if the evidence shows that it is not, to determine the nature of the inertia phenomenon; that is, to determine if it is episode-bound, episode-free, or both.

## C H A P T E R   I I

### METHOD

The attention data used in the present study were collected during the summer of 1977 as part of a larger study Anderson and his colleagues carried out in cooperation with Children's Television Workshop. Details of this study not relevant to the present study are included in separate reports (Anderson, Lorch, Field & Sanders, Note 7; Anderson, Lorch, Smith, Bradford, & Levin, Note 7; Lorch & Anderson, Note 8).

#### Subjects

A total of 300 children, 149 three-year-olds and 151 five-year-olds from the Springfield, Massachusetts, area, comprised the subject pool, with approximately equal numbers of boys and girls at each age.<sup>2</sup> The children were predominantly white (17 children were black or Spanish surname minority) and from a wide range of socioeconomic status.

#### Materials

Fifteen hour-long black and white Sesame Street programs were used. The 7 ft. x 12 ft. (2.13 m. x 3.66 m.) viewing room was comfortably furnished, and magazines for the parent were provided. Videotape equipment set up in an adjacent



room was connected through the wall to a TV monitor with a 17 in. (43.18 cm.) screen located in one corner of the viewing room. On the wall to the right of the TV monitor, random distractor slides were continually rear-projected on a one-way mirror such that a color slide image the same size as the TV screen appeared at a 45 degree angle to and about 3 ft. (.91 m.) from the TV screen. Distractor slides were used to avoid a ceiling effect for the measure of visual attention to the TV. The slides consisted of a large variety of animals, scenes from Disneyland, posters for movies, and artworks. Each slide appeared for 8 seconds, with each slide change signalled by a distinct "beep" from a box located in the viewing room just below the slide image. Two slide projectors, each with a 140-slide carousel, were connected by an electronic system which automatically switched from one projector to the other after a carousel had been completely viewed. Four different carousels of slides were used, and an experimenter replaced each carousel once it had been viewed, so that no slide was seen twice by any subject.

#### Viewing Procedure

Each subject viewed only one Sesame Street program. With one exception (see Footnote 1), ten 3-year-olds and ten 5-year-olds viewed each program, with approximately equal numbers of boys and girls of each age viewing each



program. "At each age for each program three children viewed singly, four viewed in two groups of two, and three viewed as one group of three" (Lorch & Anderson, Note 8, p. 2). Subjects were randomly assigned to one of the 15 programs and to one of the three viewing-group sizes.

After the parents and children were greeted and the study explained, the subject (or group of subjects) and one parent were brought to the viewing room. The door was closed, and the experimenters simultaneously started the Sesame Street program and the slides. During the viewing session, the parent filled out a questionnaire about his/her child's TV viewing habits at home. The child(ren) was (were) free to watch the TV, the slides, and/or interact with the parent (and/or each other).

#### Observation Procedure

Throughout the viewing session, each child was observed through a one-way mirror, with one observer present for each child in the viewing room.

Each observer had a panel with three push-buttons: one button was used to record visual attention to the TV, a second button recorded visual attention to the slide distractor, and the third button was used to record the child's overt involvement with the TV program. When, in an observer's judgment, the child looked at the TV, looked at the slide, or showed overt program involvement, the observer depressed the appropriate button until the behavior ended. (Lorch & Anderson, Note 8, p. 3)

The buttons were connected to a data logger which automatically recorded the time of onset and offset of each button push on paper tape, thus providing a continuous record of each child's attention and involvement. These data were later stored in a computer for analysis.

Attention to the TV was defined as any visual fixation on the TV screen, and attention to the slides was defined as any visual fixation on the slide image.

"Involvement" was defined as any overt expression of interest in the TV program. Included in the definition ... [were] activities such as laughing, pointing at the screen, imitating, talking about the program, [and] dancing to the music. (Lorch & Anderson, Note 8, p. 4)

Visual attention is easily measured using the above procedure and produces highly reliable data (e.g., Anderson & Levin, 1976). "Interobserver reliability for involvement, while not as high as for attention, was still respectable (average percent agreement = 97.2%)" (Lorch & Anderson, Note 8, p. 4).

#### Program Rating Procedure

Separate from the viewing session, each of the 15 Sesame Street programs was rated for bit changes. A bit change was defined as the transition point between one segment ("bit") of programming and another. At this point all on-going attributes (characters, setting, sounds) and messages (storyline, lesson, theme) terminate and others begin.

A bit change on Sesame Street is typically indicated by a "blackout" (momentarily blank screen with no sound) or a "cut" (sudden visual scene change). An example of a bit change would be a scene of the muppets Bert and Ernie in bed singing a song about imagination, followed by a cut to a cartoon character "in limbo" (on a blank background) discussing the letter "H". Note that the characters have changed from Bert and Ernie to a cartoon character, the setting has changed from a bedroom to a blank background, the audio track has changed from signing to speaking by a different voice, and the theme has changed from a song about imagination to a short discourse on the letter "H".

The procedure for rating the programs for bit changes was analogous to that used to observe the children. An observer viewing a given program rapidly depressed and released a button each time a bit change occurred. The button was connected to a computer which automatically recorded the times of onset of each button-push.

The total number of bits across all 15 Sesame Street programs was 618. The average number of bits per program was 41.2 bits, with a range of 35 to 48 bits per program. The average bit length was 1 min., 24 sec., with a range of 8 sec. to 7 min., 19 sec.

C H A P T E R   I I I  
RESULTS AND DISCUSSION

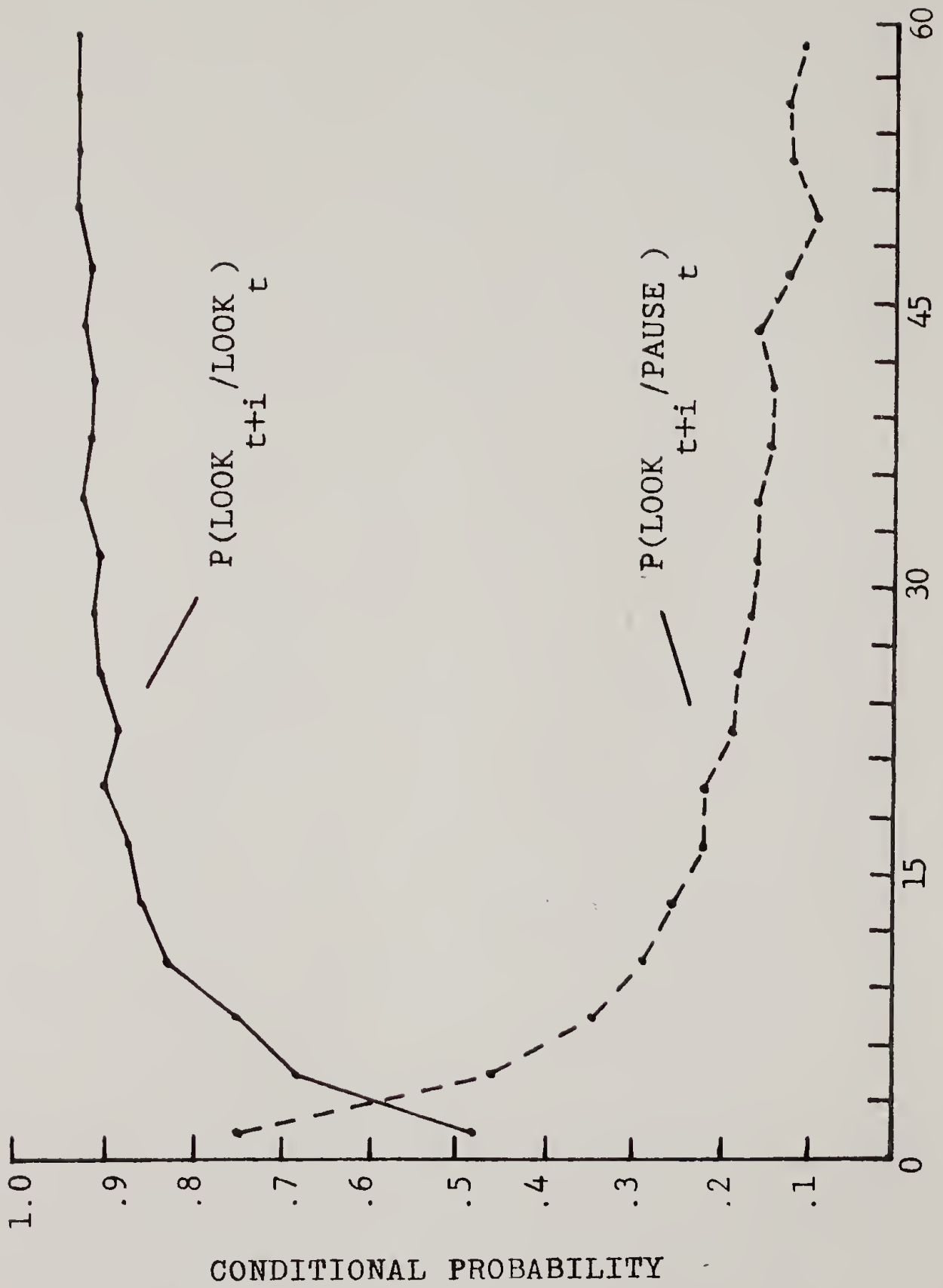
Conditional Probability Curves

The original conditional probability function,  $p(\text{look}_{\underline{t+i}}/\text{look}_{\underline{t}})$ , was plotted to confirm that an increasing curve was obtained using this new and much larger data pool. In this and all subsequent analyses, the data were collapsed over viewing group size (one, two or three children per group) and age.<sup>3</sup> As can be seen by the solid line in Figure 7, an increasing curve was obtained, the shape of which closely resembles that of inertial curves found in earlier studies (see Figure 2).

In addition, the conditional probability curve was plotted using the slide attention data to see if an increasing curve was obtained when a measure of visual attention to a medium other than TV was used. The slide attention data provided a means of testing the episode-free inertia theory. Recall that episode-free inertia requires no cognitive involvement to function. The Sesame Street programs shown provided much opportunity for cognitive involvement. They often included an underlying organization or plot structure. Adjacent scenes within most bits were related to each other, so that each bit formed a meaningful structure. The slides,

Fig. 7. Conditional probability of continuing to look at the TV as a function of time since the look began (solid line), and the conditional probability of looking back at the TV or slides as a function of time since the pause began.





$t$  = LOOK OR PAUSE LENGTH (SEC.)

Fig. 7.

however, were randomly presented. A given slide had no relationship to the slide preceding or following it. The programs, then, often provided the viewer with more opportunity to become cognitively involved than the slides provided. In fact, very little cognitive involvement was expected while viewing the slides compared to viewing the Sesame Street programs. Thus, little episode-bound inertia was expected to be functioning during attention to the slides. Therefore, if an increasing conditional probability curve was obtained using the slide attention data, it could be taken as some evidence that a mechanism like the episode-free inertia described earlier (continued looking producing an excitation or arousal of the act of looking) does function in visual attention.

Although the conditional probability curve for the slide attention data was not nearly as smooth as that using the TV attention data once the look length considered exceeded 18 seconds, it was clearly an increasing function (see Figure 8). The "noise" in the curve after 18 seconds was most likely due to the small number of looks included in the calculation of those data points compared to the number of looks considered when plotting those same points using the TV attention data, since very few looks at the slides exceeded 15 seconds. For example, only 490 looks at the slides exceeded 18 seconds in length, while 11,119 looks at the TV exceeded this length. (See Table 1 for

Fig. 8. Conditional probability of continuing to look at the slides as a function of time since the look began.

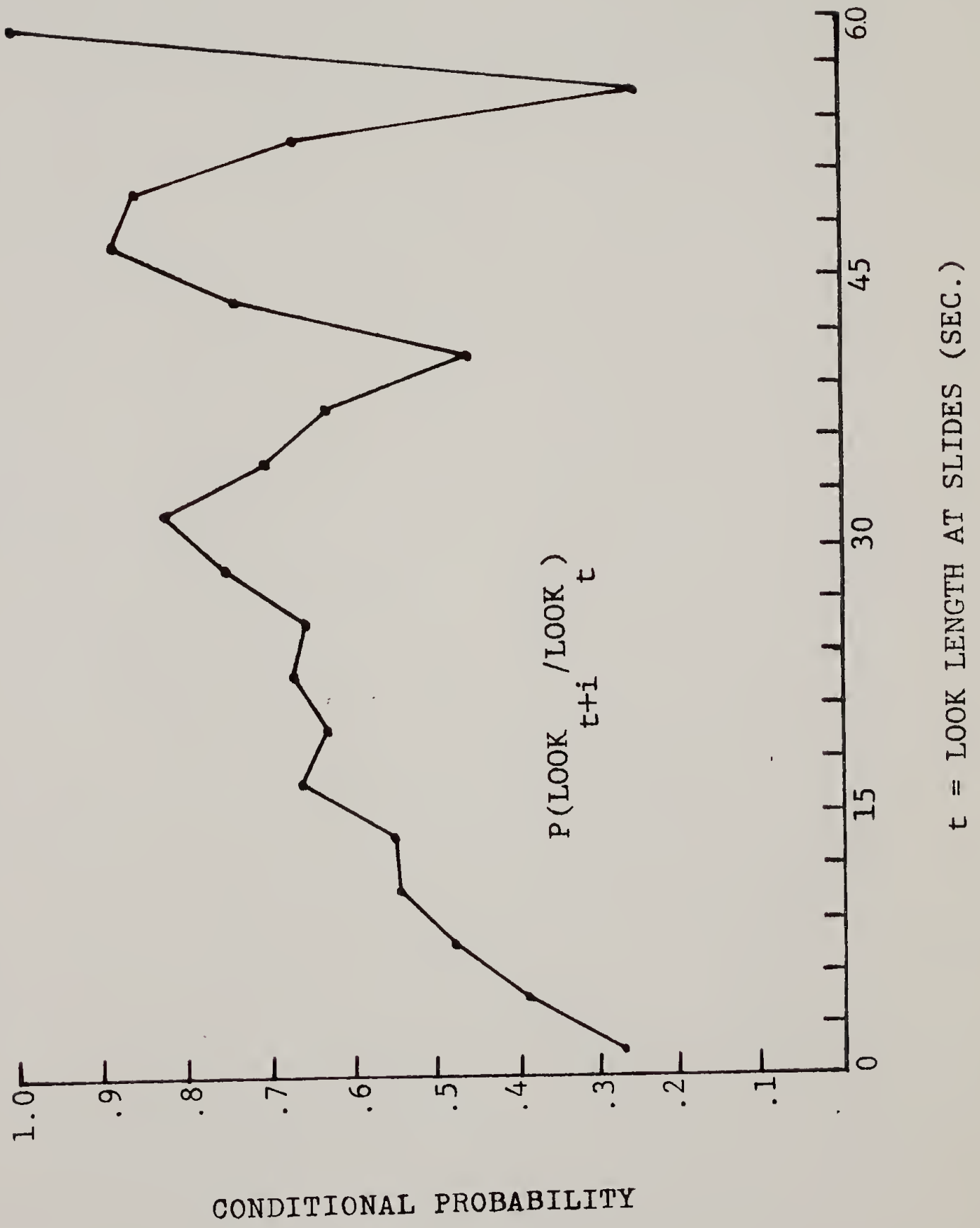


Fig. 8.

Table 1

Number of Looks and Pauses of Each Length  
for the TV, Slide, and Pause Attention Data

| Look or Pause<br>Length (sec.)        | Looks<br>at TV | Frequency          |        |
|---------------------------------------|----------------|--------------------|--------|
|                                       |                | Looks<br>at Slides | Pauses |
| 3                                     | 33,200         | 24,731             | 55,035 |
| 6                                     | 10,085         | 5,563              | 8,635  |
| 9                                     | 5,222          | 1,836              | 3,433  |
| 12                                    | 2,679          | 762                | 1,868  |
| 15                                    | 1,961          | 404                | 1,176  |
| 18                                    | 1,529          | 167                | 778    |
| 21                                    | 1,054          | 120                | 598    |
| 24                                    | 1,014          | 68                 | 396    |
| 27                                    | 752            | 47                 | 307    |
| 30                                    | 645            | 22                 | 239    |
| 33                                    | 608            | 12                 | 185    |
| 36                                    | 437            | 16                 | 158    |
| 39                                    | 443            | 14                 | 119    |
| 42                                    | 427            | 13                 | 98     |
| 45                                    | 332            | 3                  | 95     |
| 48                                    | 336            | 1                  | 65     |
| 51                                    | 245            | 1                  | 42     |
| 54                                    | 243            | 2                  | 48     |
| 57                                    | 228            | 3                  | 45     |
| 60                                    | 215            | 0                  | 33     |
| ⋮                                     | ⋮              | ⋮                  | ⋮      |
| 69                                    | 156            | 1                  | 18     |
| ⋮                                     | ⋮              | (longest look)     | ⋮      |
| (7', 3") 423                          | 1              | ⋮                  | 1      |
| ⋮                                     | ⋮              | (longest pause)    | ⋮      |
| (13', 42") 822                        | 1              | ⋮                  | ⋮      |
|                                       | (longest look) | ⋮                  | ⋮      |
| Total Number<br>of Looks or<br>Pauses | 64,266         | 33,786             | 73,630 |



the number of looks of each length for the TV and slide attention data.) This increasing curve using the slide attention data provides some initial support for the existence of episode-free inertia in visual attention.

Similarly, the conditional probability curve was plotted using all instances of the absence of attention both to the TV and slides. Such pauses in attention both to the TV and slides most likely represented instances of social interaction, since no toys or other objects were present in the viewing room. Using these pauses to plot the conditional probability curve and in subsequent analyses was, therefore, a means of testing for the presence of inertia in a behavior other than visual attention.

As the dashed line in Figure 7 demonstrates, the longer a pause in looking at the TV and slides had been in progress, the less likely it was that the viewer would look back at the TV or slides. As suggested earlier, either the viewer became "locked in" to a non-TV viewing activity (such as social interaction), or the attractiveness of the TV and slides diminished the longer the viewer looked away. If the former explanation is true, then this result, which parallels those found in earlier studies (see Figure 2) adds additional support for the presence of attentional inertia in an activity other than attention to a visual medium. (For comparison with the look length frequencies

for the TV and slide attention data, Table 1 also lists the number of pauses of each length.)

Although these analyses confirmed the past findings of increasing conditional probability curves, these curves are plagued with the same alternative artifactual explanations as the original curves. To avoid this problem, two different approaches to analyzing the data were taken based on the description of the mechanisms of episode-bound and episode-free inertia outlined earlier.<sup>4</sup>

#### Adjacent Look and Pause Correlations

The first major attempt to gain additional evidence that the attentional inertia phenomenon is real was to look for inertial effects between looks and between pauses. Recall that by postulating a carry-over effect in which some attentional arousal may carry over from look to look, the episode-free inertia theory predicts that: 1) short looks will tend to be followed by short looks and long pauses, and 2) long looks will tend to be followed by long looks and short pauses.

To test these predictions, the correlation between the length of each look at the TV and the length of the look succeeding it and between the length of each pause in attention to the TV and the length of the pause succeeding it was calculated, as well as the correlation between the length of each look and the length of its succeeding pause

and between the length of each pause and the length of its succeeding look. A positive correlation between the length of successive looks was predicted, with short looks followed by short looks and long looks followed by long looks. Similarly, a positive correlation was expected between the lengths of successive pauses. A negative correlation between the length of a look and the length of the pause succeeding it was predicted, with short looks followed by long pauses and long looks followed by short pauses. Similarly, a negative correlation was expected between the length of a pause and the length of the look succeeding it.

Table 2 summarizes these expected results, and Table 3 presents the obtained results. All the predictions were confirmed. The correlation between adjacent looks was positive and significant ( $\underline{r} = .138$ ,  $\underline{df} = 62,966$ ), as was the correlation between adjacent pauses ( $\underline{r} = .191$ ,  $\underline{df} = 62,805$ ).<sup>5</sup> The correlation between a look and its succeeding pause was negative and significant ( $\underline{r} = -.053$ ,  $\underline{df} = 63,105$ ), as was the correlation between a pause and its succeeding look ( $\underline{r} = -.045$ ,  $\underline{df} = 62,966$ ).

These look-pause relationships are illustrated in Figures 9, 10, 11, and 12. The solid lines in the four figures represent the best-fitting curves for the data, and the individual points represent actual data points.

Table 2  
 Predicted Adjacent Look-Pause Correlations

|       |       | Succeeding |       |
|-------|-------|------------|-------|
|       |       | Look       | Pause |
| Given | Look  | +          | -     |
|       | Pause | -          | +     |

Table 3  
 Obtained Adjacent Look-Pause Correlations

|       |       | Succeeding                     |                                 |
|-------|-------|--------------------------------|---------------------------------|
|       |       | Look                           | Pause                           |
| Given | Look  | .138<br>( <u>df</u> = 62,966)  | -.053<br>( <u>df</u> = 63,105)* |
|       | Pause | -.045<br>( <u>df</u> = 62,966) | .191<br>( <u>df</u> = 62,805)   |

\*The last look of each subject was omitted from the analysis if it continued beyond the last program bit into the program credits. As a result, the degrees of freedom differed for some of the look-pause combinations.

Fig. 9. Average length of a look at the TV as a function of preceding look length. The solid line represents the best-fitting curve for the data.



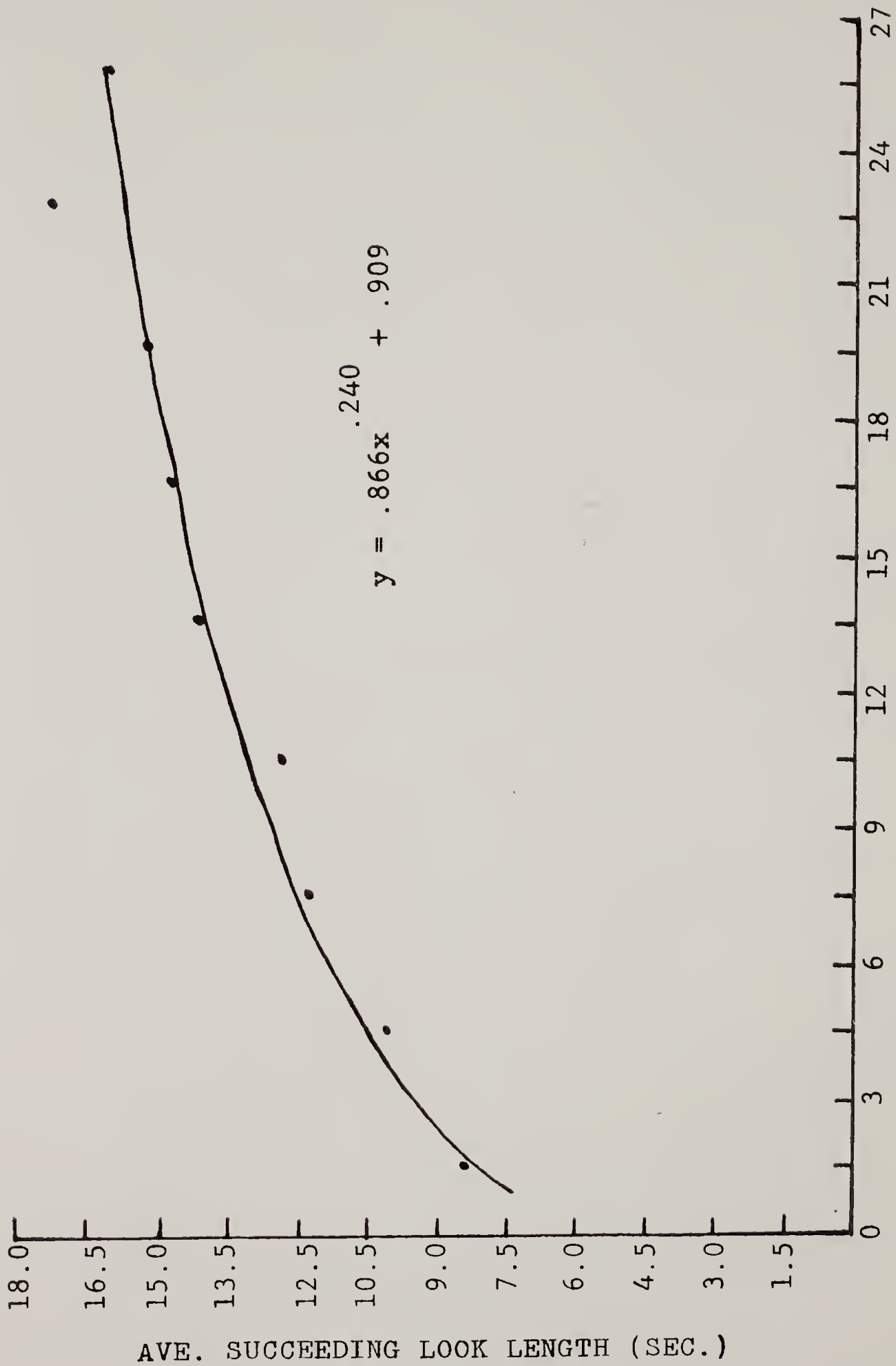


Fig. 9.

AVE. PRECEDING LOOK LENGTH (SEC.)

Fig. 10. Average length of a pause in attention both to the TV and slides as a function of preceding pause length. The solid line represents the best-fitting curve for the data.

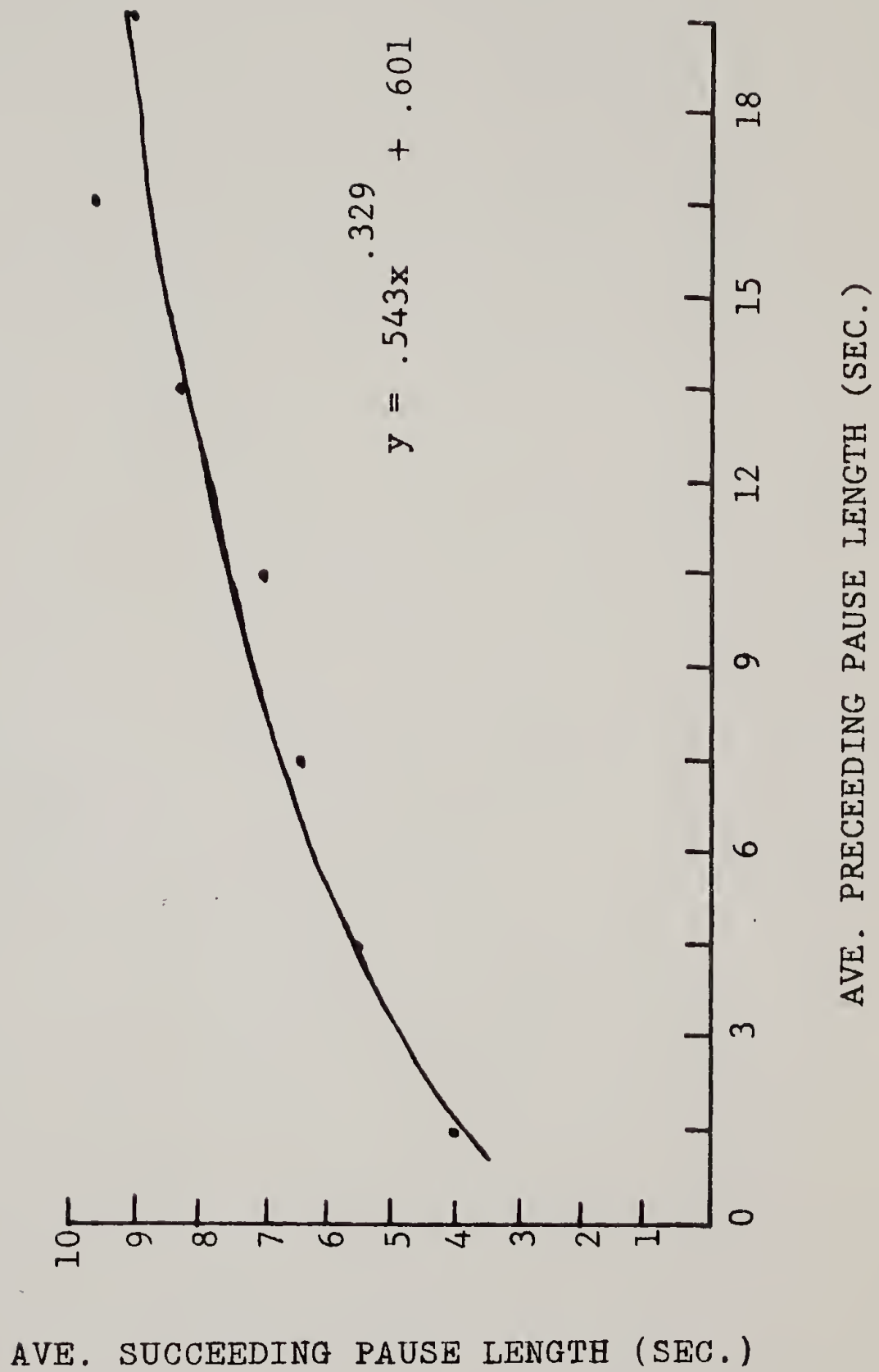


Fig. 10.

Fig. 11. Average length of a pause in attention both to the TV and slides as a function of preceding TV look length. The solid line represents the best-fitting curve for the data.

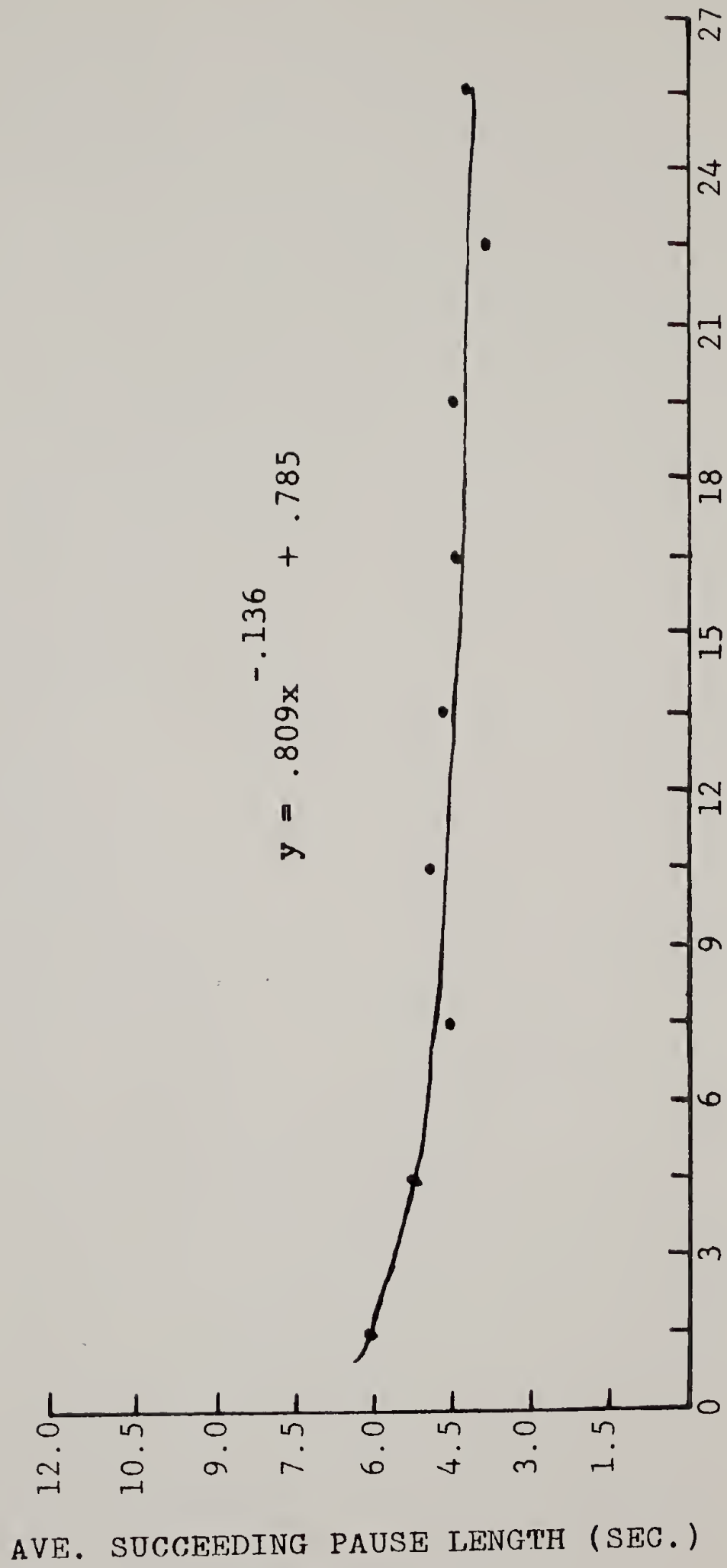


Fig. 11.



Fig. 12. Average length of a look at the TV as a function of preceding pause length. The solid line represents the best-fitting curve for the data.

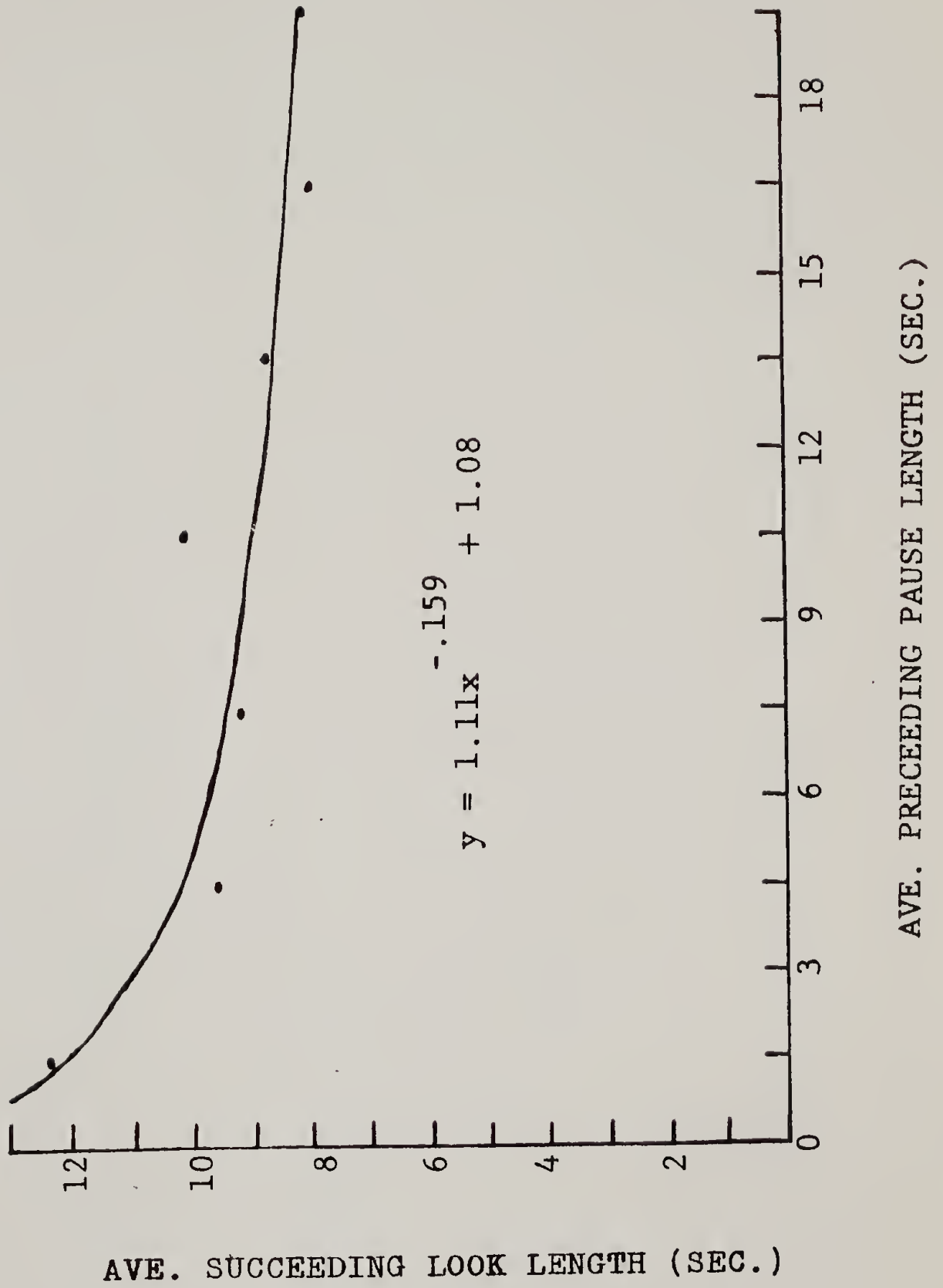


Fig. 12.

The equations for these four curves are, respectively:  
 $y = .866x^{.240} + .909$ ,  $\underline{r}^2 = .947$ ;  $y = .543x^{.329} + .601$ ,  
 $\underline{r}^2 = .966$ ;  $y = .809x^{-.136} + .785$ ,  $\underline{r}^2 = .878$ ; and  $y = 1.11$   
 $x^{-.159} + 1.08$ ,  $\underline{r}^2 = .845$ . As look length increased, suc-  
 ceeding look length also increased (see Figure 9), while  
 succeeding pause length decreased slightly (see Figure 11).  
 As pause length increased, succeeding pause length also  
 increased (see Figure 10), while succeeding look length  
 decreased (see Figure 12). Note that all four functions  
 are curvilinear, as determined by comparing the results  
 of separate linear regression analyses on the untransformed  
 and log-transformed data. This curvilinearity could have  
 depressed the correlations shown in Table 3, so that higher  
 correlations would be expected if log-transformed data had  
 been used to calculate the correlations.

The relationship between adjacent looks and pauses  
 in TV viewing was investigated in an earlier study using  
 a different analysis (Anderson, Note 9). In preliminary  
 analyses of the visual attention data of sixty 3-, 4-, and  
 5-year-old children who individually watched nearly three  
 hours of heterogeneous children's programs, Levin (Note 3)  
 categorized looks and pauses as short (three seconds or  
 shorter) or long (longer than three seconds) and then cal-  
 culated the conditional probability of a short look following  
 a short look, a long look following a short look, a short  
 pause following a short look, etc. The results were consist-

ent with the above predictions and with the obtained results. For example, given that a short look had just occurred, the probability that the next look was a short look was greater than the probability that the next look was a long look. This result is consistent with the prediction of a positive correlation between the length of adjacent looks.

### Bit Boundary Analyses

The second major attempt to gain additional evidence that the attentional inertia phenomenon is real was to look for inertial effects across episodes. Recall that an inertial effect across episodes, produced by a possible carry-over effect of attentional arousal, is predicted by the episode-free and combination theories of attentional inertia but not by the episode-bound inertia theory. By testing for inertial effects across episodes, therefore, one can begin to determine the relative merits of the four proposed theories of attentional inertia. Lack of evidence for an inertial effect across episodes would suggest that either attentional inertia does not exist or that it is strictly episode-bound. The finding of an inertial effect across episodes would contribute additional evidence that episode-free attentional inertia does exist and eliminate the episode-bound theory, but fail to differentiate between the episode-free and combination theories of inertia.

Three separate although nonindependent analyses were performed in the present study to test the prediction of an inertial effect across episodes. Before attempting any of these analyses, an operational definition of "episode" was required. Sesame Street programs consist of a magazine format in which short, unrelated segments or bits of action are strung together. For example, a scene with the muppets Bert and Ernie might be followed by a short segment about the letter "H", which is in turn followed by a film clip showing giraffes. Each such segment is called a "bit". The most objective division of the Sesame Street programs into "episodes" would be to consider each bit an episode. Because each program shown was rated for bit changes, a record of the time when each bit began and ended was available for each program. Bit changes can be considered legitimate episode boundaries due to the clear conceptual, visual, auditory, and thematic changes that accompany them.

Bit-to-bit correlation using overall-percent-attention data.

One analysis used to test for an inertial effect from episode to episode involved correlating the average percent attention to each Sesame Street bit with the average percent attention to the bit immediately following it. If episode-free inertia is functioning, a positive correlation between attention to adjacent bits is predicted. If attention to a given bit is high, this high attention level should be carried



over to the following bit. Similarly, low attention to a given bit should be followed by low attention to the subsequent bit, since little attentional arousal has been build up, providing little arousal to be carried over into the next bit.

The bit-to-bit correlation over all 15 Sesame Street tapes was .295 (df = 600). As predicted, this correlation was significant and positive, although low.

This result parallels those found in two earlier studies. In preliminary analyses of the attention data of 72 children from 12 to 48 months of age, Anderson and Levin (1976) found a low but positive correlation between the average percent attention to adjacent bits. Bernstein (Note 10) found moderate positive correlations between the attention scores of adjacent bits for 30 children four to six years of age (r = .60, df = 29), and for 35 five-year-olds (r = .55, df = 29). The significant, positive bit-to-bit correlation using the present data pool, which was much larger than the other three mentioned (300 subjects versus 72, 30, and 35, respectively) adds support to these two earlier sources of evidence for an inertial effect of visual attention across bits.

Differential effects of bit boundary on the probability of look termination. A second technique used for investigating the presence of an inertial carry-over effect from

bit to bit involved calculating the probability of a look terminating at a bit boundary as a function of the length of the look before the bit boundary. Past results have shown that the change from one bit to the next terminates a look that is in progress and initiates a look if one is not looking at the TV (Alwitt, Anderson, Lorch, & Levin, in press). These effects were replicated in the present study. Given that a child was looking at the TV, the probability of a look ending within three seconds after a bit boundary occurred was found to be .264, while the probability of a look ending at any other time (the control probability) was found to be .202. This difference of .062 in the probabilities was statistically significant,  $t(297) = 10.117$ . Similarly, given that a child was not looking at the TV, the probability of a look beginning within three seconds after a bit boundary occurred was found to be .553, while the control probability was .410, again a significant difference,  $t(297) = 14.103$ .

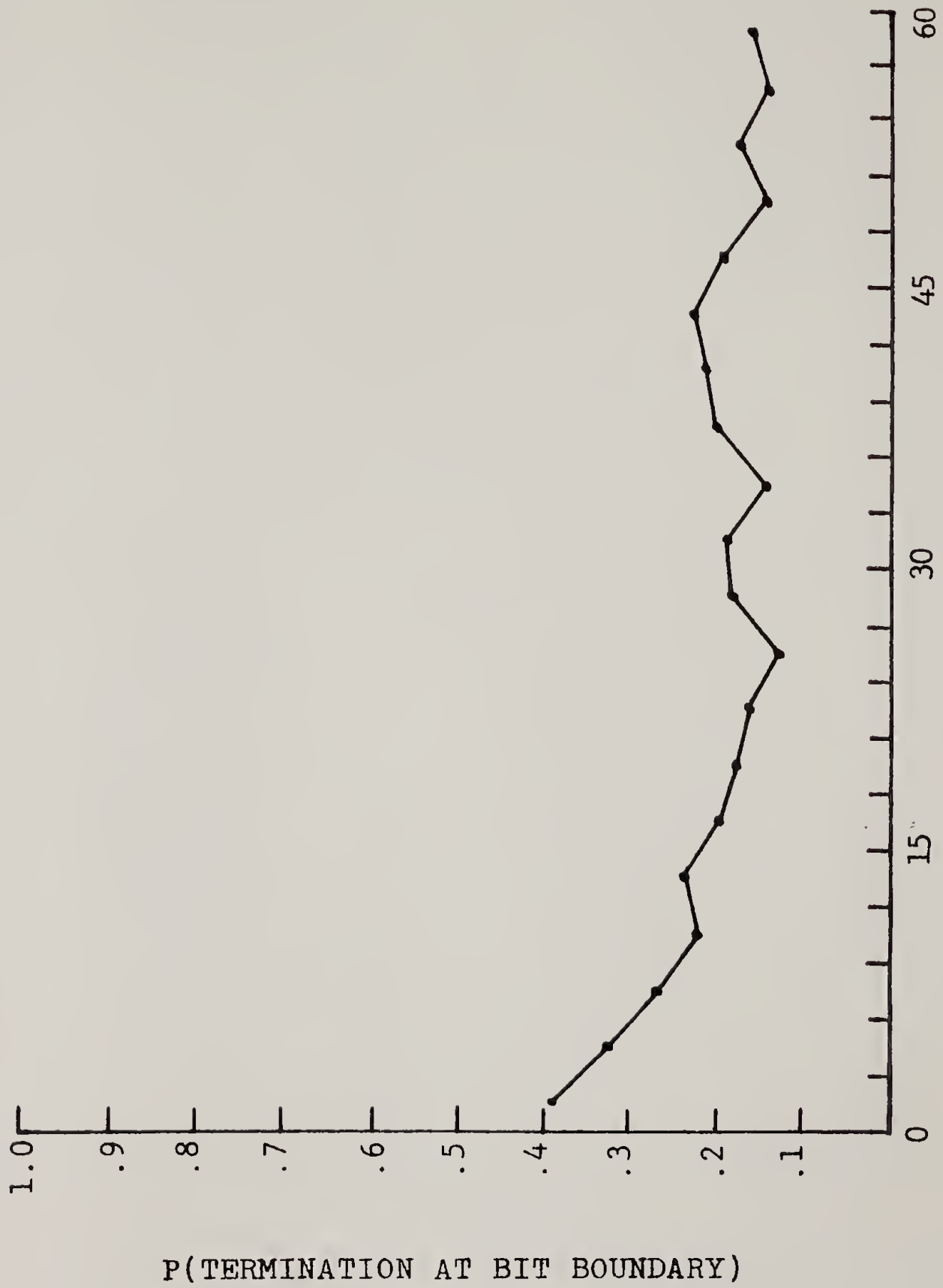
Determining whether these strong bit-boundary effects differed for long and short before-bit-boundary look lengths provided a second technique to test for an inertial effect from episode to episode and, consequently, to evaluate the relative merits of the episode-bound, episode-free, and combination theories of attentional inertia. The episode-free inertia theory predicts that the probability of termination at the bit boundary will be less for long before-bit-boundary

look lengths, because a long look is hypothesized to have a high level of arousal associated with it and will therefore tend to continue on into the next bit for awhile despite the strong tendency for bit boundaries to terminate looks. This same prediction follows from the combination inertia theory, since it includes the mechanism of episode-free inertia as well as that of episode-bound inertia. The episode-bound inertia theory predicts that the probability of termination will remain constant as look length before the bit boundary increases, because all arousal produced by cognitive involvement, regardless of its intensity, terminates at the end of a bit or episode. No carry-over from bit to bit is predicted; rather, a high probability of look termination at the bit boundary regardless of the length of the look before the bit boundary is predicted.

As can be seen in Figure 13, a decreasing function was obtained; as before-bit-boundary look length increased, the probability of a look termination within three seconds after a bit boundary decreased despite the strong tendency for bit boundaries to terminate looks that are in progress. A chi square test revealed that the obtained termination frequencies differed significantly from the frequencies expected if the probability of termination remained constant across before-bit-boundary look length ( $\chi^2(20) = 222.999$ ).

This same analysis was done using the slide attention data and the boundaries between slides to see if a differen-

Fig. 13. Probability of a look at the TV terminating at a bit boundary as a function of the length of the look before the bit boundary.



AVE. LOOK LENGTH BEFORE BIT BOUNDARY (SEC.)

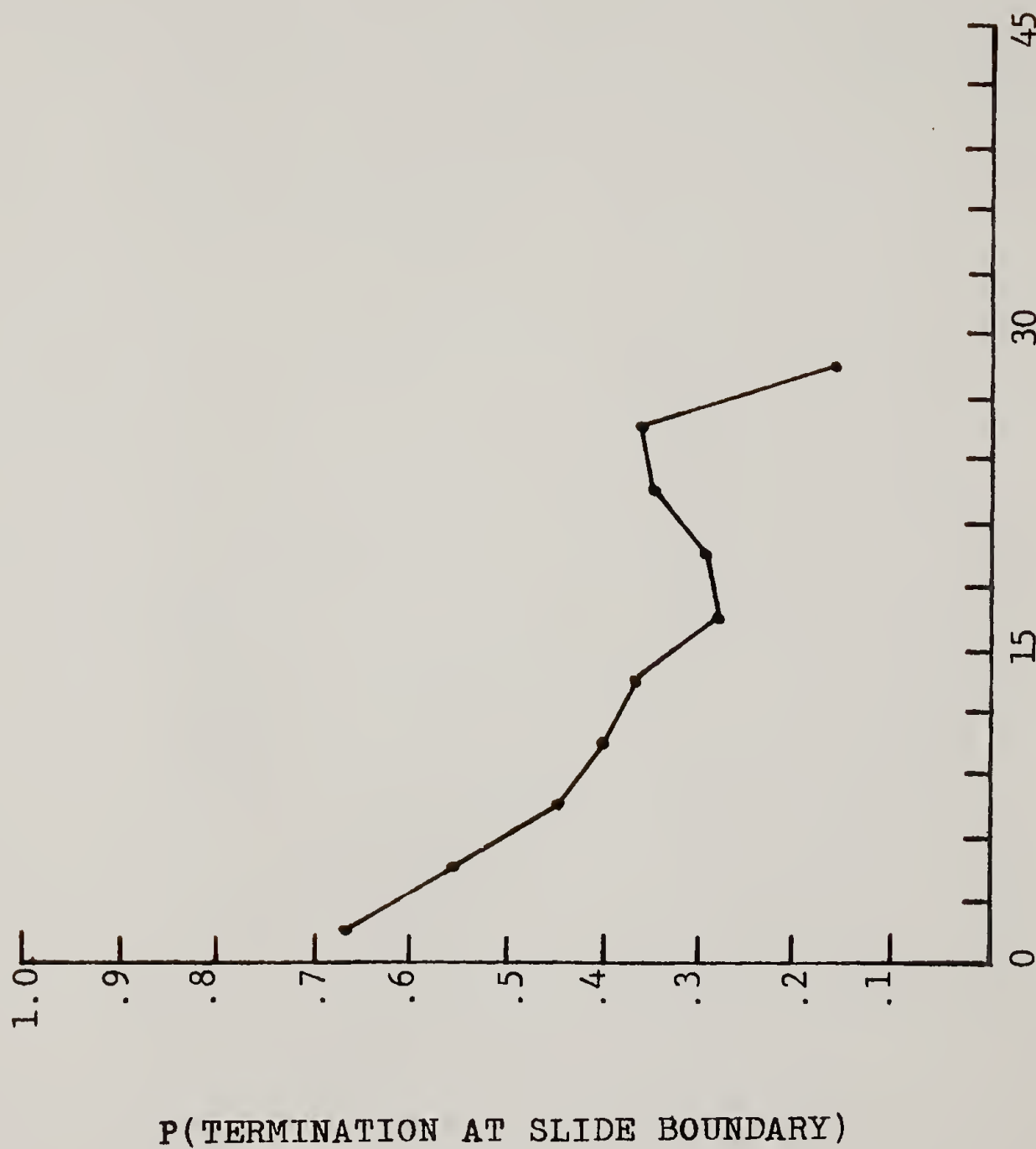
Fig. 13.



tial carry-over effect between long and short before-episode-boundary look lengths could be detected when less meaningful material, which provided less opportunity for cognitive involvement, was viewed.<sup>6</sup> A carry-over effect was predicted if episode-free inertia does exist. Consistent results were obtained. As before-slide-boundary look length increased, the probability of a look termination within three seconds after a slide boundary decreased despite the tendency for slide boundaries to terminate looks that are in progress (see Figure 14). A chi square test revealed that the obtained termination frequencies differed significantly from the frequencies expected if the probability of termination remained constant across before-slide-boundary look length ( $\chi^2(18) = 199.394$ ).

Similarly, the analysis was carried out using all instances of pauses in attention both to the TV and slides to see if pauses in attention followed the same inertial pattern, with long pauses prior to bit boundaries having a lower probability of terminating at the boundary than short pauses despite the strong tendency for bit boundaries to initiate looks when none are in progress. Again, consistent results were obtained. As before-bit-boundary pause length increased, the probability of a pause termination with three seconds after a bit boundary decreased (see Figure 15). A chi square test revealed that the obtained termina-

Fig. 14. Probability of a look at the slides terminating at a slide boundary as a function of the length of the look before the slide boundary.



AVE. LOOK LENGTH BEFORE SLIDE BOUNDARY (SEC.)

Fig. 14.

Fig. 15. Probability of a pause in attention both to the TV and slides terminating at a bit boundary as a function of the length of the pause before the bit boundary.

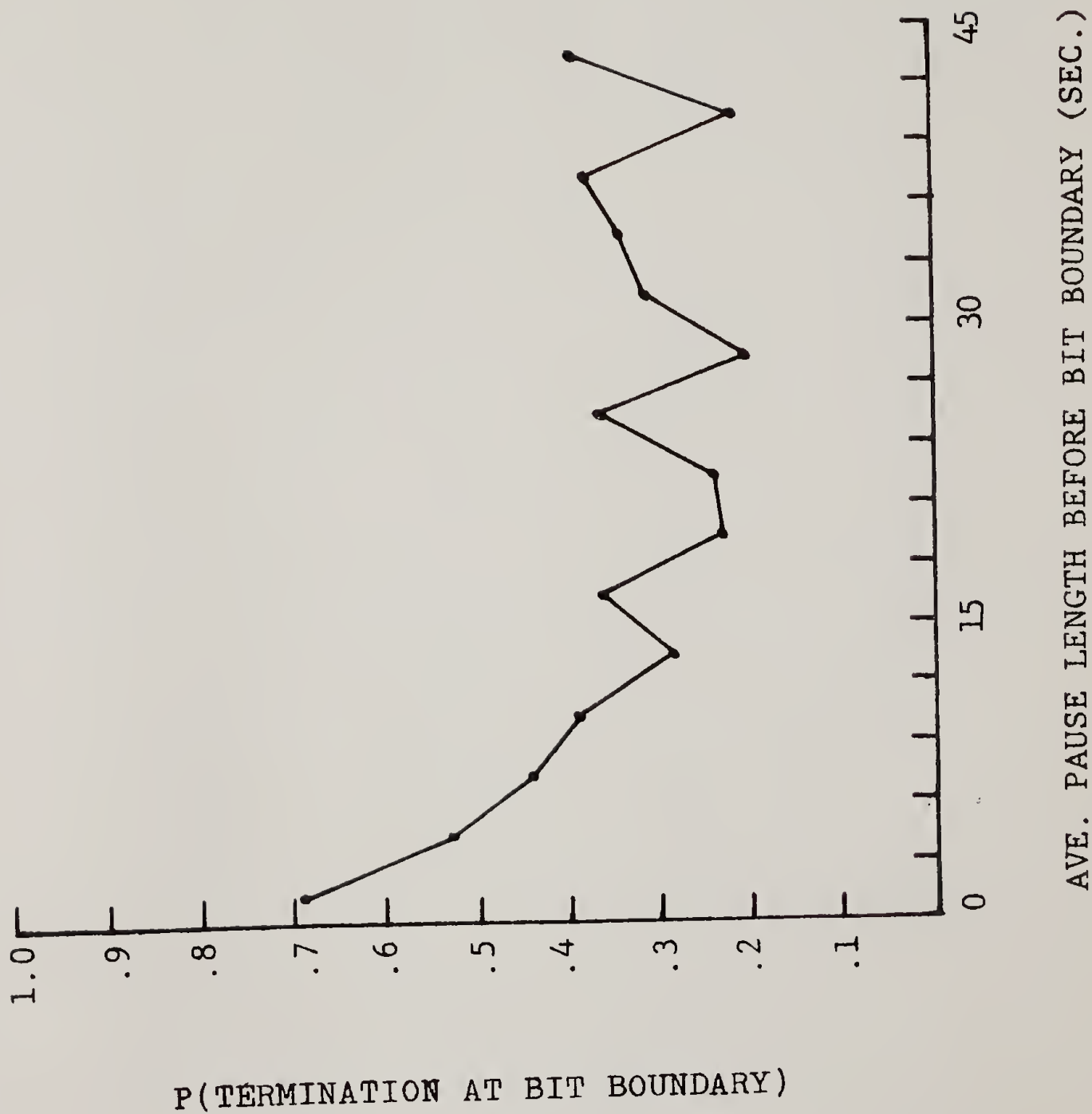


Fig. 15.



tion frequencies differed significantly from the frequencies expected if the probability of termination remained constant across before-bit-boundary pause length ( $\chi^2(24) = 148.495$ ).

To summarize, these differential effects of bit and slide boundaries on the probabilities of termination of looks and pauses as a function of look or pause length before the bit or slide boundary, using TV attention data, slide attention data, and pause data, all provide consistent additional evidence for the existence of episode-free inertia. These findings are consistent with the prediction, following from the episode-free and combination inertia theories, of a decreasing probability of look and pause termination at the bit or slide boundary as look or pause length before the bit or slide boundary increases. These findings are inconsistent, however, with the prediction, following the episode-bound inertia theory, of a high, constant probability of look and pause termination at the bit or slide boundary regardless of the look or pause length before the bit or slide boundary. Note that these results do not eliminate the possibility of the coexistence of episode-bound inertia with episode-free inertia; they simply provide additional evidence that the episode-bound theory is incorrect.

Bit-to-bit correlations using individual looks and pauses. Consistent results were obtained in the following three correlational analyses related to these probability-of-

look termination analyses. First, for all looks that crossed a bit boundary, the length of the look before reaching the boundary was correlated with the length of the same look after the bit boundary. If episode-free inertia does function in visual attention, then a look that has lasted a long time before the bit boundary should continue for a longer time after the bit boundary than a "short" before-bit-boundary look, because the longer "before" look should have more attentional arousal available for transfer to the next bit as it continues. Thus, prediction of a significantly positive before-after-bit-boundary correlation follows from the episode-free and combination inertia theories, both of which allow for carry-over effects across episodes due to the existence of episode-free inertia. No relationship between the length of a look before and after a bit boundary is predicted by the episode-bound inertia theory.

The obtained before-after-bit-boundary correlation was significantly positive, although low, ( $r = .207$ ,  $df = 8538$ ), providing additional support for the existence of episode-free inertia. Using log-transformed data, the correlation increased to  $.239$ . This finding indicates that the relationship between before- and after-bit-boundary look lengths is curvilinear rather than linear, because a curvilinear relationship would produce a depressed correlation when the raw (untransformed) rather than the log-

transformed data are used in calculating the correlation.

This same before-after-bit-boundary correlation was calculated using the slide attention data, with each slide serving as a "bit" or episode and the break between adjacent slides serving as the "bit boundary." As outlined earlier, little episode-bound inertia was expected to be functioning when the slides were viewed, because they provided little opportunity for much cognitive involvement. A significant positive correlation using the slide attention data would thus be taken as additional evidence that episode-free inertia does exist. As predicted, a significant, positive correlation between look lengths before and after slide boundaries was found ( $\underline{r} = .239$ ,  $\underline{df} = 8590$ ). This correlation decreased slightly to .238 when log-transformed data were used, suggesting either that this relationship is indeed linear or that the lack of long looks at the slides prevented any potential curvilinearity from being revealed.

Finally, this before-after-bit-boundary correlation was calculated using all instances of pauses in attention both to the TV and slides that crossed a bit boundary. This analysis determined whether these pauses in attention followed this same inertial pattern, with the pause lengths before and after the bit boundary being positively correlated. Again, a significant, positive correlation was found ( $\underline{r} = .295$ ,  $\underline{df} = 2643$ ). This correlation increased to .367

with the use of log-transformed data, again indicating a curvilinear relationship.

These correlational results lead to the same conclusions regarding the relative merits of the three theories of attentional inertia as do the probability-of-look-termination results. Any evidence for inertial effects across episodes weakens the plausibility of the episode-bound theory of attentional inertia. The consistently positive before-after-bit-boundary correlations using TV attention data, slide attention data, and pause data thus provided additional evidence that the episode-bound inertia theory is incorrect. Because the episode-free and combination theories both predict carry-over effects across episodes, these positive correlations are consistent with both of these theories and provide additional support for the existence of episode-free inertia.

Differential effects of bit boundary on average time of look termination. Analogous to the probability-of-look-termination analysis, the average time to terminate after a bit boundary (rather than the probability of termination within three seconds after a boundary) as a function of length of look before the bit boundary was calculated. Both the episode-free and combination inertia theories predict that long looks will take longer to terminate after the bit boundary than short looks, whereas the episode-bound



theory predicts that all looks, regardless of length, will terminate soon after the bit boundary. This same analysis was carried out using the slide attention data and the pause data.

Note that this third analysis is an alternative demonstration of the same relationship revealed by the before-after-bit-boundary correlational analysis. Because significantly positive correlations were found, an increasing function was expected with this analysis, with the average termination time after the bit boundary increasing as the look length before the bit boundary increased.

The findings from this analysis were as predicted, using the TV attention data, slide attention data, and pause data (see Figures 16, 17, and 18, respectively). The solid lines in the three figures represent the best-fitting curves for the data, and the individual points represent actual data points. The equations for the three curves are, respectively:  $y = 1.23x^{.215} + 1.27$ ,  $r^2 = .885$ ;  $y = .429x^{.328} + .486$ ,  $r^2 = 1.00$ ; and  $y = .561x^{.436} + .638$ ,  $r = .999$ .

The three figures demonstrate that the longer the look or pause before the bit or slide boundary, the longer the look or pause continued after the boundary. Moreover, these three functions tended to be curvilinear rather than linear, as determined by comparing the results of separate linear regression analyses on the untransformed and log-transformed



Fig. 16. Average time for a look at the TV to terminate after a bit boundary as a function of the length of the look before the bit boundary. The solid line represents the best-fitting curve for the data.

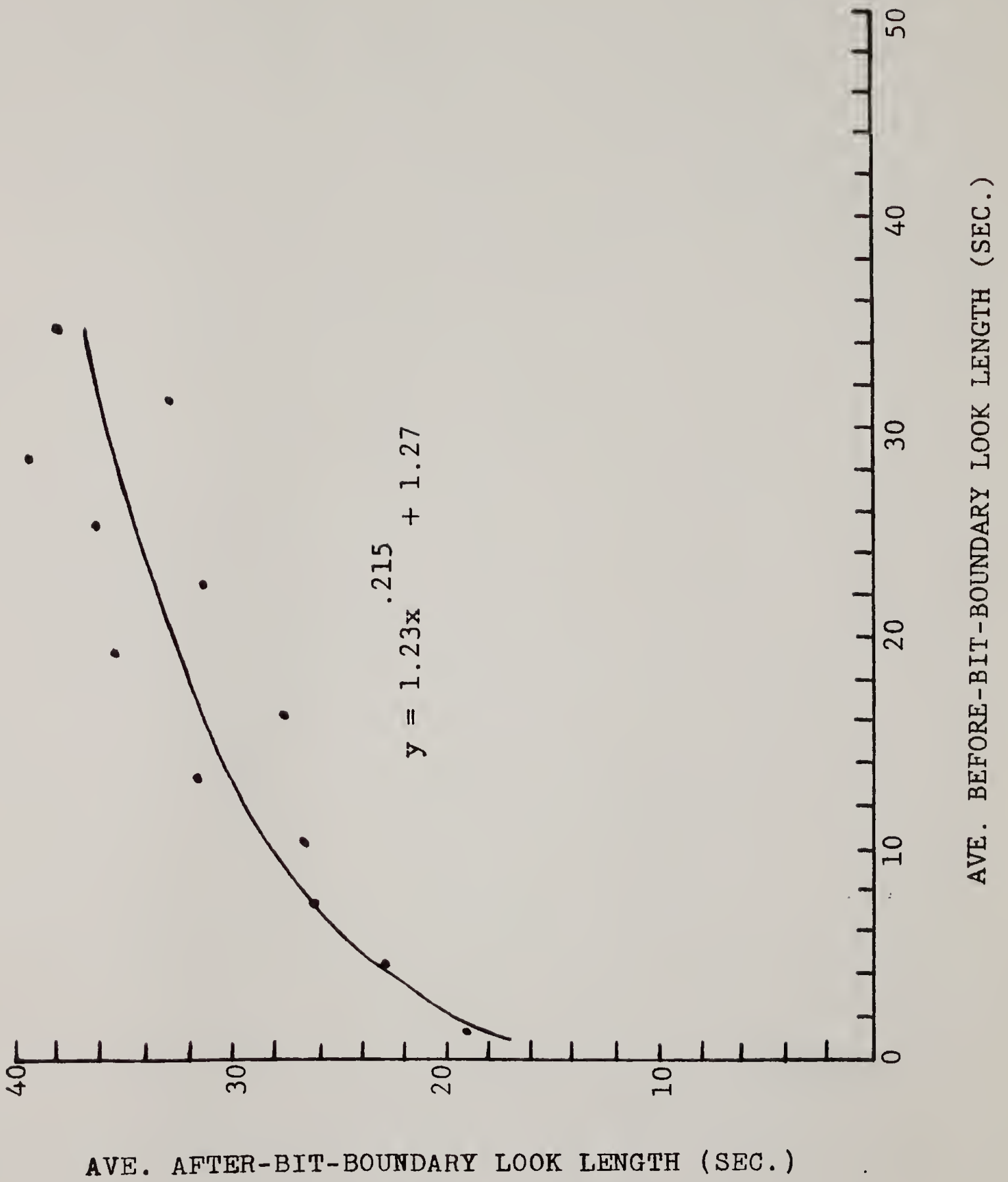


Fig. 16.

Fig. 17. Average time for a look at the slides to terminate after a slide boundary as a function of the length of the look before the slide boundary. The solid line represents the best-fitting curve for the data.

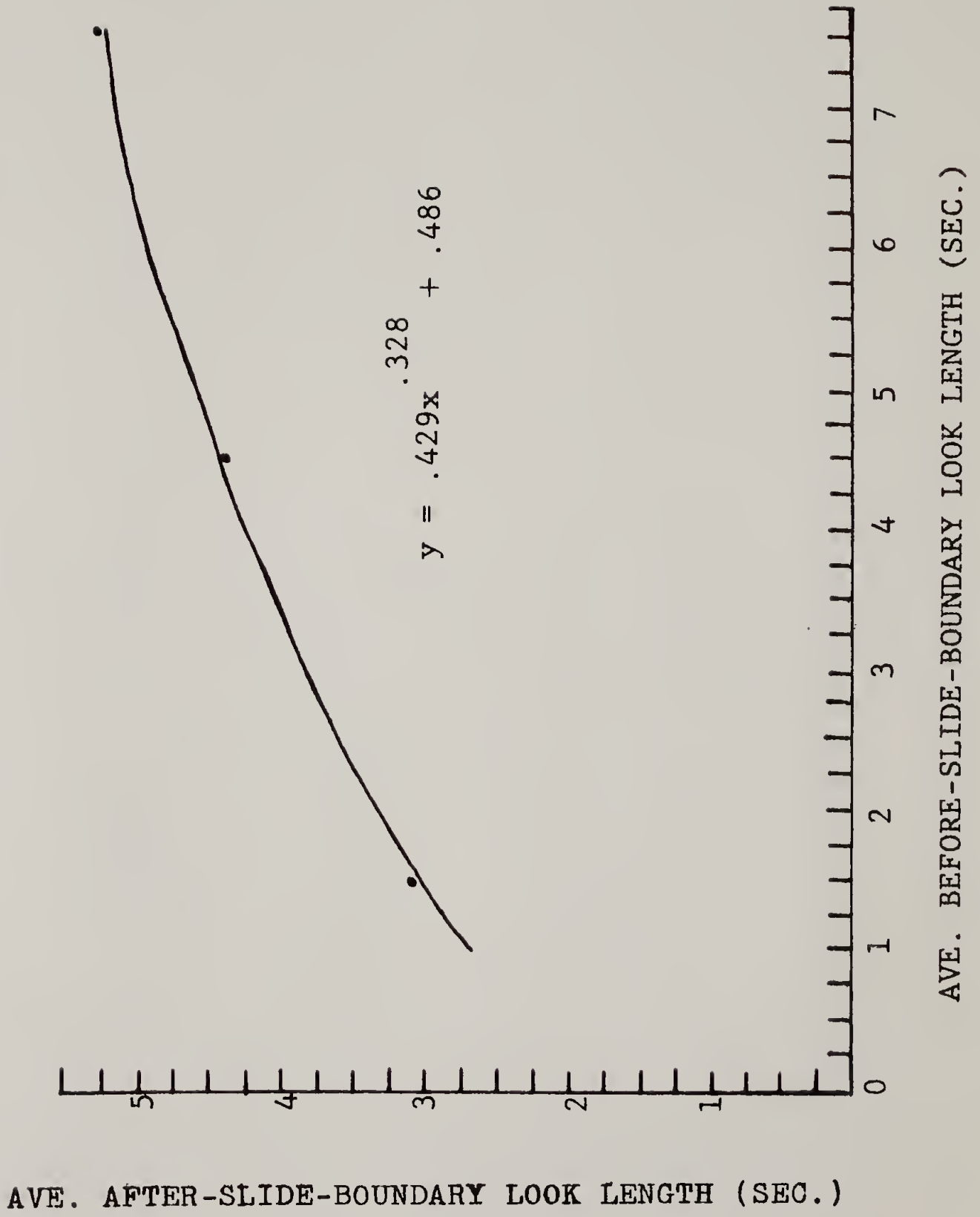


Fig. 17.

Fig. 18. Average time for a pause in attention both to the TV and slides to terminate after a bit boundary as a function of the length of the pause before the bit boundary. The solid line represents the best-fitting curve for the data.



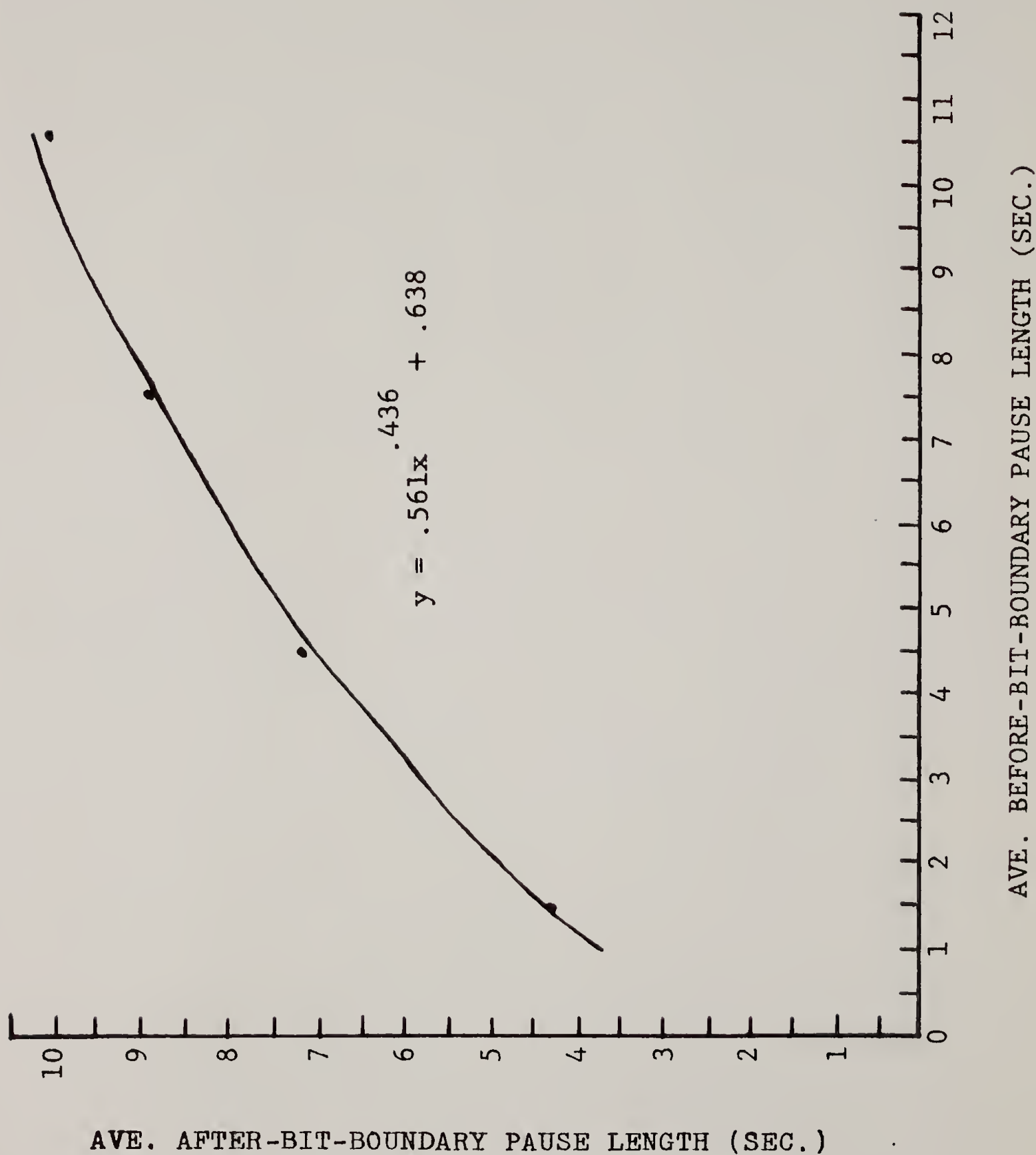


Fig. 18.

data. This curvilinearity is consistent with the increase in before-after-bit-boundary correlations when log-transformed look and pause data were used in the calculations.

## C H A P T E R I V

### GENERAL DISCUSSION

#### Summary of Results

Two objectives guided the present study: 1) to determine whether attentional inertia in TV viewing is artifactual, and 2) to determine the nature of the inertia phenomenon, if the evidence gathered suggested that it is not artifactual. With regard to the first objective, a sufficient body of evidence was accumulated to justify the conclusion that attentional inertia does exist. Increasing conditional probability curves were obtained with all three types of attention data used: attention to TV, attention to slides, and pauses in attention both to TV and slides. The large amount of data available to generate these curves compared to the smaller data pools employed to generate earlier conditional probability curves strengthens the significance of this initial approach to demonstrating the existence of attentional inertia.

A second approach, seeking inertial effects between looks and between pauses without reference to episode boundaries, consistently revealed inertial tendencies. Significantly positive correlations were obtained between the lengths of adjacent looks and between the lengths of adjacent pauses, while significantly negative correlations were

obtained between the lengths of a given look and its succeeding pause and between the lengths of a given pause and its succeeding look. Graphically, an increasing curve was obtained when average look length was plotted as a function of average preceding look length, while a decreasing curve resulted when average look length was plotted as a function of average preceding pause length. Similarly, an increasing curve was obtained when average pause length was plotted as a function of average preceding pause length, while a decreasing curve resulted when average pause length was plotted as a function of average preceding look length.

Finally, a third approach to demonstrating the existence of attentional inertia, seeking evidence for inertial effects across episode (specifically, bit or slide) boundaries, also consistently revealed inertial tendencies in four ways. First, a significantly positive correlation was found between the overall-percent-attention scores for adjacent Sesame Street bits. Second, a decreasing curve was obtained when the probability of a look (or pause) termination at a bit (or slide) boundary was plotted as a function of look (or pause) length before the bit (or slide) boundary. Third, significantly positive correlations were consistently obtained between look (or pause) lengths before and after bit (or slide) boundaries. Fourth, an increasing curve was obtained when the average look (or pause) length after the bit (or slide) boundary was plotted as a function of

the average look (or pause) length before the bit (or slide) boundary.

Considered separately, these three sources of evidence for the existence of attentional inertia in TV viewing are suggestive but not completely convincing. Taken together, they provide a stronger argument for the existence of attentional inertia. Although somewhat overlapping, these analyses did succeed in producing consistent results suggesting the presence of attentional inertia despite their differences in approach.

With regard to the second objective, determining the nature of attentional inertia in TV viewing, the evidence gathered was sufficient to eliminate the episode-bound theory of attentional inertia proposed in Chapter I, but was insufficient to differentiate between the episode-free and combination theories of attentional inertia outlined in Chapter I. The consistent carry-over effects across bit and slide boundaries demonstrated that attentional inertia is not strictly episode-bound. All the results revealed inertial effects in TV viewing that were episode-free in nature. However, no results were obtained that eliminated the possibility that both episode-bound and episode-free inertia may be functioning simultaneously in attention to TV. The lack of evidence in the present study for the existence of episode-bound inertia does not necessarily mean that it is nonexistent. Perhaps the effects of episode-free inertia



were so strong that they masked any episode-bound inertia that may have been functioning. For example, recall that despite the strong tendency for bit boundaries to terminate looks and pauses (a fact which itself could possibly qualify as some evidence that episode-bound inertia exists), inertial effects across bit boundaries (that is, episode-free inertial effects) were still obtained. Future research which controls for episode-free inertial effects may be successful in revealing attentional inertia that is episode-bound in nature.

Two additional findings were obtained in the present study. First, no age effects were revealed in any analyses across the two age groups used (three- and five-year-olds). Statistically significant results in favor of the existence of attentional inertia were consistently obtained when the attention data of each age group were analyzed separately as well as when combined. The possibility remains that age effects in attentional inertia may exist across other age groups. Future research employing attention data from older children and from adults is needed before any clear statement can be made about age effects in attentional inertia.

Second, the results of the present study consistently revealed curvilinear functions, leading to the conclusion that inertial effects in TV viewing do not continue indefinitely, but eventually reach and maintain a plateau at some point during the viewing session. Based on all the evidence



gathered thus far, this plateau is reached after approximately 12-15 seconds of continuous viewing (or nonviewing). It seems reasonable for such a leveling-off to occur, and even for an eventual drop in inertial effects to occur, or viewers would be eternally held prisoner by their TV sets once attentional inertia set in. Some evidence for a drop in inertial effects after more than about two minutes of continuous viewing (or nonviewing) was obtained by extending the various functions plotted in the present study to include looks as long as two minutes. For example, an extension of the conditional probability curves in Figure 7 is presented in Figure 19. However, this evidence for an eventual decline in attentional inertia is questionable due to the extremely small number of such long looks (and pauses) available for analysis.

#### Significance of Attentional Inertia to Television Viewing

Now that the existence of attentional inertia has been confirmed and its nature specified to some degree, consideration should be given to the contribution that the concept of attentional inertia makes to the understanding of TV viewing. In the present study, the proportion of variance in attention to the TV or to the slides accounted for by attentional inertia ranged from .2% (the correlation between the length of a given pause and the length of its succeeding

Fig. 19. Extension of the conditional probability curves in Figure 7.

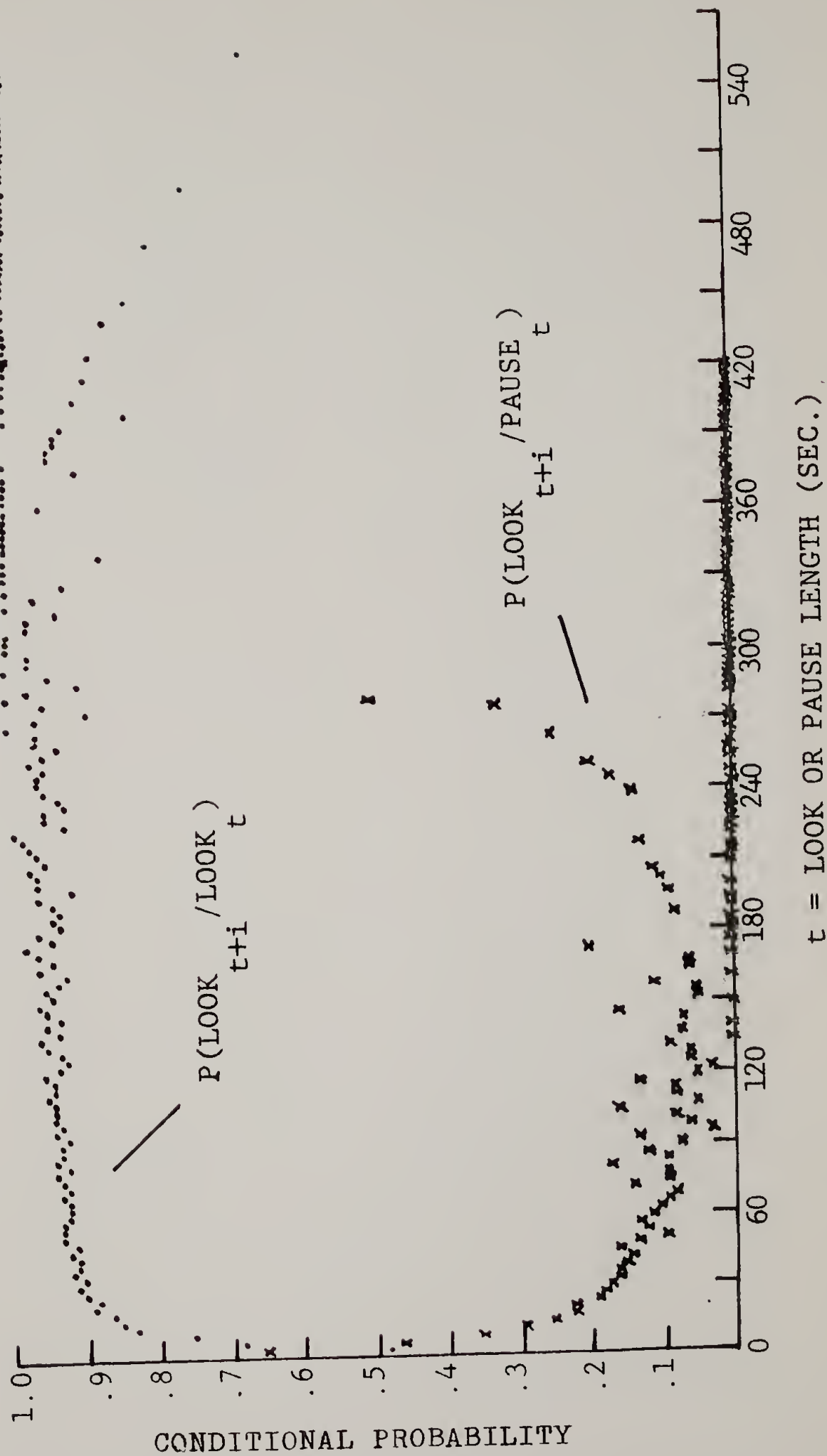


Fig. 19.

look) to 13% (the correlation between before- and after-bit-boundary pause lengths using log-transformed data).<sup>7</sup> Attentional inertia thus seems to contribute little to the understanding of attention to TV.

However, the findings by Bernstein (Note 10) reported earlier suggest that attentional inertia plays a large role in preschoolers' attention to TV. Recall that Bernstein found correlations of .55 and .60 between the attention scores of adjacent Sesame Street bits, accounting for 31% and 36% of the variability in children's attention, respectively. Furthermore, in one of his experimental conditions (five-year-olds viewing individually with access to toys), using multiple regression analyses, Bernstein identified four attributes of Sesame Street programs (position of bit within program, sex of character on screen, kind of music, storyline) that were meaningful predictors of children's attention, accounting for a total of 62% of the variance in attention. (A "meaningful predictor" was defined as any attribute that explained at least 10% of the variance in viewer attention.) When the attribute, attention score of previous bit, was forced into the regression equation first, it became the only meaningful predictor of children's attention, accounting for 31% of the variance. Similarly, Bernstein identified three meaningful predictors of attention (puns, storyline, principal speaker) in a second condition (four- to six-year-olds viewing individually in the

presence of a slide distractor), which accounted for a total of 81% of the variance in attention. When the attention-score-ofprevious-bit attribute was forced into the regression equation first, it became a meaningful predictor of attention (explaining 36% of the variance), and two attributes (puns, storyline) continued to be meaningful predictors, accounting for a total of 79% of the variance in attention in this viewing condition.

Apparently, attentional inertia, as reflected by the attribute, attention score of previous bit, can be a powerful predictor of variation in viewer attention in some viewing situations. However, it should be noted that when Bernstein forced this same attribute, attention score of previous bit, into the regression equations in two remaining experimental conditions (four- to six-year-olds viewing in groups, and five-year-olds viewing individually with no access to toys), it accounted for only 1% and 7% of the variance in viewer attention, respectively, failing to become a meaningful predictor of attention in both of these viewing situations.

Because the contribution that attentional inertia makes to the understanding of TV viewing seems to depend upon the particular viewing situation involved, it would be helpful to be able to identify those situations in which attentional inertia does play a meaningful role in explaining viewer attention. Due to the many procedural differences



across Bernstein's and the present study, and even across Bernstein's four experimental conditions, any attempt to specify the particular type of viewing situation in which attentional inertia is a useful concept in explaining TV viewing is risky and speculative. Keeping this caution in mind, one can begin to look for some pattern in the situational variables that successfully distinguishes the situations in which attentional inertia effects accounted for a large proportion of the variance in viewer attention from those situations in which attentional inertia effects accounted for little of the variance. Based on Bernstein's results, two variables appear to be important: the presence or absence of peer interaction, and the presence or absence of a distractor. First, consider the peer interaction variable. In both of Bernstein's conditions in which the attention-score-of-previous-bit attribute proved to be a meaningful predictor of viewer attention, the children viewed individually, without the presence of peers. In a third condition, in which the attention-score-of-previous-bit attribute failed to become a meaningful predictor of attention, the children viewed in groups of three or four. So far, one can conclude that attentional inertia effects play a meaningful role in explaining viewer attention only when the viewer watches TV individually, without interacting with peers.

However, in the last viewing condition, in which the attention-score-of-previous-bit attribute failed to become



a meaningful predictor, the children did watch TV individually. The second variable, presence or absence of a distractor, must be called upon to resolve this discrepancy. In this last condition, no distraction from the TV was provided, while distractors were provided (in the form of toys or slides) in the two conditions in which the attention-score-of-previous-bit attribute was a meaningful predictor. Therefore, it seems that attentional inertia effects play a meaningful role in explaining viewer attention only in those situations in which the viewer does not interact with any peers but does have access to some distractor from the TV. Both of these conditions must be present if attentional inertia is to play a meaningful role in understanding viewer attention.

Now that a set of viewing conditions has been specified within which the concept of attentional inertia is useful in explaining viewer attention, one can test the validity of this generalization by examining its success in predicting the low proportions of variance in viewer attention accounted for by attentional inertia effects in the present study. With regard to the variable, presence or absence of a distractor to the TV, a distinct distractor was provided in the present study by the slides. So far, the viewing situation seems to have been favorable for attentional inertia effects to play a significant role in explaining viewer attention. With regard to the other variable, presence

or absence of peer interaction, first recall that three viewing group sizes (one, two, or three children per group) were employed in the present study. Only 30% of the children viewed in the absence of peers. Consequently, in the majority (70%) of the viewing situations employed in the present study, peer interactions did occur.<sup>8</sup> The generalization stated earlier specified peer interaction during viewing as a viewing condition in which attentional inertia effects do not play a significant role in explaining viewer attention. Therefore, high proportions of variance in viewer attention should not be expected to be accounted for by attentional inertia effects in the present study. The actual results of the present study conform to this expectation. The generalization thus seems to be valid, at least when applied to Bernstein's and the present study.

One method of further testing the validity of this generalization would be to separate the data pool used in the present study into two groups, the attention data from those children who watched alone, and the attention data from those children who watched with one or two peers, and to redo the analyses using these two new data pools. If the generalization is correct, the proportions of variance accounted for by attentional inertia effects should increase when the single-viewer data pool is used and decrease when the multiple-viewer data are used, compared to those proportions obtained in the present study.

Before concluding, some attempt should be made to make sense out of this generalization. One may question why the presence of a distractor from the TV and the absence of peer interaction during viewing are both crucial for attentional inertia to play a significant role in TV viewing. A distractor may be necessary simply to keep the lengths of the looks at the TV within the range in which inertial effects manifest themselves. Recall that inertial effects seem to reach a plateau after about 15 seconds of continuous viewing (or nonviewing), based on the various results of the present study. Lorch, Anderson, and Levin (1979) showed individual five-year-olds two Sesame Street programs with and without toys present. Overall attention to the TV decreased from 87.1% to 44.5% when toys were available as a distractor, due to a decrease in look lengths as well as to decreased looking frequency. The presence of a distractor such as toys provides more opportunity for inertial effects to manifest themselves, due to the greater number of short looks generated.

The requirement of the absence of peer interaction during TV viewing for attentional inertia to play a significant role in TV viewing is more difficult to explain, especially since the presence of peers seems to function as a distraction from the TV just as toys or slides do. Employing the same data pool used in the present study, Anderson et al. (Note 7) found that attention to TV decreased

when peers were present. This requirement of the absence of peer interactions for attentional inertia to play a meaningful role in explaining viewing behavior thus seems to contradict the other requirement specified, the presence of a distractor.

This apparent contradiction could be resolved if a distinction could be made between this particular environmental distraction, the presence of peers, and all other distractors, such as toys and slides. One such distinction is that introducing a peer into the viewing environment adds not only a distractor to the viewing situation, but also another viewer. In an attempt to explain the potential importance of this distinction, first recall that attentional inertia is considered to be a characteristic of the viewer as opposed to a characteristic of that which is viewed or of the viewing environment. In other words, the behavior of the viewer (looking patterns, cognitive involvement, etc.) is deemed responsible for any inertial effects manifested. Second, Anderson et al. (Note 7) have shown, again using the same data used in the present study, that:

[p]eers viewing TV together influenced each other's behaviors in a time-locked fashion: when one child looked at the TV, looked away from the TV, ...or looked at the distractor, the other child tended to do the same thing. ...[T]his peer influence occurred above and beyond the common influence of the TV program itself. (Abstract)

One could therefore argue that interactions with a



peer represent interactions with another "inertial system," producing interference in both systems and, consequently, reducing the ability of the systems to play a significant role in explaining viewing behavior. Toys and slides do not possess inertial systems of their own and therefore do not interfere with the functioning of the viewer's inertial system. On the contrary, they facilitate the functioning of the system by providing the viewer with alternative activities besides watching TV so that attentional inertia effects can manifest themselves. Peers, however, are viewers themselves, with their own inertial systems, in addition to being environmental distractors. Introducing inertial systems other than the one possessed by the viewer to the viewing environment may result in such complex interactions among these inertial systems that employing the concept of attentional inertia to predict the viewer's attention to the TV becomes ineffectual.

It should be emphasized that the above attempt to make sense out of the preceding generalization is speculative at best, as is the proposed generalization itself. Much more research is necessary before the nature of attentional inertia can be understood in any detail. At present, one can only say that the concept of attentional inertia does help to explain viewing behavior in some situations, and for this reason does hold some significance with regard to TV viewing.

Significance of Attentional Inertia  
to Nontelevision-viewing Behavior

Although the meaningfulness of the concept of attentional inertia to the particular behavior, TV viewing, is restricted and as yet not understood in any detail, the concept gains new interest when considered in relation to behavior in general. Evidence for inertial tendencies in activities other than TV viewing are found in other areas of research. For example, Julian Hochberg's work on the visual perception of film led him to investigate patterns in "the impetus to obtain sensory information," which he has termed "visual momentum" (Hochberg and Brooks, 1979). This visual momentum appears to function in a similar manner to attentional inertia in TV viewing. With regard to residential movement patterns, McGinnis and his associates have proposed and tested their "axiom of cumulative inertia," which states that: "[t]he longer a person remains in a given location, the lower should be the probability that he will leave it" (Myers, McGinnis, and Masnick, 1972, p. 122). Atkinson and Cartwright (1964) introduced the inertial-tendency postulate of achievement motivation, which states that "an action tendency, once aroused, will persist until expressed in behavior" (Revelle & Michaels, 1976, p. 396). For highly motivated individuals, this axiom predicts that there is more motivation on a trial following a failure trial than



following a success trial. Revelle and Michaels (1976) have argued that this axiom implies that for positively motivated individuals, motivation should increase as the number of trials since the last success increases.

Inertial tendencies have thus been implicated: 1) in TV viewing by individuals from ages 1 through 23 watching a wide variety of TV content (see Chapters I and III), 2) in the patterns of pauses between looks while watching TV (see Chapters I and III), 3) in visual attention to film, 4) in residential movement patterns, and 5) in achievement motivation. A general trend in behavior is suggested by these observations, in which the longer a person continues a given behavior, the more likely it is that s/he will continue that behavior. Attentional inertia, therefore, may be one manifestation of a basic principle underlying all behavior. Considered from this perspective, any gain in the understanding of the attentional inertia phenomenon in TV viewing potentially makes a significant contribution to the understanding of behavior in general. Further research to acquire a better understanding of the nature of attentional inertia in TV viewing certainly seems justifiable.

## Footnotes

<sup>1</sup>It should be noted that the episode-bound inertia theory does permit the prediction of inertial effects across episodes when adjacent episodes are related to each other in some way (conceptually, visually, auditorily, and/or thematically). In such a case, the viewer may continue to perceive the ongoing action in large units even as a new episode begins, producing an inertial effect across episodes. Related adjacent episodes are common in typical TV programs. In most programs, individual episodes are related to each other to form a unified whole (the plot or storyline). However, the present study employed Sesame Street programs, which utilize a magazine format in which short, unrelated segments or bits of action are simply strung together. Within the limits of the present study, therefore, the episode-bound inertia theory does not permit the prediction of inertial effects across episodes.

<sup>2</sup>A procedural error resulted in one five-year-old viewing a program with two three-year-olds. Because this error was discovered after all the present analyses had been completed, and because no age comparisons are made in this report, this subject's data were not eliminated from the analyses in the present study.

## Footnotes, Continued

<sup>3</sup>Because no age differences were found in any analyses, the results for the separate age groups are not reported.

<sup>4</sup>The TV-involvement data were not used in any analyses due to the relatively low occurrence of such behavior.

<sup>5</sup>This and all other reported results were significant at least to the .001 level.

<sup>6</sup>A chi square test revealed that the slide boundaries, like bit boundaries, had an overall terminating effect on looks. The obtained termination frequencies across before-slide-boundary look length differed significantly from the expected frequencies determined by the conditional probability curve for the slide attention data ( $\chi^2(19) = 73.765$ ).

<sup>7</sup>The possibility exists that not all the variance accounted for by the correlations calculated in the present study can be attributed justifiably to attentional inertia alone. Some of the variance may have been due to within-subject consistencies in looking patterns and to within- as well as between-episode consistencies in interest level.

<sup>8</sup>One could argue that the mere presence of peers in the viewing room does not guarantee that interactions among the peers took place. However, Anderson et al. (Note 7), employing the same data used in the present study, reported that visual attention to the TV diminished in the presence

## Footnotes, Continued

of peers, such that attention decreased as group size increased. This finding suggests that the children did spend time interacting with one another.

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