

menting such programs lies with health departments, physicians, hospitals, safety organizations, and others comprising the community team.

Parental habits and attitudes are often a factor in burns to children. Parents seem to accept burns to their children as a part of the learning process and an inescapable fact of life. They often fail to recognize the need for environmental changes designed to protect the curious and experimenting child. Lack of adult supervision and proper discipline of the child along with the failure of parents to understand and implement educational opportunities about the hazards of burns needs study.

The education of the child as to the nature of the hazards to which he is exposed is important, and parents and teachers vary greatly in the extent to which they attempt this. The physician, and especially the pediatrician, has much to contribute in this area, not only with the child and his parents, but also in the community.

The initial responsibility for informing the child about burn prevention lies with the parents, but the final responsibility in cases of accidental clothing ignition in an unsupervised situation lies with the child to respond in the previously taught manner. Only through the foresight of a parent or

responsible person will this knowledge be imparted to those needing it most.

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AN EXPERIMENTAL METHODOLOGY FOR ANALYSIS OF CHILD PEDESTRIAN BEHAVIOR

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ALL of the considerations which prompt an investigator to use a laboratory rather than a real-life situation in research on behavior apply with full force to the study of accidents. But laboratory research on risk-taking and accident-inducing behavior is beset by several limitations. First, the ethics of laboratory experimentation preclude the introduction of hazards that can produce the more serious injuries all too common in real life. Secondly, it is doubtful whether a laboratory can replicate (or even effectively simulate) the numerous and complexly interacting behavioral and environmental variables involved in even the simplest accident—whether it be a vehicle-pedestrian collision or the ingestion of a household chemical.

This investigation was supported in part by Public Health Service Training Grant No. UI 01001-02 from the National Center for Urban and Industrial Health.

J.N. and G.M. are U.S. Public Health Service Trainees supported by this grant.

As a result, every laboratory study of risk-taking must be subjected to two questions. First, is the subject behaving in the laboratory in much the same way as he behaves in the real world. This question, which is by no means peculiar to accident research, is asked in essentially quantitative terms: Is the subject as spontaneous? Is he more inhibited?

The second question is essentially qualitative: Does the laboratory situation elicit the same kind of behavior that a real-life situation would elicit? Is the subject driving a simulator responding to the stimuli presented by a real automobile on a real highway? Is the laboratory task eliciting all the responses involved in risk-taking or does it require of the subject only an affectless calculation of subjective or objective probability? A review of the laboratory experimentation on risk-taking uncovers few studies indeed that provide defensible answers to these questions.

It is for these reasons that the study of risk-taking behavior in a natural setting is crucially important. Yet the natural site, too, presents problems. Because accidents are infrequently occurring events, studying them in a natural environment is time-consuming, expensive, and often frustrating. To eliminate the possibility of observer effect, the investigator must remain concealed. And the question of ethics does not disappear. If the investigator observes an accident about to occur, does he welcome it because it provides data or does he break out of his role and try to prevent it?

The paper that follows offers interesting solutions to several of the problems posed above. By using cinematography with a concealed camera, the investigators not only eliminated the problem of observer effect but also produced a permanent set of objective data that lent themselves to repeated and detailed analysis. Their choice of time and place maximized economy in data gathering. And their decision to study the "near accident" as well as the injury-producing accident substantially increased the proportion of relevant data.

With respect to the study itself, however, some critical questions remain. Aside from economic considerations, was the site chosen for data-gathering the best possible one? Was the behavior of the subjects influenced by their proximity to the school, or by specific school instruction in street-crossing behavior? Would children in a playground or other non-school setting exhibit more spontaneous behavior?

Moreover, broadening a study to include the "near accident" must be done only after very careful consideration. If this is done on the assumption that the "near accident" is sufficiently similar to the injury-producing accident to be treated in the same way, the investigator may neglect a careful examination of the differences between the two events; in these differences may lie clues as to effective countermeasures.

THE injury of a child by a motor vehicle is the result of a complex combination of circumstances involving elements of his own behavior, the behavior of the driver of the vehicle, and a host of environmental factors. The complexity of this situation probably requires a diversified approach to studying this type of accident. For example, investigations similar to the Vancouver study conducted by Read and co-workers¹ should be conducted in many other regions. Broad epidemiological investigations such as this can provide considerable information about causative factors involved in child pedestrian accidents. More restricted investigations, such as that recently reported by Bartholomew² dealing with child pedestrian accidents in service areas of city

recreation facilities, are also needed to provide more insight into the overall complex. In addition to studies of this sort, however, basic research in the area of child behavior is necessary to identify significant variables related to behavior in the pedestrian accident situation. Although some information of this type is available from epidemiological investigations, virtually no systematic research has been conducted in an effort to better understand the behavior of the child involved in a street-crossing situation.

Prior to attempting to study pedestrian behavior, some basic questions dealing with methodologies studies of this type must be dealt with. The present investigation was undertaken in an attempt to develop a method which could be utilized to system-

atically observe and categorize pedestrian behavior of children. Since it was viewed primarily as a methodological study, no formal hypotheses were developed for testing. Rather, the intent was to determine the feasibility of a system which, *a priori*, appeared to be a useful research tool.

METHODS

Although there was little question that the most effective method for studying children's behavior in a street-crossing situation would involve systematic observation, a variety of techniques are available. Methods involving the study of children's behavior in naturalistic settings by means of direct observation, rarely used in accident research, have proved useful in numerous studies. Procedures, methodological considerations, recording systems, etc., are reviewed in detail by Wright³ and by Heyns and Lippitt.⁴ Since these reviews are comprehensive, no attempt will be made here to discuss in any detail the numerous factors that must be considered in establishing observational techniques.

On the basis of preliminary work during which several systems for recording behavior were used, it was decided to use motion pictures. As Heyns and Lippitt point out,⁴ motion pictures have been used primarily to document observations or to supplement data collected in other ways rather than as sources of data on which observations are made. However, motion pictures may offer a number of advantages when used in this fashion. First, they provide a complete record of the behavior, which one cannot obtain from check lists or other systems commonly used for recording purposes. Their primary advantage, however, is that a more complete and detailed analysis of the behavior is possible than is the case with most systems. Thus, when making observations from a filmed sequence it is possible for the observer to run the film in slow motion, reverse it, or, if the proper equipment is available, conduct a frame-by-frame analysis. Because of the rapidity with which behavior occurs in a natural setting, it is often

impossible to directly observe and record episodes which may be significant. This problem is reduced when the behavior is recorded on film and then analyzed.

General Procedures

After reviewing a number of films made at various locations and involving several age groups of children, it quickly became apparent that it would be necessary to limit the number of variables to be considered. Although many of these were potentially interesting, the scope of the study required limitations. Consequently, the following decisions were made: (1) Kindergarten children would be utilized. Because these children are released from school a few minutes before the other grades, it was possible to concentrate on a relatively small, well-defined group of children of nearly identical ages. (2) In order to limit the variables associated with different physical locations, films were made at one specific intersection, which bordered on the school ground. During school hours a four-way stop situation exists for traffic—permanent signs on the east-west road and school stop signs on the north-south road. Between 20 and 25 kindergarten children, approximately equally divided as to sex, use this intersection on their way home from school. (3) Although both approach behavior and actual street-crossing behavior was filmed, it was decided to use for purposes of analysis only approach behavior and behavior demonstrated at the curb. (4) There were several types of behavior that the observers considered as unsafe to some degree, but only two types were selected for detailed analysis: not stopping at the curb prior to entering the street, and not looking for oncoming traffic. It should be pointed out that selection of these forms of behavior represents an arbitrary decision based on little information as to what may actually constitute unsafe behavior for child pedestrians. As more information becomes available concerning child pedestrian behavior, it may be possible to define dangerous behavior patterns more adequately.

Over a period of several weeks concealed filming was made of the kindergarten children as they approached and crossed the street on their way home at noon. The films were made by a concealed cameraman using a 16-mm camera with color film. The movies were then reviewed in the laboratory by slow-motion or single-frame projection. During these reviews, a wide range of behavior was systematically described and categorized. Although it was tempting to utilize all the categories in analyzing the behavior of the children, it was obvious that this would result in a system that would probably be too unwieldy for most purposes. Consequently, the number of categories of behavior dealt with was reduced to those considered most pertinent. These will be described further.

Behavior Analysis System

When an observer viewed a film—typically in slow motion or single frame—he recorded certain behavior patterns demonstrated by each child whose behavior had been filmed. If a group of children were involved, the observer recorded the behavior of each child in the group on an individual basis. When completing an “analysis chart” on a child, most of the information recorded fell into three broad categories, dealing with social conditions, the approach behavior, and the curb behavior. An analysis chart was designed which permits the observer to categorize most of the pertinent behavior by simply using a check mark or by circling a number on the chart. When an analysis chart was completed, the following information was on record for each child: (1) sex; (2) social conditions (whether child was alone or in group); (3) interaction level of child in group (active interaction or noninteracting); (4) approach rate of child (whether child was running or walking. Additional information concerning actual rate of approach, i.e., racing, normal run, and so forth, was included on the analysis chart); (5) activities of child during the approach (whether child appeared to be oriented toward the other children, to-

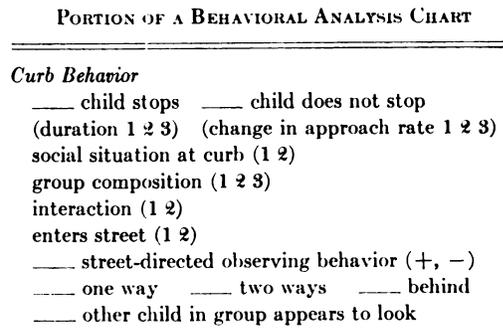


FIG. 1

ward an inanimate object and so forth); (6) observing behavior of child during approach (whether child appeared to look for vehicles in one direction, two directions, behind, or did not appear to observe for traffic at all); (7) the direction of the child’s approach to the curb. This was shown on a sketch of the intersection included on each analysis chart. (8) Whether the child stopped at the curb. If child stopped, duration of pause was indicated. If child did not stop, any change in rate of locomotion was recorded. (9) Social conditions at the curb. If the child was in a group at curb, information concerning the group was included. Also indicated was whether the observed child left the curb with the group, with some members of the group, or by himself. (10) The child’s observing behavior at the curb. Whether he did not look, looked one way, two ways, and/or behind him was indicated on the analysis chart. (11) Traffic conditions—the location of any vehicles was indicated on the chart of the intersection.

The fact that an analysis chart could be completed by an observer by means of check marks and by circling numbers expedited the completion of a chart. Shown in Figure 1 is the portion of an analysis chart used to describe the curb behavior of a child.

Reliability and Validity of the System

The reliability of an observational method is generally defined by the level of agreement between independent observers. For the described system, reliability was

TABLE I
NUMBER OF BOYS AND GIRLS WALKING OR RUNNING
DURING APPROACH AND RECORDED AS OBSERVING

<i>Running or Walking</i>	<i>Boys</i>	<i>%</i>	<i>Girls</i>	<i>%</i>
Running	26	31	37	44
observing	2	7	4	10
Walking	57	69	46	56
observing	11	19	7	15
Total	83		83	

determined by establishing the percent agreement between a number of pairs of observers who viewed and analyzed the filmed behavior of a series of children. With a minimum of training, the percent agreement between pairs of observers was generally above 90%. However, in a system such as this one, the percent agreement between observers on certain categories of behavior was more critical than the overall percent agreement. For example, there is 100% agreement on the sex of the child or whether the child stops at the curb. On the other hand, agreement is not quite this high on the observing-behavior category—generally between 80 and 85%. In considering the reliability of ratings of observing behavior, however, it must be kept in mind that this is essentially an inferential judgment on the part of the observer. Although there is agreement between observers as to whether the child turned his head and appeared to look for traffic, all that is actually being recorded is “head turning” behavior. Whether the child actually looked for traffic can only be inferred.

Until more data are available, the validity of the system cannot be assessed with any degree of certainty. The term “validity” actually has a number of meanings. If we are concerned with whether the observer’s score measures what it purports to measure, we can say that validity is reasonably high. On the other hand, if we define validity on the basis of whether the score predicts anything, there is some question as to the validity of the system.

At this state we are unable to say whether there is a relationship between the behavior that is recorded and actual accidents. However, a comparison between data obtained with this system and epidemiological data may give some indication of the validity of the system. For example, we know that boys are involved in more pedestrian accidents than girls. It will be seen from our results that boys engage in more unsafe behavior than girls. Data of these types, although indirect, may furnish us with some evidence as to the predictive validity of systems such as this.

RESULTS AND DISCUSSION

Two hundred analysis charts were completed: 100 for boys and 100 for girls. A vast amount of information regarding the behavior demonstrated by the children as they approached a street is available from these charts, and these data can be interpreted and analyzed at a number of levels. However, the actual description of the children’s pedestrian behavior was considered a secondary aim of this investigation, and the results presented below deal only with what were considered to be the most important forms of behavior.

Approach Behavior

As the children approached the street, most (83%) were in small groups. During the approach, two forms of behavior were of particular interest: whether the child appeared to observe for traffic and whether he walked or ran. It can be seen from Table I that girls were more likely to run than boys but more likely to observe for traffic when approaching the street.

While approaching the street, children tended to engage in a variety of activities. When these activities were categorized as being “other-child oriented” or “inanimate-object oriented,” it was found that most of the activities involved other children and that there were only minor differences between boys and girls in the types of activities engaged in.

Curb Behavior

As was the case with approach behavior, a number of categories of behavior were recorded under the general heading of curb behavior. However, two forms of behavior were of particular interest: whether the child stopped at the curb prior to entering the street, and whether the child appeared to observe for traffic while at the curb or entering the street. It was found that only 32% of the children came to a full stop prior to entering the street. Nearly identical numbers of boys and girls stopped. Further, whether a child stopped at the curb was largely unrelated to whether he had been running or walking during the approach.

Although boys and girls were about equally likely to stop at the curb, girls were recorded as "looking" for traffic significantly more frequently than boys. Shown in Table II are the numbers of boys and girls who were recorded as having looked at least one way before entering the street. This table also illustrates how the data obtained with the particular system utilized can be combined to show the relationship between several forms of behavior. Thus, we can consider the observing behavior at the curb of children who were running during their approach to the curb, those who ran and stopped at the curb, and so forth.

As we noted previously, the primary aim of the present study was to develop a methodology that would be useful in studying pedestrian behavior, as well as other forms of behavior, of children or adults. Consequently, the application of this method to the study of pedestrian behavior of a group of kindergarten children was considered more of a field test for the system than an investigation in which meaningful information concerning this type of behavior would be obtained. However, several of the findings were of interest. For example, under the conditions involved in this study, a surprising number of children entered the street without stopping or without apparent observation for possible traffic hazards. Also of interest was the fact that girls tended to observe significantly more frequently than

the boys. However, aside from observing behavior there were few differences between boys and girls in the types of pedestrian behavior analyzed.

It is quite likely that the system developed in this study for the observing and categorizing of pedestrian behavior might be useful in implementing a methodological approach that has been discussed in the accident prevention literature but rarely used. This approach involves the utilization of unsafe behavior rather than accidents per se as data in certain types of investigations. The rationale for this approach was discussed some time ago by Brody⁵ and by Suchman⁶ who commented:

Thus instead of describing accidents according to the type of resultant injury, we might concentrate upon the various forms of unsafe or accident-producing behavior. This approach would have the advantage of separating the dependent variable, the actual accident or injury, from the independent variable, the unsafe practice. Thus, we might talk about injury-producing behavior instead of accidents. This distinction could broaden research on accident prevention to include study of unsafe behavior which did not culminate in an accident or injury.

The problems involved in utilizing actual accidents as criteria in research are well known. Use of unsafe behavior rather than accidents has, as its primary advantage, the much higher frequency of occurrence. It would seem that the study of unsafe behav-

TABLE II
NUMBER OF BOYS AND GIRLS WHO LOOKED FOR TRAFFIC IN RELATION TO APPROACH RATE AND STOPPING AT CURB

Approach	Boys		Girls	
	Look	No-Look	Look	No-Look
Running Approach				
stop at curb	7	2	13	1
no stop at curb	4	13	5	18
Walking Approach				
stop at curb	9	9	13	2
no stop at curb	9	30	15	16

ior of pedestrians might be a promising approach to the development of procedures for reducing child pedestrian accidents. A review of the available literature, however, revealed only two studies that were concerned with unsafe behavior of pedestrians. A study by Fleig and Duffy⁷ dealt with the effects of traffic signals on the behavior of adult pedestrians. In their investigation, in which the frequency of occurrence of three unsafe acts before and after installation of traffic signals was obtained, it was found that the signals did not reduce the frequency of the unsafe acts. Backett⁸ discussed a study conducted in Scotland on regional differences in the behavior of child pedestrians. The basic assumption underlying these investigations, as well as the present study (i.e., that unsafe or high risk behavior rather than accidents per se can be utilized in many types of investigations) may prove useful.

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TRAFFIC ACCIDENTS INVOLVING CHILD PEDESTRIANS: A PROGRAM FOR THEIR PREVENTION

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THE two papers that follow report the results of painstaking epidemiological work on pedestrian accidents involving children. Because these papers relate the age of the child to specific behavior patterns that result in accidents and to specific injury patterns that result from such accidents, they would appear to offer a sound empirical base for the development of a variety of countermeasures, whether such countermeasures are intended to reduce accidents or to limit the severity of the resulting injuries.

Unfortunately, however, the ability to generalize such data is extremely limited. A given pattern of child-pedestrian behavior is the result of a highly complex set of variables: the social class and ethnicity of the child, the ecological characteristics of the neighborhood and the broader community, the characteristics of the traffic pattern and the types and density of the vehicles that make it up, the current enforcement policy, climatic conditions, road and highway characteristics, and a host of other conditions that combine and interact in various ways. Consequently, few localities are sufficiently similar to justify the application of data from one to another. The injury patterns described by Ryan, for example, are those produced by Australian

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OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

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