5 *BEHAVIORAL RESEARCH ON ACCIDENTS*

THE READINGS:

BEFORE WE EMBARK upon the first of four chapters dealing with behavioral approaches to accident prevention, it would be well to attempt a clarification of the role of behavior in accidents, a role that is often as ambiguous to the research worker as it is to the general public.

In the compiling of accident data it has become almost traditional to use a classification system which dichotomizes accidents due to human behavior and those in which human behavior apparently played no part. Thus an accident attributed to "driver error" is regarded as clearly due to human behavior, whereas an accident resulting from the failure of a mechanism—the tire of an automobile, the fuel system of an aircraft, an automatic alarm system—is classified as having no human cause.

Such a scheme is misleading for several reasons. First, it implies that enough is known about accident causation to permit accurate attribution to human or nonhuman factors. In the present state of our knowledge such an implication is not warranted. Secondly, what we do know about accident causation leads to the conclusion that behavioral elements, far from being discretely present or absent, are present to a greater or smaller extent in virtually every accident. Even the most obvious case of "driver error" may involve a nonhuman environmental situation in which "error" was greatly favored if not, indeed, inevitable. Similarly, even an accident that seems due to a mechanical failure[1] involves the human element of failure to inspect the device adequately or to provide it with fail-safe features,* just as an accident due to a hurricane or other "act of God" involves the behavioral element of the victims, who failed to predict the occurrence of the damaging winds or to remove or otherwise protect themselves from the effects.

Even when the magnitude of the human element in a certain kind of accident can be accurately assessed, it is important to note that its sheer magnitude does not inevitably make it the most appropriate target for preventive measures. The amputations and other injuries common in industry during the late nineteenth century, for example, could be clearly attributed to "human error," but the most effective countermeasure proved to be not a program to change human behavior—that is, to make the worker "more careful"—but rather the installation of machine guards which made the human error noninjurious to the person involved. On the other hand, such largely "nonhuman" kinds of accidents as those due to the failure of electric wiring, boilers, and elevators, and to spontaneous combustion have been effectively reduced by altering human behavior—through legislation requiring building codes, periodic inspection, and the provision of police and fire department personnel to prevent or reduce damage and injury.

Yet another difficulty stems from the use, in the literature, of the term "human factors" to cover a wide range of meanings. (See McFarland, Chap. 2.)[2-6] Vascular accidents, the physical dimensions of the human body, reaction time, color blindness, drunkenness, attitudes toward the police, emotional disturbances—in short, a wide variety of elements, modifiable and nonmodifiable, close to and remote from accidents—have at one time or another been labeled as "human factors." The ambiguity of this term can be a major obstacle, both to the research worker who uses it loosely and to the reader seeking to identify the objectives, the point of view, and the purposes of the studies in which it is thus used.

* See reference 5 for a discussion of fail-safe devices.

Within the limits delineated by the foregoing caveats, however, there exists a vast array of accident phenomena that lend themselves to study by behavioral scientists from various disciplines. The psychologist may examine the personalities, perceptions, and response characteristics of those involved in accidents; the sociologist, the characteristics of social groups which influence exposure to danger; the anthropologist, cultural values concerning safety; the economist, the relative costs of safe and less safe industrial processes; the historian, the development of safety legislation and other safeguards; and the political scientist, the political forces that influence safety legislation. Accident research thus oriented has not yet made great advances, but the causes and results of many types of accidents can be studied as productively from the behavioral-sciences point of view as other aspects of human experience.

Because of the several disciplines and numerous approaches represented in the behavioral sciences, we have devoted four chapters to this aspect of accident research, and additional examples are included in Chapter 3. The present chapter begins with excerpts from four papers that reflect the general emphasis and present level of development of various behavioral-science approaches to accident research. These indicate some of the current theoretical and methodological problems and provide background for the selections in the next three chapters.

SOME COMMENTS ON ACCIDENT RESEARCH

—Anatol Rapoport, Ph.D.

Although it does not present a systematic analysis of behavioral approaches, this paper is a refreshing departure from most of the behaviorally oriented accident literature by virtue of its sophistication and its wide-ranging concern with aspects of accident research and causation (such as the role of cultural factors) which have received insufficient attention from behavioral scientists. It is especially noteworthy for its avoidance of the narrow and exclusive emphasis on personality factors, which has long dominated the accident literature. Although concerned primarily with childhood accidents, its points and emphasis are of general relevance.

*JUST AS THE STUDY of childhood diseases can-*not be meaningfully separated from general problems of health and disease, so the study of childhood accidents must be related to a general investigation of accident phenomena.

The big question is where, to begin, because the different backgrounds and predilections of people interested in accidents make themselves strongly felt. Fortunately, research workers have become sophisticated enough not to permit their special interests to distort their views. Most dedicated workers have come to realize that the approach which they see most clearly because of their special interest or special training is only one of several and that ideally the several approaches should complement one another instead of struggling for primacy in matters of attracting researchers and public support and implementing proposed corrective measures.

However, a proper integration of effort is easier asked for than accomplished. Even aside from competition for effort, even if

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funds and manpower were unlimited, we would still be divided by differences of opinion about what to do first, because of differing notions of what constitutes a logical sequence. The situation is the same in any large-scale planned activity. For instance, when a society is industrialized, a certain rhythm must be preserved in expansion of capacity, expansion of market, training of cadres, and changes in patterns of living. When resources are as strictly limited as they are in research and action in the field of accident phenomena, organization of effort becomes a crucial task if any sort of effectiveness is to be expected.

The question, then, is where to begin. There are those who will not feel comfortable unless they have precisely defined the problem area. Thus we have energetic searches for a definition of "accident." The various points of view from which "an accident" can be defined have been ably summarized by Dr. Suchman. I think it should be granted that in some problem areas precision of definition is prerequisite to the effectiveness of measures undertaken to solve the problems. Thus, in medicine, nosology is of prime importance, and the reason is not far to seek. Most spectacular advances in medicine crystallized around the discovery of "specifics"—as in chemotherapy and in the discovery of the importance of vitamins and trace elements in diets. Here, of course, precise classification and identification of diseases were of supreme importance to the extent that very fine distinctions had to be introduced before progress could be made. Obviously the very nature of the specific requires that the situation in which it applies be specifically recognized.

Nevertheless it should be borne in mind that equally dramatic advances in man's war against disease were made with the discovery of the importance of nonspecific factors—*e.g.*, public hygiene and general levels of nutrition. In this connection it should be emphasized that factors not directly connected with medicine or even with the general problems of health and disease played an equal or a more important role in improving the general level of man's health and longevity. It is possible to argue that Euclid may have contributed more to medicine than all the medical discoveries from Hippocrates to Pasteur. For Euclid systematized geometry; systematized geometry made possible the science of optics; optics gave us the microscope; and the microscope led to the discovery of microorganisms and eventually to the first major breakthrough in medicine and hygiene.

We have, then, in medicine, two types of advances: dramatic discovery of specifics and a gradual, rather uneven amelioration of *conditions* in which man can safeguard his health and can come to grips with specific problems of health and disease. And while we speak of "conditions," we should certainly not forget the general philosophic orientation, the world view, the mood in which man faces the problems confronting him. In this respect the activist mood, characterizing Western society, was certainly more conducive to medical advances than the fatalist mood; naturalistic philosophy was more favorable than an animistic one, and so forth.

In dealing with accidents we can also distinguish between specific and global approaches. The discovery and removal of a structural defect in an airplane, improvements in road engineering, industrial safety devices, etc. are all obvious examples of specific measures. Their importance is by no means to be discounted, especially since the "yield" of these measures in terms of lives saved, even if small, is usually clearly demonstrable. The situations allow for "before and after" tabulations with the consequent identification of "causes." This specificity makes the fight against the accident clear and attractive. I venture to say that it taps a particularly regrettable but on occasions useful facet of human motivation—namely, the identification of a "culprit." I shall have more to say on this subject a little later.

The discovery and implementation of "global" measures analogous to public hygiene or to cultural attitudes is, in the prob

lem area of accidents as elsewhere, a much more difficult matter. Here precise definitions will not help us, because we are not dealing with a search for precise measures. To resort once more to the analogy with medicine, the value of eliminating superstition, for example, although it was probably very great in improving public hygiene, could never be ascertained exactly. We still do not know how to measure the "amount" of residual superstition or misconceptions in a population or to correlate this amount with the level of attainable hygiene. Results in such an area, then, are not bound to be dramatic, nor even precisely demonstrable. Yet their importance would be difficult to deny. I, for one, am firmly convinced that our cultural climate, our aspirations and myths, find definite reflection in the prevailing attitude toward the automobile and that these contribute in no small degree to a basic accident rate which would remain, even if all the specific measures of accident prevention were realized. This idea lurks in the paper by McFarland and Moore, *Youth and the Automobile*. Other factors contributing to accident rates, as officially recorded, factors having to do with deep-seated attitudes rather than with explicit exercise of safety measures, were soberly discussed by Dr. Foote. These matters are difficult to demonstrate, and even if some of them could be proved, we would be at a loss as to what to do about them now.

We have, then, these two extremes. On the one hand, there are the demonstrable specific accident-conducive situations. The only problem here is to induce people to recognize the situation and to do something about it. This is sometimes formidably difficult, as Dr. Freedman has shown so convincingly in his discussion of a specific type of accident—namely, lead poisoning in children eating paint in poor homes. But at least we know where to direct our efforts when we face a situation of this kind. At times such efforts are rewarded, particularly when the removal of the situation depends on people who can be made targets of campaigns: landlords, industry, common carriers, government, etc. Witness the speed with which action was taken in the polio vaccine deaths of a few years ago.

At the other extreme, we have diffuse factors, difficult to identify and even more difficult to demonstrate as relevant, but which may nevertheless be of great importance. I shall return to these factors later, but first I would like to ask this question: Do we have intermediate situations? In other words, do we have factors of importance in the area of accident phenomena which could in principle be demonstrated but which have not yet been demonstrated? In the light of the history of medicine, which, I agree with several of the participants, is entirely relevant to our topic of discussion, the answer should certainly be "yes." In fact the history of medical discovery is overwhelmingly a record of identifying factors specifically relevant to health or disease which had not been previously recognized. What had been a vague notion that low, marshy places are conducive to malaria became very specific knowledge about just what it was about these places that gave man malaria—namely, not *mal aria* (bad air) but certain definite species of mosquito, and not even these directly, but rather the protozoa parasitic on the insect.

It is axiomatic that scientific research is the discovery of causal chains, the establishment of the form "If so, then so." Now we have been amply warned, and rightly so, against the facile singling out of causes. We are shown innumerable instances of how the same alleged cause produces different effects in different contexts. However, illegitimate extrapolations of the causality principle and unwarranted simplifications do not by their failure invalidate the principle. Is not the whole notion of controlled experiment a successful circumvention of this pitfall? Wherever it is possible to reproduce essentially identical conditions except for the value of one independent variable, the "effect" of that variable on some other variable of interest can always be studied. This is not, of course, falling into

the trap of single-cause single-effect fallacy. The end result of a controlled experiment is not the answer to a question of the form "What causes X?" but rather to a question of the form "To what extent does the variation of Y, other things being equal, effect variations in X?"

Now this is known as the analytic method, time-honored in the classical physical sciences of the nineteenth century. There has been a reaction in twentieth-century philosophy against this method of inquiry. We are told that "the whole is greater than the sum of its parts" and that it is a mistake to regard the entire situation as additively composed of its components, that the entire situation has emergent properties of its own which we cannot discern as long as we contemplate only the parts, and so on. I suppose the position of Kurt Lewin must be so understood.

Now, I usually lend a sympathetic ear to the holists' objections to the analytic approach. Indeed, some entirely convincing examples can be given. Our music has a vocabulary of 12 tones—call it 72 tones if we multiply by the six-octave range of the orchestra. It is ludicrous to insist that a Beethoven symphony is essentially represented by such and such frequency of occurrence of each of these 72 tones. We know, of course, that wholes are composed of parts *arranged in patterns*. Analysis presumably destroys the pattern and is therefore irrelevant in revealing the nature of the "whole."

This criticism is valid, I believe, when it is applied to attempts to explain perception or integrated action in terms of isolated units, be they stimuli or muscular actions. These attempts fail because they ignore patterns which mold the parts into the whole. I have serious doubts, however, that this criticism is relevant when applied indiscriminately against analysis of complex situations just because the situations are complex. Analytic methods can be much misused. But this does not mean that they cannot be used to advantage if used properly.

When used properly, the analytic method does not presuppose that all causative factors are linear or that they are additive. Naive elementalism is not inherent in the analytic approach. Admittedly the analytic approach emphasizes the study of one component of the situation at a time. How the components are to be put into the whole picture is a separate problem, but the two problems should not be confused with each other.

In a controlled experiment, components are studied one at a time by a deliberate structuring of the experimental situations. The handicap under which social science must operate is the well-known fact that experiments involving the society *in vivo* are often impossible for practical or ethical reasons. The social scientist, then, must select from naturally occurring situations those aspects which best approximate controlled experiment. This is possible wherever the gross situation is composed of so many minute components that the law of large numbers has a chance to operate.

The law of large numbers is to social science what deterministic causality is to physical science. Indeed, many of the so-called deterministic laws of physical science have been definitely shown to be simply instances of statistical regularity resulting from the operation of the law of large numbers. Although the numbers involved in man's behavior are, of course, nowhere near the magnitude of numbers of molecular events involved, say, in chemical reactions, nevertheless the regularities of accident statistics are respectable, to the extent that we can speak of an operation of quasi-causal relations.

We are, then, in principle, enabled to single out differential causative factors of accidents. To do so we must select for comparative study classes of events with as much care as a sophisticated experimenter controls the conditions in his laboratory. Accidents are, to be sure, rare events in the life of a single individual. But there are so many of us that the absolute number of accidents is prodigious. The 100,000 fatalities alone are sufficient to provide statistically respectable samples for comparing

populations of events statistically identical with one another except for a selected factor treated as an independent variable. In this way a first approximation tabulation could be made of what could be expected (on the basis of a naive additive model) if the factor in question were to be changed alone in a given direction.

Of course, several such tabulations already exist. However, they are only a first step. Two other things are to be ascertained in connection with any attempt to induce action toward the reduction of accidents. First the marginal costs in appropriate units of each type of change must be ascertained. For example, it may be found on theoretical grounds from the analysis above that a reduction of speed limits on certain types of highways by five miles per hour can be expected to save so many lives, prevent so many injuries, and save so many dollars. This finding is not sufficient. One must also estimate the effort which can be expected to succeed in actually effecting the reduction of speed. Only after comparing the expected "yield" of effort in various directions would one have an idea of whether it is feasible to put out effort in a particular direction. Already on the basis of present data, one could make estimates of what one can reasonably expect from different types of ordinances, restrictions on driving licenses, campaigns for more safety in playgrounds, etc., etc. One could sharpen these estimates by more careful analysis and extend their range. Then one would have a basis for projected action.

But only a basis. This brings me to the second qualification of the analytic method. The theoretical marginal costs do not necessarily ensure that the actual costs will stay within the limits or that the expected marginal effects will be realized. For we must remember that our model of *additive* causative factors was only a first approximation. In practice the factors may be intimately intertwined. A change in one may bring unavoidable changes in others, sometimes counteracting the first changes. It is well known, for example, that safer highways tend to bring about faster driving and perhaps greater risk-taking.

When it comes to these interaction effects, our simple analytic approach may be revealed to be inadequate. It is then that the need for more holistic approaches may come to be felt. It may very well be, for example (although I have not at present the slightest evidence to support this conjecture), that accidents are indeed necessary consequences of aggressive tendencies in the population at large. What some pre-industrial cultures achieve by the ritual of blood sacrifice, including human, we may be "achieving" by our yearly slaughter of innocents. We would shrink from the idea of drawing lots to decide which 100,000 men, women, and children were to be killed each year. But in effect, we are essentially doing just that, and our explanations of what actually occurs—*i.e.*, the notion of "accident," where the events are attributed to the will of chance (just as in other cultures blood sacrifices are rationalized as pleasing to the gods)—could well be mere rationalizations.

Stated so blandly, the idea smacks of mysticism or of misanthropic defeatism, and I do not intend for a moment to ask you to take it seriously. But there is only one way to test the hypothesis to the effect that we cannot do anything about our accident fatalities (*i.e.*, that these events are inherent in the very fabric of our culture). That is to undertake an analysis of contributory factors, an estimate of the marginal effectiveness of various courses of action and of the associated marginal costs, and to see whether we *can* do anything about them.

At the extremes, there is no question about the answers. We could abolish automobile deaths by banning automobiles and accidental deaths from firearms by banning privately owned firearms. It is usually argued that the banning of automobiles would result in such crippling dislocations in our lives that the costs would be absolutely prohibitive even if the ban could be put into effect. The argument is certainly reasonable. But it does not apply to firearms. No great dislocations in our economy would result

from an absolute prohibition of firearms in private hands. The cost in terms of losses of opportunities for self-defense would be trivial: cases in which a person saved his own or someone else's life because he had a gun are, I submit, exceedingly rare. The only genuine costs involved would be the loss of opportunities for hunting and the costs of enforcement. The former could be circumvented by allowing hunters to rent hunting weapons and thus to keep the slaughter of humans by firearms almost entirely within their own ranks.

Let us further grant that there are limits on enforcement. Certain sectors of the population in the underworld or on its fringes would probably keep firearms even if it were against the law. This means we can expect deaths from firearms which result from crimes of greed and passion to continue, perhaps undiminished. But an enforcement of a law against private possession of firearms would probably be quite effecrive among ordinary, law-abiding citizens, those who keep revolvers in drawers against burglars, and this would mean that fatal accidents involving firearms would be drastically reduced. In particular most of the 500 children's lives lost annually as a result of shootings would be saved. The question to be put, then, is a straightforward one: does our society consider it a good bargain to trade the privilege of owning private firearms for 500 children's lives per year? The answer to such a question can be interpreted only from what society actually does in this and in similar matters, not from what people *say* ought to be done.

The importance of such questions is that they point up peculiar attitudes of a society toward the value of human life. It is well known that the worth of a human life as reflected in what society will undertake to do to save a life varies over a tremendous range. In fact, one could almost assert that the marginal value of a human life is inversely related to the rate at which lives are lost in given situations. The callousness of the public toward automobile fatalities compared with its responsiveness to dramas involving very rare diseases is a well-known illustration of this principle. But of course much more is involved. Rare events are much more widely publicized. For this reason, there is much more apprehension about plane travel than about automobile travel, although the former is considerably safer than the latter, statistically speaking. Also, efforts to save lives apparently doomed are usually of the utmost energy and ingenuity. Witness the rescue activity following a mine accident or even in connection with attempts to save a trapped animal. Doubtless it is drama that increases the popular valuation of life. When loss of life is routine, we witness a callousness which we deplore when we see it in other cultures in other contexts.

However, perhaps the most important reason differentiating the amount of effort which will be expended in saving lives is the lack of comprehension in the general population of the role that the probability of an event ought to play on the scale of social value. The predominant way of thinking is in terms of individual experience. An event happens or does not happen *to me*. I cannot experience (except in the vaguest way) the probability of an event. Now, on the social scale, global action aimed at reducing accidents is action aimed at reducing the probability of accident for an individual. This probability is not felt when it is reduced. That is, it is not felt in the same way that explicit events are directly experienced. To some extent on the grossest level, we do perceive the difference between clearly dangerous situations (*i.e.*, those in which probabilities of injury or death are high) and clearly safe situations (in which the probabilities are low). But we do not feel anything personally if the accident fatality rate is reduced from one per hundred million passenger miles to one per two hundred million passenger miles or, on the contrary, raised by a comparable ratio.

I think that this absence of a direct experience of probability (except among professional gamblers) is primarily responsible for the gross inconsistencies in the value placed upon life in various situations. When

some miners are trapped in a mine, everything humanly possible is done to rescue them even if the chances are all but nil. This is because the misfortune has happened to *specific* people and hence our empathy can be enlisted directly. The potential victims exist for us as individuals. But when efforts are enlisted to save many more lives needlessly lost, even lives of children, on which supposedly an extremely high value is placed in our society, nothing can be done on nearly the same scale. The potential victims do not exist for us as individuals. The deaths and maimings which are spread as "probabilities" over the entire population, with only a dim shadow of danger falling on each real individual, are not seen as misfortunes happening to members of our society.

But there are still other factors operating in the determination of public attitudes toward preventable misfortunes. I have already mentioned the recent uproar over the polio vaccine deaths. Here, statistically speaking, the danger was infinitesimal, far smaller than the danger associated with the disease itself. Yet the public reaction reached almost panic proportions. This seems to belie the earlier statement that danger, manifested as a probability, is not clearly felt. We must now qualify this statement by noting that even very small probabilities are sometimes quite dramatically felt, provided one can focus on an agent who is assumed to have the power to remove the danger. Food and drugs are made by specific agents. These agents can be made to bear the brunt of anger if laxity in safeguarding the consumer can be shown. The situation is quite different in the case of diffuse, universal dangers, when there is no specific outside agent in whose power it is to reduce the danger. Indeed, the agent, if there is one, is ourselves. It is we who must change our ways to improve the situation. Accordingly much more sophistication, awareness, and social-mindedness are needed to bring about improvements in these areas.

To summarize, the degree to which action can be effective to combat accidents in general and, of course, accidents to children in particular depends on a variety of factors. We can utilize the knowledge of these factors in guiding any planned actions of this sort. It is easiest to instigate action against accidents under the following conditions:

1. The accidents are sufficiently rare as to be well publicized. This apparent negative correlation between public awareness and accident toll is, of course, most unfortunate. But it seems real and must be taken into account.
2. The action required is specific—*e.g.*, the removal of a drug from the market or of a type of airplane from scheduled flights.
3. The actor who is to take specific action is well identified and preferably one upon whom aggression can be vented and who is vulnerable to pressure.

All these are actions aimed at the discovery and the use of what are the analogues of "specifics" in medicine. In medicine, too, specifics were usually the easiest measures to introduce to the population. This is bound up with the relative ease with which direct, lineal cause-effect relations are understood and with the well-known fact that it is easier to insist that someone else, such as the physician, do something about the situation rather than oneself.

In the next category are actions against accidents whose causes and remedies are discoverable only statistically. Here the problem is first to ascertain the causes, which are by no means obvious. Research is difficult and expensive, and the results are often at variance with preconceived notions and therefore unconvincing to the public. It is hard to accept results which de-emphasize the role of a favorite scapegoat or point an accusing forefinger at established practices.

We all have our pet villains. For example, I would love it if so many accidental shootings and hangings of children per year could be definitely pinned on the children's television diet. Dr. MacIver, in his discussion of cultural factors making for what one might call "social accident-proneness," has pointed explicitly to this possibility. But whether this is actually so or not has nothing to do with

my desire to vent my own aggressions on what I consider the seedy aspects of our mores.

Here, then, is the most obvious and the most extensive but also the most difficult area of research. The first objective of such research is to establish criteria of theoretical marginal effectiveness of some proposed measures. This figure can only be theoretical for reasons which I have mentioned and will reiterate in a moment. Marginal effectiveness of a proposed change is a theoretical figure, because we do not know in advance the interrelation of the variable in question with other variables and the side costs of implementation programs. Suppose, for example, that in very careful studies, in which every attempt is made to control selected samples so that only one component to be studied is varied, say speed limit, it is established that a reduction of speed limit by five miles per hour ought to result in a saving of so many lives, limbs, and dollars. Assuming that the reduction can be carried out, it is by no means certain that such a prognosis will be vindicated, because the speed variable may be linked with another one, which we do not know about. Moreover, the implementation may have side effects which the original analysis did not reveal.

It seems, then, that a great deal of research is needed in the field of accident analysis and prevention before all-out action campaigns can be undertaken that do not stand the danger of fizzling out or backfiring or raising the public's immunity to exhortations. This research should be on two levels—namely, statistical analysis, to determine promising areas of pay-off, and on the level of action, to determine the costs and the actual consequences of making marginal changes.

Eventually certain specific courses of action, distinguished by large expected pay-offs and feasibility of implementation, will be singled out. At this point, the propagandist, the agitator, or—to use the more polite but somewhat repulsive term—the public relations man comes into his own.

What should he sell and how should he sell it? I know next to nothing about the techniques of manipulating public opinion, especially since my immediate, instinctive reaction to pressure campaigns is a shrinking reflex. Nevertheless, we must recruit the image peddlers to good causes, if only for the reason that this will to some extent drain them away from bad ones. Armed with reliable findings of carefully conducted research, the public relations man and the lobbyist, enlisted to the cause of combating accidents, can sell lives at market prices. "In order to save 100 lives which otherwise will certainly be lost in the following manner, here is a choice of things you can do." So a brochure can be worded, giving several alternative procedures, plans of action on community, state, or national levels which can be reasonably expected to save so many lives. These brochures can have specially displayed price lists on children's lives and limbs. Such an approach has the advantage of harmonizing culturally with our deep regard for free enterprise and consumer choice. It may also capitalize on the statistics and score-mindedness of our society. Pride of accomplishment is often manifested with us in quoting figures—incomes, heights of skyscrapers, Hooper ratings, popularity indices, etc. Possibly a portion of this preoccupation with quantitative indices can be harnessed to efforts to increase properly calculated and widely publicized safety ratings. Besides having a potential for instigating action, such campaigns may have a definite value for behavioral science research.

Once a "market" is established in which lives, children's lives in particular, can be bought at fairly stable prices, we can study the market behavior of our public with respect to buying lives at current prices. This behavior can then be considered as an objective index of how lives are valued in our society. I am sure that we will find some surprising differentials. Actions will be taken, I am sure, in some areas of combating accidents, and other areas will be grossly neglected. We can then have firsthand knowledge of where the implementation pay-offs are. This is market research, or call it motivation research. This is the study of public reactions with the express purpose of future manipu-

lation of such reactions. But I think it would be in a worthy cause.

I find it extremely regrettable to be obliged to end on a note which may be interpreted as one of pessimism. Nevertheless, there is one possibility for which we must be prepared. Perhaps if we admit this possibility in advance, we can do something about it in the long run. It may well happen that even the grandest and best-directed efforts to reduce accident mortality and morbidity will produce an extremely meager yield. This may well happen if the various statistically determined "causes" of accidents which we isolate in well-designed research studies turn out to be only pseudo-causes, like the surface environmental causes of some neuroses are sometimes said to be.

In other words, it *may* turn out that the analytic approach is largely futile, that the isolation of specific correlations in accident research is an entirely spurious matter. To illustrate what I mean, suppose a Martian who knows nothing about the game of bridge undertakes to investigate bridge-playing behavior and does so by studying ever so carefully and intensively the muscular motions of the players. He will get nowhere from our point of view, no matter how many stable correlations he establishes in his study. What we know as the game of bridge—that is, its essentials—cannot be put together from a description of muscle twitches and how they are put together. The rules of the game and its strategies are described in concepts which are in an entirely different universe of discourse from that in which physiological events are described. Suppose, now, that our bridge game is played with some gruesome rules—namely, the winners shoot the losers. Our Martian tries to understand this outcome by looking for a chain of events of which the outcome is a consequence. As long as he analyzes the bridge game in terms of muscle twitches, he will get nowhere. He will understand what is happening only if he understands the rules of the game itself and the peculiar rule governing the behavior of the winners.

The example is admittedly far-fetched, but an analogue in the accident situation is not to be discounted. In fact, I believe that this is what the holists and the depth psychologists and others who seek beyond the surface causations of events are trying to point to. In the extreme instance, an understanding of the physical chains of events which lead to accidents *may* not be very relevant if accidents are manifestations, as some suggest, of global cultural factors—that is, of social analogues of destructive drives. When stated on a priori grounds, this view seems unduly mystical. Therefore, I would like to see a de-emphasis of this view *for the time being*. But we may be forced to concede some validity to it as we gather more evidence.

For example, if we should find that in spite of clear determination of the marginal effectiveness of certain measures and the actual implementation of these measures with the resulting reduction of accident mortality and morbidity in one area, the *over-all* accident incidence of morbidity or mortality remains unaffected—*i.e.*, if stopping up one wound we only help to open another, as sometimes happens in superficial cures of conversion hysterias—then we will know that something more basic is wrong with us. We will then be forced to attack the problem on other levels. In a small way, we certainly have some evidence of the operation of deeper causes of accidents. I have already mentioned the well-known finding that improvement of road safety has gone hand in hand with an increase of road speeds which counteracts to some extent the reduction of accident mortality brought about by the improvement. This is an indication that the degree of risk-taking tends to be maintained at a certain level. In an extreme case, the risk-taking could even increase sufficiently to completely offset the safety improvement. In that case the fatality rate would be kept at a constant level and conjectures related to aggression, the death wish, etc. will have to be taken more seriously.

But I insist that such pessimistic hypotheses should be entertained only on a posteriori grounds. As Dr. Deutsch has pointed out, it is not parsimonious to see accident repeaters as victims of unconscious self-destructive drives. I submit it is also not

parsimonious to view our accident-afflicted civilization as a victim of a similar global drive. To be sure, such a possibility is not to be categorically dismissed, but why should we admit that we are licked before we start?

A sensible way to start is to take the obvious measures. The good physician will investigate possible organic causes of a disease before he delves into psychosomatics, if only because organic causes can be determined with greater assurance and can usually be treated with greater effectiveness. Only when this approach fails does psychosomatic etiology come into prominence. In attacking our great national affliction, the accident, we would be wise to follow the same procedure. The causes which are easiest to identify and easiest to remove should be tackled first, even if the actual yield is low. Then the long hard pull should begin of tracing those factors which are only statistically identifiable and which require an increasing amount of education of the public. Some of these attempts will succeed; some will fail. But the successes and failures can in turn be utilized to obtain further knowledge and to educate the population further. Finally, we may come up to a residual level of accidents whose causes are deep within us as individuals and as a civilization. But perhaps by that time sufficient momentum will have been imparted to the crusade against accidents so that further inroads can be made even in that area.

SOCIAL SCIENCE TECHNIQUES IN EXPERIMENTAL CASE STUDIES OF TRAFFIC ACCIDENTS

—Sonya Orleans, H. Laurence Ross

This selection illustrates the general emphasis and some of the methods of behavioral scientists concerned primarily with social and psychological as opposed to cultural and other behavioral factors. It is one of a series of reports of what the director of the project has called a "new approach" to the study of traffic accidents.[8] The project used a multidisciplinary research team (the composition of which was not constant) to investigate a highly heterogeneous group of 43 accidents (involving 68 persons) that occurred over many months in one geographic area.

THE BEHAVIORAL SCIENTIST'S concern in the Experimental Case Studies of Traffic Accidents centered around the social and psychological characteristics of the driver, the events leading up to the accident, the accident itself and the driver's reactions to these occurrences. To investigate these concerns, the behavioral scientist used the methods of observation and interview, including two psychological tests: a "Personal Opinion Inventory" and "Driver Situations Test," the latter being a projective device to explore the driver's view of highway travel. The driver was observed and a brief statement from him was obtained at the scene by the project's physician in conjunction with the behavioral scientist. The bulk of the data were gathered during the post-accident interview. The observations and data gleaned in the course of the investigation were shared with the project's physician and engineer in the joint effort of description and analysis of the accident.

The behavioral scientist on a project such

[Reprinted from *Case Studies of Traffic Accidents*, by J. Stannard Baker. The Traffic Institute, Northwestern University, 1960, pp. *18*-5–*18*-19. Exhibits 1 and 2 and three appendices have been omitted.]

as this functions in a number of capacities. Beside his responsibility for questions which bear on social and psychological theory he is also concerned with data collection in general. Because of his training in research, in interview construction, and in interviewing, he can contribute much to obtaining useful information.

The techniques of the behavioral scientist were continually improved throughout the project. In the beginning, effort was centered on attempting to discover abnormalities of personality which might directly explain behavior in the accident. When this approach failed to yield the expected results, attention shifted toward study of the accident to determine what particular social and psychological problems confronted the driver and an appraisal of his capability of handling these problems. For example, a comparison of what the driver expected to happen in a traffic situation and what actually did happen. Toward the end of the study psychological tests were added to try to discover aspects of personality which might explain drivers' responses to the traffic problems which confronted them. . . .

Evaluation of the Interview Schedule

Two methods were used to obtain information from drivers and pedestrians about the accidents and themselves. The first was in a structured interview in which each respondent was asked a standard list of specific closed questions which required only a brief factual answer. Examples of such questions were "Who taught you to drive?" These were to obtain demographic information to classify the driver with respect to his social situation, economic status, driving experience, and so on.

The second type of interview was quite different. It was largely unstructured and the questions were open-ended. Questions of this sort do not restrict the driver to a specific answer but encourage him to discuss some subject. They might be something like: "What sort of driver do you feel you are?" In such a case the subject is free to discuss a great many things. Such questions have the distinct advantage of enabling the interviewer to note what opinions and attitudes are most important on the basis of what the driver chooses to discuss in his answer.

Several forms (Appendix A) were used to record and summarize the data and information obtained in the interviews:

M. General description of the driver, his experience and general socioeconomic status. Generally ascertained by structured questioning.

N. The driver's impression of himself, his abilities as a driver, and of various aspects of driving. Generally ascertained by unstructured questions.

Q. Inquiry into the experience and behavior of the drivers immediately prior to the accident.

R. Inquiry into the nature and purpose of the driver's trip during which the accident occurred.

S. Inquiry into the driver's experience and behavior during the accident.

T. Inquiry into the driver's reaction to the accident and the effect it has had on his behavior and attitudes.

Other forms . . . were used for medical and engineering information.

Social Characteristics: The highly structured questions on Form M (Appendix A) pertaining to the driver's social characteristics were of limited use in the Case Studies Project. They contributed little to the analysis of the accident per se, but aided the researchers in the general description of the driver, and in characterizing the sample of respondents interviewed. Data of a broad classificatory nature, pertaining to socioeconomic status, church attendance, length of residence in the community, etc. would be useful in a statistical study—a study which would center around the characteristics of drivers rather than on individual accidents. Questions of a sociological nature might be investigated with regard to the differences between drivers involved in accidents and accident-free drivers on such variables as socioeconomic status, social mobility, involvement in community activities, variables relating to the driver's position in the social

structure and his involvement in it. This area of investigation has been of interest to researchers in the accident field. Tillmann, for example, studied background factors relating to social adjustment—ascertained by a history of contacts with various social agencies, for 96 accident repeaters and 296 accident-free drivers. It would be of interest to a sociologist to pursue further such questions in a systematic fashion.

The Self-Description: After obtaining the biographical information, each respondent was asked: "Give us a little biographical sketch of yourself. We would like to know what kind of a person you are, and what kind of a life you have led." The purpose behind asking a question of this sort was to obtain some clues to the qualities of the person which might shed some light on the driving behavior leading to the accident. It was hoped that the respondent would reveal something of the way he approached his life in general and some more specific qualities which would describe him. A number of the respondents had difficulty coping with this question. If rapport was not established before the question was asked, the respondent tended to talk of very superficial aspects of his life.

It should be mentioned that before these personal questions were asked of the respondent, he was interviewed about the events of the accident itself. This ordering of the interview was decided upon so that the respondent would be more open and would feel more relaxed when the social and psychological portions of the interview were presented to him. Nevertheless, there was some hesitation on the part of all respondents to answer this type of question. When the respondent did answer the question fully, there appeared to be some information of value as a result. A good example of this is seen in Case 122.3.1. The respondent was highly verbal and rapport was firmly established between the interviewer and interviewee. He gave a lengthy self-description which revealed him as somewhat aggressive and easily angered. He stated that in his father's judgment, "I've always been accident prone." However most of the respondents were not so verbal as the one cited in the foregoing example. Many tended to describe how they would act rather than what kind of person they thought they were in terms of personality traits. It was felt that another technique might have been tried, and, were a similar project to be undertaken, should be devised. Such a technique would be in the form of a self-description check-list, which, if constructed carefully, would force the respondent to answer questions of a qualitative nature about himself.

Driving History: The experience and ability of the drivers involved in the accident under study were ascertained to indicate whether or not there was a past history of repeated violations and/or accidents. Such a history would presumably reflect on the accident under present study and shed light on possible skill defects or the driver's attitude toward traffic law and driving in general. In the experience of this research, Form N was not as helpful in explaining the accident as it was hoped it would be. On the one hand, the information about the number of violations and accidents is not entirely reliable. These data are examined in detail in *Concepts and Classifications of Traffic Accident Causes.* On the other hand, items such as the self rating yielded little information in depth. On occasion, these questions did reveal a picture of the driver as overly cautious and fearful. On a few interviews where driving skill seemed to be a factor in the accident, the data on past driving history and ability were corroborative. Generally, an evaluation of the experience and ability questions indicates that they were only sporadically helpful.

One method of ascertaining the driving skill of the respondents that was considered would be recommended should a study of this nature be done again. This would entail observing the actual driving behavior of the respondent. The difficulties involved in such a procedure are obvious. If the respondent is aware that he is being tested, the situation is not a realistic one for the purposes of research. However, it could be arranged so

that the respondent does not realize that his driving behavior is being observed. It happened that, during the course of the Case Studies interviews, this was possible. On two occasions, an interviewer drove with the respondent to the interview site. These two experiences, both of which exhibited driving behaviors characteristic of the behaviors involved in the accident, were sufficient to indicate that a permanent procedure of this nature would be worthwhile. Several driver licensing test forms were reviewed as proposed models. Among these were the form devised for the American Association of Motor Vehicle Administrators and that used by Smith and Cummings. All such driving skill scoring methods lack established proof of their reliability, that is, their ability to give the same scores when used by different people at different times. They also lack evidence that they actually measure driving skill or even components of driving skills, that is, they may lack validity.

Familiarity with Vehicle Controls: Questions pertaining to the types of cars the respondent has driven regularly, and the nature of the equipment on the car are found on Form P. These questions were asked to ascertain the degree of familiarity of the respondent with the various types of controls found on a car. The main purpose for asking questions of this nature was to construct some sort of background picture with which the driver's familiarity with the accident car could be compared. It is felt that this is essential especially if the accident car was equipped with non-standard controls, and the driver's familiarity with these controls is questionable. The data which this question yielded were sporadically useful. In Case 50, for example, the respondent had driven the accident car for the first time on the day of the accident. It was equipped with power steering and the accident occurred when the driver lost control of the vehicle while swerving to avoid hitting a man alighting from his car on the street side. Although this sort of information was useful on occasion only, it was important in a few isolated instances, and should such a study be repeated, information of this type should be obtained in some form.

Personal Background Events: The events preceding the accident both long range and short term were obtained on Form Q. Each respondent was asked: "What kinds of things were you and your family doing during the week before the accident?" Questions included: "How did this period differ from the ordinary? Was there anything special or unusual on your mind during these days?" These questions were asked to obtain a picture of the respondent's long-range background in order to ascertain whether any events of the immediate past could have influenced the respondent's involvement in the accident. For the most part, the long-range background material did not lead to the discovery of any factors which might have contributed to worry or strain on the part of the driver. In a few cases, there was evidence that the respondent was occupied with an unusual task which may have contributed to fatigue; painting the house, for example. In general, the respondent's description of his daily routine yielded nothing. The question grazed only the surface of daily life, and did not probe deeply enough into the under-currents to be of value.

To inquire into the short-range background of the driver, he was asked: "Could you tell me what you did during the day of your accident? Start with when you got up in the morning. Describe what you did until you began the trip that resulted in the accident." The following probes were used: "How did this differ from your usual day? Was there anything special or unusual on your mind that day? How much sleep did you get before you got up in the morning?" These questions were asked to get at similar information to the long-term background. The researchers were interested in any out-of-the-ordinary kinds of activities preceding the accident, evidence of strain or worry, and fatigue. In some instances, the short-range questions provided the researchers with some clues to the driver's state of mind when the accident took place, indicating that in a

few isolated instances something was bothering the respondent that day and in some cases indicated that fatigue may have been involved in the accident. Once again, as with the preceding questions, the data obtained were useful only on occasion. Questions of this nature are necessary if a complete picture of the accident is desired. However, it should be remembered that pay-off may be somewhat low in terms of usable material (data which would stimulate hypotheses about the accident or explain it in a significant way).

Description of the Trip: The background for and events of the trip until the driver encountered the hazard resulting in his accident were covered in the questions recorded on Form R. Information about trip plan and purpose, as well as timing, frequency of the trip, and familiarity of the accident location, was desired to determine whether factors related to the trip may have contributed to the accident. Familiarity with the accident location was obtained to judge whether knowledge of sign placement and any peculiarities of the particular location could have contributed to misperception or misjudgment. Timing of the trip was asked in order to determine whether or not the driver was in a hurry in an assessment of possible speed factors or hastily performed maneuvers. These questions yielded some information of use in the accident reconstruction. Bear in mind that throughout the study, any bit of information called for rarely yielded significant data. Yet without getting these bits of information, important facts may often be overlooked.

The Accident: While the data covered in Forms M through R were very helpful in some cases, and yielded little in other cases, the statement about the accident recorded on Form S was of great importance in all cases. It was the statements about the events of the accident itself on which the accident reconstruction and analysis rested heavily.

To begin this portion of the interview, the interviewer said: "Please tell me about the accident in as much detail as possible." After this information was recorded, a map of the accident site drawn on a blackboard was presented to the respondent. The respondent used toy cars to demonstrate his behavior while giving a second account of the accident. After being questioned in detail during this phase of the respondent's accident reconstruction, he was presented with photographs taken at the scene. The interviewer requested the respondent to "See if there is anything else you notice in them that you have forgotten to tell me."

The behavioral scientist asked questions about the events of the accident from a series of probes which had been formalized. These probes listed areas to be covered rather than posing specific detailed questions. As each accident contained unique occurrences, and as this schedule could not, given the project's limited experience, include a detailed coverage of every topic, it was up to the interviewer to ask the most pertinent questions as they arose without the assistance of prewritten questions. The data from this form were used by all members of the research team in their own analysis of the accident. Therefore the questions asked by the behavioral scientist had to be applicable to all facets of the analysis. To assist in this task, when possible, the engineer or the physician were called in to observe the proceedings and ask questions they felt were important. As the behavioral scientist participated in the accident analysis and reconstruction with the engineer and physician, he gained in experience and knowledge and learned what questions were important to cover. The burden of the interview, however, rested on the behavioral scientist and his interviewing skill at the moment of the interview. The question can be raised as to whether the behavioral scientist was able to ask questions which were "out-of-his-field," so to speak. It is possible that not all of the pertinent questions were asked.

In any future study of this type, a more structured interview should be designed to include detailed questions which the engineer and physician might think important and useful. It would be especially helpful partially to reconstruct the accident after

initial collection of data and before the interview so as to have a specific list of questions for the particular case needed to complete the description of the events of the accident. Such questions would probe the memory of the driver with respect to position on the road, point of perception, speed, attempts at evasive action and so on that might possibly be overlooked otherwise.

One further problem with Form S might be mentioned. This is the problem of reliability. If the research team had to base their analysis on only one driver's statement recorded on Form S, the analysis would be incomplete and unreliable. The driver's statement could not always be taken at face value—there were often contradictions in his own statement, differences in his first statement at the scene and his statement during the post-accident interview, and most often disparities between one driver's statement and another. On one occasion, (Case 132) for example, a driver of a motorcycle reported that he could not have avoided the accident by changing lanes because of the presence of another vehicle in the available lane. The other driver involved did not report the presence of another vehicle and two witnesses when asked about this possibility, denied having seen the vehicle. It is difficult to tell whether the respondent in question deliberately falsified the information which he reported to the research team at the time of the post-accident interview or whether he distorted the situation in his own mind at the time of the accident.

Other instances of respondent distortion occurred during the course of the interview. Timing of the events of the accident, speed and distance evaluations were not accurately reported. Errors of this sort were noticed during the research team's accident reconstruction when speed, time and distances were calculated from all available information. It is likely that the respondents unwittingly misjudge—underestimating their own speed, overestimating the speed of other cars, underestimating the timing of various events and so forth. Except for the speedometer, there are no objective standards on which the respondent can make these judgments. They are estimates. With regard to the speed factor, it is possible that since the drivers were generally proceeding in built up areas, and on routine trips, the speedometer was not noticed. It is also possible that these under and over estimations were deliberate falsifications. An obvious reason for this might be the desire to appear blameless in the accident. Although every attempt was made to assure the respondent that the data obtained would be kept confidential, and that the purpose of the study was not to assign blame, it is possible that falsification of this type of evidence was used for self-protective purposes.

Instances of unreliability of the respondent's accounts of the accident raise questions about the methods of accident investigators and policemen covering an accident. The problem is adequately to assess for their purposes the facts as the respondents give them. It seems doubtful that an adequate scientific assessment could be made in a brief interview of one or two individuals involved. Much more detailed information is required to give a full analysis of the accident. In general, the more times the accident is recounted, the better is the material with which to work.

In seeking clues as to exactly how the accident happened and especially in trying to discover why, the more versions of the accident the better. Information lacking in one may be supplied by another. Impressions from memory may be revised when the respondent is confronted with scale diagrams of the location and photographs of the scene. Hence, the events of the accident were reviewed a number of times under different circumstances: a verbatim account without prompting during the post-accident interview, a diagrammatic account with model cars, and a discussion with colored slides of the approach to the accident location.

The respondent was permitted freedom to give a complete accounting as he saw it, and was questioned in detail with the use of specific probes. Each time the accident was

recounted, by two respondents separately, by witnesses, or in the many different statements by the same respondent, more information was obtained, and added to the total picture of the accident as seen by the various individuals involved. It was then up to the research team to dissect this information, and to proceed very much as an historian might in the analysis and reconstruction of the accident. The research team had to weigh the evidence presented by all observers, to balance this information with other data obtained during the post-accident interview, in order to come up with their interpretation of the accident. This interpretation was only as adequate as the data were adequate and their interpretation valid.

Driver Opinions: An important source of information about why the driver or pedestrian was involved in the accident is his opinion about the accident, his retrospective view. Although this is subjective, it may reveal to the investigator aspects of events and personality that would not otherwise come to light.

Form T provided a place to record such opinions. It was useful to the behavioral scientist in his assessment of the driver's approach to the driving situation in general. Such questions as: "Thinking back over it, what do you think caused the accident?" and, "If you found yourself in this same situation again what would you do differently?" were asked to gain a clearer picture of the accident by inquiring into the driver's own perception of the accident and his feelings of responsibility with regard to it. It gave the researcher some idea of how the driver was affected by the accident, especially in what ways, if any, the driver was trying to modify his driving behaviors. It also provided some clues as to whether the specific behaviors which may have played an important part in the accident had been learned and practiced over a long period of time and therefore might be presumed to be resistant to change, or whether they were unprecedented in the driver's history and arose in response to a unique constellation of events producing the accident.

For example, in one case, a woman approached a traffic signal which began to turn yellow. She stopped somewhat short and perceived the contact car directly behind her and knew she would be hit. When questioned she indicated that even if this same situation were to happen again, she would not chance going through the yellow light and would "sit there and take it." Even though this respondent knew how to avoid the accident, the response elicited in the accident situation was basic to her approach to driving and the accident itself had no effect in changing it.

Personality Tests: To try to learn why a person had an accident, the behavioral scientist needs to know intimately how the person thinks, feels, and acts under various circumstances. In the few hours available for interview, it is difficult to come to understand a personality well enough to say whether some psychological peculiarity made him do as he did. The interviewer can get some clues to personality from the person's description of the accident, what he says, what he did or thought, how he felt, and what he believes about others involved. Additional clues come from social, economic, and educational background and status, particularly as described by the individual. His opinions about certain traffic matters also help the interviewer to know him. These sources of knowledge of personality have been mentioned in earlier parts of this report.

But the impressions gained in this manner are neither sufficiently searching nor systematic. What the behavioral scientist really wants is some concise evaluation of the basic personality traits which will point out a driver's strength and weakness and so do for the behavioral scientist what the X-ray blood pressure measurements, urine analysis and eye examinations do for the physician. So there was a search for "instruments" with which to measure personality quickly and usefully. Personality inventories in common use for other purposes seemed too cumbersome for the specific purpose of accident studies; they did not seem to describe personality in terms of dimensions which could be readily applied to behavior in accidents

and, most important, these ready instruments had not been conspicuously successful in distinguishing between drivers likely to have accidents and those not likely to have them. Therefore the behavioral scientist began by thinking about tests especially for accident study.

The difficulty of designing personality tests is well known. Work on the Case Studies could not be put aside while such tests were developed. Nevertheless several tests were tried, although none to the extent required to prove its worth. One of these tests involved having the subject tell for a list of traffic law violations what penalty he would assess a convicted violator were he the judge. This was intended to show how the subject regards violations. An attempt was made to determine whether, for young drivers, peer or parent orientation of values might be useful in pointing out a tendency to accidents. None of these special tests were given in the early phases of the case studies. The two which were subject to experiment when data collection ended were the Personal Opinion Inventory, a test intended to give a profile of basic personality characteristics, and the Driving Situations Test, a special adaptation of the Thematic Apperception Test. These two and what was done with them are more fully described in the appendices.

Suggestions for Future Research

Because the present study was designed primarily to provide hypotheses rather than to test them, suggestions for future research are in order. Therefore a number of areas for future study which appear relevant will be mentioned. One such study would examine the process of decision making. The road, the vehicle and other drivers present an environment in which a particular driver must make decisions as to how to behave. He must evaluate possibilities by estimating the likelihood that, given a certain set of circumstances, particular behavior will lead to a particular consequence. Once this is assessed, the driver takes action. For the student of traffic accidents, this decision-making process would be of great interest and of potential practical value.

In a study of decision-making two facets of the problem must be considered: one concerns the manner in which different drivers assess the likelihood that certain events will occur; and the other focuses on how various possible lines of action are evaluated. In the first instance, the problem concerns the driver's attempt to study the environment and to predict what will happen in the immediate future. Once he has made this prediction, he is ready to choose among possible actions appropriate to the situation. The second facet of study concerns the latter problem—how does he choose among possibilities within a given environment—what values does the driver place on these possibilities and their associated outcomes?

Posing of such problems suggests the use of a game theory model. Game theory deals with choices people make when there are various outcomes associated with these choices. Game theory deals with the individual's preferences for certain outcomes based on the satisfaction or utility he would receive. Individual choice is based on maximizing expected satisfaction. Generally, game theory deals with two players who compete for rewards. When one player wins, another loses. In the driving situation an accident means that *both* "players" lose and avoiding it means that they win. Hence, the game theory representing competition between drivers does not characterize the traffic situation. Yet as a decision-making model it may serve as an analogy. The satisfactions gained by quick arrival compete with those gained by avoiding accident. To put it another way, negatively, the small chance of an accident which would have a high "cost" must be weighed by the driver against the high probability of being late which would have a relatively low cost. The notion of maximum satisfaction or minimum trouble is directly relevant to decisions in strategic aspects of controlling speed. Drivers differ in their evaluations of outcomes of various lines of action. It would be interesting to know how different kinds of drivers evaluate

risks. The game theory might also throw some light on traffic accident situations by showing how one person predicts the actions of another.

An example will illustrate how choice of driving behaviors may be phrased in such terms for study. The analysis of this situation takes into account only one driver and his evaluation of alternatives in terms of maximizing satisfaction—the subjective evaluation of the differential values of various possible actions.

For example, driver was proceeding down a busy street and he saw a car backing out of a driveway. He was confused as to whether the car would or would not stop for him. The choices available to him were to stop quickly or to speed up. He chose to stop and was hit (the driver of the other car assumed he had gone past). Stopping the car, as he did, had a high probability of collision, but a low probability that the damage would have been great. Had he chosen the alternative of increasing speed and going past the car, the probability of collision would have been low, but if he were hit, there was a higher probability that the damage would have been greater. In this situation, the driver chose the alternative with a high probability of occurrence over the alternative with a low probability of occurrence because he placed more weight on the severity of the accident than he did on having an accident. Another driver may have evaluated the situation in the opposite manner. Exhibit 3 illustrates the choices and their associated outcomes.

EXHIBIT 3.—OUTCOMES OF ALTERNATIVE ACTIONS: ONE DRIVER

Stop	*Speed up*
Accident likely Damage little	Accident unlikely Damage great

A study which deals with individual preferences among possible outcomes may use a number of possible techniques. A situation could be set up in which the subject must choose between alternative actions. This might be in the form of a questionnaire requiring the subject to mark his responses on a paper. The situation above might be adapted to this purpose.

In the suggestions for study of individual preferences, the assessment of the likelihood of environmental occurrences was omitted. To complicate the study, and to bring into it the aspects of a game, another driver may be added. The task involved in this sort of a two-person game would be to evaluate alternative actions, taking into account the actions of another driver. The respondent must then assess the likelihood of certain behaviors on the part of the other driver. Although this makes the task more difficult to handle in a research situation, it increases the realism of the situation and expands the amount of information obtainable.

In Exhibit 4, the following situation is considered: two drivers meet at an intersection controlled by a four-way stop sign; they arrive at the intersection simultaneously. Both drivers are late for an appointment. There are two alternatives available for each driver. The driver can wait or he can proceed through the intersection. The matrix of outcomes is considered from the position of Driver 1.

EXHIBIT 4.—OUTCOMES OF ALTERNATIVE ACTIONS: TWO DRIVERS

IF DRIVER 1	AND IF DRIVER 2	
	Goes	*Waits*
Goes	Accident Late	No accident Not late
Waits	No accident Late	Prolonging decision Late

This type of experimental situation could be accomplished with the use of toy cars—the experimenter manipulating one car according to a prearranged set of maneuvers, and the respondent manipulating the other. Another possibility for accomplishing such a study would be the use of motion pictures or slides. The driver could be presented with a situation including another driver, and he would then be told the alternatives and their respective pay-offs. If the hypothesis is advanced that a driver who is likely to have accidents is generally a high risk taker (i.e.

he does not choose alternatives rationally), a study could make use of game situations which are completely abstracted from the driving situation. The assumption involved in these situations is that if a player acts rationally he behaves so as to maximize his rewards and minimize his losses.

Conceptualization of the decision process and the construction of research designs to explore this process are not done simply, and the lack of realism mentioned above may be a deterrent. One of the reasons such a study was not included in this project was because of its complicated nature and the shortage of time—as well as staff trained specifically in the area of game theory and its associated mathematics. However, it is also believed that this would be an exceedingly fruitful approach to the study of accidents, and it is urged that such a study be done in the near future.

Another area of proposed research is the study of role-taking. When an individual assumes the viewpoint of another individual, he is taking the role of the other. In an important sense, this is an intrinsic aspect of making the game theory model applicable to the driving situation. The player of a game must assess the possible actions of other players and make his decisions accordingly. In the driving situation, a driver must be able to put himself in the other driver's shoes to predict the other's actions. Driving behavior is based on such predictions about the nature of the environment and its changes.

Role-taking is helpful to the driver in assessing the possible maneuvers of another driver. Sociologically, a role is a set of obligations and expectations accorded to a status position. For example, a father is a role composed of certain obligations and expectations with regard to his children. When a sociologist speaks of role taking, he refers to a son putting himself in his father's place and acting as a father. The driver does not take on a *different* role when he attempts to predict the behavior of another driver. Rather, he attempts to predict the behavior of another individual playing the *same* role in different circumstances.

The relative ability to take roles is an individual characteristic that is hypothesized to be relevant to the driving situation. The more accurately an individual can play someone else's role, the better able he is to predict his behavior. The more accurately a driver is able to put himself in the place of another driver, the better able he is to predict that driver's future actions.

With regard to the driving situation, an individual's ability to predict the behavior of others is possibly a function of three things: his ability to take the role of the other (this involves his ability to abstract himself from his immediate circumstances), his experience as a driver and his driving skill. The driver must have sufficient experience to be able to know what drivers usually do so that he can predict what they will do in a particular situation. He must also have a sufficient knowledge of the rules of the road and the skills to carry out these rules so that the driving behavior which he predicts (on the basis of what he would do in that situation) is skillful and lawful. Even if a driver is very capable of putting himself in the other person's place, he may not correctly predict the other's behavior because he himself does not know the rules of the road or have the skill and driving experience necessary. Similarly, even if the driver has the appropriate skills, he may not have the ability to abstract himself from his immediate circumstances and predict what the other driver will do. This would suggest that in studying role-taking in the driving situation, the respondent's skill and experience be held constant.

Role-taking ability may be studied both within the driving realm or abstracted from it. If it is studied in the context of the driving situation, such techniques as movies, slides, and paper and pencil situational tests may be employed. A motion picture could be designed, for example, that would show the other driver's behavior in situations in which the number of behavioral alternatives is few and controlled. Actual experiments were made with such films in connection with this project. The respondent could then be asked to "tell what the driver will do next." Similar

situations could be done with slides with the loss of some realism.

A first attempt at a study of role-taking in the driving situation was made with the use of the Driving Situations Test. However, this was used in a diagnostic fashion to obtain a picture of how the respondent viewed the driving world. The test requires that the respondent predict what the driver in the picture will do and what he is "like as a person." One of the assumptions of this test was that the respondent would view himself as the driver in the picture. This type of situation could be converted to a role-taking test if it were specified that the person pictured is the other driver.

Because it may be hypothesized that role-taking ability of a more general sort may be useful in predicting the behavior of drivers, it may prove profitable to investigate this ability to see another's viewpoint. For this purpose, it would be possible to employ role-taking experimental situations of a more general nature than those relating specifically to traffic. It might even be possible to employ role-taking tests already developed such as those used by Sarbin. He found that middle class groups perceive the role cues in the same way. He was thus able to establish a model response for each sentence. He also found differences among individuals who responded in the model way and those who did not. In an experiment of Cline's reported by Sarbin, motion pictures of job applicants in a realistic situation were shown to respondents. They were asked to check an adjective checklist of personality traits as though the job applicant had checked it. They were also asked to describe the individual on the basis of a series of multiple-choice items. These studies are suggestive at least of techniques which might be adapted to the driving situation.

On the basis of the use of the Driving Situations Test in this project and theoretical considerations, it is felt that a study of role-taking and predicting the behavior of other drivers should be done in the near future. This has been a badly neglected area of investigation in the accident field.

The above ideas for applying techniques of game theory and role-taking to traffic accident situations are intended only to point out two of many possibilities of focusing scientific attention on the problems of the ordinary driver in traffic situations.

Unfortunately, generalizations from the data obtained in this work cannot be made with confidence. As detailed in the full report, the criteria for selection of the case group apparently lacked consistency, varying with time of day and month. The case group seems, as a result, to have borne no known relationship even to the accidents occurring in the same area during the same period. Furthermore, because no control drivers, pedestrians, vehicles, or highway situations were studied, there was no way of knowing whether the characteristics of the case group differed in any way from those of the population at risk. Hence there can be no certainty that the characteristics described, other than those relative to the crashes per se, were differentially—and, hence, potentially causally—associated with the occurrence of the accidents studied.

Another major weakness of accident research in general is the grouping together of accidents of too great heterogeneity. Since there is much evidence that the significance of specific causal factors can vary substantially among accident types, it is essential for most purposes that the groups studied be homogeneous, especially when resources are limited and only small numbers of cases can be studied. In addition it is usually far more profitable and scientifically defensible to limit consideration to the number of variables that can be cleanly studied rather than to include a vast array of possibly germane and often poorly studied factors. (The "Case Study Data Sheets"

used in the preceding study provide for 380 items of information, and 289 "accident factors" were "derived" from the 68 cases. Even if the case series had been obtained with statistically satisfactory methods, and even if controls had also been obtained, it would be difficult, if not impossible, to rule out chance associations in studying such an array of factors in relation to fewer than 70 individuals.) Despite these limitations, however, such studies can be useful for the development of new research techniques, as was the case with this work.

This portion of the full report serves as an excellent introduction to what its authors describe as "the behavioral scientist's concern [with] the social and psychological characteristics of the driver, the events leading up to the accident, the accident itself and the driver's reactions to these occurrences." It contains, in addition, several interesting suggestions for further research.

A CONCEPTUAL ANALYSIS OF THE ACCIDENT PHENOMENON

—Edward A. Suchman, Ph.D.

Accident research has, for the most part, been so concerned with meeting the immediate demands of prevention and control that until recently relatively little attention has been paid to the development of accident theory. Lacking such basic formulations, much of the research in the field has been conducted haphazardly, using a variety of definitions and measurements and proceeding on various assumptions, with little continuity of conceptualization or accumulation of knowledge from one project to the next. In the absence of an over-all framework, investigators have tended to overemphasize certain behavioral elements, such as personality factors, and to neglect others of perhaps greater importance, such as social values concerning safety.

In the following paper, Suchman attempts to develop a systematic and sophisticated definition of accidents from a behavioral-science point of view. His conclusion is that accidents should be regarded as a form of injury-producing behavior that can profitably be studied in much the same way as any other social act. In this formulation, the major defining characteristics of an accident are "degree of expectedness," "degree of avoidability," and "degree of intention," with corollary "symptoms" including "degree of warning," "duration of occurrence," "degree of negligence," and "degree of misjudgment." Suchman suggests the study of other behavioral events which have characteristics similar to those of accidents—for example, forgetting an appointment or losing an article. The analysis of such a class of accident-like events considerably broadens the range of behaviors of interest to the accident researcher, as has already been well demonstrated by the study of near-accidents.[9-11]

In the analysis of accidents as social acts, Suchman divides the accident process into a number of stages, of which the actual injury is only the final outcome. Thus the behavioral scientist should perhaps be interested in all unsafe practices or behaviors, regardless of whether they culminate in an injury. He should also be concerned with the entire ecology of danger (see Gibson's discussion in Chap. 6) and with the gamut of bodily and structural insults, not merely those that produce

damage of certain types. (Infections, for example, although they are usually just as unexpected and damaging as burns, are rarely considered accidental.) Suchman's model of behavioral analysis would require that all such events be studied as a form of human behavior, all appropriate psychological and social concepts being employed.

Of especial interest is Suchman's point that, "as our knowledge of causal factors increases, we are more likely to describe an event in terms of these causal factors and less likely to label it an 'accident'." Since the specific causes of the types of unexpected damage that are still regarded as accidental are now also recognized, perhaps the texts of the future will eliminate their sections on accidents and substitute chapters concerned with the nature and prevention of the mechanical, thermal, chemical, and other insults that were formerly considered accidental. The fact that this change has already begun[5] reflects the general shift in the emphasis of accident research and prevention activities to which we referred in Chapter 2.

Several other problems of definition and classification discussed by Suchman are of similar concern to medicine. For example, most insults to the body are usually catalogued in terms of their results alone. Thus, the classification is not usually based on whether a pathogenic virus *may* reach the host; rather, it is based on the results that insult produces when it *does* reach the host.

* * *

Problems of Definition

Research on accidents must begin with an attempt to define more clearly which events shall be called accidents. It is doubtful that any single definition will cover all types of events of interest to the student of accidents. Much will depend upon the objectives or special interests of the researcher. If we view an accident as the end product of a sequence of acts or events which result in some "unanticipated" consequence that is judged as "undesirable," we can immediately see that what is called unanticipated and undesirable may vary from individual to individual, from situation to situation, and even from culture to culture. These are subjective terms which are not easily amenable to rigorous definition.

Let us look briefly at some of the variations in meaning and emphasis which these terms can have. From the point of view of medicine and public health, accidents are listed among the various diseases as a cause of death. Certainly an accident is not a disease in the physiological sense, and it is not the accident but the "undesirable" injury that is the ultimate cause of death. In medicine and public health, therefore, the accent is upon the *consequences* of the event as determining whether or not that event will be called an accident. The same event, e.g., falling down stairs, will be called an accident if it results in an injury, but not called an accident if the individual picks himself up without any bodily injury. (But this event may still be labeled an accident if it subsequently produces some emotional disturbance, such as a fear of heights.) Thus, from the medical point of view, an accident may be viewed as a form of *injury-producing behavior*. The medical interest lies in preventing, lessening, or treating the injury (e.g., a good public health technique for preventing playground accidents might be to use sawdust under the swings—the child may still fall off but there will be no accident as long as there is no injury). Accidents, therefore, from a medical point of view are of interest only as "causes" of injury or death. It is not the accident per se that is of interest, but, like

[Reprinted, with omissions, from *Social Problems*, 8:3:241-253, 1961.]

poor housing, or a polluted water supply, the accident is attacked because it produces an unhealthful condition.

Other points of view beside the medical are possible. For example, the field of law would probably be more interested in the antecedents than the consequences of the accident. Here the emphasis is upon the "unanticipated" variable in our definition of an accident. A legal analysis might attempt to determine to what extent an individual should be held responsible for the sequence of events leading to the accident. Homicide, for example, is an accident only if it is unpremeditated. Important distinctions are made between "acts of God" and "acts of man" in terms of liability. The focus of the undesirable consequences may also shift from individual injury to property damage. If our victim of the fall down the stairs escapes injury (and therefore a medical accident), he is still liable to a legal accident claim if in the course of his descent he damages the banister.

A great deal of the present confusion in discussions about accidents stems from these quite legitimate differences in points of view. Our task will be to see to what extent we can separate the uses to which the term *accident* is put from its inherent distinguishing characteristics. How may we logically define the concept of accidents in such a way as to separate accident from non-accident events, and then to develop a taxonomy of accidents which would permit us to classify the various forms of accidental events?

We begin with the two major attributes of accidents already noted in the common-sense definition of the term—unanticipated (i.e., chance) "causes" and undesirable (i.e., negative) "effects." These two factors do seem to constitute the major dimensions of most definitions of accidents. For example, Gordon and Aycock define accidents as "a chance event developing without foresight or expectation, and resulting in injury or loss." The *New International Dictionary* defines an accident as "(1) an undesirable or unfortunate happening; casualty; mishap, (2) anything that happens unexpectedly, without design, or by chance."

We can, however, raise several challenging questions concerning these two characteristics. First, what do we mean by an unanticipated or chance event? The so-called "act of God," such as being hit by lightning or drowning in a flood, is generally considered as the most completely unavoidable and fortuitous event. At the other end of the scale would be an "act of man," where it is quite clear that the event was due to some manmade intervention. However, in a great many cases, this distinction between "acts of God" and "acts of man" becomes quite arbitrary. As science learns more about the "acts of God," they tend to become "acts of man." Furthermore many behavioral (or manmade) events are even less predictable or controlled than natural phenomena (acts of God). It would seem to make much better sense from the point of view of definition to avoid this rather mystical distinction and instead to classify events according to their degree of predictability and control.

In a similar way, we can examine the dimension of "undesirable" effects and, once again, note the subjectivity of this appraisal. Physical injury in the medical sense can vary from minor cuts to crippling and to death. The assessment of the amount of property damage resulting from an accident may require the skills of a highly experienced insurance adjuster. Several research workers have questioned the validity of including the injury or damages altogether as an inherent part of the definition of accidents. "The resulting injury is a consequence of this unplanned event, and does not in itself constitute the accident—it follows afterward."

If we relate these two dimensions of unpredictability and injury, we see that, to a large extent, these two variables are quite independent of each other. It is, for example, possible for an individual to fall down the stairs (the chance event) without hurting himself (the injury), just as it is possible for an injury to be the result of some "planned" event rather than a chance event. Although the presence of an injury or damage may be a necessary condition for a medical or legal interest in accidents, it does not appear to be

an inherent part of the definition of the accident phenomenon.

The analysis above underscores some of the major problems involved in defining an accident. It seems apparent from the criticisms of much of the current data that we are dealing with a complex event for which we can only hope to develop a "range" definition rather than a "class" definition. We cannot define accidents as a simple, unitary concept; instead we must list a set of criteria for characterizing accidental events. In describing some event, the term "accident" is more likely to be used the more the event manifests the following three major characteristics:

(a) *Degree of expectedness*—the less the event could have been anticipated, the more likely it is to be labeled an accident.
(b) *Degree of avoidability*—the less the event could have been avoided, the more likely it is to be labeled an accident.
(c) *Degree of intention*—the less the event was the result of a deliberate action, the more likely it is to be labeled an accident.

Thus, an accident may be defined as that class of event which involves a low level of expectedness, avoidability, and intention. This definition would therefore include as accidents not only those events that result in bodily injury (e.g., *medical* accidents) but also those unexpected, unavoidable, and unintentional acts such as losing things or forgetting appointments (e.g., behavioral accidents).

From this point of view, the definition of an event as an accident becomes a matter of setting up a cut-off point as to the degree of the unexpected, unavoidable, and unintentional that is required before one is willing to accept an event as being an accident. It is obvious that this cut-off point will vary from group to group (e.g., a child's swallowing of poison is more likely to be accepted as an accident than would the same act by an adult) or from time to time (e.g., a person falling ill with malaria a hundred years ago may have been more readily viewed as the victim of an accident than would an individual today who deliberately enters a malarial mosquito-infested area without taking due precautions). Knowledge, in both cases, is assumed to reduce the unexpectedness and unavoidability and to make the subsequent negative consequences more the fault of the individual (i.e., intentional) than of the circumstances.

This definition of an accident clearly removes the presence or absence of an injury from the definition itself and makes it a consequence of the accident. Why the individual was injured becomes a separate question from why the accident occurred. Furthermore, there is nothing in our definition to limit accidental events to those with undesirable consequences. Whether the result of the unexpected, unavoidable, and unintentional act is an unhappy or a happy one remains independent of our definition. Our attempt here is to set up a class of events which can be studied quite independently of their consequences.

To our list of three defining characteristics, we may add certain corollaries which appear to be associated with the degree of expectedness, avoidability, and intention. To some extent these may be viewed as symptoms of accidents—the more they are present, the more likely is it that the event will be diagnosed as an "accident":

(a) *Degree of warning*—the less warning, the more likely the event is to be labeled an accident. (This characteristic is related to the degree of avoidability, since preventive behavior is more likely to occur if the individual is given enough time.)
(b) *Duration of occurrence*—the more quickly the event happens, the more likely it is to be labeled an accident. (An accident is usually over quickly, again reflecting a low degree of control.)
(c) *Degree of negligence*—the more recklessness or carelessness associated with the event, the less likely it is to be labeled an accident. (Negligence implies that the event was avoidable and therefore, "It was no accident.")
(d) *Degree of misjudgment*—the more mistakes in judgment associated with the event, the less likely it is to be labeled an accident. (Misjudgment implies a degree of predictability and, hence, the less likelihood of such an event being called an accident.)

In another sense these characteristics may be viewed as predicters or causes of accidents. We hypothesize that the more an event involves each of these characteristics, the more likely is it that the event will have

the kind of consequence (i.e., injury or damage) which will lead one to label it an accident.

There is some degree of the unexpected and unavoidable in all events, and which of these events is called an accident depends upon the cutting-off point one wishes to use. For the researcher, this means that almost all events can be studied for their accidental qualities—and that all "accidents" must be studied in terms of their nonaccidental qualities. This approach opens up for analysis large areas of human activity which previously were not envisioned as being of interest to the accident researcher: losing articles, forgetting appointments, etc. Similarly it forces the accident researcher to challenge a great many of his current concerns (e.g., adult poisonings) in terms of their inherent accidental qualities.

To a large extent the labeling of an unexpected and unavoidable event as an accident is a matter of cultural definition, depending upon the value a society places upon the consequences of that event. Thus, in different societies and perhaps even among different groups in a single society, the same event may or may not be called an accident depending upon the society's judgment as to the degree of predictability, control and damage involved. To the extent that the society views the event as unexpected or the damage as serious, it is likely to call the event an accident. Thus it also follows that knowledge of causation increases the predictability of an event and may serve to remove the event from the accident classification. (We have already noted the change in definition of an "act of God" to an "act of man" with an increase in knowledge of causation.) This has been illustrated repeatedly in medicine, where a disease may at first be viewed as an accident, but with increased understanding of the etiology of the disease and increased success at prevention, it is no longer viewed as an accident.

Thus the description of an event as an accident, we would maintain, is largely a matter of the degree of understanding of causal factors in the situation, the possibilities of control or prevention, and the seriousness of the damage involved. As our knowledge of causal factors increases, we are more likely to describe an event in terms of these causal factors and less likely to label it an "accident." The problem of defining an accident for research purposes becomes largely a matter of determining the "operational" indices for observing and measuring the amount of predictability, control, and damage associated with the event.

Problems of Operational Indices

* * *

An accident may be thought of as progressing through a series of stages. In describing the accident, we are likely to concentrate on the immediate events which produce the injury or damage. However, the accident began at some earlier stage, and just where to cut the developmental sequence is a problem of operational definition. We might divide the entire sequence into three broad segments. Working backwards from the accident, we have first the actual injury-producing event, preceded by the unsafe behavior in the face of some existing hazard or danger, in turn preceded by some predisposing characteristic of the individual involved in the accident. . . .

Brody offers an interesting possibility of defining accidents not so much in terms of their outcome as in terms of certain "unsafe practices" which could lead to an accident. ". . . the accident criterion is much weaker for analytic purposes than the criterion of unsafe practices or violations. By far the great majority of the latter never become accidents because other conditions necessary to precipitate an accident are not in play at the precise moment of time." 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 our dependent variable, the actual accident or injury, from the independent variable, the unsafe practice. Thus, we might talk about injury-producing behavior instead of acci-

dents. This distinction could broaden research on accident prevention to include study of unsafe behavior which did *not* culminate in an accident or injury.

The determination of unsafe practices is largely a matter of subjective evaluation. We have to make judgments as to predictability and control, including an assessment of individual negligence or responsibility. It is doubtful that any set of objective operational criteria can be developed to separate accidental from nonaccidental events. From a research point of view, it appears much more promising to classify events according to the degrees of predictability and control and to speak about accident research as research aimed at determining those factors which increase or decrease the predictability or control of specific events. Research on traffic accidents would thus attempt to evolve a set of operational indices for such factors as reckless driving behavior, hazardous road conditions and dangerous car conditions according to which collisions etc. (not "accidents") could be evaluated.

It has been claimed that accident research is difficult because accidents are rare and unanticipated events. What is really meant is that, out of the large number of unexpected and unavoidable events that involve any single individual, only one or two may result in an injury serious enough to require medical attention. It is our contention that any individual is constantly having accidents, and that we can learn a great deal about this phenomenon by studying all accidents rather than only those that result in a reportable injury. This point is especially relevant to accident prevention because we are interested in decreasing the lack of predictability and control in the situation quite apart from the element of injury.

It would be extremely interesting to compare accidents with other phenomena involving the unexpected and unavoidable, such as "accidents" in which one oversleeps or forgets an appointment or loses an object. In what respects can these forms of behavior be classed with accidents which produce bodily injury? Another important empirical question would involve the degree to which actual accidents are recruited from near-accidents. Are there other differences besides the injury between accidents and close calls?

From a research design point of view, it becomes important to reformulate our definitional characteristics in terms of predictive criteria (or else we run the danger of defining an accident in terms of its symptoms, leaving ourselves no way to then test the validity of these symptoms as predicters of accidents). Thus we would have to hypothesize that more unexpected, unavoidable, and unintentional acts will result in measurable consequences of an accident (i.e., injury or damage) than would expected, avoidable, and intentional acts. It becomes extremely important to study nonaccidental events for the presence or absence of these definitional characteristics or symptoms.

The following table indicates the various factors that need to be considered in research on accidents, using the above approach. This scheme anticipates our discussion in the next section on explanatory models, but we present it here, without detailed comment, because of its relevance to the problem of operational indices.

According to this model, we may study injuries as the measurable indices of the accident but the "accident" itself is the unexpected, unavoidable, and unintentional act resulting from the interaction of host, agent, and environmental factors within situations which involve risk taking and perception and judgment of danger.

* * *

Since an accident, like any other form of human behavior, progresses through a series of stages of development, several models have been developed for the analysis of the accident sequence or chain of events. It is in fact difficult to distinguish between an accident and a non-accident event prior to the moment of the actual accident. In an analysis of the dynamics of a traffic accident Fansler distinguishes twelve stages in the development of an accident and concludes "The interesting thing to notice about this

MAJOR FACTORS IN THE ACCIDENT PHENOMENON

Predisposing characteristics	*Situational characteristics*	*Accident conditions*	*Accident effects*
Susceptible host, hazardous environment, injury-producing agent	Risk-taking, appraisal of hazard, margin of error	Unexpected, unavoidable, unintentional	Injury, damage

chart is that for the unsafe driver the chain of circumstances is the same through to stage X whether the result is a collision or a near miss. . . . A traffic accident may be said to begin when a driver climbs into his car and drives off." While this analysis according to stages is more descriptive than it is explanatory, it does underline the need to view accidents as a gradually developing sequence rather than solely in terms of the immediate emergency situation.

There can be little doubt that the injury is only the end-point of a developing sequence of behavior surrounding the accidental event. From the behavioral point of view, the injury is actually of interest only as an indicator that an accident may have happened. The activity preceding the injury can be viewed as a segment of behavior and studied in much the same way as any segment of behavior. To be sure, the focus will be upon those factors which determine the exposure of the individual to a hazardous situation and his reactions within the situation. This model would concentrate upon the determination of factors which make for unexpected, unavoidable and unintentional acts involving situations with a potentiality of injury or damage.

* * *

Like many theoretical formulations, the validity of this conceptual approach depends upon its usefulness in the more rigorous testing of hypotheses concerning the factors that favor the occurrence of accidents. A test of its validity would involve the observation of accidents, near-accidents, and accident-like events to verify whether in fact each of these is a special case within a larger class of behavior. Should the assumption prove valid, this approach to accidents would enable the full force of social and psychological theory and research to be brought to bear on a larger range of accident-related behavior than is possible at present.

To date, social and psychological studies of accident causation have not been highly productive. The relationships discovered between specific social and psychological factors and accidents have been relatively few, and often in the direction to be expected.[12] To some extent this may be due to the fact that accident situations are highly complex and often transient, and that an individual's susceptibility may involve a host of personal characteristics. Although a high proportion of accidents may be initiated by substantially behavioral factors, the behaviors involved are highly varied, and it is doubtful that many specific factors per se regularly play major roles. Thus, although statistically significant relationships may be found between specific social or psychological factors and accidents as a whole, these associations are likely to be weak and to have little relevance to the bulk of the accident problem.

It must be borne in mind, however, that although a specific behavioral factor may be related only weakly to the heterogeneous totality of accidents or even to a heterogeneous category of accidents (automotive accidents, for example), this same factor may be very powerfully related to a homogeneous segment of the whole. Such a segment, even though it is a very small fraction of the totality, may nevertheless

represent a substantial number of deaths and injuries. Thus, if a behavioral factor is found to be of major importance in only 5 percent of automotive accidents in the United States, its control could save some 2000 lives per year and avert innumerable injuries.

For these reasons, the most sophisticated—and probably the most productive—use of behavioral variables is likely to lie in the delineation of relatively homogeneous segments of the totality of accidents. In addition, behaviorally oriented accident research seems likely to become more productive to the degree that it employs more reliable and valid methods of data collection and clarifies its definitions of behavior in relation to the ecology of danger (see Gibson, Chap. 6). But, by and large, it appears that the behavioral scientist would have much more to contribute to accident research if he devoted relatively less attention to individual factors and more to social attitudes and behavior in so far as they influence the presence of environmental hazards and the decision to take risks. An understanding of these broader processes, particularly in relation to individual risk-taking behavior and its dynamics, may succeed where narrower studies of individual characteristics have failed.

Despite their shortcomings, most of the studies presented in the next three chapters represent the upper end of the range of quality in behavioral research on accidents. In general, the quality of studies in this area is quite poor, in part because of the inherent difficulty of studying systematically phenomena that usually occur infrequently (and over which the individual may have little control), where observations of the actual phenomena as they occur are often impossible, and where reliance must often be placed upon second-hand reports and other ex post facto sources. However, similar difficulties in connection with the infectious and other biological insults to the body have not prevented sophisticated research, and their presence in accident research is not a valid excuse for work of poor quality.

In general, many of the social and psychological studies of accidents have suffered from the following deficiencies, several of which have been discussed also in Chapters 2, 3, 4, and 9:

1. Lack of hypotheses clearly formulated in a form which permits reasonable proof or disproof.
2. Poorly defined concepts both of causal factors and of the kinds of accidents being studied.
3. Use of second-hand reports and data sources of unknown representativeness, reliability, and validity, which, in addition, often yield samples of inadequate size.
4. Absence of adequate controls for matching accident and nonaccident groups on such crucial variables as degree of exposure and background characteristics.
5. Excessive reliance upon respondents' subjective reports of accident sequences (see Chap. 9 with respect to the influence of the rapidity with which accidents happen on the participants' perception of what takes place).
6. Insufficient attention to the dynamics—the how and why—of the accidents studied. (For examples of studies concerned specifically with the how and why of accidents, see Sheldon, Warren *et al.*, and Brown in Chap. 4, De Haven and Hasbrook in Chap. 9, and references 8 and 13.)
7. Inadequate statistical methods.
8. Absence of necessary qualifications to findings and overgeneralization of results.

Much more could be done to overcome these obstacles than is being attempted at present. At least from a behavioral-science point of view, accident research has not yet come of age.

SPECIFIC AREAS OF NEEDED RESEARCH

—Edward A. Suchman, Ph.D., Alfred L. Scherzer, Ph.D.

We conclude this chapter with the following analysis of accident research possibilities for the behavioral sciences. This list of areas of needed research was prepared in relation to the study of childhood accidents, but it is also largely applicable to research on adult accidents. It shows the wide range of problem areas that are opened up when one brings behavioral science approaches to bear upon accident problems.

* * *

The Conceptual Definition and Analysis of an "Accident:" Basic to further research on accidents is the study of a wide range of accident and near-accident events in an attempt to determine the major conceptual dimensions of "accidents" and their operational counterparts. By collecting detailed descriptions of actual and potential accident situations and analyzing the major characteristics of these situations, we may be able better to define accidents both conceptually and operationally so as to permit comparative and cumulative research. Conceivably we may be able to develop a typology of accidents including such variables as the role of "chance" factors, the degree of human "planning or control," the amount of risk involved, the extent of injury sustained, etc. The objective of this research approach would be to try to answer such questions as:

What factors determine which events should be called "accidents"? [See Chap. 9 for a discussion of this question. Eds.]
How can accidents be classified?
What are the major dimensions involved in accidents?
In what respects do accidents that happen to preschool children differ from accidents to other age groups?
Can accidents occur "deliberately"?
Must an accident involve some injury?
How do accidents differ from near-accidents?
How much control does man have over accidents?
To what extent are "decision-making" and "risk-taking" involved in accident situations?

The "Causal" Analysis of an Accident Sequence: Closely related to the conceptual definition of an accident is the identification of the major stages or steps in the accident sequence. We need to know more about the way in which accidents develop—or are circumvented. Accident situations need to be analyzed in detail to identify the "causal" chain of events and the occurrence of "trigger" events that touch off the accident. This type of detailed description of what actually occurs in an accident situation, including data on the environment (the physical accident potential), the participants (the personal susceptibility), the act (the sequence of events), and the injury (the accident result), may be expected to yield answers to such questions as:

How and when does the accident sequence get started?
Through what stages do accidents develop?
What are the critical points at which "trigger" events occur?
What factors "frustrate" the accident chain?

[Reprinted from *Current Research in Childhood Accidents*, Association for the Aid of Crippled Children, New York, 1960, pp. 47-52.]

. . . .

When does crucial decision-making take place?

When and how does risk-taking occur?

Do different people or situations show different accident sequences?

Developmental Study of Accident Behavior: We know very little about the way in which children and adults learn to behave in actual and potential accident situations. To a large extent accidents result from poor learning or mistakes in judgment. We can hypothesize that the child learns to avoid accidents on the basis of unfortunate personal exposure, vicarious experiences, successful admonitions, and the learning of general and specific skills. Such learning probably involves elements of cognition, memory, productive thinking, and evaluation. We have very little knowledge about the mental or developmental factors that are involved in accidents—both in prevention and in behavior during accidents. Similarly, we know very little about personality development in relation to accidents, or about the role of parents' child-rearing attitudes and behavior. A detailed study of developmental behavior in regard to accidents should shed light on such questions as:

What factors promote or deter the learning of safe behavior?

What factors of the intellect are involved and how do these develop?

What kinds of judgment does the individual make in an accident situation?

Can we develop criteria of safety development among children and discover how these may be used to evaluate progress?

How does parental supervision affect the development of the child's safety behavior?

What role does past experience with accidents play?

What part does personality play in safety behavior?

What are the best ways of promoting the development of safe behavior?

A Study of Decision-making and Risk-taking in Accident Situations: We have hypothesized that accidents are most likely to occur where an individual with poor decision-making ability takes high risks in an unsafe environment. As yet, however, we know very little about the kinds of decisions that are called for or the decision-making models that would be most productive for the study of accidents. Similarly, we have yet to develop probability models for risk-taking in relation to childhood accidents. A study of decision-making and risk-taking should also take into account the social and psychological factors that affect decision-making and risk-taking. An understanding of these processes should help to answer such questions as:

To what extent and in what ways do the child and the adult assume decision-making responsibilities in various accident situations?

What conditions promote risk-taking?

What factors interfere with good decision-making?

What is the relationship between perceived and real accident probabilities?

How does a child learn the probabilities of risk-taking?

How do role and status factors, personality, and social pressures affect decision-making and risk-taking in relation to accidents?

Under what conditions does decision-making occur "irrationally," involving impulsive, casual, or confused behavior?

Study of Accident Repeaters: Currently, there is a great deal of inconclusive debate concerning the validity and utility of the concept of "accident proneness." This concept has been attacked on both theoretical and methodological grounds. It has been argued that accident proneness does not constitute a meaningful conceptual entity and that insufficient attention has been given to the purely chance occurrence of accident-repeaters or to adequate controls on degree of exposure to accident-producing situations. There is a great need for a rigorous study of this concept, taking into account the underlying "mechanisms" or needs served by

repeated accidents. This study should provide conclusive evidence concerning such questions as:

Do certain individuals over a long period of time tend to have more accidents than others under conditions of equal exposure?

Can we predict future accident occurrence for individuals on the basis of their past accident history?

How do transient emotional factors such as periods of stress and indifference affect accident repetition?

Does "accident proneness" carry over from one situation to another, or are certain individuals more susceptible to accidents only under certain conditions?

What are the personality characteristics of the accident repeaters, and do these form any kind of identifiable psychological entity?

What role and status factors, social pressures, environmental conditions, etc. are most likely to "cause" repeated accidents?

Can "accident proneness" be "cured"—*i.e.*, how can the pattern of repeated accidents best be interrupted?

A Comparative Study of Accidents: Most studies of accidents to date have been limited in terms of both the populations and the types of accidents studied. We know very little about cross-group differences in accident occurrence. Conceivably, we may find that both the rate and type of accident will vary for different cultural or social subgroups and that certain kinds of social systems tend to have more accidents. Cross-community comparisons would aid our understanding of those factors in the social or cultural climate which influence safety behavior and the occurrence of accidents. Similarly, cross-situational comparisons of similar groups would indicate the degree and nature of transferability of accident factors from one situation to another. Some of the questions such comparative studies might serve to answer are:

Do different international and intranational communities show varying accident patterns?

What cultural and social factors are related to differential rates and types of accidents?

Can accidents serve as an index of social integration or control?

To what extent can we predict accident rates on the basis of social or cultural settings?

What is the *relative importance* of situational, individual, and social factors in accidents?

How do cultural differences in child-rearing patterns affect safety behavior and accidents among children?

In what way are individual accident patterns affected by changing group memberships?

What community or group factors are most subject to the successful control or prevention of accidents?

The Function or "Meaning" of Accidents: Many accidents, we hypothesize, serve an important function for the victim. In some cases the accident may be "caused" deliberately in order to produce some desired result; in other cases, even if the accident is unintentional, it may be used by the individual for some personal purpose. We need to know more about the social psychological functions that accidents may serve. Furthermore, we may hypothesize that an accident has a different meaning to different groups and individuals. For some it may represent an "act of God," perhaps a form of punishment, whereas for others it may serve as proof of personal weakness or inadequacy. It may be expected that the individual's reaction to an accident and to attempts to develop his safety behavior will reflect the function or meaning that the accident has for him. A study of the different functions or meanings of accidents would help us to answer such questions as:

What are the functions which accidents can serve for the individual?

How do various groups and individuals view the occurrence of accidents and near-accidents?

In what ways does one's definition affect one's attitudes toward and behavior in accident situations?

What cultural values relate to the meaning and function of accidents for the individual?

What is the meaning of danger or risk-taking to different groups?

Why do some individuals "accept" accidents more readily than others?

What social and psychological factors determine the individual's acceptance or rejection of safe behavior patterns?

How do various groups view the victim of an accident?

How can accident prevention take into account the "meaning" of accidents for the individual or the group?

The Adjustment to and Consequences of Accidents: Much research has been done on the problem of rehabilitation of the individual injured as the result of an accident. Most of this research, however, has been limited to medical problems of physical rehabilitation. There is also a need for research on the problems of social and psychological adjustment of the child who is crippled or disabled and of the consequences of this disability for the child's family. A serious accident, especially to a preschool child, is likely to have far-reaching psychological and social effects upon both the child and his family. The extent of group support or disapproval of accidents and the accident victim will affect the course of adjustment. The accident potential of individuals who have had accidents may be increased or decreased by their ability to learn from the accident and by the meaning the accident has for them. We may hypothesize that adjustment following an accident will raise several special problems. Among these are the following:

What factors affect the individual's reaction to an accident?

What changes occur in the individual's self-image as a result of the accident and the injury?

How are problems of adjustment—*e.g.*, feelings of guilt or inadequacy—affected by the nature of the accident?

How is the individual's future behavior affected as a result of having had an accident?

How is the parents' behavior in relation to the child affected by the accident?

To what extent does labeling a child as "accident-prone" result in the "self-fulfillment" of this prophecy?

Prospective Study of Accident "Causation:" We do not yet have a detailed study of the "causative" factors in accidents conducted over a long period of time with a representative sample of children. Such a study would provide basic prevalence and incidence statistics and would permit the testing of some of the hypothesized "causal" factors. This type of social epidemiological study could obtain detailed information about the social background of the child and his family, personality characteristics of the child and his parents, information about special mental, emotional, and physical conditions, detailed descriptions of accident situations, including physical, social, and psychological variables, etc. The study should include instances of near-accidents as well as actual accidents. Predictions should be made and checked about the future occurrence of accidents. This type of prospective survey could provide basic information on such questions as:

What are the prevalence and incidence of various types of accidents for various groups of children?

Which factors are associated with which types of accident for which groups of children?

How do developmental and growth factors in children affect the occurrence of accidents?

What is the relative importance of "environment-host-agent" factors in childhood accidents?

What factors are most predictive of future accidents?

What situational factors appear most significant in the accident sequence?

Experimental Studies of Specific Factors: As we learn more about the various factors that are associated with accidents, it will become increasingly necessary to subject some of these hypotheses to experimental testing. These experiments could be conducted in nurseries, day care centers, playgrounds, camps, schools, etc. Although many factors will remain beyond experimental manipu-

lation, certain basic variables could be studied under controlled conditions. Some of these might include:

The effect of different types of supervision—*e.g.*, permissiveness *vs.* authoritarian control.

Comparison of restrictive *vs.* free environments.

Relative effectiveness of various safety devices and environmental controls.

Effect of differing social climates—*e.g.*, high *vs.* low morale, conflict *vs.* cooperation.

Effect of experimentally produced conditions—*e.g.*, fear, stress, emotional disturbance, fatigue, noise.

Experiments on developmental behavior—*e.g.*, conditions of learning safe behavior.

Variations in interpersonal relationships, including types of formal and informal leadership, peer relationships, etc.

Studies on the Effectiveness of Prevention Programs: Although successful prevention ultimately depends upon the kind of knowledge to be derived from the studies listed above, there is a great deal of research that can be done concurrently upon methods of changing both the individual and the environment in order to reduce the probability of an accident and the seriousness of the injury in accidents that do occur. We need to develop action programs with specific objectives that are subject to scientific evaluation. These objectives should include intermediate goals, such as changed attitudes and behavior, as well as the ultimate goal of a reduction in accidents. The questions that these evaluation projects of prevention programs could attack would include:

What is the relative importance of environmental controls *vs.* changed human behavior in reducing accidents?

How effective are information and education in changing attitudes and behavior and in reducing accidents?

What forms of education are most effective—*e.g.*, mass media *vs.* informal group discussion?

What arguments or facts are most persuasive in changing attitudes and behavior—*e.g.*, the use of fear?

What are some of the possible negative side effects of making people safety-conscious?

What community forces can be organized to make a prevention program more effective?

What role can the medical profession play in accident prevention?

What environmental controls can be instituted to reduce accident hazards and injuries?

Among which groups of individuals are prevention programs most likely to be successful?

The eleven areas of needed research described above do not, of course, exhaust the many possibilities of productive research in childhood accidents. They are intended only to stimulate ideas about possible research projects. The questions posed are deliberately provocative rather than systematic. They do highlight some of the areas of current ignorance, and each one, it is hoped, offers the possibility of worthwhile research. . . . the questions above, based more upon a conceptual analysis than upon existing findings, may challenge research workers to gather the data necessary for an evaluation of the relative importance of the questions proposed. It is said that the first sign of progress in research is the ability to ask the right questions. We look forward with high expectations to this next step in research on childhood accidents.

Much of what we now know about such psychological functions as perception, learning, and motivation and such sociological processes as identification and socialization may be profitably translated into hypotheses for accident research. At this stage of knowledge about behavioral factors in accidents, it is probable that the general literature of psychology, sociology, and anthropology will prove as helpful to the student of accidents as the behavioral science literature specifically devoted to the subject.

The stress upon the need to study cultural, social, and psychological factors in accident causation should not be taken to mean that research on engineering and environmental controls can be neglected. In fact, the opposite may well be true. Research may show behavioral factors to be highly significant but not readily amenable to change. Information and understanding are not equivalent to control, and it is quite likely that most successful mass accident-prevention programs may still have to depend upon environmental changes, with the increased social and psychological knowledge being used to maximize the acceptance and effectiveness of environmental controls.

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