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SCOPE 27 - Climate Impact Assessment

16 Perception

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16.1 INTRODUCTION

Environmental perception is what makes us take our umbrella with us, even when it doesn't rain, or complain about neighborhood air pollution while we are smoking. It helps the farmer to adjust his crop planting patterns to the forthcoming rains and the municipal engineer to get his snow ploughs out in time.

Environmental perception is the means by which we seek to understand environmental phenomena in order to arrive at a better use of environmental resources and a more effective response to environmental hazards. The processes by which we arrive at these decisions include direct experience of the environment (through the senses of taste, touch, sight, hearing and smell) and indirect information from other people, science, and the mass media. They are mediated by our own personalities, values, roles and attitudes. The study of

environmental perception has to encompass all these means of processing environmental information and to place the individual psychological processes of prediction, evaluation and explanation into a relevant social and political framework.

The main objective of a perception approach to environmental management is to analyze decision-making and choice of adjustment from the inside-out, or from the perspective of the decision-frame (that is, the decision and its context) as it appears to the decision-maker, with all its imperfections. Indeed, it is often the limitations and inconsistencies in subjective decision-frames that become the focus of attention in perception research.

Subjective decision-frames can provide post-hoc explanations for human behavior, some of which may seem at first to be `irrational', and they can indicate directions for education and improved public information and public policy. The learning process is not just one-way, from the policy-makers to the public. Some of the most useful perception research has revealed to policy-makers both the value of `folk' environmental knowledge and the need to incorporate lay people's values into scientific and policy models.

Thus, research has shown what is intuitively obvious: that choices are made within the framework of *perceived* alternatives and *available* information. Alternatives and information are profoundly affected by people's attitudes and values and the roles they play in relation to the decision to be made.

There are many techniques available within the methodological resources of the social sciences to measure the psychological and social parameters of decision-frames and decision-making. Some of these techniques have been used successfully in developing countries as well as in the modern industrial societies for which they were originally developed.

The major problem in adopting a perception approach is not so much in finding appropriate techniques to measure specific variables, but in knowing what variables to measure. The issue of knowing where to bound the system to be studied is one familiar to all scientists. It is a particularly intractable problem for environmental perception research because human response to the natural environment is everywhere mediated by strong social forces.

For example, the eastern Caribbean is one of the most seismically active areas in the world. The small islands are subjected to earthquakes, major volcanic eruptions and hurricanes as well as a number of less devastating natural hazards. Yet these events hardly impinge on the daily lives of the local people. Their concerns for their countries and neighborhoods are dominated by economic and social problems (see Table 16.1). Even individual and governmental decisions that directly affect the vulnerability of the population to natural hazards, such as house construction style and land use zoning, are determined primarily by other considerations, such as traditional land tenure systems and the desire for increased tourism (Whyte, 1982).

Table 16.1 Public perception of main problems facing people living in five East Caribbean islands

Problems in island	Barbados *n* = 682 %	St Kitts *n* =103 %	Nevis *n* = 51 %	St Lucia *n* = 321 %	St Vincent *n* = 259 %
Lack of jobs	52	45	90	62	65
Poor education	3	11	14	12	6
Inflation	49	53	69	57	38
Crime	27	7	–	11	2
Rastafarians	9	4	–	8	2

People's attitudes and behavior	9	12	14	17	5
Low wages	11	32	55	18	17
Crowding	4	3	–	1	2
Transportation	4	3	8	3	1
Tourists	1	-	–	-	–
Politics	4	10	-	25	4
Shortages of goods	1	1	4	2	4
Poverty	3	2	4	1	1
Land/ Labor	1	1	–	1	–
Environmental hazards	1	–	–	1	–
Lacks facilities	1	12	28	4	4
Other problems	10	6	4	9	9
No problems	2	–	–	1	–
Total %*	192	202	290	233	160

* Percentages total more than 100 percent because more than one response from each person is included.
Source: Whyte, 1982.

It is factors like these that have led critics of natural hazard research to argue against the unrealistic 'roping-off' f human response to hazards from the rest of man—environment relations (Hewitt, 1983) but the problem is a more general one for environmental perception.

16.2 FRAMEWORKS FOR STUDYING CLIMATE PERCEPTION

This discussion of perception focuses on the factors that lead to decision-making and the choice of alternative adjustments to climatic processes and events. Perception studies, however, are considerably broader than this in scope; for example, one could be designed to measure the contribution of weather to the value of a landscape, or the role of climate in people's nostalgia for their childhood environments.

A simple framework is to imagine choice as the outcome of interactions between climatic variables, decision-maker variables, and perception processes (Figure 16.1). This enables the researcher to define what aspects of climate, what kinds of decision-makers and what types of decisions represent the focus of study.

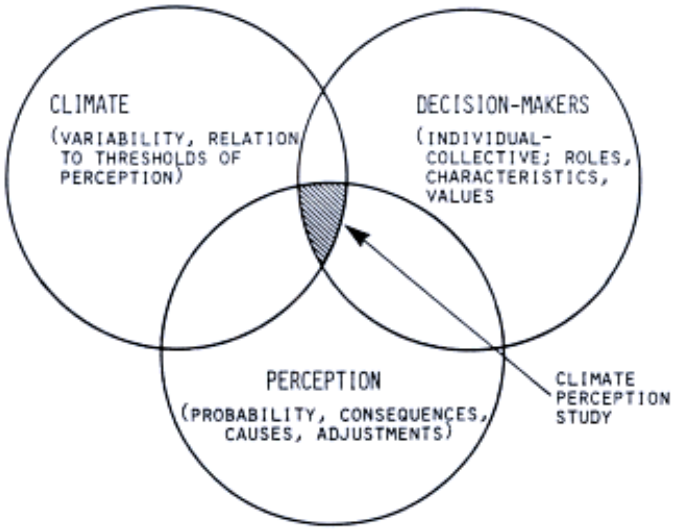


Figure 16.1 Main components in the design of a climate perception study for impact analysis

In the context of the models of Chapter 1, this framework, simply stated, represents a form of the interaction model with feedback and underlying process depicted in Figure 1.5C. It encompasses climate variability and change, individual and collective exposure units, impacts and consequences, and the choice of adjustments. It also incorporates some underlying processes related to the subjective perception of these elements, as well as the socially defined roles, characteristics and values of the decision-makers.

16.2.1 Climate as Perceived

A useful breakdown of climate in relation to human response is to consider it in terms of variability from normal, expected values and in relation to thresholds of direct human perception (Figure 16.2). In terms of the three classes of events addressed in this volume (see Chapters 1, 2) it can be hypothesized that extreme interannual events and natural hazards are likely to produce the greatest behavioral response because they are above the perceptual threshold of direct human experience and are easily recognizable as extreme events. Longer-term climatic events such as `little ages' or CO_2 warming of the atmosphere cannot be directly perceived by individuals, and although short-term seasonal and annual variability can be felt, they are not usually regarded as extreme enough to be significant. Decadal variability appears to be below both the level of expected variability and direct perception. Pilgrim, in Chapter 13, reports on the METROMEX study in which a 30 percent increase in precipitation over a 30-year period went virtually unnoticed.

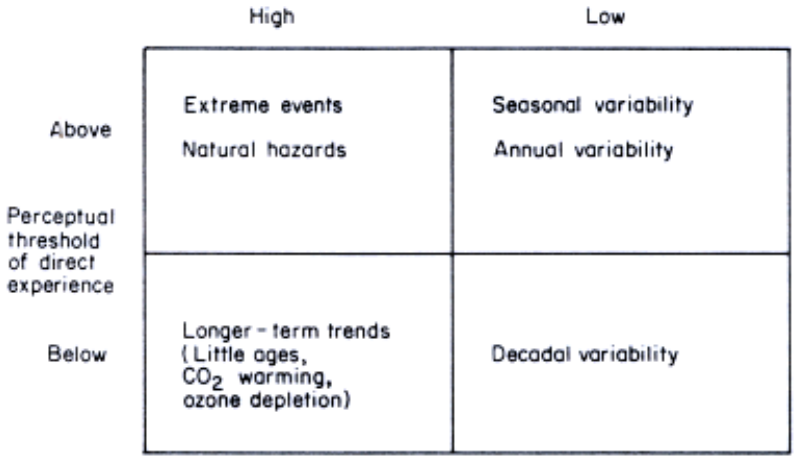


Figure 16.2 Climatic variability and direct experiential perception

Drawing from the diverse literature on risk, hazard and decision-making, it can be further hypothesized that varying characteristics of climatic processes affect the salience of climate for human perception and response. For example, the public and policy-makers alike

tend to disregard future risks and put resources instead into responding to more immediate problems. They are prone to attach greater importance to events which are likely to occur and about which there is some experience, or at least agreement, about what will happen. Thus, scientific uncertainty and controversy become translated into public apathy in a world where problems compete for attention and resources.

Some of the characteristics of climate that affect perception relate to the magnitude and frequency distribution of the processes involved in relation to the time perspective of the decision-maker (see Table 16.2). Other characteristics relate to the size, nature and distribution of the impacts. These characteristics stem from the interaction of the physical nature of climate and the type of socioeconomic system being impacted. In turn, the nature of past or expected impacts affects the way in which they are perceived.

Table 16.2 Characteristics of climatic processes which affect perception and response

Higher salience	Lower salience
High probability	Low probability
Recurrence interval within living or historical memory	Impacts not previously experienced/long time in past
Expected to occur soon	Longer time in future
Extreme event	Lower variability from norm
Imaginable/definable event	No clear beginning/end
High consequences	Lower consequences
Direct impact on people's welfare	Indirect effects
Loss of human life	No human lives lost
Identifiable victims	Statistical victims
Impacts grouped in space/ time	Impacts random
Reasonably certain to occur	Uncertain/controversial
Effects/mechanisms understood	Effects/mechanisms not understood
Dramatic impacts	Less perceptible impacts

One way to understand this complex set of interactions between past events, future expectations, and perception processes within the decision-maker is to imagine it in terms of a decision-frame. The decision-frame is composed of all the information, values and attitudes which the decision-maker brings to bear on a particular choice. The inclusion or exclusion of a particular piece of information can profoundly affect the eventual choice. Sometimes information is excluded from consideration in a particular decision, not because it is unknown, but because it is deemed not to be relevant or to belong to a different category.

This subjective process is a recognized aspect of medical and legal judgments, where careful sifting of much evidence is required. Several experimental studies have examined the effects of decision-framing on choice (Kahneman and Tversky, 1979). One study of the use of automobile seat belts found that reluctant users tended to frame their decision in terms of the risk of death per *individual trip*. This is very low (1 in every 3.5 million person-trips in the USA). If, however, the users considered the risk over their whole lifetime (40,000 trips or a probability of being killed of 0.01), they were more likely to believe in the efficacy of wearing seat belts (Slovic *et al.*, 1978).

In the climate context, the decision-frame can be powerfully affected by the imaginability of the climatic processes or events (Slovic *et al.*, 1974). Thus, for the layperson, hurricanes are more imaginable than droughts because they are more clearly defined in space and time. They are more memorable because the physical processes are more dramatic and their impacts on human well-being are more

direct and better understood. Hurricanes provide well defined 'events', each of which can be added to the mental category of `hurricane'. The victims of a hurricane are sufficiently well grouped in space and time that they are attributed to a *named* event.

In contrast, drought regions and drought periods have more blurred edges. When the `events' are less well defined, they are less likely to be remembered as falling in a sequence, or as units in a larger category of events. The proportion of indirect victims is greater for droughts than for hurricanes and many losses will never be included in drought impacts. Put simply, the decision-frame for drought is likely to be based on a subsense of past events and past impacts. For newly recognized climatic hazards like ozone depletion or CO_2 warming of the atmosphere, the framing of the decision is determined less by memory and subjective categories than by individual values and belief in authoritative predictions.

16.2.2 Categories of Decision-makers

The definition of the decision-makers who are the focus of a particular study (see the discussion of exposure units in Chapter l, stakeholders in Chapter 13, and victims in Chapter 15) also influences the selection of perception variables to be measured. The level of description will depend primarily on whether individuals, a large group, or an anonymous collective of decision-makers are involved. For example, a perception study of a small group of farmers may be able to measure adequately their risk-seeking or risk-aversive personalities, whereas a study of public perceptions at the national level is more likely to use standard demographic measures such as age and education as explanatory variables.

Standard measures of individual and group characteristics include age, sex, occupation, education, income, ethnic origin, language and religion. These descriptors are relatively easy to obtain and use for the analysis of individual decision-making and public surveys. They cause some difficulty, however, when applied to other levels of decision-making, such as households, which may contain great variability and for which mean or median values are not helpful. They are least useful for the analysis of collective decision-making, as for example in different levels of government.

Less recognized, but equally important for perception studies, is that each individual simultaneously plays several roles, and that this multiplicity of roles affects the ways in which decision-frames are constructed. A government administrator is also a member of a household, has a professional specialization but is also a layperson, and is a member of the public and a member of diverse smaller social and other groups. Some measure of these roles, and particularly the conflict or inconsistency that they produce in making choices, is important in the delineation of decision-makers.

Another significant aspect of role is the self-identity of individuals and their sense of belonging to particular groups, communities or places. The ways in which a researcher classifies and codes the sample population may not include the significant ways in which the individual categorizes himself or herself. It has been shown, for example, that scientific information can be more effectively passed within self-reference groups (in this case, defined by professional training) than within the organizations where people work (Whyte, 1976). In studying individual or household responses to a disaster, a better predictor of evacuation behavior is whether the individuals are parents, especially with small children, than characteristics like their age or education (Burton *et al.,* 1981).

It is useful to think of decision-making as a nested hierarchy in which each level, from the individual to higher government levels, affects and is affected by other levels. This is part of the social context of perception and decision-making and it is important to include it as part of any perception study. The exposure units of population, places and activities discussed in Chapter 1 are another context that affects decision-making.

16.2.3 Perception Processes

Figure 16.3 illustrates one attempt to simplify, into a very general model, the many variables that have been measured in perception studies. The variables are arranged from right to left approximately in order of generality to specificity for a particular decision, for two levels of decision-makers (individual and collective).

Linking the individual and social variables are four independent processes which together act as the main organizing force in the system. There are the `perception processes' which link all the components. In this model they are considered as four process elements on the pragmatic grounds of what are measurably different components of perception at the field level. Thus, *categorization and judgment* are grouped together in the model because they are usually observed together, although they are conceptually different parts of the perception process.

The other three major divisions of perception used here are: *sensory perception (e.g.* sight, smell); *attitudes;* and *communication and information* flow. In the field, these processes (either separately or together) can be investigated as links between any subset of variables relevant to the study.

The model was designed as an heuristic device to help the research planning task (Whyte, 1977). It does not provide any help with developing specific hypotheses, nor in delineating the direction of flows between the components.

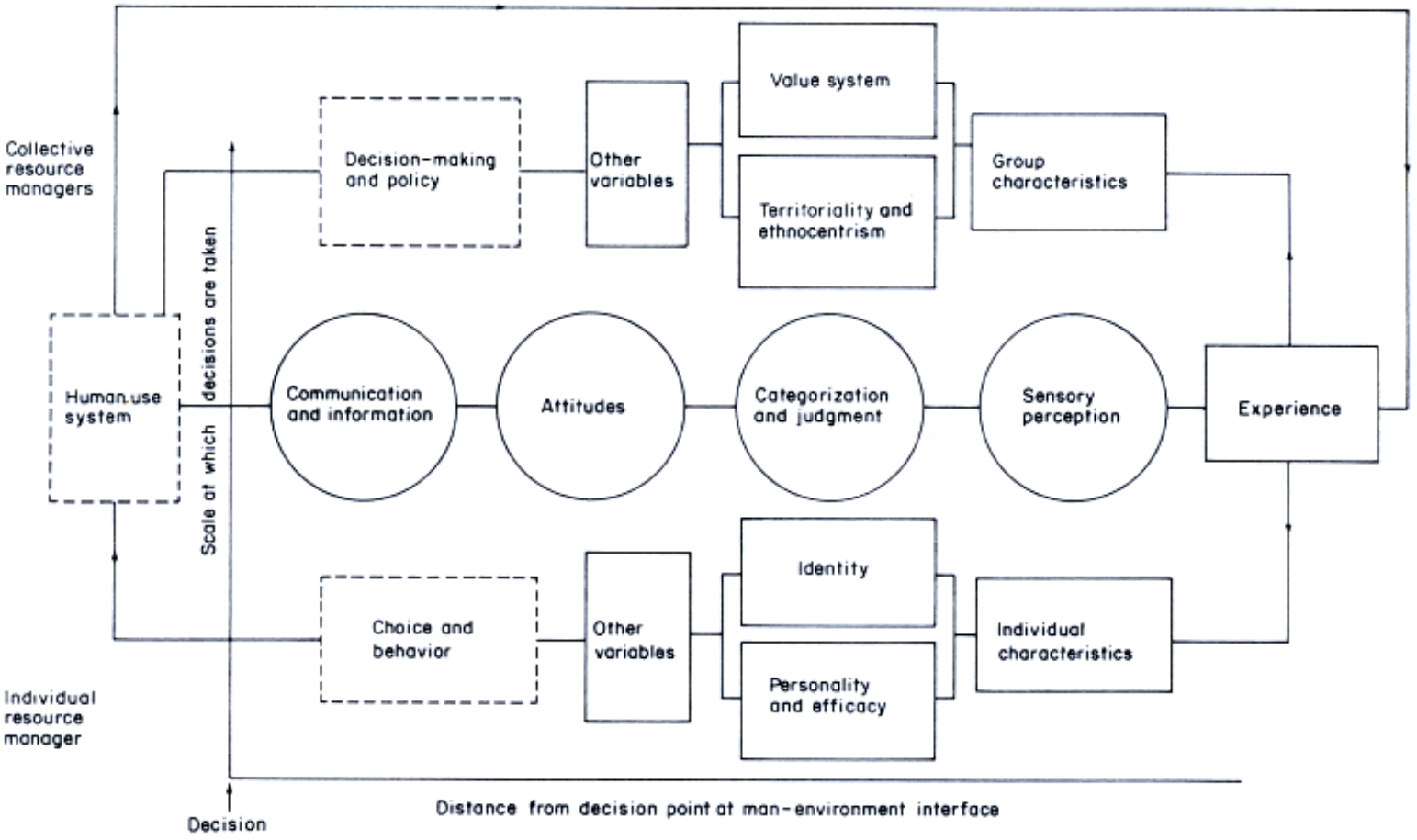
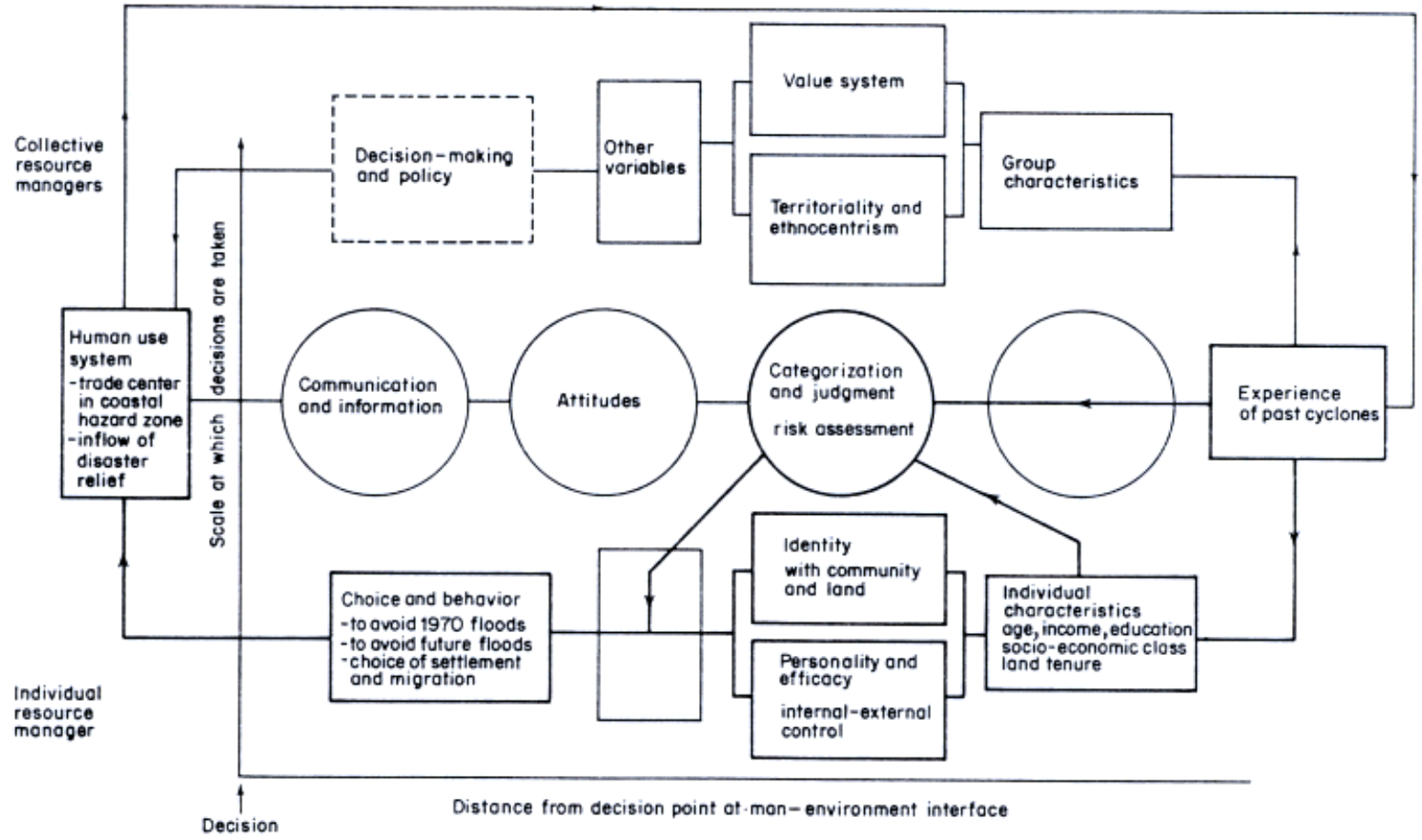


Figure 16.3 General model of variables and related perception processes commonly measured in environmental perception studies. The variables are arranged from right to left approximately in order of generality to specificity relevant to a specific decision. The upper stream relates to collective levels of decision-making and the lower to individual levels. From Whyte, A. V. T., *Guidelines for Field Studies in Environmental Perception.* Map Technical Note 5. © Unesco 1977. Reproduced by permission of Unesco



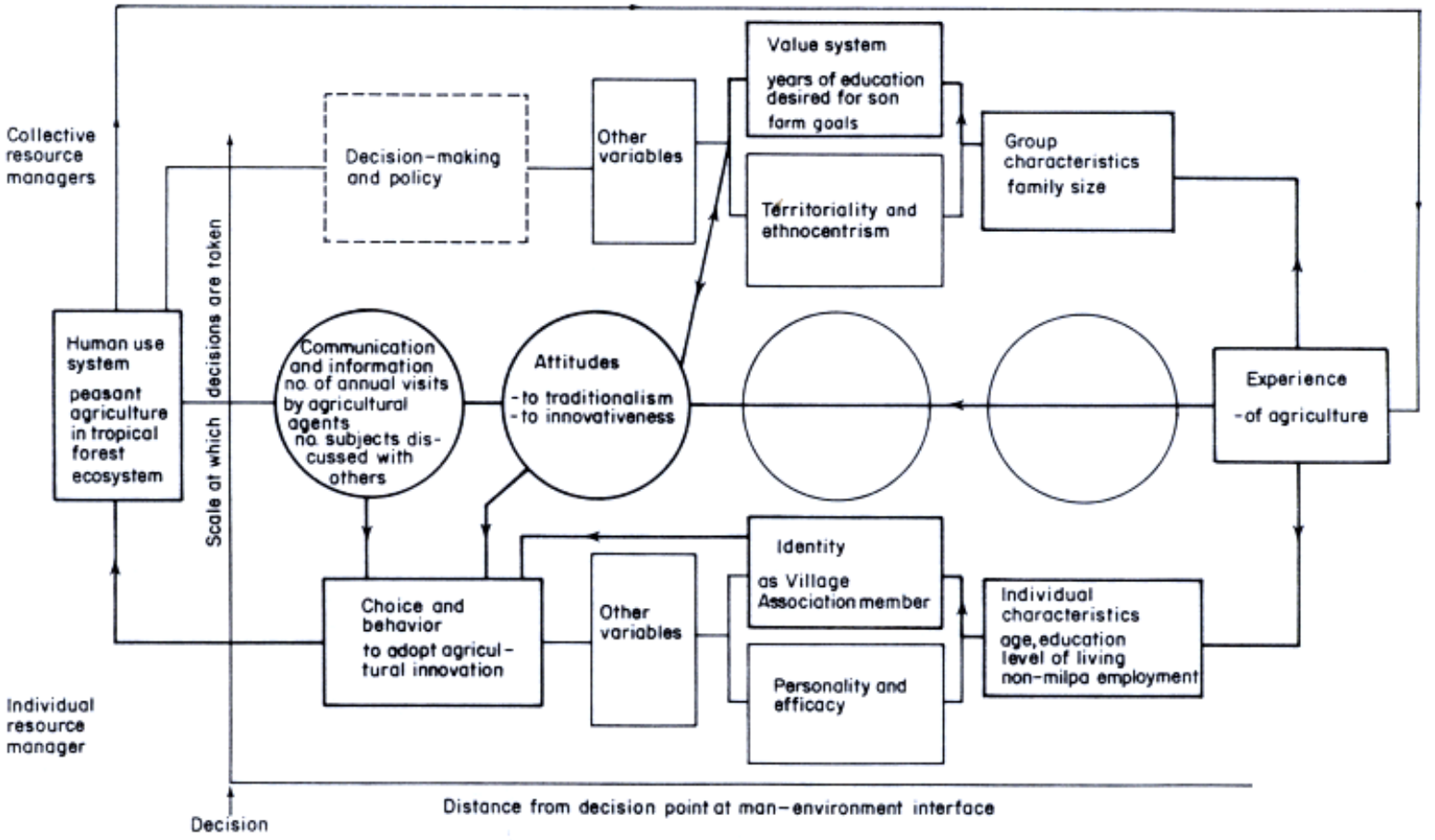


Figure 16.4 Two examples of perception research designs: A, for perception of tropical storm hazard in coastal Bangladesh; B, for

adoption of agricultural innovation among Central American peasants. From Whyte, A. V. T., *Guidelines for Field Studies in Environmental Perception.* Map Technical Note 5. © Unesco 1977. Reproduced by permission of Unesco

It does allow different research designs to be compared and the measures used for each variable to be specified.

The research design for a study of coastal flood-hazard perception from tropical storms in Bangladesh is shown in Figure 16.4A. The study was undertaken to see how hazard perceptions influence the choice of migration from a hazard zone on the rebuilding of homes in the same location. Interviews were held with 66 heads of households living in a community which was inundated to depths of 3–9 meters in the 1970 disaster (Islam, 1974). The main method used was a standard questionnaire given in a face-to-face interview that included some projective (indirect) perception tests. Figure 16.4A can be compared with Figure 16.4B, which shows a very different research design for a perception study of the adoption of agricultural innovation among Central American shifting agriculturalists (Feaster,1968).

Within the perception field, the specific concerns of *risk* perception are particularly relevant to climate impact studies because they focus on the perception of phenomena that are uncertain, probabilistic in nature, and that have generally negative impacts.

16.3 RISK PERCEPTION

Risk perception is the process whereby risks are subjectively, or intuitively, understood and evaluated. The term is often used in relation to lay people's assessment of risk but studies (for example, Tversky and Kahneman, 1974) have shown that statisticians and other scientists also estimate risks according to intuitive `rules' when they are outside their area of expertise or familiarity.

The risk perception equation includes more components than the commonly used definition of risk as simply `probability X' consequence, with consequence usually measured in deaths, dollars lost, or person-days of work lost. Specifically, the following elaborations of the consequence expression become significant in risk perception:

1. the *cause* of the consequence (whether `natural', Act of God, managerial incompetence, etc.);

2. the *type* of consequence (e.g. long, painful death *vs* quick `heart attack'; great physical incapacity producing a burden on the family *vs* death);

3. the *victim* of the consequence (old, infirm person *vs* breadwinner of family, *vs* child);

4. the type and scale of the *worst case scenario* that is *possible*, however improbable.

Thus, in risk perception, all ways of death cannot be assumed to be equal, nor all lives equal in value. Nor, at the same time, can events with different causes (though similar consequences) be expected to be viewed by those at risk with equal acceptance, resignation or outrage. It is more useful to view these elements in risk perception not as the indiosyncracies of the ignorant, but as challenges to the scientific community to improve its own measures and expression of risk.

16.3.1 Perception of Probability and Uncertainty

More attention, particularly by psychologists, has been given to the perception of probability than to the perception of consequences in risk perception research. This may be because perceived probabilities are more easily quantified and compared with mortality and morbidity statistics.

An example of this approach is shown in Figure 16.5, taken from Slovic *et al.* (1979). The relationship between laypeople's perceived probability of death from 41 causes is compared with statistical estimates for the United States. Each point in the figure represents the average value for the subjective data obtained from 111 university students and 77 members of the League of Women Voters in Eugene, Oregon. Bars for selected points show the 25th and 75th percentiles of the range of perceptions observed.

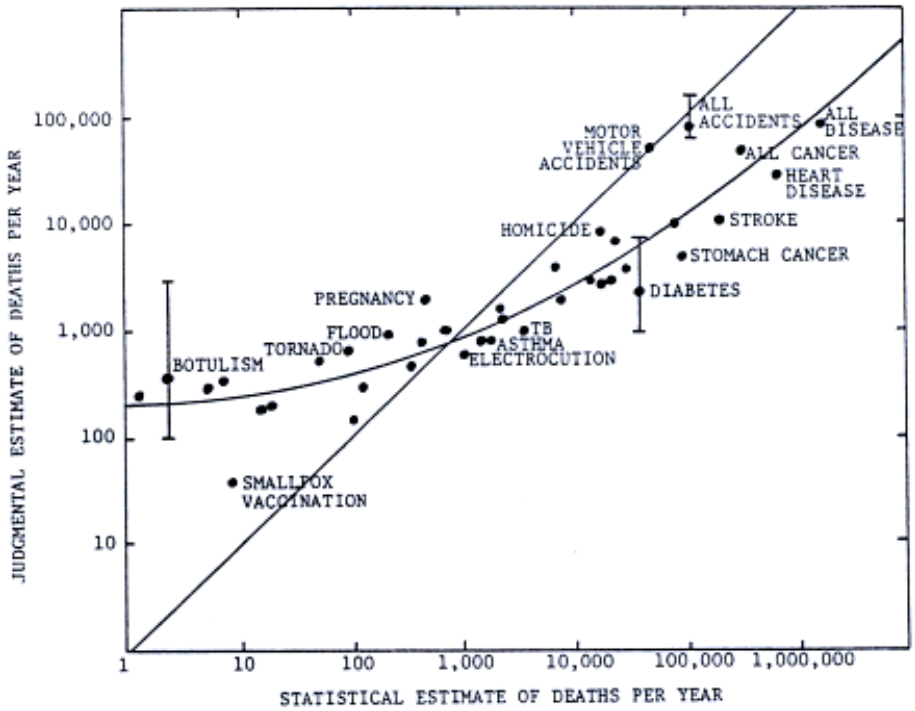


Figure 16.5 Relationship between frequency estimated (perceived) by 188 subjects and actual number of deaths per year for 41 causes of death in the USA. The straight line is the hypothetical perfect correlation between mean estimated and actual frequencies, the curved line a fit to the actual data. (Source: Slovic *et al.*, 1979)

Respondents were found to underestimate the differences in the probabilities of the most and least frequent causes of death. In other words, the subjective estimates narrowed the range of probabilities from six to three to four orders of magnitude. The hazards whose probabilities were exaggerated by laypeople tend to be characterized by high visibility, sensationalism and easy imaginability (for example, botulism, tornado) while the incidence of common diseases like cancers and heart disease was underestimated.

One important explanation for these and similar findings is framed within decision-making models of risky choices. The errors in subjective probabilities are ascribed to limitations in human information processing. Many welldesigned experiments have shown that people (including scientists and statisticians away from familiar subject matter) rely on a relatively small number of shortcuts for estimating probabilities. Reliance on these intuitive rules leads to systematic biases in judgment (Nisbett and Ross, 1980; Kahneman *et al.*, 1982). Three important rules, or heuristics, are representativeness, availability and anchoring.

People tend to evaluate probabilities without taking adequate account of base-rate frequencies or relative sample sizes. They are overly influenced by superficial similarities and by stereotypes when estimating the probability that an observation X falls within class A or B. The heuristic also applies to judgments about chance events. The layperson's perception of randomness is that chance is a self-correcting process and that short random sequences will mirror longer sequences. The well known gambler's fallacy that after a long run of `heads', a tail is now due, is also based on intuitive reliance on the representative heuristic.

In this context, availability is the dependence on memory to bring examples of events to mind. If one can recall other similar events or observations, the subjective probability of event X is elevated. The heuristic introduces bias into perceived probability estimations because the memory, or availability, of similar past events is influenced by their salience, the time elapsed since the last event, and their imaginability. It is this heuristic that seems to be operating to increase subjective probabilities of natural hazards after the recent occurrence of one. The availability bias could also account for the exaggeration of dramatic events like tornadoes as causes of death.

Anchoring is another decision heuristic that has been demonstrated in several experiments. When asked to estimate quantities or probabilities, people tend quickly to select an initial value and then to adjust it before reaching a final figure. Typically, the adjustments made (by mentally searching for more information and `rationalizing') are insufficient. The initial, more intuitive, value acts as an anchor. It is this initial value that is most influenced by the availability and representativeness biases. Thus anchoring compounds any error in probability judgment that has been made (Tversky and Kahneman, 1974).

One of the ways in which the uncertainty associated with probabilistic phenomena is dealt with psychologically is to perceive a pattern of events. This can provide the individual with a sense of control over the environment or allow him to believe that he is in the hands of a higher authority who has both motivation and command (see also Section 16.3.4). A common reaction to news of an event is to seek to attribute a cause to that event (causal attribution or attribution theory). It is apparently difficult for us intuitively to accept that events can be `uncaused' or, more accurately, be random. Indeed, experts in climatology struggle with tendencies to perceive trends or cycles which may or may not exist (Chapter 2).

The notion that there is motivation, and therefore pattern, to events is a very powerful one. For example, many studies of natural hazards, particularly hazards with a recurrence interval measured in years rather than in decades or longer, have found that laypeople perceive patterns where statistical records show none. Common patterns perceived for floods, hurricanes, tornadoes, and so forth is that they come once in every 3 or 7 years (Burton *et* al., 1978). The biblical view of drought is that it comes once in every 40 years.

A study of Mexico of the perception of rainfall by peasant farmers in a semi-arid area found that commonly believed rainfall patterns included 3-, 4-, 5- or 7-year cycles as well as autocorrelation between years (that is, one wet year was followed by another). When these perceived patterns were compared with meteorological records and with memories of specific past wet years, the commonly perceived pattern of a 3-year cycle could be seen as an idealization of actual annual rainfall variability (Figure 16.6). The pattern of remembered past events, however, indicated that a more extreme recent event (higher rainfall year) effectively blotted out the memory of earlier, less extreme events and seemed to act as a reference point against which to calibrate later episodes. Thus, the most recent wet year was remembered, but memory of preceding wet years extended back only to the one which was even wetter, and so on (Kirkby, 1973).

16.3.2 Perception of Impacts

Limitations in human information processing partly explain how differences arise between statistical probabilities and perceived risks. Another explanation is that the finer points of subjective probability are not very important to risk perception because our attitudes to risk are more powerfully shaped by perceived links between causes and effects and by the perceived nature of the consequences. For example, the efforts of the nuclear industry in several countries to convince the public of the acceptibility of nuclear power, based on its low probability as a cause of death, have not been successful. Public attention is not focused on the question of probabilities, however low, but on consequences, which conceivably could be catastrophic (Whyte,1983).

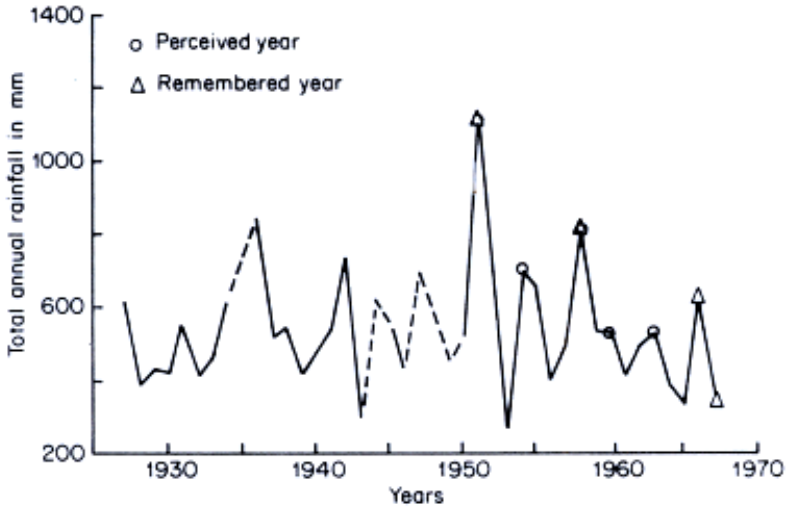


Figure 16.6 Patterns of rainfall memory and perceived wet years related to annual rainfall record (broken lines inferred) among peasant cultivators in Mexico. *Remembered* years are specifically named by respondents. Perceived years are inferred by the author based on patterns described by respondents. (Reproduced by permission of The University of Michigan, Museum of Anthropology, from Kirkby, *Memoirs of the Museum of Anthropology, No. 5* (1973) Kirkby, 1973)

Long-term climatic change presents somewhat similar characteristics to the layperson. The probabilities of disastrous change are perceived as low, but the scale of the consequences can be imagined as global and catastrophic. Scientific controversy about the direction, magnitude and time-scale of such long-term climatic changes, however, significantly reduces the concern and attention that the public gives to the matter.

There is evidence, both for extreme weather events like hurricanes and for longer imperceptible climate changes, that the characteristics of the impacts affect perception and response more than do their probability distributions. Expected utility measures and simple risk equations based on standardized measures of impact (deaths or dollars lost) fail to capture people's sensitivities to different types of impacts and ways of dying. This is an important consideration in designing climatic risk perception studies.

It is often regarded as axiomatic that people will accept higher risks if they expect to be compensated directly or indirectly by higher benefits. Perception studies of climatic impacts therefore need to include perception of the distribution of the associated benefits.

Formal cost/benefit and risk/benefit analysis have their own parallels in intuitive decision-making. In both cases, the framing of the analysis is critical to the outcome. What costs and benefits are to be included? The public is aware (or can be made aware) that tradeoffs inevitably have to be made between production of energy and acid rain. The issue is not so much public inability to recognize the existence of tradeoffs as it is who pays and who benefits. An individual is more likely to accept risk if he also benefits, but not if he perceives the benefits to be going elsewhere.

Social surveys have probed the risk/benefit equation for the public on a number of environmental issues. Several US surveys since the 1970s have asked the public to choose between economic growth and environmental protection. In polls conducted in 1975 and 1978 it was found that about 60 percent of the US public preferred higher prices and a cleaner environment to lower prices and more air and water pollution (Harris and Associates, 1975, 1978). These findings have been replicated in several other surveys (Mitchell, 1980; US National Science Board, 1981). Another survey found that 52 percent of the US public favored `the environment is more important than growth' scenario rather than the opposite (Harris and Associates, 1979).

In the environment versus energy equation, however, the US public generally has been found to favor somewhat higher environmental costs to ensure energy supplies and development. These differences in findings support the argument that the public understands cost/benefit analysis and can discriminate between alternative tradeoffs.

16.3.3 Attribution of Causality

One of the important findings of risk perception research is that the scientific distinction between `natural' and `manmade' events does not necessarily coincide with the causes of those events as perceived.

For natural hazards, the influential force sometimes may be viewed as supernatural, but increasingly in modern societies it is seen as a natural process compounded by human choice. Thus the public in the United States tends to regard floods as caused more by engineering and zoning decisions than by `Acts of God'. Similarly, explanations of the causes of the Sahelian desertification of the 1960s and 1970s tend to include both natural climatic variability and human activity, such as the concentration of animal herds around technologically developed waterholes.

Experimental studies have shown that, in general, initial attributions about cause, effect and responsibility, once made, are remarkably resistant in the face of later, conflicting information (Ross and Anderson, 1982).

The significance of attribution of causality for behavior is that, when impacts are seen as not falling randomly, there is an urge to blame some other sector of society. The choice of adjustment becomes more dependent upon expectations of where responsibility lies and upon the perceived motivations, credibility and competence of other people and groups (see Section 16.4.3). In this case, the research model becomes more focused on social variables than on environmental perception.

16.3.4 Perception of Control

Starr (1972) pointed out that the risk of death in many voluntary activities is higher than that considered acceptable for involuntary activities. Private flying is more risky than commercial air transportation, and skiing or canoeing is more dangerous than travelling by car. He estimated that the risks accepted in voluntary activities were a thousand times greater than for involuntary ones. While there has been criticism of the reliability of Starr's data, the view that the voluntary–involuntary dimension is important to risk perception is accepted by many analysts.

In a climate context, we may infer that we will probably willingly tolerate higher levels of the risk of skin cancer from voluntarily

sunning ourselves on the beach than we will from involuntary exposure to increased radiation because of our occupation or anthropogenic changes in the Earth's atmosphere.

16.4 THE ROLE OF INFORMATION

16.4.1 Direct versus Indirect Information

There are several components to direct information. The first is the perception of a hazard directly through one's own senses of sight, hearing, taste, touch or smell. But a hazard can exceed the thresholds relating to human sensory perception, and direct experience then becomes a powerful information source.

A second experiential source of information is that of an individual who is, or personally knows, the victim of an affliction such as cancer. In this case, the direct experience is of the consequences of a hazard that may be beyond one's own sensory perception, but observed in another.

A third aspect of direct information is the directness and certainty that can be attached to cause and effect. A flood that drowns, a fire that burns, or a plane that crashes are more direct in their effects than a carcinogen with latent effects that show some 40 years (and a lifetime of carcinogens) later.

Direct information usually influences individual decision-making more than indirect. For example, Adams (1971) examined the comparable effects of direct, personal weather observations and television weather forecasts on outdoor recreation decisions, and found that personal observation clearly was more significant.

In the case of indirect information, risk perceptions are more likely to reflect the quality of reporting and the credibility of the information source than actual levels of exposure or risk.

16.4.2 The Role of the Media

For many climatic changes, the magnitude of the hazard and the links between cause and effect can be obtained only from indirect sources. For those who learn about hazards and their consequences indirectly, the mass media (television, radio, newspapers and magazines) are the principal sources of information. In the last decade, the amount of information given to climate change in major newspapers of record has tripled (see Figure 16.7).

One of the functions of the mass media is to distribute information from official sources to a wider audience, but the information that finally appears is selective, is usually accompanied by evaluative comment, and is put into a particular context. All of this changes the impact and meaning of the message.

For example, Riebsame (1983) tracked the news media coverage of the US National Weather Service's 1982–83 winter forecasts by monitoring 1710 daily and 8200 weekly newspapers. He found that the forecasts were quite accurately conveyed but that prior, widely publicized disagreement between government and private forecasters was prominently reported on virtually every news story on the forecasts.

Scientific and quasi-scientific media reporting can also shift perception. Warrick and Bowden (1981) suggest that partly because of 18 major media articles reporting on an expected drought on the US Great Plains in the 1970s, laypeople, government and the media itself acted as though a major drought actually was occurring, an event not borne out by observation.

The biases that often are criticized in media reporting (focus on rare events, large-consequence events, dramatic stories, `big bang' events with strong visual images) are but explicated versions of the layperson's perceptual biases. Media reporting thus exaggerates the already existing intuitive biases of risk perception. For example, an analysis of the reporting of causes of death over a 1-year period of two US newspapers (one in Massachusetts and one in Oregon) found that many of the statistically common causes of death (such as diabetes, emphysema, various cancers) were rarely reported. Relatively rare violent events such as tornadoes, fires and homicides, however, were more frequently reported. Diseases take 16 times as many lives as accidents in the United States, but two newspapers reported accident deaths three to seven times as often (Combs and Slovic, 1979).

The same study found that the correlation between people's judgments about the frequency of death from various causes and newspaper reports (holding statistical frequency constant) was 0.89 and 0.85 for the two newspapers. Although intuitive risk perceptions can be related to newspaper reports, the direction of the relationship is not known: do newspapers reflect intuitive biases of the public or help to create them?

16.4.3 Credibility and Expectation

An important aspect in the reception of information is how credible it is perceived to be. Although the public may recognize that journalistic accounts of events can be biased, it often feels that `there is something in them'. The issue of credibility is more critical to governments, official agencies and the private sector than it is to the mass media in determining how the information that is disseminated will be received.

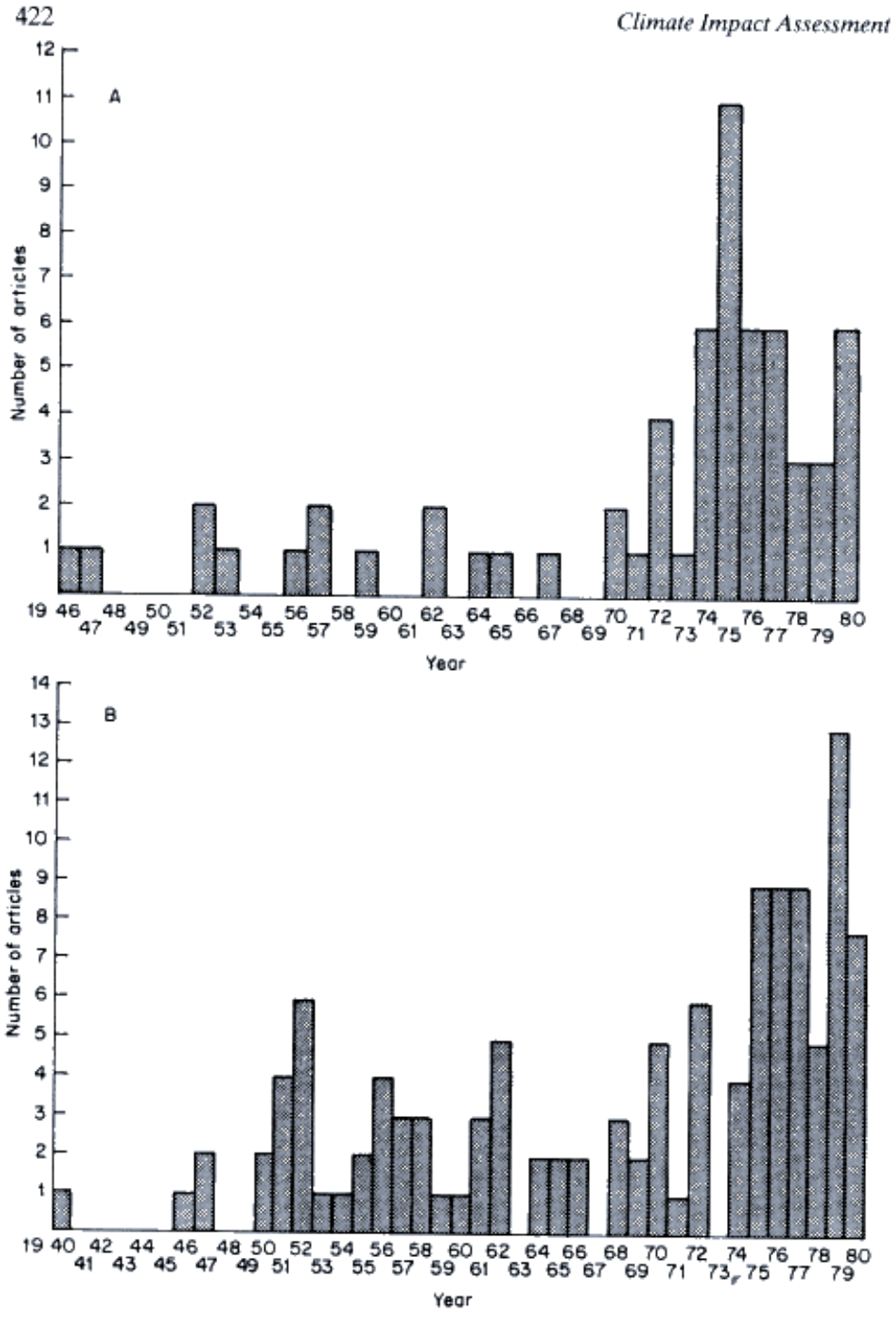


Figure 16.7 Numbers of articles on climatic change appearing in A, *Toronto Globe and Mail*, 1946-80; B, *New York Times*, 1940-80. Reproduced by permission of the American Meteorological Society from Harrison, *Bulletin of the American Meteorological Society*, **63**, 730-738 (1982)

A preeminent example of the credibility problem is nuclear power, where the mass media are more believed by the public than are the governments and government agencies. Declining trust in the national government is a major factor in public risk perception in some countries. There is evidence of a mismatch between public expectations of governmental responsibility in solving environmental problems and public ratings of past governmental performance. The credibility issue is also important in climate risk perception at the international level. International effort is seen as necessary for reducing problems, but usually little hope is held out for any effective action.

16.4.4 Historical Dimensions

As each wave of environmental crises and hazards to health successively hits the headlines, the public is often bombarded with information about industrial irresponsibility, government lapses, or incompetence. We are told of increased hazards in the home, on the road, at the workplace, and even in the very air that we breathe and water that we drink. Within the last 10–15 years the public has become sensitized to risks and has come to recognize `risks' as a category of phenomena to which it is exposed in everyday living.

A survey in the United States indicates that the public is more risk conscious than in the past (Marsh and McLennan, 1980). Almost 80 percent of those asked believed that risks to society are increasing and that the US public is becoming more aware of risk (Table 16.3).

Table 16.3 Perception of increasing future risk and public awareness of risk as seen by the US public in 1980

	n = 1488
Risks to society will be	%
Greater	55
Less	18
About the same	22
Not sure	5
	n = 1488
US public is	%
Overly sensitive to risk	15
More aware of risk	78
Both	2
Not sure	5

Source: Marsh and McLennan, 1980.

The longer-term effect of crisis events is cumulative. Not only is there increasing public concern about risks within a category (for example, air pollution), the concern extends to other risks as well. A study of the effects of the 1979 Mississauga derailment (near Toronto) on risk perception found that, compared to a control group, evacuees had a higher expectation of a major nuclear accident happening in Ontario within the next 10 years. The accident experience had thus increased their sensitivity to other hazards (Burton *et al.*, 1981).

16.5 METHODS

16.5.1 Choice of Research Approach

Although there are a number of specialized techniques and instruments available for measuring environmental perceptions, the three basic methods of investigation are observing, listening and asking questions. Of the three, asking questions is the most commonly used method and is usually done through structured questionnaires or semi-structured interviews in face-to-face situations.

There is no single `best' method for studying perceptions. Different techniques have been developed for answering different research questions and for different research situations. Methods of observation, listening and asking questions can provide mutually reinforcing and complementary data so that they should be used in combination wherever possible.

The range of techniques available to measure perceptions is illustrated in Figure 16.8 and is ordered according to the degree of control exercised by the researcher versus the flexibility of response open to the respondent. This is an important consideration in the selection of techniques because this spectrum also represents a tradeoff between more controlled, experimental designs and replicable observations and more idiosyncratic, less statistically reliable but often more relevant, findings of 'situation-defined' research.

These differences in research style are typified in the contrast between public opinion surveys and in-depth case studies. Each has merits and drawbacks as well as appropriate research techniques. The less structured approaches to perception studies, however, place greater demands on the individual capabilities and credibility of the researcher, and are also more dependent on content analysis of perception data. They are likely, therefore, to require more research time per unit of observation.

16.5.2 Limitations on Existing Studies

Data on risk perception have been obtained primarily through three methods:

1. *laboratory experiments*, such as those conducted by social psychologists on heuristic biases;

2. *field studies*, such as those carried out by geographers on perception of natural hazards in tornado zones, floodplains, etc.;

3. *social surveys*, such as those conducted by sociologists and public opinion pollsters on national samples of the population.

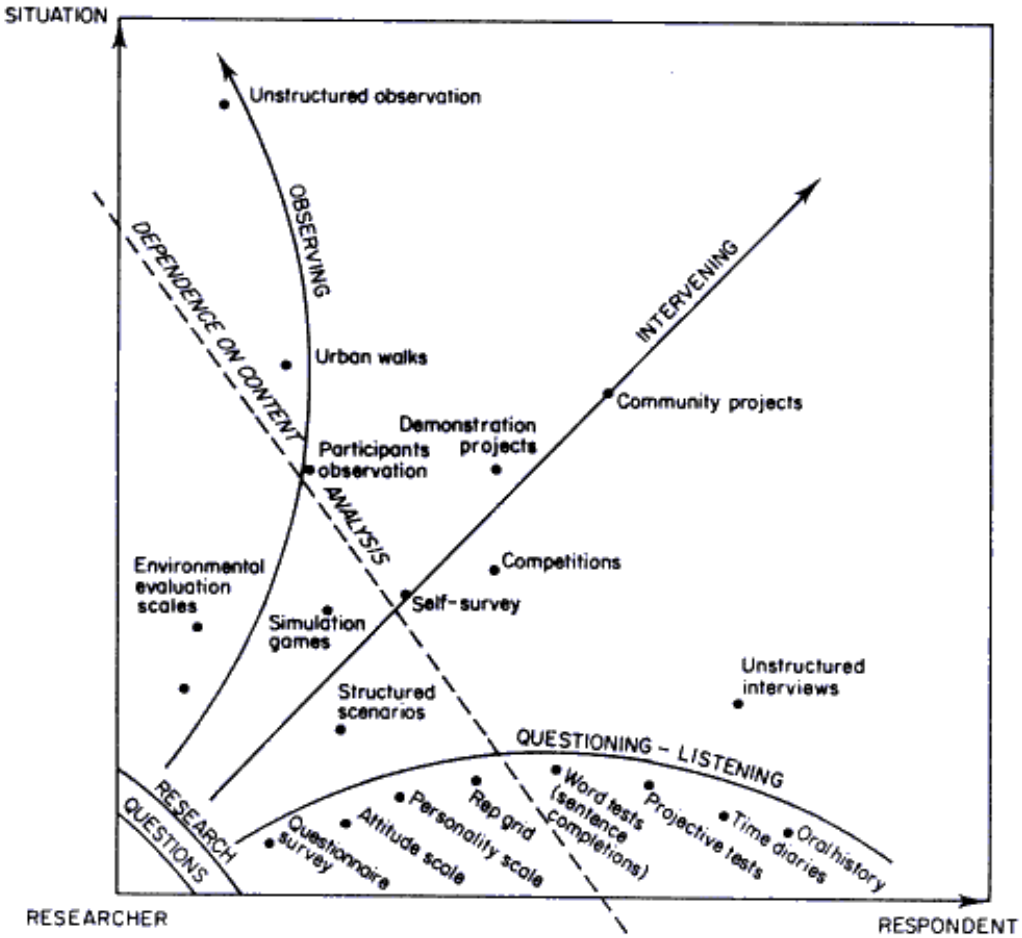


Figure 16.8 Techniques for measuring perception in relation to the degree of control exercised by the researcher. From Whyte, A. V. T., *Guidelines for Field Studies in Environmental Perception.* Map Technical Note 5. © Unesco 1977. Reproduced by permission of Unesco

Each of these methods brings with it various strengths and weaknesses.

In a *laboratory setting,* the parameters of the risk decision can be simplified and manipulated to isolate and test individual dimensions of perception, such as the anchoring effect. When similar effects are found to be repeated under different experimental conditions, one can with some confidence accept that such an effect exists generally in risk perception, whatever risk is under consideration. (Some repeatedly observed effects, however, such as `risky shift' in small group decision-making, are now believed to have been an artifact of the experimental situation rather than a reflection of any real-world phenomenon.) The main limitations of such experimental data are that:

1. by isolating parameters in risk perception, they fail to predict outcomes when all parameters are combined, as they are in real-world decision-making;

2. they have tended to focus on the probability component of risk perception, whereas other evidence would indicate that it is perceived differences in consequences that is more important to public perception;

3. they tend to use small samples and to use university students as subjects, so that any generalizations to the public as a whole should be made with caution (more caution than usual);

4. the experimental setting is itself an artificial one; subjects are not facing real decisions and even where monetary rewards are involved for `right' decisions, their values do not adequately represent the value of avoiding death or pain to people in real-world decisions.

Field studies, on the other hand, do study people in real-life situations. Examples include many empirical projects on the perception of natural and manmade hazards from the point of view of those at risk, usually through the location of their residence in hazard zones (such as coastal floodplains subject to hurricanes; residents around nuclear reactors or along transportation routes for dangerous goods; residents of areas with high air or water pollution levels). Field studies usually use a face-to-face questionnaire schedule that includes a large number of open-ended questions, and even simple projective tests, to probe explanatory variables for the perceptions measured. Their focus on one hazard, while it may bias response in one direction, does provide a coherence and logic to the interview that can be grasped by the respondent.

The main limitations of many (not all) of these studies are:

1. their inadequate sampling frames and procedures, which are the result of cutting cost but which limit their validity for larger populations, although it is demographic measures that are the main independent variables;

2. their focus on one hazard, rather than `all hazards at a place', and the definition of that hazard by the researcher rather than by the population. This approach has been known to measure perceptions of air pollution or earthquake risk for people who were unaware that the hazard existed before the interviewer came along;

3. their emphasis on the individual as the decision-maker and their relative neglect of the social dimensions of decisions, particularly in the household or family context, and (for developing countries) the community (tribe, village, etc.) context. These contexts certainly limit the choices that most individuals make and in many cases such decisions are really better modeled as family or group decisions.

The main strength of *social surveys* is their sampling methodology and their generalization to large populations. Their limitations are similar to those of field studies except that they are even more severe, namely,

1. social surveys may include a wide range of items that bear no relation to one another. Respondents may be asked their opinion

on the effects of acid rain, the use of forest sprays, whether they think the government is doing a good job in relation to unemployment, foreign policy, and so on, in rapid succession. There is no context to these questions and responses beyond basic independent demographic measures such as age, sex, education and income;

2. there is no independent measure of respondents' exposure to risk, as there is in localized field studies, and absolutely no social context in terms of the household or larger decision-making unit;

3. economic measures such as `willingness to pay', which are sometimes included in social surveys, are as hypothetical to the respondent as are experimental situations. They clearly measure something but it is not `willingness to pay' in terms of willingness (or ability) actually to hand over the money.

16.6 EXAMPLES OF CLIMATE PERCEPTION STUDIES

The literature on climate perception is very limited. Some work has been done on public perception of weather and climate information and forecasts (see, for example, Murphy and Brown, 1983), and on the use of manuscript records, such as travel logs and diaries, in the reconstruction of past climates (Lawson,1974), but the literature lacks studies of climate perception *per se.*

One story that stands out is a survey of senior citizens' contemporary and recollected climate perceptions that was conducted by Oliver (1975) and his colleagues in Terre Haute, Indiana. They interviewed 93 people, ages 60–92, with an emphasis on their perceptions of climate change during their lives. Most (70 percent) felt that the climate had changed, but they expressed different views as to the types of changes. Comparing respondents' recollections of past climate to the instrumental record, the researchers concluded that their sample was able to compare quite accurately past and current climate. The respondents were also quite accurate in their recall of specific weather events and memorably severe seasons (such as particularly snowy winters).

16.6.1 Perception of Annual Rainfall Variability

A perception study being conducted in the Mapimi Biosphere Reserve in the states of Durango, Chihuahua and Coahuila in northern Mexico is concerned with the choice of adjustment to annual rainfall variability and the related carrying capacity of and rangeland for cattle (Whyte, 1984). The average annual rainfall of the area is 200 mm, 80 percent of which falls in heavy thunderstorms between June and September.

Land tenure in the area is undergoing considerable change as new ejidos (agricultural community-based cooperatives) are established in land that was formerly in private ownership. The oldest settlements in the area were established around 1940; the most recent ejido was granted in 1981 and has not yet built houses in the area. Within a small area, therefore, the effects of private versus cooperative land tenure, experienced and inexperienced cattle herders, and different administrative jurisdictions (three state and four municipal governments) can be compared.

There are nine small settlements within the Reserve, ranging in size from one to five family units. Public services are minimal—there is no electricity, housing conditions are poor, cooking fuel is mostly wood, and there are no paved roads. The major economic activity of the area is raising cattle for meat export to the United States. Some horses, goats and a few sheep also are grazed. The animals are allowed to range freely and only the privately owned ranch is completely fenced. There are presently between 16 and 25 hectares per head of cattle.

The main components of this perception study are illustrated in Figure 16.9. The data on perceptions are obtained through unstructured interviews in Spanish with ejiditorios and ranchers, in their homes, without the use of a formal questionnaire or projective techniques, which would arouse distrust in this setting. Data on behavior are obtained through participant observation, and on range management through interviews and the examination of written livestock records. Some climate records and historical data on past resource use in the area are also available.

The focus of this study is to analyze the annual decisions made about stocking levels in terms of the decision-makers' expectations of the carrying capacity of the semi-arid pasture over the dry season (October–March). It is possible, on the basis of summer rainfall (April –September) to have a good estimate of the carrying capacity of the land in the critical dry period. This, then, is an interaction study of interannual variation and response to it.

The largest private owner in the Reserve does annually adjust his herd size in response to his expectations of rainfall-dependent variations in rangeland carrying capacity. The ejiditorios, especially those with least experience in the area, do not. A major objective of the study, therefore, was to discover the reasons for the differences in choice of adjustment.

The critical differences between the ranchers and ejiditorios are *not* to be found in their perceptions of the annual variability in carrying capacity, but in important differences in their aspirations, attitudes and the degree to which they have control over their own management decisions. The Mapimi case study, therefore, illustrates very well the need for perception studies to look beyond perceptions *per se,* and to consider the decision-frame and the social context of decision-making.

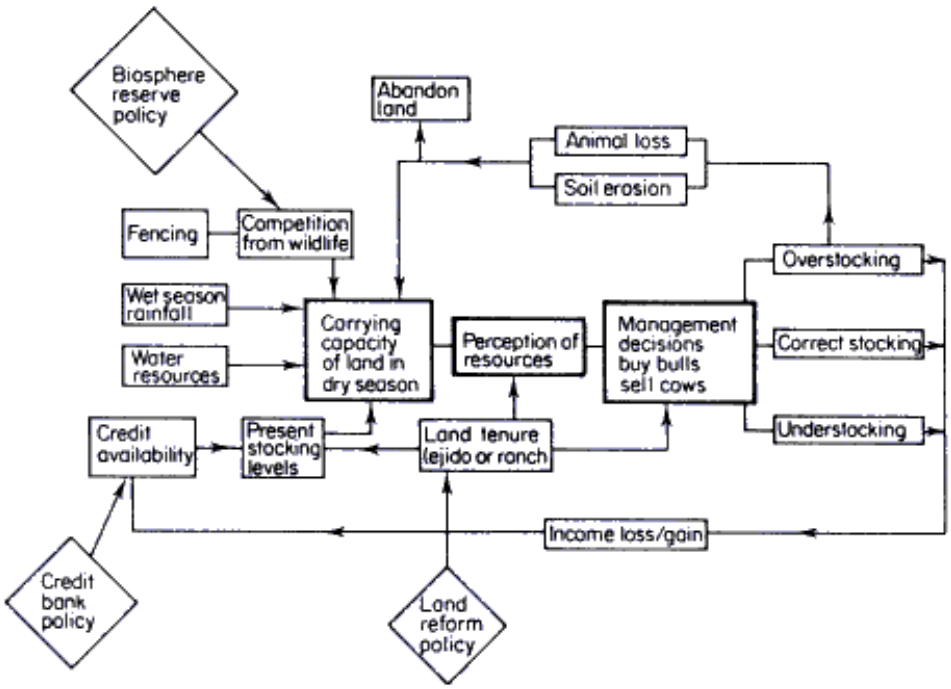


Figure 16.9 Model for annual range management decisions based on perception of seasonal carrying capacity, Mapimi, Mexico. From Whyte, A. V. T., (1984), in Di Castri *et al., Ecology in Practice,* Part 11. © Unesco 1984. Reproduced by permission of Unesco

For example, the decision-frame for a private owner is to make annual adjustments in herd size in response to rangeland carrying capacity so as to maximize economic return and maintain rangeland productivity in the long term. He has owned the ranch since 1942, lives in town, and has other economic resources. He keeps careful accounts of annual productivity, has fenced the land so that he knows its productivity, and has adopted modern herd management policies.

The ejiditorio's decision-frame is dominated by aspirations to improve his economic situation and that of his children, which he sees as dependent on building up his herds as rapidly as possible. His perceptions of annual variability in rainfall become translated into adjustments in the rate of increase of stocking levels rather than adjustments of total herd size.

The second important lesson to be learned from the Mapimi perception study is the need to take into account the effect of other levels of decision-making on choices that are made at any one level. In the Mapimi case, three policy areas—credit banks, land reform and biosphere reserve policies—influence the range management decisions taken (see Figure 16.9).

The control exercised by the credit banks over herd stocking levels is particularly critical for rangeland management in some ejidos. Whereas private owners can decide for themselves how many cows to sell, ejiditorios are often *told* by bank officials how many cattle they will buy. This decision, although it affects the rangeland management in Mapimi, is not made as an adjustment to local rainfall, but in the context of the bank's decision-frame. This appears to be dominated by international cattle prices, profitability and cattle quality standards for export.

The Mapimi case study is, therefore, an illustration of the need to design perception studies which are open with respect to their immediate time and space boundaries. The explanation for differences in perceptions found within a sample population may lie both beyond the immediate frame of main decisions being analyzed, and beyond the sphere of the influence that the study population can

itself exert on the outcomes. In the Mapimi case study the wider social context of perception becomes the major explanatory variable for the choice of adjustment.

16.6.2 Perception of Weather and Long-term Climate Change

A pilot study in Ontario, Canada, undertaken for Environment Canada in 1981, is one of the few studies known on the public perception of long-term climatic change (Whyte and Harrison, 1981). The study used a structured questionnaire administered in a telephone survey to samples of urban and rural resident and snow plough operators.

The study probed the relationship between memory of past winters, especially of the winter of 1980−81, and expectations of the weather of the next winter before asking questions about long-term climatic change. This approach was adopted in order to establish rapport and interest in the survey. Most respondents feel comfortable in giving opinions about the weather, and in Ontario, winter conditions are particularly salient to rural and urban dwellers alike.

The choice of a telephone survey to obtain data was made on the grounds of least cost, but such a method severely limits the quality of the perception data and the number of independent and dependent variables which can be obtained within a 10-minute interview. It is therefore appropriate only at the exploratory stage of a perception survey or when large population samples are needed. One of the objectives of the Canadian study was to explore if public awareness of a climatic change is sufficiently widespread to justify a future perception study.

The contrast between the two case studies could hardly be greater. The focus of attention in Mapimi was on an annual event, one which could be directly perceived, and was translated into decisions which directly affected the decision-makers' wellbeing. In Canada, not only is the socioeconomic situation of the respondents very different from that of a poor area of Mexico, but the object of perception is a low-probability, highly uncertain future event which may never affect the respondents directly, and about which no direct decisions are required of them. Further, direct perception of weather is formed from experiencing climatic noise (short-term variations) rather than from information about climatic change. Public awareness of climatic change comes largely from indirect sources, especially the mass media; part of the Canadian study therefore focused on an analysis of newspaper coverage of climatic change from 1946 to 1980.

When asked to predict the following winter's weather, only 13 percent of the respondents declined, and the majority made reasonably correct predictions of colder than normal temperature and heavy snowfall. One common explanation given for the predictions was the observation of nature and climate during the fall, which was particularly cold. Many people believe that a cold fall augurs a cold winter (37 percent of the respondents). The behavior of animals, insects, birds and plants, as well as the fuel stockpiling of local Indians, were cited as other signs of a hard winter to come (14 percent). Another group of respondents (18 percent) subscribed to the view that nature is a self-correcting patterning process, so that one mild winter `will be paid for' by a cold one.

When asked if the climate in Canada is changing, 66 percent of the respondents said yes, 21 percent said no, and only 5 percent said that they did not know. Changes in winter, rather than summer, weather were the major indicator referred to, although the perceived direction of the changes shows a large variation from respondent to respondent (Table 16.4).

The two main groups of responses for the perceived *cause* of climatic change were specific references to *manmade* causes (38 percent) and general references to natural trends, variability and change (28 percent). In addition, 31 percent of the respondents could give no reasons for climatic change. Teleological explanations (`God's will') were offered by only two people. Thus, many people see climatic change in Canada as a manmade problem (Table 16.5).

Questions were included in the survey to probe whether people had heard about loss of ozone, the `greenhouse' effect, or an increase in CO_2 (all of which have appeared frequently in news media reports), and whether they believed that they were linked to climatic change. The results show that in 1980 people were more aware of the ozone problem than the increase in CO_2, but that both issues were regarded as part of climatic change.

The inclusion of three sample populations in the study was designed to test whether the level of awareness of weather and climate was a function of life style and `contact' with weather. Snow plough operators, rural dwellers and urbanites spend greater to lesser amounts of time dealing directly with winter weather. The results showed that perceptions of weather and long-term climatic change did not vary significantly among the three populations, nor were they a function of individual characteristics like age, sex or educational level. Perceptions of climatic change seem to be part of the Canadian public's general environmental awareness. Awareness of issues, in

contrast to knowledge of issues and attitudes towards them, does not usually show strong demographic or life style differences (Whyte and Burton, 1982).

Table 16.4 Responses to the question: `In what ways is the climate changing in Canada?' given by 422 respondents in Ontario, 1980

Respondent mentions (up to three responses)	Total	% of total responses*
Winters		
shorter	14	2.6
longer	15	2.8
colder	13	2.4
warmer	114	21.1
more snow	6	1.1
less snow	60	11.1
	222	41.1
Summers		
cooler	69	12.8
hotter	10	1.9
drier	6	1.1
wetter	6	1.1
longer	1	0.2
shorter	24	4.4
	116	21.5
Years		
colder	26	4.8
warmer	36	6.7
wetter	13	2.4
drier	6	1.1
	81	15.0
Trends		
less predictable	73	13.5
more temperate	11	2.0
equilibrium	17	3.1
seasons later	12	2.2
windier/cloudy	4	0.7
worse	2	0.4

	119	22.0
Don't know	2	3.7
Total number of responses	540	99.6

* Percentages do not add to 100% because of rounding of decimals.

Source: Whyte and Harrison, 1981.

Table 16.5 Public perception of the reasons for climatic change in Canada

Respondent mentions (up to three responses)	Total	% of total responses*
People's occupation and activities on earth and in space		
Space exploration	55	14.5
People/pollution/urbanization	46	12.1
Nuclear explosions/tests	38	10.0
Loss of ozone	5	1.3
		37.9
Natural long-term global reasons		
Global changes	36	9.5
Natural variability	34	8.9
Ice age coming	17	4.5
Long-term trends	13	3.4
Volcanoes	8	2.1
		28.4
Other		
Know from experience	5	1.3
God's will	2	0.5
People's paying attention	2	0.5
Don't know	119	31.3
		33.6
Total number of responses	380	99.9

* Percentages do not add to 100% because of rounding of decimals.

Source: Whyte and Harrison, 1981.

16.7 CONCLUSION

There are many aspects to the perception of any environmental phenomenon and a number of ways to study perception. As was suggested in Section 16.2, the first research task is to clarify what components of climate, what types of decision-makers, and what aspects of perception form the focus of the investigation. From these decisions flow the choice of method, sampling frames, and specific measurement techniques to be used.

The section of risk perception (16.3) provides an overview of some of the main perception parameters that are considered relevant for climate impact studies. Few of these aspects of risk perception, however, have been examined specifically with respect to climate impacts, except for natural hazards. The reader will note some discrepancy between the discussion of risk perception in Section 16.3 and the parameters measured in the two examples described in Section 16.5.

In the field, many of the more psychological aspects of risk perception, such as attribution of causality or perception of probability, became masked, or dominated by, contextual parameters. In Mapimi, these included the constraints of decisions made by others on the choice of adjustment of the study population. In Ontario, awareness of climatic change is more influenced by the mass media than by direct experience, so that a more sociological and less individual-oriented approach is relevant.

The bulk of this discussion has dealt with climate as hazard (which is discussed also in Chapter 3) and within this context, more attention has been given to the perception of probabilities of risk than to the perception of consequences or adjustments. Still less attention has been given to the perception benefits, and least attention to the perception of the benefits of climate itself or climate as a resource.

A well-designed and conducted perception study does not come cheaply, and research costs and time are typically underestimated. The value of perception studies lies in the insight that they can bring to explaining human behavior and the directions that they can provide for public policy in an increasingly uncertain and risk-conscious world.

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Back to Table of Contents

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