chapter twenty-two

Behavioral change and risk perception

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22.1 Behavioral Change

22.1.1 Model for planned behavioral change

Consumers do not always behave in a way food experts consider healthy or safe. Therefore, interventions have been and will be developed to change dietary behaviors of the population. Based on experiences with other risk behaviors, such as smoking, systematic knowledge about planned behavioral change is now available. This knowledge can be applied to changes in dietary behavior.

Before developing interventions for behavioral change, the health or safety problems concerned should be analyzed. Then the behavior related to this problem, the determinants of that behavior, the possible intervention methods, and the possible implementation strategies can be analyzed (see Figure 22.1).

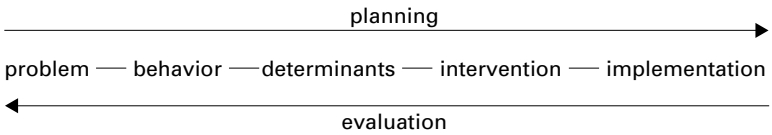

Figure 22.1 Model for planned behavioral change.

The model in Figure 22.1 consists of a planning phase and an evaluation phase, each with a five-step sequence. The *first* step in the *planning phase* is analysis of the problem: what exactly does the problem imply and how serious is it? Health problems of concern might be cardiovascular disease, cancer, or food intoxication. Only if the health problem is serious does the planning process move onto the next step.

The *second* planning step is behavior analysis: to what specific behaviors is the problem related? In the case of cardiovascular disease, the behavior might be consumption of too much food, too much salt, too much fat, etc. With regard to food intoxication, the behavior might be negligence in keeping food fresh, or insufficient heating during preparation. Analysis of behavior is intended to select specific behaviors to which the problem is strongly related.

The first two planning steps are primarily within the field of epidemiology. The Dutch Nutrition Council has published consensus reports on health and safety problems in relation to dietary behavior. These reports include advice on behavior, both general advice and specific advice for various target groups, such as children and the elderly. Assuming that the behaviors which should be changed are known, the planning is continued.

The *third* planning step is analysis of the determinants of behavior: the reasons why people behave as they do. Why do people eat too much fat? Why do people keep food insufficiently fresh? A behavior is often determined by more than one factor and different behaviors often have different determinants. Therefore, these have to be analyzed specifically. In Part 1B (Chapter 7), a model is presented that can be used for analyzing determinants of dietary behavior, in combination with the results of a number of studies on determinants of specific dietary behavior.

The *fourth* planning step is analysis of intervention possibilities and the development of an intervention. Which intervention is likely to be most effective depends largely on the specific behavior and its determinants, and on the characteristics of the target group. Different determinants often need different interventions. In Section 22.1.3 the four types of intervention will be discussed: health education, provision, pricing, and regulation. Nutritional education as part of health promotion will be emphasized in particular.

The *fifth* and last step of the planning phase is implementation of the intervention. This step includes an analysis of the political situation and the policies of the different factors involved in the intervention. Especially important for dietary behavioral change is the achievement of cooperation between retailers, caterers, (local) governmental authorities, etc.

The sequence of the five planning steps can be illustrated by the following example. A national government is worried about the incidence of cancer in its country. Cancer is a serious problem that is related to a number of unhealthy behaviors such as smoking' and eating too much fat. High fat intake is mainly attributed to the amount of high-fat meat in the daily eating pattern. A (hypothetical) determinant of high-fat meat consumption is the consumer's perception that there are no alternatives to high-fat meat. Therefore, the intervention should present alternatives, i.e., low-fat food products. These could, for example, be displayed at the place of purchase: the supermarket, where the consumer can taste them. The next step is then to increase the assortment of low-fat food products.

The *evaluation phase* consists of the same five steps, but in reverse order. Now, the first step concerns implementation; in the example above: was the cooperation between the educators and the supermarkets successful? The second step is to find out whether the intervention has been carried out as planned: have people seen and tasted the alternatives? In the third step, the determinants are queried: are the consumers now better informed about possible low-fat alternatives? The fourth step concerns behavioral change: do people eat less high-fat meat? In the last step, the result of the intervention is the focal point: has the health problem, in this case cancer incidence, decreased in size? This question can only be answered in the long term because of the latency period of cancer. Consequently, on its own, reduction of the initial health problem is often not a realistic evaluation criterion. In such cases, a change in problem-related behavior is the best criterion for success of the intervention. The evaluation phase has been introduced here after the planning phase. In practice, however, evaluation starts right from the first step of the planning phase with data collection. To interpret evaluation results, it is important to compare pre-intervention measures with post-intervention measures. For large-scale interventions where there is no control group, e.g., a public campaign, longitudinal pre-intervention measures are the only basis for concluding whether or not an intervention has been successful.

Alcohol abuse is a behavior (step 2). The physical problem may be liver damage. Alcohol abuse may be caused by social pressure (in bars or at parties), or by the fact that alcohol is seen as a way to cope with problems such as unemployment or loneliness. An intervention may be developed that teaches people to resist social pressure. This intervention can then be used by organizations working with people who have an alcohol problem.

22.1.2 Importance of planned behavioral change

Planned behavioral change is an intensive and time consuming activity. This is one of the reasons why practitioners have their doubts about the need for such an elaborate approach. In order to investigate this problem, a meta-analysis of a large number of studies on the effectiveness of different educational methods has been carried out (Mullen et al., 1985). The first finding was that there appeared to be no difference in effectiveness between the various methods; every method can be effective depending on the behavior involved, the determinants, the target group, etc. The second finding was that a positive result of interventions only depends on *the quality of the planning process*, i.e., conscientious answering of the planning questions. As a result, the success of the intervention also depends on the strength of the relationships between the various planning variables: problem–behavior, behavior determinants, etc. If the answer to one planning question is not clear, e.g., there is no consensus on the specific behavior that might be related to the problem, the subsequent questions can not be answered conscientiously. Unfortunately, this situation is not uncommon. Governments and experts are often forced into action, including health education, against a certain health threat at a time when the epidemiological data are not yet conclusive. In a pragmatic approach, the responsible authority will develop interventions based on the best estimation of the answers to the planning questions. At the same time, research projects will be started to fill the gaps in the knowledge that is necessary to answer those questions conclusively.

Besides planning, evaluation is important. Without evaluation, the effects of the intervention remain unknown. During the planning all kinds of decisions have to be made. Planned evaluation can examine the decisions and adjust them, if necessary. Evaluation is also needed for the identification of unexpected and undesirable side effects of the intervention.

As stated above, planned behavioral change is a time consuming and costly affair. In the long term, however, it is effective in preventing wrong decisions, and wasted money

and effort because of them. Wrong decisions are often made if the planning steps are not conscientiously taken. A number of pitfalls which are quite common and often result in wrong decisions are listed below. The pitfalls are related to the various steps.

Pitfall 1: Development of an intervention for a problem that does not really exist. An example is a campaign against the use of alcohol, and especially the decision of the Dutch government to pay particular attention to the use of alcohol by pregnant women. Researchers were requested to analyze the planning steps. First, they found that the data collected showed that the assumed relationship between behavior (the mother's alcohol drinking) and the health problem (for the child) was not confirmed for small amounts of alcohol. Actual problems with the child only occurred if the mother drank more than one glass a day. Secondly, it was found that only about 3% of the population of pregnant women drank more than one glass a day. Pregnant women appeared to be very well-informed about the risks due to alcohol and almost all complied with the advice on drinking. These results made clear that the campaign would be a waste of money, since the problem did not really exist. Moreover, the campaign might even have had undesirable side effects, such as feelings of guilt in mothers who found out about their pregnancy rather late.

Pitfall 2: Development of an intervention intended to change a behavior for which there is no consensus about the relation to the problem. This can be illustrated by the discussion on cholesterol testing. Only recently has some consensus been reached about the relationship between cholesterol plasma levels and specific cardiovascular health problems. In addition, currently the relationship between diet and cholesterol levels is being questioned. As a result, interventions intended to lower the cholesterol content of diets may have limited effects on health. Changing behaviors which are not unequivocally related to a problem will not be helpful in reducing the problem.

Pitfall 3: Development of a behavioral change intervention, based on a misconception of the determinants of the behavior in question. This is one of the most common mistakes made in health education as well as in nutritional education. The main reason for this probably is a lack of money and time. Notably, health risk, though a cause for concern for nutrition experts, toxicologists, and health educators (e.g., cancer, intoxication), is almost never a major determinant for consumers in their choice of behavior. Taste, convenience, costs, etc., are the determining factors while health and safety are seldom of overriding importance. Just informing the public about health risks and preventive behavior hardly ever results in behavioral change. (If it did, the habit of smoking, for example, would be eradicated by now).

Pitfall 4: Development of a wrong intervention, e.g., an intervention that is directed at the wrong target group, or a message that is too complex. This can be illustrated by a school project on (un)healthy food aimed at children and adolescents. The target groups are not really involved in decisions on their own dietary behavior. The important decisions are made by their parents, for example, the choice of vegetables in the main meal.

Pitfall 5: Development of an intervention that pays insufficient attention to its implementation. An example is the development of a potentially effective program to be used by local health services, without an adequate system of distribution or without even the means for disseminating the knowledge in the program.

Pitfall 6: Unjustified satisfaction with the effects of an intervention. Without serious evaluation, people use marginal criteria to determine the success of the intervention, such as the quantity of educational materials that have been handed out or the number of participants in the educational meetings. Important as these successes may be, they do not give any information about the desired behavioral change or the reduction of the problem, which are the only real criteria for success.

Falling into these pitfalls may seem unnecessary but is in fact quite common. Mistakes like these can be prevented by careful planning and evaluation. Using the planning model is no guarantee for success, but the (few) successful programs known, followed the

planning model. As discussed above, the analysis of problems and behaviors is within the field of epidemiology. Information on determinants of behavior can be found in Part 1B; this chapter continues with a further study of the development, implementation, and evaluation of interventions that are directed at changing dietary behavior to prevent adverse health effects following food intake.

22.1.3 Methods of behavioral change: policy

Four methods of interventions aimed at behavioral change can be distinguished: health education, provision (e.g., assortment), pricing, and regulation. This distinction is only an abstraction, others are also possible. *Health education* is based on voluntary behavioral change. People receive information, help, or training, but eventually they themselves decide about their behavior. *Regulation* is on the other end of the continuum and involves enforcement, with sanctions and control if necessary. *Provision* and *pricing* are interventions in between the two extremes of enforcement and voluntary change. Often they are governmental decisions, but the individual's choice is still voluntary. Pricing is based on the psycho-economic principle that people buy what is cheaper. If healthy food were less expensive than unhealthy food, pricing might well be the decisive behavior determinant for many people. Figure 22.2 shows the so-called "food health policy matrix": the different intervention types vs. the actors in the nutritional field.

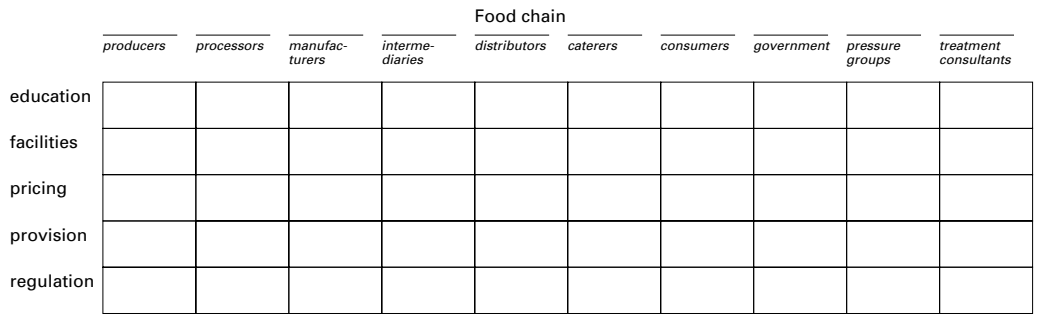

Figure 22.2 Food health policy matrix.

The choice of interventions in dietary behavior takes up an essential place in governmental policy. With regard to nutrition, however, policy is not always consistent, not even in the case of a crucial subject like smoking. An exception is the Finnish antismoking policy, visualized in Figure 22.3.

A change policy based on only one type of intervention will seldom be effective. Integrated approaches are needed. Two examples can illustrate the feasibility of an integrated nutrition policy.

Norway is one of the few countries with an integrated nutrition policy. Since 1976 this country has worked to achieve four goals:

1. promotion of a healthy diet (reduction of fat intake, increase in vegetables and fiber);
2. stimulation of the country's own food production: fulfilling 52% of its need in 1990, compared to 39% in 1976;
3. stimulation of agricultural developments in thinly populated areas, taking environmental protection requirements into consideration;
4. contribution to world food safety and stimulation of food production in developing countries.

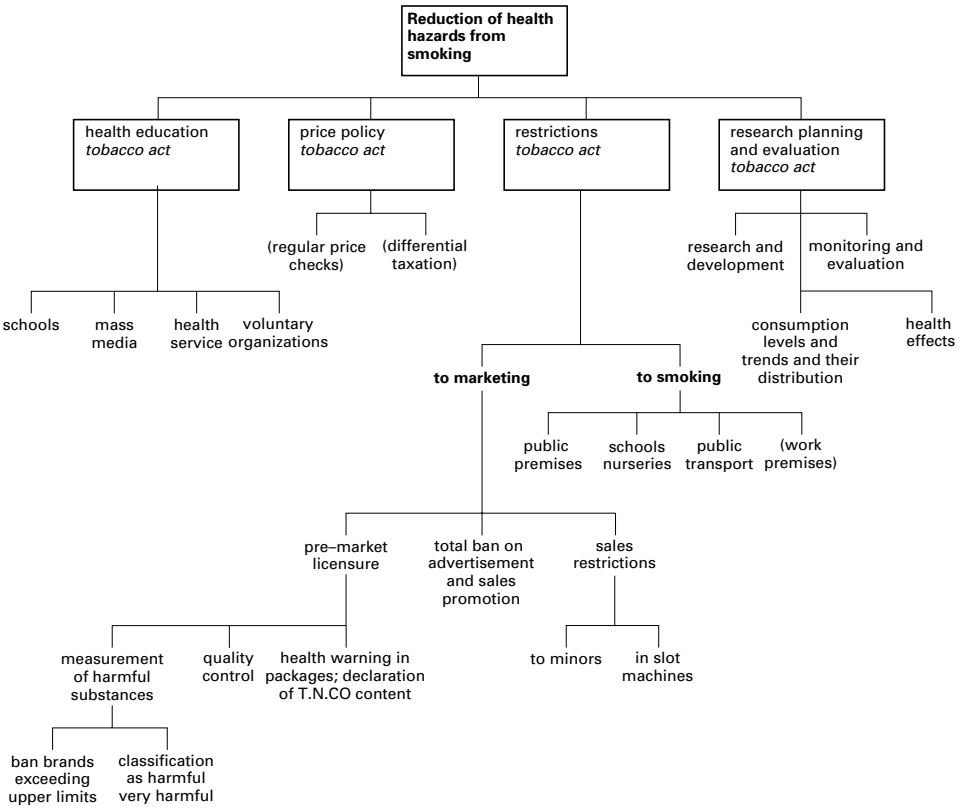

Figure 22.3 Objectives and means of the Finnish antismoking policy. (Source: Leppo and Vertio, 1986. With permission.)

A necessary condition for this integrated policy was that it should have no negative macroeconomic implications. The government financed the necessary investments out of the oil revenues. Due to the short period of time since the implementation of the policy, no improvement in public health has been proven. But from an economic point of view, the Norwegian project has already proved to be a success. The investments appear to be cost-effective and the economic situation of the farmers has improved.

What are the characteristics of the Norwegian nutrition policy? First, it is an integrated policy. Knowledge in the fields of agriculture, economics, nutrition, and health care are integrated. This means that a number of interventions are combined: regulation, long-term planning, health education, financial and economic stimulation, and continuous evaluation of the effects of the interventions concerned. The implementation of the interventions is the task of an intersectoral management team, of all the actors involved, called the Norwegian Interdepartmental Nutritional Council. Why does Norway succeed in the implementation of an integrated nutrition policy, while other countries do not? On the one hand the Norwegian situation was characterized by long-term lobbying activities by individuals as well as organizations, combined with the fact that the risks from negative macroeconomic effects were low. On the other hand, all actors agreed on the integrated policy, including the government itself.

The principle of an intersectoral, i.e., integrated policy being more effective than only one type of intervention, is also applicable at the local level. Integrated local nutritional interventions have been developed and implemented in several countries, using the so-called *community-based approach*. Community-based programs are directed at all members of a certain community, in the sense of an existing social network, such as a neighborhood,

village/city, work site, school or organization. Important characteristics of the community-based approach are:

1. it makes use of the existing means of communication of the social network;
2. it stimulates participation of the target groups themselves;
3. it uses intersectoral programs, i.e., including health education, provision, pricing, and regulations, that are carried out by existing organizations, such as the local government, the distributors, and health organizations;
4. it involves multi-media educational interventions including interpersonal communication;
5. it includes training paraprofessionals or volunteers from within the target group as educators;
6. it considers dietary behavior as part of people's lifestyle.

Evaluations have confirmed that community-based nutrition interventions are more promising than the more classical approaches with only one type of intervention, e.g., health education. Further, community-based programs are particularly successful in reaching "difficult" target groups, such as groups with a low socio-economic status and immigrants, who have a lower state of health, partly caused by an unhealthy lifestyle. This is very important, because in general, interventions have been most successful for people that need it the least, such as groups with a higher income and higher education. In interventions effective in reaching consumers with lower education and lower income, the above six characteristics of community-based programs are easily recognized. It may be clear that at this local level too, coalition formation and intersectoral cooperation are essential conditions for success with regard to characteristic 3.

As stated above, local interventions are only partly educational. Programs intended to affect the consumers' environment have been reported to be effective in changing dietary behavior. These programs have some characteristics in common with those based on the community-based approach since they:

1. stimulate changes in the availability of products: low fat, low calorie, low salt, more fiber; healthy menus in restaurants; training of servers (intersectoral cooperation, multi-media approach);
2. provide nutrition information at the moment of choice: in supermarkets, in restaurants, including work sites (existing means of communication of the social network);
3. cooperate with distributors by giving information, training (intersectoral cooperation, multi-media approach);
4. carry out interventions at the work site: weight loss programs during work time, availability of testing (existing means of communication of the social network, intersectoral cooperation);
5. bring changes in health care organizations: training of dieticians and doctors (intersectoral cooperation, multi-media approach).

An integrated approach is more effective. Behavior is often determined by several factors and some of these, for instance price or inavailability of products, cannot be altered by health education.

22.1.4 Education as a method of dietary behavioral change

As mentioned above, nutritional education should always be considered as part of an intersectoral health promotion policy. An approach that is solely based on educational activities will hardly ever be effective. As part of an intersectoral program, however, in

combination with the other types of intervention, planned health education can indeed be effective in changing people's behavior.

The development of theories concerning behavioral change by communication has resulted in a matrix with the stages of the change process vs. the communication variables (see Figure 22.4).

	message	*receiver*	*channel*	*source*
attention				
comprehension				
attitude change				
change in social influence				
change in self–efficacy				
maintenance of behavioral change				

Figure 22.4 Matrix of behavioral change by education (Adapted from McGuire, 1985.)

On the left of the matrix the stages that lead to a continuous change in behavior are listed:

- attention for and comprehension of the message;
- alteration of the determinants of behavior, such as attitudes, social influence and self-efficacy (see Part 1B), in combination leading to a change in behavior;
- maintenance of the behavioral change.

Above the matrix the communication variables can be found: message (form and content), receiver (target group), channel (medium), and source (an expert, organization, authority, etc.). The questions that need to be answered in the development of communication interventions can be formulated as: what is communicated *(message)*, to whom *(receiver)*, how *(channel)*, and by whom *(source)*? The boxes of the matrix represent large numbers of decisions which have to be made in order to develop an effective educational intervention. The first decision concerns the desired behavioral change (message) in a particular target group (receiver). The second decision is directed at the determinants of behavior, i.e., what message is needed to affect attitude, social influence, and self-efficacy (see Part 1B). Subsequent decisions concern the communication of the various messages to target groups, choosing appropriate channels. A decision is necessary on how to attract attention, as well as on how to get people to understand the message.

A good deal of knowledge is available concerning the various boxes in the matrix. In order to make optimal decisions, the existing empirical data and theoretical insights should be carefully weighed. It should be noted, however, that decisions in one box may conflict with decisions in another. A source that attracts the most attention may not necessarily be a credible source for attitude change. A mass medium that reaches many people may not be the best medium to improve skills (e.g., the ability to prepare low-fat meals). These dilemmas have also been studied. In the next paragraphs, a number of conclusions from research in the various boxes are summarized. The reader who wants to try and develop a new intervention should always bear in mind that there is no such thing as "one

intervention method is always more effective than the other." The "rules" that are presented here should always be weighed carefully against the specific characteristics of a new problem. The following remarks are relevant here as regards the effects of the four communication variables.

Message effects. In health education, messages' explicit conclusions are often more effective than implicit conclusions. The more a message is repeated, the more effectively it is received. After three times, however, repetition may no longer be effective, or may even lead to opposite effects. New and valid arguments may change someone's attitude, but information about the opinions and behaviors of others may also contribute to changes in attitude and perceptions of social standards. The discrepancy between the position of the source regarding the issue at hand, and the position of the receiver should not be too large, especially in the case of high involvement of the receiver in the issue under consideration. Improvement of self-efficacy by giving specific instructions is important, particularly in the case of fear-arousing messages (e.g., about the relationship between diet and cancer). An individual's efforts and perseverance in attaining a behavioral change are stimulated if a challenging but realistic goal is stated in the message and care is taken to give feedback information about the effects of the change, as has been shown in weight-loss programs.

Receiver effects. Characteristics of the receiver may affect the results of health education. Changes in attitudes and behavior are curvilinearly related to age. Up to nine, the higher the age the more change. For older people the reverse has been found. Public commitment of the receivers to a certain behavior may cause them to resist change. However, public commitment to the new (changed) behavior can lead to greater maintenance of the behavioral change. Low self-efficacy can be the cause of lapses or relapses (people falling back into their former unhealthy behaviors). It may even keep a person from trying to change. Improving self-efficacy by relapse prevention techniques can result in behavioral change and maintenance of that change. In relapse prevention, four steps are distinguished:

1. convince the person that the reasons for former failure are not stable, but changeable;
2. identify high-risk situations and find adequate responses to high-risk situations;
3. put those responses into practice until they become automatic;
4. in case of (re)lapse, use the lapse as a learning experience and start again with 3, 2, or 1.

Relapse prevention techniques have proved to be effective in changing compulsive and habitual behavior, such as (non)compliance with diet advice.

Channel effects. As far as the effects of communication channels are concerned, it is important to pay attention to mass media on the one hand and interindividual communication on the other. Mass media can be very effective in reaching many people, and in attracting attention to the message. However, interpersonal communication is essential in improving self-efficacy, resistance to social pressure, skills, and maintenance of behavioral change. The simplest conclusion is of course to combine the strengths of both channels in a multi-media intervention. Recently, a number of technological innovations have made it possible to use mass media in combination with interindividual communication, e.g., interactive computer programs and computerized individualized feedback.

Source effects. The source of an educational message is not always the educator himself or herself. It can also be the organization represented by the educator, e.g., a national cancer foundation. Important sources are opinion leaders from people's own environment: medical doctors and paraprofessionals such as dieticians, but also colleagues and friends. The effectiveness of sources is positively related to their competence, their integrity, their

attractiveness (including similarity), and power. Powerful and attractive sources may lead to compliance, i.e., do what the source wants you to do. However, this change will only continue while the source is present. On the other hand, competent and trustworthy sources will lead to acceptance, i.e., an internalized change of attitudes and behavior that will be maintained by itself.
The requirements for the source to motivate people to a certain change are:

- explicit conclusions,
- some repetition, but not too much,
- new and valid arguments,
- information on the opinion and behaviors of others,
- information that is not too discrepant from the receiver's position, and
- specific instructions.

And his/her own characteristics are preferably: attractiveness (similarity), competence, integrity, and power.

The various stages of the change process need completely different interventions. Educational programs should have the possibility of differentiated interventions for people at different stages. In the case of people not aware of a possible problem with their diet, the accent is on attention, comprehension, and attitude change. For people who are aware of problems but do not know how to change their behavior, interventions should be directed at attitude change, social influence, and in particular, at self-efficacy and skills (including resistance to social pressures). For people who try to change their behavior, the intervention is focused on maintenance of that behavioral change, and methods such as feedback and relapse prevention are used.

Approaching people who are not aware of a problem with interventions directed at training skills is as useless as approaching relapsers with information about the nutritional problem: it may even be counterproductive.

Community-based programs (see Section 22.1.3) are a specific application of the matrix approach. The six characteristics of these programs, particularly the use of the social network and the participation of para-professionals from the target group, improve the chances of achieving attention and comprehension. Messages will be better adapted to the psychological, social, and structural situation of the receivers, resulting in more changes in determinants and behavior, and in maintenance of behavioral changes.

Even professional educators tend to underestimate the differences between the target group and themselves regarding receiver characteristics. This explains also the effectiveness of paraprofessionals from within the target group itself. The source–receiver dissimilarity can be approached by careful *pretesting* of all materials that are used in the intervention. Pretesting consists of a critical review of the educational materials by the following groups:

- experts in the field of the subject concerned;
- experts in communication and health education;
- a subpopulation of the target group itself, preferably a random sample.

Pretesting by the latter group is extremely important in order to prevent costly mistakes.

The effectiveness of nutrition education programs has not been studied much. In addition, the range of behaviors involved is rather wide. This, combined with the low quality of the research designs, makes it difficult to draw well-considered conclusions.

Programs aimed at students were found to impart knowledge, but not to lead to behavioral change. As far as high-risk groups such as patients with diabetes, cancer, kidney problems, high blood pressure, high cholesterol level, and obesity are concerned, maintenance of behavioral change (diet compliance) is the major problem. Mass media nutrition education programs do not yield positive results. Successful nutrition education programs are characterized by interpersonal contact, social support, self-control, and feedback. Adaptation of the intervention to the individual's attitudes and skills is effective. Interventions aimed at groups (e.g., patient groups) and those based on relapse prevention techniques are promising. For example, in the Netherlands, a large number of programs are available, but subsequent evaluation is often lacking. The "Way of Life" television campaign, intended to combine health education with entertainment, appeared to attract people's attention, and to heighten their awareness of the importance of a healthy lifestyle (including nutrition) for the prevention of cardiovascular diseases and cancer. Group interventions as well as individual counselling have been proven to be effective in weight-loss programs.

In conclusion:

1. effective nutritional education interventions are possible if they are carefully planned and evaluated. They should be based on the results of an analysis of the determinants of the behavior involved;
2. education interventions alone are not sufficient to change an individual's behavior. They should be integrated in an intersectoral approach, not only at national level but also at local level (community).

22.2 Risk perception, risk acceptance, and risk communication

22.2.1 Introduction

The way experts perceive toxicological risks due to food intake often differs considerably from the way the public perceives them. For example, people worry about the health consequences of the presence of antioxidants and colorants in food, and food irradiation, while experts consider these risks involved to be minimal. Experts warn the public of bacterial infections and intoxications, and of consuming too much fat, while the public generally does not worry about these issues (see Part 3, Chapter 16).

A few explanations of the differences in risk perception between experts and lay persons will only be touched upon in this section, as they are so plausible that they do not need much discussion. First, in practice, the opinions of experts may sometimes not reach the public. In this case individuals who want to eat "healthy" foods have no other choice than to base their risk judgments on hear-say or on their own intuition. Secondly, even when the message of the expert does reach the public, they may prefer to rely on their own intuition, because the expert's message is distrusted. Lack of confidence in experts may have several reasons. For example, experts may have lost their credibility because they have made mistakes before. Disagreement among the experts themselves may also lead people to conclude that experts are not to be believed and that they "don't know either." However, the gap between experts and the public also appears to exist when the public receives the expert's message and considers the experts trustworthy. A third explanation of differences in risk perception between lay persons and experts concerns the way the former perceive probabilities and risks.

This section will be mainly devoted to the last explanation, as it is less trivial than the others, and therefore warrants more discussion. The consequences of the ways in which people normally assess risks for the practice of risk communication are also included.

In Section 22.2.2 expert risk assessment methods are summarized (preceding chapters have discussed this in more detail). It will be stressed that experts normally cannot be 100% sure of their risk assessments, as they themselves realize quite well. This uncertainty in the expert's judgment is relevant here, because messages which contain an element of uncertainty are difficult to communicate adequately to the public. Furthermore, the ways people deal with probabilities and risks are discussed. This will be largely based on risk perception research that does not directly concern food and food safety. Hardly any studies have been reported in this area. In the last subsection, recommendations are given on how to communicate toxicological risks arising from food intake, based on information in the preceding subsections on the way experts assess risks and the public perceives them.

22.2.2 Expert risk assessment

In general, experts base toxicological risk assessment on data from animal as well as epidemiological studies. They are well aware that there may be differences in physiology between species and interindividual differences in sensitivity to a toxin. For that reason, scientists apply safety factors in their recommendations (see Chapters 17 and 18).

A certain degree of caution in risk communication, however, remains warranted because of some other limitations of risk assessment methods. First, combined actions (synergism or interaction) may occur (see Part 2, Chapter 13). For example, a high-fat diet may promote azoxymethane-induced intestinal cancer. Secondly, long-term effects, which are sometimes difficult to determine in research, may occur. For example, two-generation studies on the possible mutagenicity of saccharin have revealed effects which had not been observed in one-generation studies. Thirdly, in some cases, the safety factors which used to account for inter– and intraspecies variations, may not be appropriate.

Although the above aspects of expert risk assessment cannot be denied, one should realize that guaranteed zero risk levels cannot be given. The risks lay persons run without any further thought in everyday life are usually considerably higher than those from food intake, which experts judge relatively safe. The important point here is that experts often cannot give the 100% certainty the public wants. People do not like uncertainty, however small the risk involved is. They want the experts to tell them which food is absolutely safe, and which food is absolutely hazardous. An American senator once stated: "We need one-armed scientists, who cannot answer questions with: On the one hand the evidence is so, but on the other hand ..."

The next subsection deals with the lay person's perception of probabilities. Some illustrations will be given of the preference people have for certainty.

22.2.3 Probability perception

Scientists use special data sets and advanced statistical computer programs to assess the risk from toxins. Of course, the public does not have such data and tools at hand, and therefore relies upon much simpler methods. For instance, people may apply the so-called availability heuristic, i.e., memories which have some relevance to the problem are used as starting points to estimate the risk involved.

The way in which such a heuristic works is illustrated by the following example. Imagine a man trying to find out whether food colorings are toxic. A quick memory search results in two examples of people who always eat incredibly pink cakes and puddings. One example concerns a child, the other a woman of 85. Since the child looks really pale and the woman has stomach complaints, the man is likely to conclude that colorings are toxic.

This shows how the way lay persons handle data differs essentially from that of epidemiologists. First, the lay person relies heavily on small biased data sets. Salient, vivid, or emotional memories are likely to come to mind first. Secondly, the man only considers one class of data, viz. data on individuals who have a bad state of health and ingest a considerable amount of colorings. He does not take into account any data on individuals who did not ingest large amounts of colorings, or who are healthy. Few people would understand that one would need (at least) four categories of data to establish the association in question: (1) data on healthy people who consume colorings; (2) data on unhealthy people who consume colorings; (3) data on healthy people who do not consume colorings; (4) data on unhealthy people who do not consume colorings. The speed with which people establish associations should not be considered "dumb" without further thought. Heuristic processing is quite adequate for situations where evidence is strong and there is little time to think. Since sophisticated statistical processes only begin to yield results after one has managed to survive in relatively simple situations where quick decisions are needed, heuristic processing appears to be valuable, all things considered.

Of course, the lay person's way of establishing associations would not pose any problem to risk communicators if only people would easily change their minds on the basis of information given by the experts on the risks they assessed. However, psychological research shows that heuristics even affect risk judgments when objective statistical evidence is at hand. This is intuitively plausible. Many people defend their smoking and drinking behavior by referring to the old man they once knew who smoked two packets and drank a bottle of liquor a day, and lived healthily until the age of 96.

Although the evidence in this respect is scarce, it seems plausible that lay persons' associations play an important role in risk and probability perception. Because some types of chemicals are dangerous, all chemicals (even vitamin C if it is designated as ascorbic acid) are perceived to be toxic. Foods of natural origin, however, are considered to be healthy. A complicating factor is that, once an idea has been formed about the riskiness of a substance, the idea is often resistant to change. People are either selective in the information they are looking for, or they interpret the facts in a way that supports the already existing ideas. For example, the accident at Three Mile Island was interpreted by nuclear energy supporters as evidence that nuclear energy is safe (there were no large negative consequences), and by nuclear energy opponents as evidence that it is dangerous (there had been an accident).

22.2.4 Certainty and uncertainty

Another characteristic of people's ideas on probability is that all probabilities are perceived to have much in common. A probability of 30% is not viewed different from a probability of 50%, as one would expect from a rational point of view. The difference between certainty (100% probability) and 80% probability, however, is perceived in a completely different way.

In an experiment on this issue, a group of subjects were asked to choose between two options, A and B, of which option A meant 20% chance to win \$4000, and option B, 25% chance to win \$3000. From a rational point of view, subjects should choose option A, because the expected benefits of option A are more substantial ($^1/_5$ of \$4000 = \$800) than those of option B ($^1/_4$ of \$3000 is \$750). Indeed, the results show that 65% of the subjects chose option A. However, another group also had to choose between two options, A and B. Now, option A meant 80% chance of winning \$4000, while for option B the chance to win \$3000 was 100%. Using the same approach as before one would again predict a preference for option A ($^8/_{10}$ of \$4000 = \$3200, a larger sum than \$3000). In this case — and that will be intuitively plausible to most people — 80% of the subjects preferred option B; a certain benefit is preferred to an uncertain one. In the case of losses, empirical evidence was

obtained for the behavior to be exactly the reverse. In general, to be sure of losing a certain amount of money is less preferred than the risk of loosing a larger amount. The preference most people have for certainty was also shown in a study in which two groups of subjects were asked whether they would decide to become vaccinated in a certain situation. One group of subjects was informed that 20% of the population was expected to be infected with the disease in question, and that the vaccination would protect half of the group against the disease. The second group was told that the disease has two variants, each of which would infect 10% of the population. The vaccination would provide protection against one type of the disease, but not against the other. In both cases, vaccination reduces the chance of infection from 20 to 10%. However, in the second case the subjects more often chose to be vaccinated than in the first case. In the second case, vaccination gives 100% certainty of protection against one type of the disease. Therefore, vaccination seemed more useful than in the first (uncertain) case.

22.2.5 Perception of probabilities and risk communication

What are the consequences of the lay person's comprehension of probabilities for risk communication in food safety practice? First, risk communicators themselves should realize that people cannot be expected to deal accurately with the probability aspects of risk messages. Secondly, risk communicators should realize that the public feels that all probabilities have much in common, but that people make a clear distinction between chance and certainty. Thus, although experts claim that the chance of a certain type of additive causing cancer is really small (for example: 0.0000016%), people may still perceive this probability as greater than one would expect. By formulating the message slightly differently, the facts may sometimes be conveyed better. People may comprehend more easily that a danger is actually small, when the message says that the particular type of additive increases the risk of dying from cancer from 24.7% to 24.7000016%.

In literature, more examples can be found of the way presentation influences probability perceptions and decision making. For example, a study on patients revealed that a therapy was chosen more often when the percentage of patients that survived (e.g., 90%) was given, than when the percentage of patients that died (10%) was mentioned.

22.2.6 Safety scale

Several scientists have proposed the introduction of so-called safety scales as a solution for the relatively poor comprehension people have of the concept of probability. A safety scale, as proposed by Urquhart and Heilman (1984) shows how safe or unsafe a certain activity is on a 1 to 8 scale: the higher the score, the safer the activity. For example, smoking cigarettes (a packet a day) scores 2.3, flying is 5.9. Numbers are assigned to activities by logarithmic transformation of statistical data. When, for example, a certain activity takes the life of 1 person a year per 100 people who carry out the activity, the score on the safety scale is 2. Urquhart, however, is of the opinion that it is not necessary for people to know how the score on the scale is calculated. He argues that people also have an idea of what an earthquake of five on the Richter scale means without knowing the background to measurement and calculation. Although such a scale might give the public more insight into the magnitude of risk in some cases, not all risk communication problems seem to be solved by it. First, people need to be informed about risks which are relatively unknown and of which a detailed estimate in terms of human lives lost per year is not possible. Secondly, comparing risks which differ considerably in nature does not make anything clearer. For example, flying by plane and ingestion of food additives are so different that a direct comparison does not make any sense. Normally, one survives the intake of food

containing additives (possible health effects only show themselves after some time), but one either survives a flight or not. Thirdly, there are often more reasons than only the deaths an activity causes for calling the activity risky. The activity, for example, may also be considered risky because it may lead to illness or handicaps. Related to this is the fact that people do not define risk as the probability that an activity leads to death. This point will be considered in more detail in the next subsection.

22.2.7 Risk perception

Risk, as defined by the lay person, seems to be a concept that has many qualitative dimensions. By using multivariate techniques like factor analysis, two fundamental dimensions have been shown in several studies. The first dimension is called "threat," the second "observability." A third dimension that sometimes shows itself is "the number of people that may be affected." The first two dimensions and their characteristics are summarized in Figure 22.5. The figure shows that activities are perceived to be less risky if they can be carried out voluntarily. It also shows that activities are perceived as less risky if the activity is more or less familiar, and its consequences are manageable and non-global. Further, risks are considered to be more acceptable if many advantages are attached to the activity.

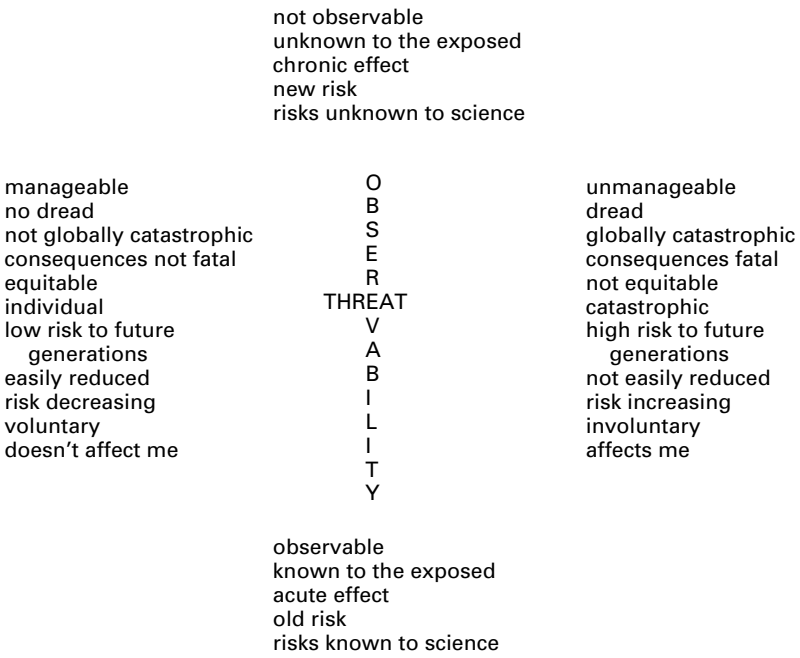

Figure 22.5 Dimensions underlying risk perceptions (results of a factor analysis) and the characteristics of the dimensions. (Source: Slovic et al., 1982. With permission.)

The recognition that the lay person's risk perceptions are related to the qualitative aspects of risky activities leads to several recommendations for risk communication. First, whenever possible, people should be left to choose whether they want to take the risk, however small that risk may be in the expert's eye. People should be given the information they need to decide whether they want to eat food to which colorings have been added, or food that has been produced by new biotechnological techniques. Adequate labeling of food products is one necessary step to enable consumers to choose freely. Furthermore, the

advantages of the risky activity should be mentioned, especially the advantages it has for the consumer. Also, the measures that have been taken to manage the risk and its possible negative consequences should be stressed. Further, not only the new aspects of the risk should be mentioned, but also the "old" ones.

Some authors have suggested that "catastrophic potential" is the most important determinant of the lay person's risk perception. The more severe and the more globally effective the theoretically possible negative consequences are, the stronger the risk is perceived. At first sight this seems a fairly simplistic and crude way of evaluating risks since several important aspects of risk, such as the probability of negative consequences and the advantages of the risky activities, are not taken into account. However, this way of risk evaluation may be understood better from a "survival of the species" point of view. In a (micro-)evolutionary sense, it makes quite a difference whether an activity costs one life per year during a million years, or whether it costs the lives of a million people in one catastrophe once in a million years. In the eyes of general public, it makes a difference whether in a worst-case scenario the whole world population may die, or just one individual. So, the perception of risk in terms of catastrophic potential may have some value after all.

The research referred to above is merely descriptive, and largely empirical. A theoretical basis may be found partly in the stress theory and in research. The stress theory states that stress originates from something (an event, an activity, a substance) that is perceived in a primary appraisal process as a threat ("a risk"). However, only after an inventory has been made of the available coping mechanisms (secondary appraisal), and these coping mechanisms do not seem adequate to handle the threat, an individual will experience stress. Thus, the stress theory seems to underline the importance of the manageability of the threat or risk and its possible negative consequences.

In health education, self-efficacy, a concept related to manageability, has proven its value in predicting people's behavior. Self-efficacy is the judgment the person has of his or her own efficacy to display a certain behavior, i.e., to manage and eliminate barriers and difficulties. To impart self-efficacy and a sense of manageability, risk communication should give detailed and clear information on the way in which risks and their negative consequences can be managed.

Of course, in some cases it is not possible to give detailed information. Many severe threats cannot be removed easily. Some authors have suggested that the so-called reactance and learned helplessness theories should be integrated, to gain insight into situations where a threat occurs without clear possibilities of managing it. In such situations, individuals will sense a loss of control, and will first show reactance. They will try to regain control in several ways. However, when they do not succeed in doing so, feelings of helplessness take over. They do not take actions to reduce the threat anymore, and stay apathetic even when the threat has become manageable again.

When such a situation occurs, there may be a tendency to conclude that the public is not worried about the threat, because only a small group shows actual concern. However, the majority may consist of people who take the threat seriously, but do not see any solution and hence have decided (either consciously or unconsciously) to repress feelings of threat-related concern. For example, some people may "decide" not to worry about *Salmonella* infections of food, because they do not know what to do to enhance food safety. What should be done in such a situation is to tell them how they can reduce the risks effectively: explain in detail how the food should be stored, prepared, and cooked. Once they feel capable of managing the risk, people will be more inclined to admit that the risk really exists.

A last interesting characteristic of the lay persons' risk perception is that in general individuals think they are less susceptible to negative events such as disease, divorce, and

robbery than the average person (of course, this is logically implausible). One explanation for this so-called unrealistic optimism is that people only believe what they like to believe. Another explanation is that individuals only think of the steps they themselves already take to reduce the risk, and do not realize that others also take measures to reduce it. Anyhow, it may be useful to stress that everybody runs risks and that one should take all available measures to reduce them.

22.2.8 Recommendations

After the above discussions of experts' risk assessments and the lay persons' perception of risks and probabilities, this Section provides a number of recommendations on communicating toxicological risks due to food intake. The recommendations must necessarily be tentative, for they are formulated on the basis of the limited information available. This information is not only obtained from studies on toxicological risks due to food intake, but also from studies on technological risks and gambling studies. Thus, some reserve is in order here.

The first recommendation urges experts to indicate clearly (as they generally do already) that their risk assessments may be incomplete. Risk assessment is always based on the present state of knowledge and this may be incomplete.

Secondly, the public should have freedom of choice. There are two reasons for this: first, there may be uncertainty about the conclusions of risk management; secondly, people will find risks more acceptable when they can choose voluntarily. However, the public should of course be informed of the expert's judgments of the risks involved.

As a third recommendation, the experts should stress the advantages of the risky activity, especially the advantages to the public.

Fourthly, the measures already taken to manage the risk should be emphasized, especially the measures that reduce the possibility of negative consequences.

The fifth recommendation stresses the point that particular attention must be paid to the way risks and probabilities are presented. General guidelines for how risks should be presented cannot be given. A comparison of risks may be helpful, but only if the risk one wants to communicate does not differ too much from the risk with which it is compared. Further, one should be especially careful in communicating very small and very large probabilities (because of the psychologically big difference between certainty and probability), and give a framework of reference when possible (e.g., the chance of dying from cancer anyhow). It may also be useful to check a message for emotions releasing concepts. Mentioning death, for example, seems to augment the perceived threat considerably. The recommendations given above are of particular importance when the first aim in risk communication is reassurance of the public (e.g., you can safely eat food with licensed additives) and not behavioral change. However, sometimes the public underestimates the risk involved (e.g., bacterial contamination of food), while the risk communicator would like people to take risk-reducing steps. In this case, clear advice should be given on the steps one should take to reduce the risk. Clear advice may enhance the individual's self-efficacy, and consequently he or she will be more strongly inclined to act according to the communicator's advice. Furthermore, because of the "unrealistic optimism," it should be emphasized that everybody may be exposed to the negative consequences of the risk, and that the advice to reduce the risk should be followed completely.

Finally, communicators should realize that behavioral change requires more than an adequate perception of the risks involved. Generally, factors such as self-efficacy, attitude and social influence are regarded as more important.

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