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Dialogue guides awareness and understanding of science: an essay on different goals of dialogue leading to different science communication approaches

Maarten C.A. van der Sanden and Frans J. Meijman

Dialogue has become a buzzword in science communication. Many governmental initiatives involving information transfer use dialogue as a selling point. We have, for example, a dialogue on genetic manipulation, a dialogue on the scientific future of Europe, a dialogue on food safety. Dialogue has almost become a communication target on its own, beside such things as public understanding or awareness of science. Dialogue is, however, just a technique, a method that can be used in any modality of science communication to serve any of its goals. New developments in the growing use of dialogue should therefore be considered as part of science communication as a whole. In this essay we discuss the various operationalizations of dialogue for different science communication modalities and goals, based on different notions of science. Dialogue offers various possibilities for science communication. There is an important difference between dialogue with a functional goal and dialogue with a conceptual goal. This distinction and its implications are based on our recent study on effective biomedical science communication on predictive DNA diagnostics.

Introduction

Science communication is now understood to be a two-way communication process (Felt, 2003; Burns et al., 2003). It includes people interacting, either with and within a group, or via a mass medium with lots of other people. The traditional transmission of information has changed into an exchange of information (Hanssen et al., 2003; Dierkens and Von Grote, 2003). By moving away from the "deficit model" to a more dynamic non-directive transactionable vision, science communication's goal has also changed. In the dynamic vision, sender and target group or receiver negotiate about meanings and facts. The deficit model had to be redefined (Dierkens and Von Grote, 2003). Felt (2003: 11) writes:

> … from a historical point of view … the rigid demarcation between genuine and popular knowledge turned out to be problematic, for non experts appeared to have their own

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> models and representations of the world surrounding them, and these conceptions could not simply be ignored or declared excessively simplistic. Consequently, the dichotomy between scientific texts and popularised accounts gave way to the idea of a continuum of different kinds of texts. Popularisation started to be understood increasingly as the negotiation of meaning, and it was underlined that both the very act of popularisation and popular knowledge would be fed back into the process of knowledge production and thus have an impact upon the cognitive dimension of science itself.

This describes the need for the exchange (negotiation) of knowledge between scientists and the lay public in order to achieve a reciprocal understanding. This science communication process applies particularly to new technologies that have a large impact on society, such as genetics and new foods, a process that is well served by debate and dialogue (Bonfadelli et al., 2002; PCST-8 Congress Proceedings, 2004). As Jasanoff (2003: 39) describes it: "… there is a need for new deliberative forums and discourses to build visions of the future that can be accepted by scientists as well as their fellow citizens."

At the moment, this new development (two-way communication built on dialogue, negotiation from science and towards science) is mainly used to achieve "modern" science communication targets such as public awareness of science and public engagement with science (EC, 2001; Hanssen et al., 2003). Dialogue is not playing a role in the "classical" goals of the science communication process such as public understanding of science. With the development of public awareness and public engagement, dialogue seemed an obvious tool, and we have probably forgotten to look "back" to use dialogue for public understanding of science as well. Unlike dialogue on public awareness and engagement, dialogue on public understanding of science is about the negotiation of facts related to a scientific development, and the use of those facts. This will be discussed more fully later.

Preliminary results from our own research indicate that this partial use of dialogue does not contribute to effective overall science communication (Van der Sanden and Meijman, 2004b). In the field of health communication, for example, dialogue is effectively used in health promotion as well as in health education, albeit not completely (Dutta and Vanacker, 2002; Lee and Garvin, 2003).[1] Therefore, this essay argues that within the development of science communication, all the distinct targets, modalities and instruments must be investigated and validated on their own merits, according to the particular field of science communication.

In our opinion, *science communication goals* (public awareness of science, public engagement with science, public participation in science, and public understanding of science), *science communication modalities* (science promotion, science education, and "prevention of knowledge deprivation" (Van der Sanden and Meijman, 2002)) and the use of *(science) communication instruments* such as dialogue, are not clearly distinguished in form and function at present. This vagueness is probably strengthened by governments that want a prompt solution for the debate on, for example, genetic manipulation and food safety. They often consider dialogue a panacea when dealing with public awareness of science (EC, 2001).

Science communication researchers and science communication professionals must not forget their "traditional" scope of work (Van der Sanden and Meijman, 2004b). When a science communication problem occurs, they need to consider the whole scope of science communication modalities, targets and instruments, keeping all options for dialogue open. In our opinion, the public understanding goal is just as open to dialogue as the public awareness goal of science communication.

We have seen that at present dialogue in science communication is mainly used for public awareness of science and public engagement with it, and not for public understanding of science. However, experience in health communication suggests that dialogue is useful within the public understanding of science (PUS) as well as in public awareness of science (PAS). As we will show by using the examples of asthma and predictive DNA diagnostics, a PAS dialogue deals with feelings, emotions and fears. A PAS dialogue is therefore a dialogue on the conceptual level. A dialogue regarding PUS, on the other hand, is a dialogue on the facts of science. In this paper, we conclude that different levels of knowledge (facts) and different basic notions, emotions and fears (concepts), do require dialogue with different goals.

In the next section, we will start by describing dialogue as technique, then we describe dialogue in mass communication, and finally compare dialogue with discussion.

Dialogue

In this essay, we see dialogue as an inquiry into ideas, as defined by Littig (2003). Burns et al. (2003) stress this is a dialogue in which scientists may have scientific facts at their disposal, whereas members of the public have only local or so-called lay knowledge of the problems. Both kinds of knowledge need to be exchanged. One of the most remarkable examples of lay knowledge is Wynne's case study of sheep farmers and radioactive contamination in *Misunderstanding Science? The Public Reconstruction of Science and Technology* (1996). In this case, the communication process would probably have been more effective had there been a dialogue in which the common arguments of scientists and farmers were settled first. Similarly, in the PABE (Public perception of Agricultural Biotechnologies in Europe) report (Marris et al., 2001), ten myths are presented which form the starting points of the perceptions and expressions of lay audiences. It is important for science communication to clarify local knowledge or lay knowledge. Dialogue could be a good communication instrument for scientists and laypeople to learn to understand each other, and develop a common platform of ideas. As Bohm (1996: 6) writes:

> Dialogue comes from the Greek word *dialogos*. Logos means "the word" or in our case we would think of the "meaning of the word". And dia means "through". It doesn't mean "two". … the picture or image that this derivation suggests is a stream of meaning flowing among and through us and between us … and this shared meaning is the "glue" or "cement" that holds people and societies together … In dialogue nobody is trying to win.

So, dialogue is different from discussion: "Discussion is almost like a ping pong game, where people are batting the ideas back and forth and the object of the game is to win or to get points for yourself" (Bohm, 1996: 7).

Dialogue is not about winning or convincing, but about informing the other or oneself about facts, concepts, notions, feelings, emotions and fears. Notions, as we see it, are deeply embedded feelings that dictate thoughts, emotions and behavior. Notion, therefore, goes before attitude. Attitude is an operant sign of notion.

In a Bohmian dialogue, no goal or even a theme is established beforehand. Of course, this pure form of dialogue is hard to use as a practical instrument of mass communication (see Figure 1). In mass communication, the theme needs to be defined in order to focus the dialogue and to get the target group interested in the subject. The pure Bohmian dialogue would not be useful for biomedical science communication on predictive DNA testing. However, dialogue in a communication field which has a goal and a theme should incorporate some aspects of this pure Bohmian dialogue such as "in dialogue nobody is trying to win" and "this shared meaning is the 'glue' or 'cement' that holds people and societies together."

These so-called meta-aspects of dialogue are useful in any dialogue. And as this is the case in both a dialogue about facts and one on concepts, dialogue can be used as an instrument for public understanding of science as well as for public awareness of science.

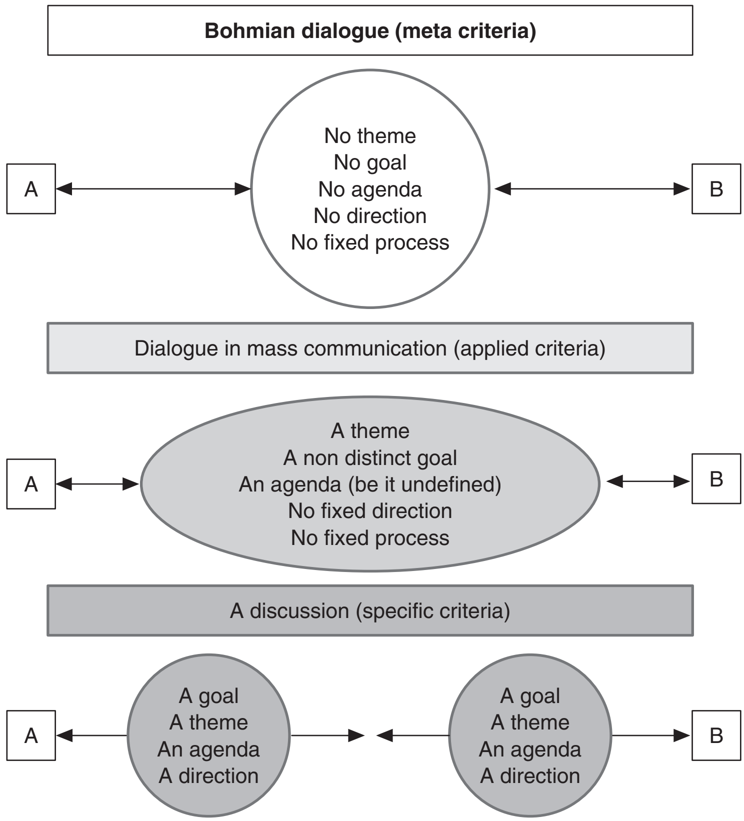


Figure 1. From Bohmian dialogue to discussion
Note: In Bohmian dialogue there is a common playground to find out what participants mean by a concept. In a Bohmian dialogue, there is an arena but no agenda, no theme, no direction, just dialogue. Mass communication requires some focus, though dialogue is still important to determine common ground. The process should be non-directive, even though there is a theme and an agenda. In the discussion, on the other hand, there is a specified goal, theme and agenda, and not necessarily any common ground.

A dialogue in its pure form and its mass communication application could be either about concepts or about facts. For example, a dialogue on the existence and meaning of DNA for a lay audience is different from a dialogue on the facts of DNA. Though these are different in theme and in goal, both are still dialogues. Of course, there is no sharp demarcation between fact and concept, because facts belong to concepts and concepts include facts. Nevertheless, the form of the dialogue will depend on its goal. Here, we want to define a dialogue about facts as dialogue with a *functional goal*[2] and a dialogue about concepts and notions (and feelings, emotions and fears) as a dialogue with a *conceptual goal*. Daily medical practice offers an example of different types of dialogue with different goals.

Asthma as an example

Laypersons, patients and doctors differ in their emotions (fears, optimistic or fatalistic expectations) and knowledge regarding a condition such as asthma. We know that emotions come before facts in effective communication (Fennis, 1999). So (whether explicitly or implicitly), communication in the doctor's office should first focus on mutual exploration and recognition of the emotional connotations that this patient, parent or caregiver, and this doctor have, regarding such issues as a wheezing cough, steroid-inhalers or smoking. A child's wheezing cough seems alarming to the parents, but gives the doctor the pleasant feeling that she has something effective to offer: a drug. A patient may think, "Steroids are dangerous hormones," whereas the doctor may view them as a "magic bullet." A doctor could understand and explain the patient's craving for a cigarette. These are examples of a verbal and non-verbal exchange of vague and emotional aspects. This dialogue has a communicative aim: to build an effective and human doctor–patient relationship. Though it is easy to recognize the need for such a dialogue, dialogue is also necessary at the level of knowledge. In lay belief, asthma may be viewed exclusively as "an allergy" that needs anti-allergy drugs such as anti-histamines, if anything. The medical approach—maintenance treatment with steroids to suppress "the inflammation"—will face opposition (expressed or hidden) if the differences between patient knowledge and doctor knowledge are not first subject to dialogue—and settled. This is an example of a dialogue about "facts" with a functional goal: mutual agreement and patient compliance, facilitated by the exchange of knowledge (dialogue/non-directiveness).

According to Bohm (1996: 3):

> If, however, two people merely want to convey certain ideas or points of view to each other, as if these were items of information, then they must inevitably fail to meet. For each will hear the other through the screen of his own thoughts, which he tends to maintain and defend, regardless of whether or not they are true or coherent. The result will, of course, be just the sort of confusion that leads to the insoluble "problem of communication".

This conclusion seems too "static." From the examples given above, it seems the communicative problem can be solved.

From the asthma example, it is clear that dialogue is useful in public understanding of science as well as in public awareness of science. With respect to PUS, dialogue concerns facts of science. With respect to PAS, dialogue concerns feelings, emotions and fears related to science. In other words, the "PAS dialogue" is a dialogue on concepts.

In the following text, we will first give a short description of the case of predictive DNA diagnostics, followed by a discussion of health communication and the use of dialogue. As the asthma example showed, dialogue is an instrument with different goals. From this perspective, the broad application of dialogue in the field of science communication will be discussed in the light of seven different ways of responding to new developments in technology as provided by Smits (2002) and Durant et al. (2003). It becomes clear that using dialogue in different forms, to achieve many goals, forms an option for all science communication modalities, leading eventually to numerous types of science communication.

Theoretically bound

Theories and insights from other fields of communication are useful to validate and identify best theories and practices for science communication (Van der Sanden and Meijman, 2002, 2004b). In our study, we compare effective health communication, medical psychology, effective advertising and effective education with science communication. The application of theories from these different fields should lead to effective science communication towards a broad audience. To investigate the different fields in a scientific way, we used the evidence based science communication (EBSC) strategy (Van der Sanden and Meijman, 2004a). EBSC is based on the principle that literature used in research should be evaluated according to its relevance for the research subject, and that its validity should be assessed by different criteria. The literature used in the case of health communication and medical psychology has been systematically collected and validated,[3] and it seems very useful to the broader field of science communication.

More generally, there is a theoretical connection between these three fields of science. This is not a surprising remark. Health communication and (medical) science communication are closely related and psychology is generally considered to be one of the pillars of communication. However, actually making the comparison in the literature study helps to solve or at least indicate many of the problems within the field of science communication. For example, in a previous study we found that the use of health communication theories in science communication allows us to use concepts such as *self efficacy* and *locus of control* (Van der Sanden and Meijman, 2002). In the field of science communication, self efficacy refers to the ability one feels to learn something (*"Mathematics … that's something I'll never get"*). Locus of control (or *Knowledge Locus of Control*) refers to who one feels is responsible for learning (*"It's not up to me to get the information on predictive DNA diagnostics; the doctor has to tell me"*) (Van der Sanden and Meijman, 2002, 2004b). If self efficacy and locus of control are useful in the field of science communication, the way dialogue is used in the field of health communication might be copied to the field of science communication as well.[4]

Case: predictive DNA diagnostics

> The Human Genome Project and genetic research in general have increased understanding of the genetic contribution to health and disease, and new information will accrue rapidly for the foreseeable future. This will result in increased possibilities for genetic testing for diagnosis, management and assessment of genetic susceptibility in individuals and families. (Haan, 2003: 458)

Developments in predictive DNA diagnostics are increasingly rapid (Haan, 2003; Pilnick, 2002). During the 1980s, the first genetic test became publicly available in the Netherlands (Nelis, 1998). At present there are more than 250 genetic tests that are available in different countries (for the Netherlands, the following websites provide information: www.vsop.nl; www.dnadiagnostieknijmegen.nl). Within decades, everyone in the Western world will probably know someone who has been tested on the inherited or acquired risk for disease on the basis of their genomic profile.[5] These rapid scientific and technological advances in the field of human genetics have created a gap in knowledge and understanding between the specialists involved and the general public who are the intended beneficiaries (Pilnick, 2002).

Moreover, DNA tests will no longer be a diagnostic tool only for rare hereditary diseases, such as Huntington's disease, but also for acquired heart diseases and several kinds of cancer. Tests may even be possible for genetic predisposition for sensible use of vitamin C. These kinds of tests and research are meant to serve so-called pharmacogenetics. In the near future, every individual in the developed countries will probably come into contact with one of these predictive DNA diagnostic methods. Therefore, communication with a general public about predictive DNA diagnostics, and the probabilities of acquiring certain diseases will be necessary, in the light of *informed consent*. Informed consent is only possible when a person (in this case a patient or health care consumer) is knowledgeable about his or her own disease, risks or health. Informed consent is of great importance because, in addition to the opportunities, there are many drawbacks associated with the developments on predictive DNA diagnostics. For example, Baird (2002: 518) explained:

> In the absence of reliable information on the absolute risk for those with the gene, as well as on the increased relative risk, susceptibility testing is likely to create unnecessary anxiety among those who have a susceptibility gene but whose risk is nonetheless quite low, and a false sense of security among those who lack a susceptibility gene but whose risk is nonetheless real.

Not only does the patient need information, but the general public does as well. The Dutch Health Council recently published a report based on interviews on the general public's information need about genetics (Dutch Health Council, 2003). The general public was grouped into six separate groups on the basis of relevance of and interest in predictive DNA diagnostics (Nelis, 1998; Dutch Health Council, 1998) (see Table 1). The science communication literature refers to the attentive public (people with a high level of interest in a given issue and a sense of being well informed about that issue), the interested public (people who are aware of the subject and may use the gained knowledge), and the residual public (people who are neither attentive nor interested, therefore only a remote target group) (Miller and Pardo, 2003). The attentive public has a high level of interest and a sense of being well informed, whereas the interested and residual publics are less interested or involved. Almond (1983, cited by Miller and Pardo, 2003) compared the role of the attentive public to that of reserve units in the military. Attentive citizens read about the issues that interest them and talk with friends and colleagues with similar interests. When a science or technology dispute arises, attentive individuals may be persuaded to engage in direct efforts to influence decision-makers. These different groups require different communication modalities, targets and instruments. Dialogue could, of course, be one of these instruments.

Health communication and dialogue

In the health communication literature, a distinction is made between three different modalities: 1) health promotion; 2) health education; and 3) prevention of ill-health or health protection. All three modalities are used in health communication, and each has its own particular applications (Holland et al., 1983). Two-way communication plays a role in each of these

Table 1. Relation between an individual's attitude and science/health communication modality

Target groups (Nelis, 1998)	Attitude (Miller and Pardo, 2003)	Science/health communication modality	Science/health communication target
No patient—not interested	residual	promotion	PAS 90%; PUS 10%
No partient—and interested	attentive/interested	education	PAS 60%; PUS 40%
No patient yet—not interested	residual	promotion	PAS 90%; PUS 10%
No patient yet—and interested	attentive/interested	education	PAS 40%; PUS 60%
Patient—not interested	residual	education/prevention	HP 20%; HE 80%
Patient—and interested	attentive/interested	education	HP 10%; HE 90%

Notes: In column one the different levels of a person's involvement with predictive DNA diagnostics are described. A so-called 'no patient yet' is someone who has a genetic burden but is not showing the symptoms yet. The kinds of attitudes in column two are transposable to the field of health communication as well as to the field of science communication. In column three, different science communication modalities are described that may contribute to an effective biomedical science communication on predictive DNA diagnostics. PAS is Public Awareness of Science and PUS is Public Understanding of Science. The different percentages (examples) describe which kinds of science communication targets could be emphasized during the communication process. From this point, a mediamix occurs. HP is short of Health Promotion and HE is short for Health Education, since there is no difference in normenclature within health communication in modality and goal.

modalities (Lee and Garvin, 2003). Dialogue can also play a role, though the function of dialogue will be different in each of these three modalities. First, what do these three modalities communicate?

> *Health promotion*, according to the Ottawa Charter (WHO, 1986), is the process of enabling people to increase control over and improve their health. Downie (1998) defines health promotion as comprising efforts to enhance positive health and reduce risk of ill-health, through the overlapping spheres of health education, prevention and health protection. Petersen and Waddel (1998) make the definition even broader and define health promotion in the sense of how people can function healthily in society.
> *Health education*, according to MacDonald (1998), is communication to educate both those in powerful positions and the community at large about positive health (this includes health groups, campaigns and lobbies). Green et al. (1980) define health education as any planned combination of learning experiences designed to predispose, enable, and reinforce voluntary behavior conducive to health in individuals, groups or communities.
> *Health protection*, according to MacDonald (1998), is the more traditional public health approach: legal, fiscal and political measures, regulations, policies or voluntary codes to prevent ill-health and/or enhance well-being (for example, mandatory use of car seat belts, taxes on cigarettes and alcohol).

In these definitions, promotion starts with the question: Why should I be healthy? Education is about how to get or stay healthy. Protection is about instructions to be or stay healthy or to become healthier: "Don't do this," or "Just do that." The use of dialogue as a communication tool has a different goal in each of these three different health communication modalities. For example, communication on the "why" question involves concepts, notions, schemas,[6] backgrounds, etc. A dialogue on the "why" question is a dialogue with *a conceptual goal*. A dialogue on the "how" question, however, is a dialogue with a *functional goal*: interactive communication of lay and professional knowledge of health.

The groups and modalities distinguished in Table 1 could be useful. Health communication using a dialogue with a *functional goal* could be effective in the case of an interested individual who is not a patient yet: health communication as health education, dealing with the negotiation between professional knowledge and native knowledge or "local wisdom." On the other hand, health communication using a dialogue with a *conceptual goal* could be effective in the case of an individual who is not a patient (yet). With this uninterested individual, one first needs to communicate why knowing something about predictive DNA diagnostics is important: health communication as health promotion, linking to lay notions, feelings and fears.

Science communication

The goals of science communication have been described as public awareness of science (PAS), public engagement with science (PES), public participation in science (PPS), and public understanding of science (PUS) (Van der Auweraert and Van Woerkum, 2003). PAS is about feeling the urgency of science; PES is about being warm-hearted to science; PPS is being involved in science; PUS is learning about and dealing with science. The three modalities of health communication (promotion, education, and prevention) can be useful to all four of these goals. Similarly, the modalities of science communication could be described as science promotion (to strengthen the ideas and awareness of science and technology), science education (to learn about the principles, potential, and dangers of science and technology), and prevention of knowledge deprivation (to protect someone from harm caused by a lack of knowledge: e.g., antibiotics do not protect one from viral infections) (Van der Sanden and Meijman, 2002).

In light of this theoretical connection between health communication and science communication in terms of targets and modalities (even terms such as self efficacy and locus of control relate to both), dialogue could function as a tool for two-way communication for all modalities of science communication just as it does in health communication. If this is the case, dialogue should not be used exclusively in science promotion, as currently occurs. For instance, in the case of predictive DNA diagnostics, dialogue with a *functional goal* and dialogue with a *conceptual goal* could both be used for effective science communication. A dialogue with a conceptual goal on predictive DNA diagnostics would deal with the difference between medical and scientific notions. Questions asked could be: How do we see our future world? How do we feel about health and genetics? Does genetics feel controllable? This could have an effect on both the individual *notions of knowledge* and the individual *growth of knowledge* (Van der Sanden, 2003). Miller and Pardo (2003: 109) discuss these lay notions or schemas.

> Although we expect that some individuals have much more developed schemas about science and technology than others, as reflected in the variations in interest and civic scientific literacy, we expect that most people in a modern society have some schema or schemas for scientific and technical matters.

A dialogue with a functional goal on predictive DNA diagnostics would deal with the difference between medical knowledge and lay knowledge of genetics. A question central to this functional goal could be: What is genetics? This could have an effect on both the individual growth of knowledge (the same as within the conceptual goal) and the *individual use of knowledge* (Van der Sanden, 2003). This is a dialogue on facts, with a functional goal (cf. the use of steroids in the asthma example).

This use of dialogue in the field of genetics, as in other fields of technology, depends on the notions, emotions and fears of the public (as well as those of scientists, practitioners and policy makers!) about developments in science and technology. We will describe some of the relevant models and theories in the following section.

Notions and emotions

Durant et al. (2003: 144) describe the general attitudes towards science and technology in Eurobarometer terms: “progress, panacea and future shock … It captures the public’s sense of pessimism versus optimism about science.” Other relevant distinctions have been made by Greenhalgh et al. (2004). They describe ten different attitudes towards risk which depend on various cognitive biases such as: *acceptable risk* and *illusory correlation*.

Acceptable risk is about some risks (such as lung cancer from smoking) which are subjectively viewed as more acceptable than others (such as vaccine damage), even when the probabilities of occurrence are much higher. Hazards generally deemed acceptable are familiar, perceived as under the individual’s control, have immediate rather than delayed consequences, and are linked to perceived benefits. Illusory correlation is about prior beliefs and expectations about what correlates with what and leads people to perceive correlations that are not in the data.

At the basis of science communication are the developments in science and technology itself and the notions and information needs of the public. While the developments are relatively objective, the notions and information needs of the public are variable and often lack explicit representations. For example, Greenhalgh et al. (2004) write about drug regulatory decisions, which are to some extent socially constructed through active and ongoing negotiation between patients, practitioners, and policy makers. All parties should recognize that non-rational factors are likely to have a major influence on their perceptions:

> Greater awareness of affective factors as well as our cognitive biases should help us understand why different stakeholders interpret the benefit-harm balance of medicines differently, and this awareness could provide the basis for strategies to counter such influences. (Greenhalgh et al., 2004: 50)

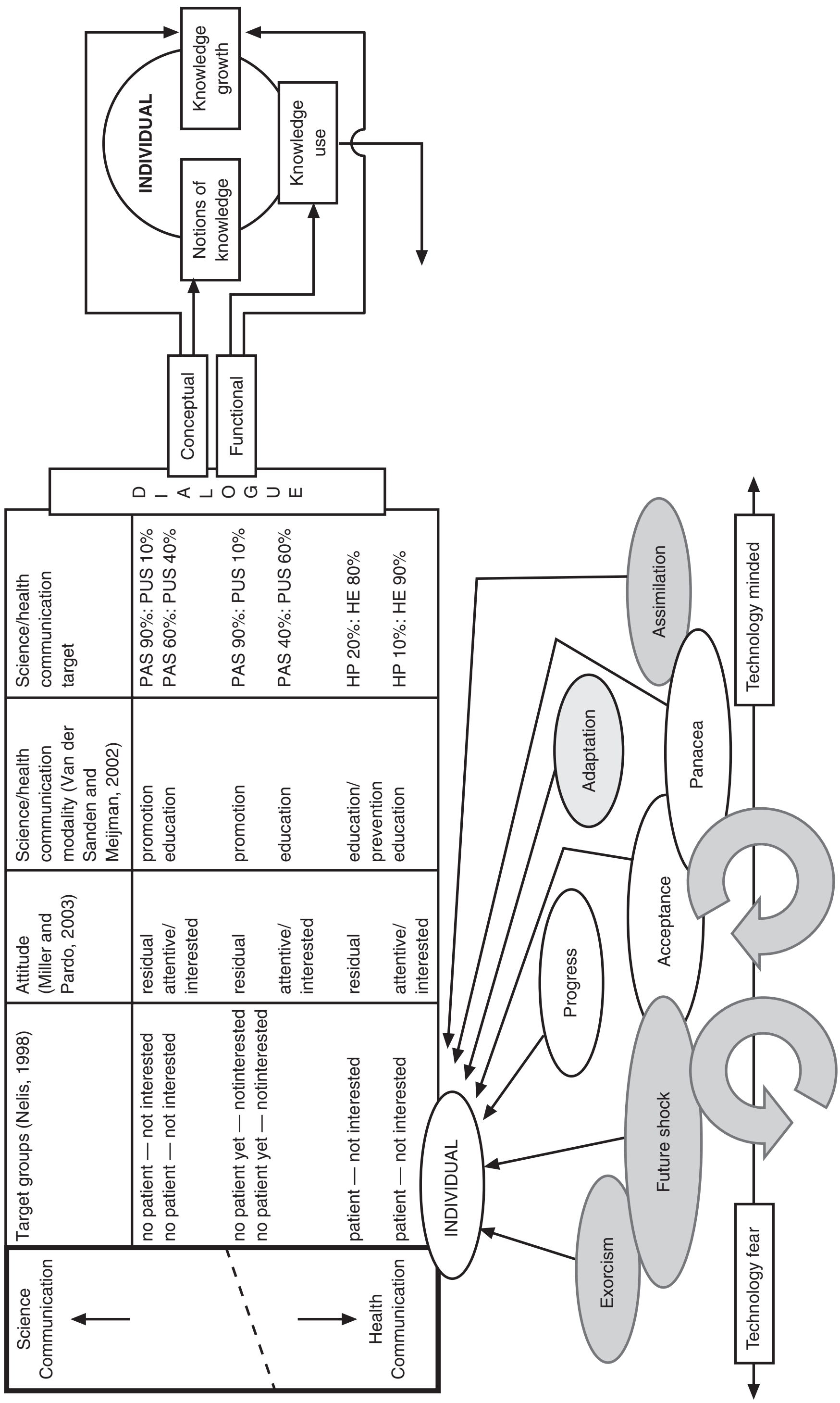
One of the instruments to counter such influences could be dialogue. According to perception of science, or even the incorporation of science, Smits (2002) defined four different ways for lay audiences to get involved with developments in science and technology, which could function as a foundation for all science communication. Smits uses the metaphor of monsters to explain these four approaches to the development of science and technology. First is *exorcism*, driving out monsters: according to Smits, in this dogmatic response to science and technology, there is little room to change or adapt existing ideas. Developments in technology and science are experienced as threatening and must be shut out. The second approach is *adaptation*, adapting monsters: here, the audience is less apprehensive of science and technology. Although it is not a part of their lives, the audience does not condemn it. The third approach is *assimilation*, assimilating monsters: here, the boundaries between people and science and technology are more instrumental than fundamental in nature and can be overcome. There is no resistance to the developments in science and technology. The fourth approach is *acceptance*, embracing monsters: this is referred to as romantic, because it is so clearly different from the struggle for clarity and control that is present in the first two styles, and partly in the third. The styles are presented in order of the fear of monsters, starting with the greatest fear, exorcism, and ending with fear being replaced by fascination, acceptance.

According to Smits, the only approach that allows a real reshuffle of concepts and facts leading to new developments is assimilation. Science communication, however, can respond to each of the four ways of coping with new developments in science and technology, though different approaches may be required. As Smits describes it, exorcism may need a certain type of dialogue, one with a different content than the scientific communication dealing with the other three approaches. According to Smits, in the case of developments in science and technology, it is more useful to ask individuals what they want to be responsible for than to ask them what they want to have. Cultural and social beliefs are affective and are therefore more or less immune to factual information. As Parales-Quenza (2004: 136) stated:

> By emerging from [cultural] themes, core contents [of a social belief system] become affectively laden, which explains why some of them function as attitudes. This fact explains the primacy of affect in the conformation of shared beliefs, and the fact that preferences do not necessarily require information.

In discussions and debates, it is therefore important to recognize and respect other opinions and to negotiate with each other from different points of view. In practice, of course, this is one of the most difficult points in dialogue.

As discussed above (and seen in Table 1), a dialogue between the "ignorant" public and the medical world is about both concepts and facts, a dialogue with a conceptual goal and a dialogue with a functional goal. The goal of dialogue changes as one gets more deeply involved with the topic of, for instance, predictive DNA diagnostics. All these possibilities for dialogue depend on the different approaches of the lay audience. People who are not interested may take the "exorcism" basic approach, and therefore negotiation on the meaning and practice of "ground level notions" must clear the way to other concepts of science and technology


Science Communication
Health Communication
Target groups (Nelis, 1998)
no patient — not interested
no patient — not interested
no patient yet — notinterested
no patient yet — notinterested
patient — not interested
patient — not interested
Attitude (Miller and Pardo, 2003)
residual
attentive/ interested
residual
attentive/ interested
residual
attentive/ interested
Science/health communication modality (Van der Sanden and Meijman, 2002)
promotion
education
promotion
education
education/ prevention
education
Science/health communication target
PAS 90%: PUS 10%
PAS 60%: PUS 40%
PAS 90%: PUS 10%
PAS 40%: PUS 60%
HP 20%: HE 80%
HP 10%: HE 90%
DIALOGUE
Conceptual
Functional
INDIVIDUAL
Notions of knowledge
Knowledge growth
Knowledge use
INDIVIDUAL
Exorcism
Future shock
Progress
Acceptance
Adaptation
Panacea
Assimilation
Technology fear
Technology minded

that may make sense: science promotion with a public awareness target, using dialogue with a conceptual goal.

Take the case of genetically modified food: Parales-Quenza (2004) found three basic cultural themes in the debate—natural/artificial, tradition/change, health/disease. These primary components allowed participants to associate with an unfamiliar subject on which they did have opinions. According to science promotion using dialogue with a conceptual goal, one may change an individual from a believer in tradition (i.e., exorcism) to a believer in change (i.e., adaptation).

The group of interested individuals, who may embrace technology, may want to know more about genetics: s*cience education, with a public understanding or a public engagement target, using dialogue with a functional goal*. A dialogue with a functional goal is only successful when lay knowledge and professional knowledge are exchanged. Different basic notions and approaches form the basis for different types of communication in which dialogue has a multiple function. (See Figure 2.)

Conclusion

To conclude, there is not much difference between health communication and science communication in terms of communication modalities and communication targets. In some cases, science communication can shift smoothly to health communication, for example in the case of medical subjects. If dialogue is successful in all health communication modalities, one could assume that dialogue would be a successful tool in all science communication modalities, not only science promotion. Different levels of knowledge (facts) and different basic notions, emotions and fears (concepts), require dialogue with different goals. It seems inappropriate to restrict dialogue exclusively to the public awareness of science. As we have seen (Figure 2), there are numerous configurations of approaches depending on the variables and categories.

As science communication develops, one could easily grasp for new methodologies. However, to build a well-founded theoretical basis for effective science communication, we need to consider science communication as a whole. If we are only blinded by the flickering of new, however useful, buzzwords like dialogue and do not see science communication as a whole, we miss useful new possibilities or insights. Of course, this is also a notion open to dialogue.

Figure 2. Use of dialogue in science communication.

Notes: Table 1 forms the heart of the system. Figure 1 can be recognized at the right side of the figure. In the far left column one can see that in the case of medical subject communication will probably smoothly change into health communication. A sentence such as “Electrical current in bad for your health” depicts such a change. This sentence could be used in science communication as well as in health communication. At the bottom of the figure, seven basic approaches to science and technology (taken from Smits (2002) and Durant et al. (2003)) are put on a continuum from technology fear towards technology minded. One, or a combination of these notions, forms the basis for an attitude towards science communication or health communication. Dialogue must be seen as a communication instrument with two goals: conceptual and functional. These dialogue forms are used to communicate with the individual on the basis of knowledge notions/beliefs, knowledge growth and knowledge use. Effective science communication may change the notions, the growth, ot the use of the knowledge. The curved arrows at the bottom depict this process. The figure thus depicts the numerous configurations of approaches that may be taken.

For example, 7 notions ×6 stakeholder groups ×3 types of attitude ×3 science communication modalities ×4 science communication targets ×2 goals for dialogue ×3 ways of influencing the individual = 9072 possibilities of dialogue. However, when a science communication professional makes decisions at the beginning of the model (far right: what knowledge does an individual or group need?), one gets more and more involved within one string of choices which decreases the number of possibilities. Of course, different numbers (e.g. fewer or more stakeholders), would change the number of possibilities.

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Notes

1 Dutta and Vanacker (2002) describe how models like the Health Belief Model—used within the field of health communication—focus on the functional needs of an individual, without paying attention to other issues such as the social impact of health.

2 Miller and Pardo (2003: 82) state:

> Historically, an individual was thought of as literate if he or she could read and write their own name. In recent decades, there has been redefinition of basic literacy skills to include the ability to read a bus schedule, a loan agreement, or the instructions on a bottle of medicine. Adult educators often use this term "functional literacy" to refer to this new definition of the minimal skills needed to function in a contemporary industrial society. (Cook, 1977; Harman, 1970; Kaestle, 1985; Resnick and Resnick, 1977, as cited by Miller and Pardo, 2003)

As Con&cced;alves (2003: 62) puts it:

> Another reason is that the issue of scientific and technical literacy entered a new political discourse where it became associated with the idea that people living in a complex scientific and technological civilization should possess a certain degree of scientific knowledge, know-how, or both (Durant, 1993). In more advanced countries, concerns about the level of workers' technical skills, its impact on the competitiveness of industry have been particularly recurrent. Some observers have called it functional literacy, meaning the ability to respond meaningfully to the technical issues that pervade modern daily lives and the world of political action (Ayala, 1996).

3 The additional literature on dialogue used for this essay has not been systematically collected and validated.

4 This transdisciplinary comparison is not only theoretically and practically useful, but is also theoretically possible (Van der Sanden and Meijman, 2005). Hofstadter (1999) shows this in his book *Gödel, Escher, Bach* in which he explains Gödel's Incompleteness Theorem. This theorem states: *All consistent axiomatic formulations of number theory include undecidable propositions*.

5 One can be tested for DNA-related diseases that can develop during one's life, or one can be tested for hereditary diseases.

6 "The social psychology and cognitive science literature indicates that most individuals when faced with the daily barrage of complex information from media, friends and colleagues, construct schemas to filter and manage the receipt and organization of information … A schema is a cohesive set of expectations about objects, situations or sequences of actions" (Miller and Pardo, 2003: 108).

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