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How to fulfill the expert role in public dialogue: The Dutch dialogue on human germline genetic modification as a case

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Over the last decades science communication theory appears to have evolved at a much faster pace than science communication practice. Scientists seem willing to step into the public domain, but a genuine two-way interaction with the public is only rarely observed. We argue that part of this discrepancy between theory and practice may actually be caused by the lacking of a clear description of the modern expert role; the role a scientist should take in contemporary science communication. In this contribution we use an example of good practice—the Dutch dialogue on human germline genetic modification—to inform theory. We analyse guiding principles for the design and execution of this dialogue and observe expert behavior in three separate dialogue sessions. With the combined findings, we present a detailed description of the modern expert role in terms of three responsibilities, with for each responsibility three prompts for behavior. For the *responsibility to share* these are to select expert knowledge that is relevant to the goal; to present expert knowledge in a meaningful and accessible language; and to be cautious in sharing personal considerations. For the *responsibility to listen and learn* these are to consider interactions with members of the public as opportunities to learn; to be patient and supportive; and to assist in stimulating in-depth dialogue. For the *responsibility to invest in relationships* these are to assist in creating an ambiance of safety and relevance; to preserve trust; and to convey respect for every contribution and every point of view. Each behavioral prompt is further concretized with concomitant actions and practice examples as collected from observing experts in action. The implications for scientists engaging in contemporary science communication, as well as for science communication trainers, are discussed.

KEYWORDS

science communication, dialogue, public engagement, expert role, science communication training

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Introduction

Over the last few decades, public dialogues accompanying the introduction of new and emerging technologies have become increasingly common worldwide. In the Netherlands, a public dialogue on human genetic germline modification (HGGM) ran between October 2019 and December 2020. In multiple dialogue sessions members of the public and experts (here: researchers and health care professionals with expertise on HGGM from within their specific discipline) assembled to discuss the desirability of modifying the genetic code of human germline cells (DNA-dialoog, 2021). Former research indicates that fostering meaningful interactions between technology experts and representatives of the public can be challenging. Entrenched ideas about "roles and responsibilities" easily hinder establishing genuine two-way dialogue (Krabbenborg and Mulder, 2015). In addition, increased circulation of misinformation (e.g., false rumors or otherwise incorrect or misleading information) and (perceived) hierarchal differences may complicate feelings of trust (Bijker, 2017; Iyengar and Massey, 2019). We contend that public dialogues, and other expert-public interactions alike, can well benefit from gaining insight into what constitutes a constructive expert role in contemporary encounters between experts and the wider public.

The field of science communication has a clear history in studying communication between science experts and the public. Over time insights concerning the "why" and "how" of science communication changed; largely summarized in what is now often called the turn from deficit to dialogue (Smallman, 2016; Bucchi and Trench, 2017). As from the late twentieth century the dialogue communication model, typically associated with two-way interaction and mutual benefits, gradually discredited the one-way, science-centered approach linked to the deficit model. A major shift, which was accompanied by extensive scholarly discussion (see for example, Bucchi, 2008; Short, 2013; Bucchi and Trench, 2017). Some argued that the dialogue model would never be able to function without deficit-like elements—meaning that two-way interaction was always to be preceded with a one-way transmission of "required" (scientific) knowledge. Others were convinced the dialogue model would only be used as a cover to pursue in fact deficit goals—such as filling knowledge gaps. Regardless of the tenability of these assertions, it can be called striking that today's scientists—when interacting with non-scientist publics—keep displaying mostly deficit-like thinking (i.e., in which informing is key) (Davies, 2008; Hamlyn et al., 2015; Dudo and Besley, 2016; Jensen and Holliman, 2016; Metcalfe, 2019). Obviously, new insights in the field of science communication might not automatically filter through to the scientists responsible for its practice. Yet, this discrepancy between theory and practice may also suggest a failure of modern models such as the dialogue model to offer sufficient guidance on how to fulfill the expert role. While in the deficit model the expert role seems rather straightforward, that is "simply" delivering expert knowledge in an accessible way, the dialogue model lacks such clear directions.

Along with shifting accents in theoretic models, science communication scholarship has focused on (skill) training—either as part of (post-) graduate science curricula or as stand-alone courses or workshops. Questions have been posed as to what such training entails and how it might be improved (e.g., Bray et al., 2012; Besley et al., 2016; Yuan et al., 2017; Stevens et al., 2019). Moreover, efforts have been made to capture learning goals (Baram-Tsabari and Lewenstein, 2017) or identify key skills (Mercer-Mapstone and Kuchel, 2017) with which to guide existing and future training. What may complicate such efforts is the wide range of activities through which the act of science communication manifests. Different activities imply differences with regards to setting (e.g., science museums as opposed to public hearings), target audience (e.g., youth as opposed to patient groups) and so forth. Additional complexity, however, may be induced by lacking a well-defined description of the (modern) expert role. Without a clear-cut idea of what an expert should do or how (s)he should act, it is impossible to construct concerning educational strategies for training in science communication.

The Dutch dialogue on HGGM offers a welcome opportunity to investigate the modern expert role in a real-life situation. As we contend, particularly science-public interactions handling highly controversial topics with significant impact on humanity can well benefit from dialogue-oriented experts. This paper discusses how the Dutch dialogue as a concrete example of science communication practice can inform science communication theory (i.e., the modern expert role). In previous work, we called on researchers in the life sciences to rethink their role in public dialogue. We proposed three expert responsibilities that could help them to get a sharp view on this role (Reincke et al., 2020). Here, we use these responsibilities as a lens to focus analysis and interpretation of two data sources of the Dutch dialogue: (1) an advisory report containing guiding principles for design and execution of the dialogue, and (2) real-time observations of experts in action.

The structure of this paper is as follows. In our theoretical framework below, we situate each responsibility as one of three sub roles in theoretical work on the dialogue model and modern science communication in general, as well as scholarly literature on skills and training (Section Expert responsibilities in dialogue). We proceed by offering a brief introduction on rationale and set-up of the Dutch dialogue (Section The Dutch dialogue as an example of good practice). Next, we describe how we used this dialogue to study the modern expert role in practice (Section Methodology to study the Dutch dialogue). With the combined findings, we present a description of the expert role in terms of three expert responsibilities, concomitant behavioral prompts, and examples of concrete behavior as observed in practice (Section Results). We close off with a reflection on

study limitations and discuss the implications of our findings (Section Discussion).

Expert responsibilities in dialogue

One of the key changes in moving from deficit to dialogue concerns the *meaning* of the act of science communication, for example as reflected in perceived goals and outcomes. In the "old" deficit model, the meaning of science communication seems absolute: it serves to educate a scientifically illiterate public, largely departing from the assumption that increased knowledge leads to an increase in trust (Stocklmayer, 2018). In the "new" dialogue model on the other hand, science communication seems to hold varying meanings, serving variable goals, wearing multiple faces. Regardless of function or form however, the dialogue model clearly transcends a mere transmission purpose of science communication. Scientific knowledge is no longer considered as reflecting absolute truth; rather is it used in combination with other forms of knowledge, including values and experiential expertise, to create shared understandings (McCallie et al., 2009). This is not to say that in the dialogue model scientific knowledge has been downgraded to "just another opinion", or that the integrity of the scientific method is questioned. It merely suggests that in modern science communication one can no longer speak of *the* expert. Especially in the case of complex science-based societal issues—being largely "conflicts over values and worldviews"—expertise is hold by many (McCallie et al., 2009). Science communication then, serves mainly to accommodate mutual learning [Lehr et al., 2007; American Association for the Advancement of Science (AAAS), 2016]. Consequently, today's scientists have to move beyond the informing role that requires them to share scientific knowledge, to extend it with a role that requires them to be receptive to the expertise of others.

Share tailored knowledge and insights

Informing in the dialogue model encompasses more than in the deficit model. In the deficit model scientists typically share knowledge that is crucial from a scientists' perspective. In the dialogue model, where scientists and members of the public are equal partners in conversation (both capable of bringing in valuable contributions), scientists need to take into account the needs and preferences of non-scientists. Moreover, they can be held accountable for adequate reception of shared knowledge. They should put effort in, amongst other things, using comprehensible language and connecting with prior knowledge and interests (see for example, Varner, 2014; Cooke et al., 2017). Research into skills and training confirms this shift toward a more audience-centered view on informing in modern science communication. For example, Mercer-Mapstone and Kuchel (2017) reported core competencies for scientists to effectively communicate with the public, amongst which they identified the ability to adjust language to and to align content, context and mode of communication with an audience. Bray et al. (2012) conducted a Delphi study amongst New Zealand experts of science communication, leading them to suggest training programs should focus on skills related to being able to connect with an audience, as well as to stimulate an audience to state their point of view. In sum, informing in the dialogue model is better defined as *sharing tailored knowledge and insights* (in short: *share*). According to our view, this knowledge and insights can be both professionally and personally based. As members of society and equal partners in conversation, scientists can be expected to share personal considerations, such as hopes and fears, as well.

Listen and learn

Being receptive to the expertise of others requires, first of all, a willingness to listen. Indeed, Yuan et al. (2019) reported both scientists and communication scholars consider listening to non-scientist publics an important communication objective for modern science communication. Furthermore, listening (e.g., to audience concerns) has been found to prevail as a learning goal in contemporary science communication training (Baram-Tsabari and Lewenstein, 2017). Yet, being receptive to the expertise of others seems to imply more than mere listening. The scarce scholarly literature in which the modern scientific expert role is explicitly discussed points to the importance for scientists to acknowledge other forms of expertise, such as the experiential knowledge that patients have (e.g., McCallie et al., 2009; Escobar, 2011; Zwart et al., 2017), and to be willing to learn from others (Illingworth, 2017; National Academies of Sciences, Engineering, and Medicine, 2017). We define being receptive therefore, as *listening and learning*.

Invest in relationships

Many goals associated with the dialogue model or modern science communication in general can be linked to either the *sharing* or the *listening and learning* role of scientific experts. Informing and stimulating debate on science-related issues with societal implications, seeking public input into science issues, or influencing the direction of scientific research and policy (Miller, 2001; Bucchi, 2008; McCallie et al., 2009; National Academies of Sciences, Engineering, and Medicine, 2017), to name just a few. Others however, do not seem to fit in either category. For example building trust, which is another frequently mentioned goal in regard to modern science communication [e.g., American Association for the Advancement of Science

(AAAS), 2016; Hebets, 2018; Kappel and Holmen, 2019]. In the same vein, recent research within a North-American population of academics revealed eight communication objectives for scientists (Besley et al., 2018) of which only four seem to address the *sharing* and *listening and learning* roles. All other objectives reflect relational aspects, such as feelings of trust, equality and a sense of shared identity (Besley et al., 2018). This is why we define a third role for expert scientists in the dialogue model: *invest in relationships*. This can concern both the more pragmatically motivated, communicative relationships for the actual duration of the interaction, and—from a more ideological point of view—affective relationships that allow for structural cooperation on the long run—e.g., in collectively handling complex issues.

In accordance with the above given (sub) roles, in our theoretical framework we distinguish three responsibilities for expert scientists in modern science communication: share (1), listen and learn (2), and invest in relationships (3).

The Dutch dialogue as an example of good practice

Rationale and set-up

The Dutch dialogue on HGGM, which was funded by the Dutch Government, was initiated by a multidisciplinary consortium of 11 organizations with a range of expertise (hereafter: DNA-Dialogue). The project aimed to stimulate a nation-wide dialogue on the desirability of modifying heritable DNA in human embryos, i.e., a collective process of opinion forming (Van Baalen et al., 2019). Thereto, multiple dialogue sessions were organized in which various experts conversed with various publics, led by a conversation moderator. Of the 27 dialogue sessions in total, individual session ranged from intimate conversations with as little as three people to large-scale group conversations of as much as 210 participants. Some were set up to reach mixed audiences (i.e., the general public); others were directed to a specific audience (e.g., children and youth, women with a migration background). More information about the sessions, as well as an overview of the public perceptions as expressed by participants, can be found in Van Baalen et al. (2021).

Lessons for a public dialogue

In preparing the dialogue, an advisory report containing ten "lessons" to inform the design and execution of the dialogue was drafted by one of the parties of DNA-Dialogue; the Rathenau Instituut (Van Baalen et al., 2019). The Rathenau Instituut performs research and organizes societal debates on the impact of science, technology and innovation on society. The results of their work are, among other things, meant to inform political decision making on science, technology and innovation. As an institute, it was involved in organizing public dialogues on new and existing technologies that (can) have a major impact on society, e.g., nanotechnology (Hanssen et al., 2008), synthetic biology (Rerimassie and Stemerding, 2014) and nuclear waste (De Vries et al., 2015). The ten lessons for the Dutch dialogue on HGGM were based on years of experience, a review of the debate on HGGM in the Netherlands so far and a systematic analysis of the social and ethical issues concerning HGGM. Moreover, the formulated lessons were proven successful in pilot focus groups with diverse publics prior to the dialogue (Heugens et al., 2019).

Methodology to study the Dutch dialogue

Analysis of the advisory report

For the purpose or our study, we considered the advisory report drafted by the Rathenau Instituut as a guide to setting up a dialogue in which expert scientists fulfill a modern expert role. We used our theoretical framework, i.e., the three expert responsibilities, as a lens to analyze the content of the ten "lessons".

The goal of our analysis was twofold:

1. to examine if and how the responsibilities could be recognized in the lessons
2. to consolidate each responsibility with concrete prompts for behavior

In *step 1*, we screened the full text of the ten lessons for elements that could be linked to either one of the responsibilities. In three separate rounds, one for each responsibility, we searched for either direct, expert-specific instructions, e.g., an advice to avoid using jargon, or (more) indirect instructions that could be discerned from guidance on other aspects of dialogue design and/or orchestration. All relevant passages were collected (see Table 1). In *step 2*, we used the selected passages to discern prompts for expert behavior (see Section Results).

Observations

Parallel to analyzing the lessons an observation scheme was developed for observing (invited) experts in the Dutch Dialogue. Thereto, theoretical insights as presented in Section Expert responsibilities in dialogue were complemented with results of *a first, gross, analysis of the ten lessons*. This resulted in a list of *16 items* representing behavioral and attitudinal aspects, divided over the three responsibilities. Items linked to the responsibility to share included for example "puts knowledge in a relevant context" and "uses comprehensible language". For the responsibility to listen and learn they included for

TABLE 1 Lessons for a public dialogue.

	Lesson
1	The questions of "whether" and "how" are interlinked—the dialogue should, therefore, not be limited to one or the other • "Scientists and opinion makers regularly suggest that the discussion about the modification of the DNA of embryos … should not be concerned with the question of 'whether we wish to use it', but only the question of 'how we are going to use it'. … that question cannot be answered without thinking about the purposes for which it will be used and the conditions under which it will be used."
2	Include the question of what is at stake in the dialogue • "To expand the dialogue on human germline genome editing as widely as possible, it is important not to establish any prior constraints." • "The challenge is to expose this [implicit normative assertions about what is or is not at stake] and to conduct a dialogue about whether, and if so why, such concerns (…) are relevant in the case of germline genome editing. In other words, any subject that participants in the dialogue regard as relevant must be acknowledged and explored in the dialogue."
3	Clearly explain what is needed to make use of human germline genome editing (the research trajectory and basic conditions for the use of the technology in practice). • "… it must be clear to the participants what will be needed before genome-editing technologies can be used to modify heritable DNA of embryos (and hence of future persons)." • "… there is still considerable uncertainty about the opportunities for and risks of clinical application [of HGGM]." • "How great the theoretical benefits of modifying heritable DNA will actually be in practice is, … still uncertain; the same applies to who could profit from those benefits."
4	Discuss the broader implications of the targeted editing of the human genome for the individual, society, and humanity • "The dialogue must, …, not only be about genome-editing technologies (such as CRISPR-Cas9) themselves (the purposes they can be used for, their medical benefits and their risks). Their impact on the practices and the social context in which they are applied must also be discussed." • "… there must be a discussion of how the practice of reproductive medicine and the norms and values surrounding pregnancy and reproduction will change. The same applies to attitudes toward sickness and disabilities."
5	Turn it around: think about the society of the future—what its core values should be and what role modification of heritable DNA in humans could play in that respect • "Reflection on broad social consequences of germline genome editing also raises questions about the type of society we pursue and what key values should be protected in it."
6	Organize a dialogue not only between groups of stakeholders and interested parties, but also amongst themselves • "Scientists, patients with a serious heritable disorder and prospective parents do not form a homogeneous group and their attitudes toward germline genome editing will differ. It is, therefore, important for these groups to converse not only with each other, but also amongst themselves."
7	Actively seek ways of reaching and informing less accessible groups and engaging them in the dialogue • "It is not necessary for everyone to have an active voice in a dialogue, but the largest possible number of groups should be represented."
8	A dialogue is not a platform for exchanging fixed views • "There are various interests involved in this dialogue, such as the desire of many scientists to create embryos specifically for research …" • "… the crucial objective of the dialogue is to promote a joint process of opinion formation." … "It must be clear in advance to the participants that they do not necessarily need to have made up their minds, that there is room to express doubts and reservations and to explore the issues together."
9	Involve and instruct appropriate experts and people with practical experience • "… we stressed the importance of providing all of the participants with sufficient information about the broad potential consequences [of HGGM] for individuals, society and humanity to take part in the debate." • "They [specialists and practical experts] must use language that is intelligible to everyone in attendance." • "The presence of patients with a serious heritable disorder or 'learned' scientists might lead to … or to people being too reticent to engage in the discussion."
10	Think carefully about the themes, the material, the terminology and the subject matter that will be discussed during the sessions • "Present the material in a context that fits with the personal environment of the participants. This could be done using the techno-moral vignettes … based on the scenarios …" • "… there should always be room for members of the audience to express their concerns and ask questions."

Selected and reprinted from Van Baalen et al. (2019, p. 86–92).

example "listens attentively" and "asks questions". Items linked to the responsibility to invest in relationships at last, included for example "is open and transparent" and "shows interest". Each item contained a short description of related (observable) behavior, as well as (possible) concrete examples. The goal of the observation was twofold:

1. to examine if and how the responsibilities could be recognized in experts in practice
2. to collect concrete practice examples for each responsibility

Observations were done in real-time, without making use of video and/or audio recordings afterwards (only one session was recorded in audio). Data are therefore per definition incomplete and must be read as a qualitative exploration of expert behavior. The observation scheme served as a means to focus attention on specific behavior (consistent with the 16 items) during the observations, and as a coding scheme to categorize and analyze the data afterwards. In total, three dialogue sessions were observed by making use of the observation scheme. *Sessions 1 and 2* took place at the yearly recurring Housekeeping and 9 Months (pregnancy) Fair in the country's capital Amsterdam. Both sessions were attended by a moderator and two experts: a biomedical geneticist (hereafter E1), also last author on this paper, and a medical psychologist (hereafter E2). Public attendants, 11 for session 1 and 10 for session 2, had either signed up for the dialogue in advance, thereby earning a free ticket for the fair, or were recruited by the organizers (DNA-Dialogue) on the spot. *Session 3* was organized by Veritas-forum, a foundation with a Christian base that organizes gatherings for students and lecturers of higher education about life's big questions, in consultation of DNA-dialogue. The session was attended by 75 public participants (mostly students), a moderator and two experts: an ethicist (hereafter E3) and a biomedical ethicist (hereafter E4).

Data of each session consisted of quotes and short situational descriptions as noted by two separate researchers. The collated data were used to draft a detailed observatory report for each session. In *step 1*, agreement was sought between observers on coding each observatory report according to the *16 items* of the observatory scheme. During this coding process, we experienced some difficulties with applying codes. For example, we noticed some items had overlap with others, which made it difficult to code consistently. Furthermore, although all items were accompanied by short descriptions of target behavior, including examples, sometimes it appeared difficult to decide whether a given behavior could be classified as such. In the meantime, the *definitive analysis of the lessons* had resulted in the formulation of nine prompts for behavior (see also Section Results), that in fact covered all 16 items, but in a more considered and coherent configuration. This is why we decided to follow up with a second step of analysis of the observatory reports. In this *step 2*, we analyzed each observatory report on the base of the nine *formulated behavioral prompts (three per responsibility)* (see Section Results).

Ethical approval

The medical ethical review board of the UMC Utrecht concluded that this study falls outside the scope of the Dutch laws that regulate medical research with humans and therefore did not require review.

Results

Table 2 presents the collated results from the lessons and the three observed dialogue sessions. For each responsibility, three behavioral prompts were discerned from the lessons. For each prompt, at least one example was observed in practice. The most illustrative examples are displayed in Table 2. In the remaining of this section, we will expand on our results. For every behavioral prompt, we start by explaining how we discerned it from the lessons. Next, we describe observational data that we found applicable to this prompt.

Responsibility to share (1)

Select expert knowledge that is relevant to the goal

Lessons

Firstly, we recognized the responsibility to share in lessons 3 and 4. In lesson 3, Van Baalen et al. recommend experts in the Dutch dialogue to clarify the (scientific and technical) steps that still need to be taken to progress toward practical use of HGGM as well as to stress the uncertainties in the opportunities and threats of its applications. In lesson 4, they advise to focus on more than medical risks and benefits of HGGM, and to include in the discussion possible personal and societal implications. Informing people on these different aspects of HGGM is believed to support people in shaping their opinion in a solid way, which is the goal of the Dutch dialogue. Expert scientists thus, are to select out of their full body of knowledge those bits that are relevant to the dialogue goal. As it may differ between (groups of) people what knowledge is indeed relevant (e.g., due to differences in prior knowledge, ideas and experiences), expert scientists may benefit from studying dialogue partners' backgrounds in advance. During the dialogue session, they could invite dialogue partners to explore what knowledge *they consider* relevant to the goal.

Observations

For sessions 1 and 2, several observations were noted that can be linked to *sharing knowledge relevant to the goal*. Examples include a reflection on the opportunities and risks of HGGM (e.g., medical but also broader such as related to social equality) and a reflection on the (im)possibilities of standard procedures as an alternative to HGGM (1.1.1 in Table 2). For session 3, only more general remarks were made that reflected *poor execution* of this prompt. For example, it was noted that both experts started off with an introduction on the subject matter that contained many (irrelevant) specialist details.

TABLE 2 Behavioral prompts and examples of concrete behavior per responsibility.

	Behavioral prompts		Concrete example situations	
Responsibility to share (1)	1.1	Select expert knowledge that is relevant to the goal - Prepare for a session by studying dialogue partners' backgrounds - Invite dialogue partners to explore what knowledge *they consider* relevant to the goal	1.1.1	E1 reflects on the (im)possibilities of standard procedures (embryo selection) as an alternative to HGGM
	1.2	Present expert knowledge in a meaningful context and accessible language - Connect to the values, ideas and experiences of dialogue partners - Use techno-moral scenario's to sketch the moral impact of technologies	1.2.2	E4 explains inviolability: imagine a hospital on fire, forcing you to choose between the lives of a child and a box full of embryos; who would you save?
	1.3	Be cautious in sharing personal considerations, including viewpoints - Refrain from acting authoritative and persuasive toward others - Be transparent about the reasoning behind a (personal) position or point of view	1.3.3	E2 shares a practice case in which she had asked herself for the first time: what if HGGM could have been applied? She continues with indicating that she is very anxious to hear others' thoughts on this case.
Responsibility to listen and learn (2)	2.1	Consider interactions with members of the public as opportunities to learn - Make an effort to understand different forms of knowledge and varying perspectives - Encourage others to say more, e.g., by asking (further) questions	2.1.1	E1 elaborates on a participant stating to see no problem in "making" children more intelligent, asking her whether she can think of an application of HGGM that she would say: "this is not ok anymore?"
	2.2	Be patient and supportive - Allow for moments of silence and convey non-verbal involvement - Actively invite others to contribute	2.2.2	E3 and E4 show to have full attention for a public attendant sharing his thought about living with autism, by looking in his direction and frequent nodding
	2.3	Assist in stimulating in-depth dialogue - Introduce different perspectives and viewpoints - Help identify and explore borderline cases	2.3.3	E1 stimulates public attendants to approach HGGM from a financial point of view: "What if we consider HGGM as a means to reduce healthcare expenses?"
Responsibility to invest in relationships (3)	3.1	Assist in creating an ambiance of safety and relevance - Be modest and refrain from dominating the conversation - Emphasize that complex issues such as HGGM can only be addressed by combining many forms of knowledge, including values and emotions	3.1.1	E2 regularly passes the moderator's invitation to speak to others, therewith consciously re-directing attention from her to public attendants
	3.2	Preserve trust - Balance between showing expertise and being transparent (e.g., about interests) and honest (e.g., about uncertainties in knowledge) - Refrain from using expertise to persuade and/or to compensate for gaps and uncertainties in knowledge	3.2.2	E1 indicates that there are still many uncertainties with regards to the safety of HGGM
	3.3	Convey respect for every contribution and every point of view - Display genuine curiosity and ask open questions - Check back at understanding	3.3.3	E1 demonstrates genuine curiosity toward a public attendant showing some resentment by questioning: "could we ask where this resentment comes from?"

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Present expert knowledge in a meaningful context and accessible language

Lessons

Secondly, we recognized the responsibility to share in lessons 9 and 10 that advise experts to use plain, accessible language (9), and to help participants recognize the relevance of shared scientific knowledge by presenting it in a meaningful context (10). Again, what counts as a meaningful context and accessible language, differs between (groups of) people. We advise expert scientists therefore—in addition to studying dialogue partners' backgrounds—to make a serious effort to connect to their ideas and experiences, as well as important values. A specific example of putting knowledge in a meaningful context is a so-called techno-moral scenario (as also suggested in lesson 10). Techno-moral scenarios have been shown to stimulate reflection on the moral impacts of emerging technologies, by providing possible personal and societal effects in a meaningful context (Boenink et al., 2010).

Observations

For all sessions, positive examples of *putting knowledge in a relevant context* were noted. For instance, E2 shared a practice case where HGGM could have been life changing. In this case a couple of prospective parents had undergone standard procedures to prevent passing on a genetic predisposition for a given condition to their offspring. When this failed, HGGM could in theory have offered them additional possibilities to fulfill their child wish after all. Furthermore, E4 explained the term inviolability by putting it in the context of a hospital on fire, forcing one to choose between the lives of a child and a box full of embryos; who would you save? (1.2.2 in Table 2). For session 3, a few examples of non-accessible language were noted (e.g., "plural reasoning"), for sessions 1 and 2 none.

Be cautious in sharing personal considerations, including viewpoints

Lessons

In the lessons presented by Van Baalen et al. it remains unclear whether experts in the Dutch dialogue should share merely professionally based knowledge and insights or that they can also share personal considerations such as hopes, concerns and viewpoints with regards to HGGM. In our view, excluding expert scientists from (actively) participating in the opinion-forming process may create distance, which is not considered positive. For example, this may foster an idea that scientists are not, in the same way as their dialogue partners are, members of society. In the same vein, we do not expect expert scientists to adopt a neutral position or to feign neutrality when in fact they hold a particular stance. Especially the latter might undermine an expert's credibility (Davies, 2022), which in turn can complicate feelings of trust (see also Preserve trust). On the other hand, expert scientists sharing personal considerations may unwillingly influence non-expert participants. Experts in the Dutch dialogue are invited because of their (perceived) expertise concerning (aspects of) HGGM. This could well imply that an expert's contribution deserves superiority over that of the average participant not invited as expert. In light of all, we recommend expert scientists, foremost, to be cautious in sharing personal considerations. For example, when expressing a (personal) position or viewpoint, they should refrain from acting authoritative and/or persuasive toward others. Moreover, we encourage them to be transparent about the reasoning behind their position or point of view, e.g., to which extent it is based on epistemic knowledge, and which additional factors, knowledge or values play a role.

Observations

Several examples were noted of sharing personal considerations. In sessions 1 and 2, personal considerations included mainly *concerns* and *reflections*. For example, at some point E1 indicated to be somewhat nervous that allowing HGGM would lead to societal pressure to use it, e.g., to reduce healthcare expenses. Another example is when E2 reflected back at the practice case above, recalling that it was in *this* situation that she had asked herself for the first time: what if HGGM could have been applied? (1.3.3 in Table 2). For both sessions, no remarks were made of experts being *authoritative* or *persuasive* in sharing personal considerations. In session 3, personal considerations included mainly *viewpoints*. It was noted that, in stating their point of view, sometimes the experts tended to be somewhat directive. For example, E4 answered the question in the "hospital on fire" case scenario (who would you save?) by firmly stating: "the child of course". On the other hand, at several instances both E3 and E4 concluded with indicating that they were very interested to hear the other experts' point of view.

Responsibility to listen and learn (2)

Consider interactions with members of the public as opportunities to learn

Lessons

Firstly, we recognized the responsibility to listen and learn in lessons 1 and 2 that highlight the importance of keeping a maximal open dialogue, and lesson 8, stating that dialogue does by no means stand for exchanging already fixed opinions. This calls upon expert scientists, as well as all other participants, to enter a dialogue with an open mind and a willingness to listen. To stimulate openness, we recommend expert scientists to consider interactions with members of the public as opportunities to learn. They should make an effort to understand different forms of knowledge and varying perspectives, and encourage others to say more. For example by asking (further) questions, or by trying to reveal values

underlying spoken words. It may also help to consider in advance what it is they would want to learn (while at the same time accepting that this may not match with what others wish to share and/or want them to learn).

Observations

Several observational notes were made that can be linked to this prompt. In a direct way this concerned *asking (further) questions*, which was mainly observed in sessions 1 and 2. For example, at some point a public attendant reacted at the question posed by the moderator which conditions participants would rate as "serious enough" to use HGGM for, indicating that she believes perceptions about the severity of a condition are very personal. E1 elaborated on that asking her: "would it be best to leave the choice whether or not to use HGGM all up to prospective parents?" Another example is that E1 elaborated on a participant stating to see no problem in "making" children more intelligent, asking her whether she can think of an application of HGGM that she would say: "this is not ok anymore?" (2.1.1 in Table 2). In a more indirect way this concerned a mix of varying behavior. For example, one time E4 warned the moderator when a participant requested for the microphone, which the former had not noticed. Another example is that both E1 and E4 indicated at some point in the dialogue that they do not have a clear opinion on HGGM yet, and that therefore they are happy to participate in this dialogue.

Be patient and supportive

Lessons

Secondly, we recognized the responsibility to listen and learn in lesson 10, stating that there should be sufficient time and opportunity for questions and concerns coming from the public. It may well be that, in comparison to other participants, expert scientists are already well versed in the topic at hand. They might have reflected on the subject more often, or they have encountered many different perspectives already. In order to ensure every participant has the chance to actively participate in the dialogue process, it seems important for expert scientists to realize that others may need time. Time to interpret incoming information, time to construct a response, and time to find words to express this response. We recommend expert scientists therefore to be patient and supportive. They should allow for moments of silence, and confirm their partners in dialogue with non-verbal involvement. It may also help to actively invite others to contribute.

Observations

In all sessions, observations were noted that indicated patience and supportiveness. Mostly by displaying *non-verbal involvement* and *inviting others to contribute*. An example of the former is that E3 and E4 demonstrated full attention for a public attendant sharing his thought about living with autism. Especially when this participant indicated that he would have been happy using HGGM if it could have meant for him to live a (more) normal life, E3 and E4 looked in his direction and nodded frequently (2.2.2 in Table 2). Examples of the latter include E2, in asking the group of public attendants how they view the possibility of using HGGM for the couple in the practice case above, and E1, in posing the hypothetical question how public attendants would think of making their offspring a bit more intelligent and attractive.

Assist in stimulating in-depth dialogue

Lessons

In a more implicit way we recognized the responsibility to listen and learn in the recommendation to include different societal groups in the dialogue process (lessons 7 and 9), to have these different groups also converse amongst themselves (lesson 6) and to discuss HGGM from a broader societal point of view (lessons 4, 5 and 9). Robust opinion-forming, based on a wide range of perspectives and many different viewpoints, does not only require knowing or hearing them. It also needs bringing all these perspectives and viewpoints together, followed by deep reflection and careful balancing of benefits and harms. However, some groups in society are more difficult to reach than others. Furthermore, bringing many different groups together at the same time can be challenging in terms of organization. It is therefore that we advise those expert scientists that have encountered many different perspectives and viewpoints already (see also prompt Be patient and supportive), to bring in some of these perspectives and viewpoints themselves. In this way they could assist in stimulating in-depth dialogue [note: by thinking in terms of societal groups, it is important to keep in mind that individual members may in fact hold very different views (see also lesson 6)]. In the same vein, it may help to invite participants to collectively identify and explore borderline cases.

Observations

In sessions 1 and 2, a few examples were noted that can be interpreted as stimulating in-depth dialogue. For instance, at some point a public attendant shared her negative experience with (professional) healthcare for her disabled daughter ("it's dramatic"). In reaction to that, E1 stimulated further reflection on healthcare quality and the role of HGGM by inviting public attendants to approach HGGM from a financial point of view: "What if we consider HGGM as a means to reduce healthcare expenses?" (i.e., with HGGM certain diseases could in theory be eliminated) (2.3.3 in Table 2). Another example is that E1, at some point, suggested that it might be interesting to imagine if and how HGGM can affect our definitions of health and disease, and/or how we view fellow citizens that choose not to use HGGM. For session 3, no observational notes were made that indicated this prompt.

Responsibility to invest in relationships (3)

Assist in creating an ambiance of safety and relevance

Lessons

Firstly, we recognized the responsibility to invest in relationships in lesson 9 that alerts expert scientists to refrain from assuming the role of "learned" scientist, since this may discourage others to contribute to the conversation. Especially when discussing highly complicated matter such as HGGM, participants may—apart from needing time—feel little confident to express themselves. Moreover, they may believe their involvement in the dialogue is mainly tokenistic and/or struggle with hierarchal differences. In order to overcome these hindering beliefs, expert scientists can be recommended to *assist in creating a safe ambiance* such that all participants feel confident to contribute, as well as a shared sense of *relevance*. In relation to the former, expert scientists can be advised to remain modest and to refrain from dominating others and/or the conversation. In regard to the latter, it could help to emphasize that complex issues such as HGGM can only be addressed by combining many forms of knowledge, including values and emotions.

Observations

For sessions 1 and 2, several notes have been made of E2 trying to re-direct attention from her to public attendants that could be interpreted as being *modest* or *refraining from dominating the conversation*. For example, more than once she passed an invitation of the moderator to share her point of view on to others (3.1.1 in Table 2). With regards to session 3, observational notes indicate that the conversation was in fact very much dominated by the experts. The moderator gave them constant opportunity to speak, whereas public participants were only rarely invited to contribute. Secondly, observations were noted that indicated creating *relevance*. An example is when at some point after several public attendants had shared their thoughts, E2 reacted upon that stating how their contributions clearly illustrated that HGGM actually concerns everyone. Another example is when E1—in reaction to the moderator's question how he views Dutch law, i.e., its current restrictions for research in his disciplinary field—indicated that this is exactly why this dialogue is so important. "After all, why would I desire investigating a technique that society does not deem preferable?"

Preserve trust

Lessons

Secondly, we recognized the responsibility to invest in relationships in lesson 8, stating that in the dialogue around HGGM different interests are at stake. For example, scientists might have the ambition to further knowledge on early-stage embryo development for which generating embryos in a laboratory specifically for research purposes should be permitted (note: currently Dutch law prohibits this). Obviously, when discussing the desirability of applying a technique that has the potential to shape future life in an impactful way for all, any (perceived) conflict of interest may complicate feelings of trust. To preserve trust, we recommend expert scientists at all times to be transparent about interests. In the same vein, we advise them to be honest about limitations and uncertainties in knowledge, as well as about the positions they hold (see also Be cautious in sharing personal considerations, including viewpoints). Both transparency about interests and honesty about limitations and uncertainties have been shown to stimulate public trust in science (Johnson and Slovic, 1995; National Academies of Sciences, Engineering, and Medicine, 2016). However, another factor that has been linked to trust is expertise (Hendriks et al., 2016a). And showing expertise can feel conflicting with being transparent and honest, especially being honest about uncertainties and limitations in knowledge. Thereto, we advise expert scientists to carefully balance between showing expertise and being transparent and honest. Above all, they should refrain from using expertise to persuade and/or to compensate for uncertainties and gaps in knowledge. In fact, actively communicating flaws or uncertainties in research results, has been shown to positively influence perceptions of integrity—and therewith trust (Jensen, 2008; Hendriks et al., 2016b).

Observations

Several examples were noted that can be linked to preserving trust, mainly in the form of being *transparent* and/or *honest*. For instance, somewhere in the beginning E1 stated that there are still many uncertainties with regards to the safety of HGGM (3.2.2 in Table 2). Somewhat later, he indicated that we cannot get round the fact that the first human to use HGGM on [with granted permission] will be part of an experiment that should be closely monitored, as we are simply not sure how it will turn out. There were no observational notes that indicated *using expertise to persuade and/or to compensate for uncertainties and gaps in knowledge*.

Convey respect for every contribution and every point of view

Lessons

Thirdly, we recognized the responsibility to invest in relationships in lessons 4 and 5 that point to dialogue as a collective exploration of the normative views at stake. Notably, any participant in dialogue can be held accountable for respectfully handling normative views that conflict with his or her own. However, particularly in the case of expert scientists, not respecting the views of dialogue partners might strengthen feelings of inequality. We advise expert scientists therefore to actively show that they respect every contribution and every

point of view. For example by displaying genuine curiosity, and by asking open—instead of closed—questions. It may also help to repeatedly check whether the words of others are understood as they were meant.

Observations

A few notes were made that can be linked to showing respect. For example, one time E2 reacted on two opposing views as expressed by public attendants, by stating how much she welcomed both their points of view (the perspective of a prospective parent against that of an unborn child). Another example may reflect genuine curiosity. When at some point, a public attendant seemed to show some resentment, E1 reacted with: "could we ask where this resentment comes from?" (3.3.3 in Table 2). A last example is that both E1 and E2 tried to reassure one of the public attendants who expressed her amaze and concern: "Am I really the only one in favor of HGGM?" by stating she is certainly not, and that in any case it is important that she expresses her opinion.

Discussion

In this paper we investigated the scientific expert role in a real-life case: the Dutch dialogue on HGGM. We started with examining an advisory report for the design and execution of this dialogue. We analyzed if and how we could recognize three expert responsibilities that are contained in the expert role, in the "lessons" presented in the report. We used our findings to concretize each responsibility with concomitant behavioral prompts. Next, we analyzed if and how we could recognize these behavioral prompts in practice by observing expert behavior in three separate dialogue sessions. With the results, we were able to consolidate each behavioral prompt with at least one example of concrete expert behavior. Before reflecting on the implications of our results, we will discuss the most important study limitations.

Study limitations

One key limitation is that we studied the expert role within a specific context. Our findings therefore, apply primarily to this context and cannot automatically be extrapolated to other contexts. Different contexts, e.g., with regards to (geographical) location, or topic of dialogue, might require differences e.g., as to how behavioral prompts are operationalized into actual behavior. For example, different cultures may have different norms or habits about demonstrating non-verbal involvement. Moreover, factors that determine trust in experts may differ between populations and/or vary depending on the topic. Mihelj et al. (2022) examined trust in experts in times of COVID-19 within a relatively understudied population (inhabitants of four east European countries characterized with generally low levels of trust in science). They found additional factors (positively) related to trust in experts, i.e., perceptions of an expert's political independency and whether one knew an expert personally. Different contexts may also pose differences as to how individual responsibilities are interlinked and/or how they work best together. For example, in case of polarized issues such as childhood vaccination or climate change, scientists can be confronted with fierce opposition or deeply grounded distrust. This may place significant interest on the responsibility to invest in relationships, in expense of others. Future research should be directed at extending our findings with results from multiple different contexts.

Secondly, the number of dialogue sessions ($n = 3$) and expert scientists ($n = 4$) of which we collected observational data is fairly low. This might have resulted in a biased and/or incomplete view of experts in action. In fact, in hindsight, we must conclude that sessions 1 and 2 were indeed examples of good practice (i.e., dialogues in which experts fulfill a modern expert role). In session 3 however, experts seemed to have a more traditional role. To illustrate, in session 1, public attendants and experts were seated interchangeably in a circle-like configuration, the moderator was able to walk around. No strict agenda was followed and public attendants and experts were more or less free to contribute as they wished. In session 3 on the other hand, the experts were seated on an elevated stage. The moderator walked around on the stage and public attendants were seated in rows in front of and facing the stage. The session started with two (long) lectures, 15–20 min each, provided by the two experts. The remaining of the session was built around five statements that were formulated to stimulate discussion (e.g., "Applying HGGM for non-medical purposes is ethically responsible"). With every new statement that was brought in, both experts and public attendants could react by showing emoticon cards that expressed different emotions (e.g., sad, happy, hesitant). However, most of the time only the experts were asked to explain the emoticon card of their choice in words. Public attendants were only rarely invited to react verbally. Overall, session 3 turned out not to be a convincing example of good practice. We recommend future research to test and/or extend our results with data from a range of experts, different set-ups of dialogue sessions, and various numbers of participants.

Conclusions and implications

On the base of our findings, we present a description of the scientific expert role in terms of three responsibilities, with for each responsibility three behavioral prompts and three concomitant practice examples. Even though the latter are specific for the context of our case study, in a more generic way these examples are meant to offer both expert scientists and professionals in the field of training important insight in how to convert behavioral prompts into actual behavior. It is our

hope that, by offering a first (detailed) description of the expert role in modern science communication, we infuse scholarly discussion and stimulate further research on the topic. We invite scholars in the field of science communication and related disciplines to use our description for further scrutinization and/or refinement. Educational research could be directed at developing educational strategies for training associated target behavior. In this respect, it seems important to note that our description is meant to inform the expert role in a context of science communication where mutual learning between scientists and members of society is key. We investigated this expert role by studying an example of such a context: the Dutch (public) dialogue on HGGM. However, this does not mean that we claim our description applies to all sorts of (science-based) public dialogue or public dialogue in general. There are fine examples of public dialogues that do not aim for (direct) mutual learning between experts and public participants, where experts are not actively participating in the dialogue, but only have a limited role of introducing a topic and/or sharing important background information (see for example Reedy et al., 2020; Blacksher et al., 2021).

Although, in general, all three responsibilities within our description of the expert role seem equally important and are likely to act upon each other, we are inclined to think that the responsibility to listen and learn serves as the best starting point to improve expert performance with relatively little investment. As we mentioned in the introduction of this paper, despite ages of evolution in science communication theory, experts seem to have remained "stuck" in deficit-like thinking that keeps them mostly in a speaking position. Yet, despite a growth in training programs and considerable interest of scientists to participate in it, the majority of science communication training still focuses mainly on speaking behavior, such as message clarity and storytelling (Dudo et al., 2021). Although these are very important competences for a scientist interacting with the wider public, such a focus on speaking does not particularly invite scientists to transcend the informing role in favor of other roles. If we aim for scientists to engage in genuine two-way dialogue, science communication training should at least take both arms of the communication process equally serious: speaking *and* listening. In fact, being a complex skill, listening can be challenging to do well. For example, "active listening", a specific form of listening often associated with good listening, involves specialist communication behavior such as paraphrasing another's contribution, conveying non-verbal involvement and asking questions that encourage elaboration (Weger et al., 2010). Moreover, to listen with full attention requires one to overcome common habits such as responding in reflex or rushing into judgment (Escobar, 2011). It is therefore that, in closing of this paper, we plead for renewed training aimed at making scientists aware of the many pitfalls associated with listening, while at the same time providing them with the necessary tools and practice to develop positive listening behavior. As we contend, such focused training has the potential to bring theory and practice of science communication closer together and therewith makes it possible to use science, technology and innovation in a responsible way for mankind.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

CR and MM contributed to study conception and design. CR collected and analyzed the data and prepared the main body of the draft manuscript. MM, AB, and SB reviewed, edited, and supplemented with additional content. All authors contributed to the article and approved the submitted and re-submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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