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Analysing Dutch Science Cafés to better understand the science-society relationship

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Abstract

Science cafés offer a place for information and discussion for all who are interested in science and its broader implications for society. In this paper, science cafés are explored as a means of informal science dialogue in order to gain more understanding of the science-society relationship. Perspectives of visitors, organisers and moderators of science cafés were analysed. Findings show that science cafés stimulate discussion and engagement via informal learning processes. Visitors come to broaden their knowledge in an informal ambiance. Organisers and moderators hope to enhance understanding of science and confidence of people to participate in debates.

Keywords

Informal learning; Public engagement with science and technology

Introduction

In the current changing science-society relationship where new developments in science and technologies are often debated, public engagement has been assigned an important role. Often, actors in the science-society relationship assume or hope that including publics in dialogue and participation processes may lead to more acceptance of science [cf. Bauer, Allum and Miller, 2007; Gregory and Lock, 2008]. In addition, engaging publics in science issues from the stage of agenda-setting onwards is considered a way to restore trust in experts [Hagendijk, 2004; Wilsdon and Willis, 2004]. All in all, dialogue and public participation processes have attracted considerable attention both in policy making as well as in academic studies [cf. Chess and Purcell, 1999; Hagendijk and Irwin, 2006; Rowe and Frewer, 2004]. While most of the theoretical work and empirical research focuses on dialogue and participation processes which aim at influencing policy decisions, not all dialogue and participation processes seek to inform decisions on the policy level. According to Davies et al. [2009], these type of activities, which include science cafés, are under-theorized and under-researched.

Therefore, this paper aims to analyse the way dialogue and participation are shaped in science cafés, and, in doing so, aims to deepen our understanding of the changing science-society relationship [cf. Dijkstra and Gutteling, 2012]. It does so by studying perspectives of various groups of participants in science cafés, in particular, by studying views of visitors (dataset 1) and organisers and moderators (dataset 2).

In the remainder of this paper, first, general characteristics of science cafés are presented, followed by a theoretical frame on dialogue and public participation processes within the science-society relationship. Thereupon, the methods for this study are described as well as the results. This paper concludes with a discussion and reflection on dialogue and participation within the science-society relationship.

The rising popularity of science cafés

Worldwide, science cafés continue to rise in popularity. Since 1998, when the first *cafés scientifiques* were organised both in the UK and France, all over the world science cafés — as they are called elsewhere — have been set up with, according to Grand [2014], an estimation of about 700 science cafés in 2014. In science cafés, both scientists and the public can meet in an informal environment and participate in discussions about science issues [Dallas, 1999; Dallas, 2006]. Originally started in a café, all informal venues, such as (book)shops, restaurants, pubs or even pop music halls, are suitable to engage members of the public who might not attend formal lectures. Various formats exist, but the few studies that included science cafés all mention the informal and friendly atmosphere, open access for everyone, and the possibility to discuss developments in science or technology with the scientists or researchers who present their work [cf. Dallas, 1999; Dallas, 2006; Dijkstra and Critchley, 2016; Grand, 2014; Navid and Einsiedel, 2012]. According to Navid and Einsiedel [p. 1 2012]. 'these informal venues offer an opportunity to engage members of the public who might not attend a formal lecture'. Lehr et al. [2007] called such activities 'dialogue events' and argued that these may be appropriate arenas for both learning about and discussing a wide range of scientific and technological (controversial) topics. At the same time, science cafés will often be attended by members of the public who typically share key attitudes towards a topic, and consequently, according to Priest and Greenhalgh [2012] would be called attitudinal communities [cf. Dijkstra and Critchley, 2016].

Dialogue and participation processes in the science-society relationship

In the past few decades, dialogue and public participation have been in the spotlight because of its democratic rationale, that is that the public should be able to and be encouraged to deliberate and decide on new scientific and technological developments. That the public needs a say in risk issues is not only a democratic right [cf. Pidgeon, 1998] but it is also argued that lay judgments of risks are as sound or more so than those of experts [Fiorino, 1990]. Participation processes therefore have been encouraged while key is that the output of these processes should have a genuine impact on policy [cf. Lehr et al., 2007]. Some authors criticise public participation that influences policy making when it has disconnected facts or aims at support for technology [Pestre, 2008]. In those cases, often the ideal of equally interested views which parties 'share and try to reconcile' is compromised by desired outcomes from one party [cf. Gregory and Lock, 2008].

In addition, according to Mejlgaard [2009], the role of the public in the science-society relationship is based on two dimensions. On the one hand, citizens should become competent in matters of science and technology. When citizens have more knowledge they are able to deal more effectively with science and technology and its concerns and become empowered [cf. Hansen, 2005]. Familiarity and understanding are prerequisites for such processes while citizens have the right to be informed also about adverse effects. On the other hand, because risks

are too often ignored, citizens' perceptions and concerns should be taken into account and, therefore, citizens should become active participants in this process. Mejlgaard [2009], therefore, understands the role for citizens in the science-society relationship as a balance between citizen competence and public participation.

However, the science-society relationship may be more complex than thought. For example, findings for the case of a public participation process, the public debate about GM food in the Netherlands in the year 2000, first of all, illustrated that policy influence was hardly reached, and, secondly, that the level of participation of citizens in new developments — based on Arnstein's ladder of citizen participation [Arnstein, 1969] — mainly was restricted to lower steps on the ladder of participation, that is, receiving information about GM [cf. Dijkstra and Gutteling, 2012; Dijkstra and Gutteling, 2012]. When offered the opportunity to engage in debates about new developments people participated only in small numbers while the larger public indicated to be interested in information but had no time or priority to participate actively, to reach higher steps on the ladder of participation — e.g., to actively attend meetings or organise them. The studies concluded that publics (groups of citizens) fulfil various roles and in these roles people may — more passively or actively — participate in science and technology. In active roles, publics want more influence on and in decision-making processes. In passive roles, such a claim is not made, but the need for open and transparent information and communication is still present in order to become more competent [cf. Mejlgaard, 2009].

Meanwhile, Powell and Lee Kleinman [2008, p. 345] concluded that citizens, who participated in their study into citizens' perceptions after they participated in a citizen conference on nanotechnology, felt they gained knowledge and efficacy during this process and became more confident. According to them, events that offer dialogue and participation, although they have little or no influence on policy making, can have an influence in breaking down barriers to citizen participation as citizens increased their beliefs that they are able to participate meaningfully in techno-scientific issues.

Science cafés do not aim to influence policy-making, but as Dijkstra and Critchley [2016] concluded, for a specific attentive public, they offer a place for debate and information. According to Davies et al. [2009], non-policy dialogue events that do not claim to influence policy making could also be envisioned as part of a new science-society relationship where experts (researchers), policy-makers and the public each fulfil roles as citizens. As such science cafés contribute to processes of social learning with social learning being viewed as open-ended learning, not aiming at prefixed goals but where articulation of different viewpoints is possible. Thus, non-policy dialogue events 'may provide an important and effective venue for adults to voluntarily engage with science in the context of society' [Davies et al., 2009, p. 343], and may be places where citizens can become more familiar and informed about topics [cf. Powell and Lee Kleinman, 2008]. Learning, for example, may then be viewed as empowering participants for further debate while participants are free to explore all positions. As Davies et al. [2009] argue:
non-policy dialogue could therefore be viewed as part of, and in fact linked to, wider and more formal interactions between science and society, and such dialogical processes (…) can empower and equip individuals and small groups, which sometimes might even initiate small policy impacts.

This paper aims at gaining more understanding of participation and dialogue processes which take place at science cafés. Therefore, views of visitors and organisers and moderators were assessed.

Methods

For the analysis, this paper draws on two sets of data about science cafés. According to various authors methodological pluralism, using quantitative and qualitative data, can deepen the understanding of — in this case — the science-society relationship and can contribute to a richer analysis [e.g. Von Grote and Dierkes, 2000; Tashakkori and Teddlie, 2003].

In *the first set*, both quantitative and qualitative data were collected from citizens, in their role as visitors of science cafés. The choice to collect opinions of café visitors was informed by the knowledge that visitors are citizens who may learn about and become empowered and equipped regarding techno-scientific issues. In a *second set of qualitative data*, collected in 2015–2016, citizens, in their role as organisers and moderators of Dutch science cafés were interviewed. The choice to interview organisers and moderators was informed by the knowledge that organisers and moderators are citizens taking up their role of active participation in processes of science communication. Furthermore, organisers and moderators are expected to be able to reflect in an in-depth way on science cafés as science communication means.

Science café visitors: first data set

The first set of data were collected as part of the so-called Nanotrail project in 2010 and exists of three sub sets of data. As part of the Dutch Societal Dialogue on Nanotechnology, a national collaboration of science cafés organised a series of science café meetings about nanotechnology and its possible applications. Visitors of these science café meetings, were asked to fill in a questionnaire during the break in which they were asked about their general attitudes towards public participation, their own level of participation (in nanotechnology), and their opinions about activities such as science cafés (this paper, data not published before) as well as their perceptions on nanotechnology (data which were published in Dijkstra and Critchley [2016]). The science café meetings took place in five places in the Netherlands. In each café, scientists spoke about various aspects of nanotechnology and possible applications. The meetings were live streamed. The number of visitors varied from 75 to 120 people per meeting. A total of 455 people visited at least one of the meetings with a total of 233 respondents filling in the questionnaire (response rate 55%). This group is labelled 'café visitors'. In addition, people who received the news letters about the science cafés visited science café meetings about other topics but did not attend the specific meetings about nanotechnology were asked to fill in the same questionnaire. This resulted in an additional 378 respondents. In this study they are labelled 'occasional visitors'. Finally, the meetings were qualitatively analysed. The recordings of the five café meetings on nanotechnology were transcribed verbally upon which categorisation in themes and subthemes took place in an iterative and inductive process which guided the further analysis.

Organisers and moderators of science cafés: second data set

A second data set was collected by means of semi-structured interviews with organisers and moderators of science cafés in the Netherlands. Organisers and moderators both contribute to the organisation of the science cafés, either by organising them in a practical sense, or, by moderating the meetings. Interviews were conducted with help of an interview protocol until saturation took place and no new themes came up [cf. Patton, 2002]. In the interviews, respondents were asked why and how they organise science cafés, what makes the cafés successful, what are drawbacks, as well as what they expect from science cafés and visitors as a means of contributing to the informal science dialogue and participation in science and technology. In 2015, a total of about 15 to 20 science cafés were organised on a regular base in the Netherlands. In total, 11 respondents, organisers and moderators, were interviewed from six different science cafes. The interviews lasted about one hour each and were recorded and transcribed. After transcription, key views and arguments were clustered and thematically analysed in an iterative process. Subsequently, data was further categorized in sub themes based on induction, meaning that sub themes arise from the data.

Results

In this section, the findings from the two data sets are given. First, the opinions and views of the visitors are described. Thereupon, the results from the interviews with organisers and moderators of Dutch science cafés are provided.

Visitors about science cafés

In the Dutch science cafés about nanotechnology about one third (38%) of the café visitors had visited a science café for the first time, as well as one third (37%) had been to meetings between two and five times while 26% were frequent attendants and attended meetings more than five times. Occasional visitors, who did not visit the specific meetings on nanotechnology but visited science café meetings before, had frequented science cafés less often. Of the occasional visitors about one in ten (9%) frequently had attended meetings. Main reasons for these respondents to participate in science café meetings were 'interest in the theme of the meeting' (73%) and 'to broaden or deepen my knowledge', while to a lesser extend reasons such as 'to be introduced informally to science' (21%), 'to meet others' (14%), 'for enjoyment and a pleasant sphere' (9%) or 'other' (6%), were mentioned. In addition, café visitors were asked to provide their opinion about the meeting via an open question. Answers were grouped and were mainly positive, although a few critical comments were given. Positive answers referred to the meetings as being 'interesting' (70 times mentioned), 'informative' (34), 'good' (25), 'fascinating' (19) and 'educational' (15) while also positive associations were given with the words 'fun' (10) 'clear' (8) and 'music' (7). Few respondents found the meeting 'worrying' or said that 'mankind always is behind the times'. In various wordings respondents referred to the importance of discussing societal aspects by saying that the meeting is 'relevant for society' and 'engaging'.

In another question, respondents' own level of participation in nanotechnology ranging from lower to higher steps on the ladder of participation was asked for. The steps stand for more passive to more active forms of participation [cf. Arnstein,

Table 1. Level of participation for both groups of respondents (% Café visitors / Occasional visitors).

Did you ever …	*No never*	*Once or sometimes*	*Regularly or often*	*Mean (SD)*	*t-test (group difference)*
	% café visitors (N=233) *% occasional visitors (N=378)*				
See, hear or watch information about nanotechnology in newspapers, on radio, or on television?	9.3 *6.7*	58.9 *65.9*	31.7 *27.4*	2.96 (1.1) 2.92 (1.0)	t(602)=.37, NS
Talk with someone about nanotechnology?	27.8 *34.3*	55.6 *56.3*	16.6 *9.3*	2.39 (1.2) 2.14 (1.1)	t(595)=2.66**
Search for information about nanotechnology at the library of on the Internet?	47.0 *54.9*	38.5 *35.5*	14.6 *9.6*	2.13 (1.2) 1.83 (1.1)	t(602)=3.10**
Attend a meeting about nanotechnology (e.g., a lecture or a public hearing)	59.0 *75.5*	30.6 *19.6*	9.4 *5.0*	1.77 (1.1) 1.45 (.9)	t(595)=3.92***
Participate in a discussion group about nanotechnology?	87.1 *87.2*	9.6 *11.0*	3.2 *1.8*	1.23 (.7) 1.24 (.7)	t(599)=-.19, NS
Organize a meeting about nanotechnology?	95.2 *96.1*	2.4 *2.6*	2.4 *2.3*	1.11 (.6) 1.09 (.5)	t(599)=.51, NS

NS = not significant; **p<.01; ***p<.001

1969; Dijkstra and Gutteling, 2012]. In Table 1 findings are given. Differences between the groups were analysed with t-tests. Two findings of interest can be derived from the table. First, in both groups, more than 90% of the respondents heard about nanotechnology once or more often. At the same time, more than 87% of the respondents in both groups never participated in a discussion about nanotechnology and more than 95% never organised a meeting about nanotechnology which are the more active steps on the ladder of participation. Second, respondents answered positively when they were asked if they talked to someone about nanotechnology once or more often (72% and 65%), and if they searched for information once or more often (53% and 46%) although the groups differed significantly. The majority never attended another meeting about nanotechnology (59% and 76%).

In contrast, despite the fact that respondents' own behaviour is restricted to mainly lower steps on the ladder of participation such as hearing, talking or searching for information, both groups considered the possibility of citizen's participation important (see Table 2). A majority of the respondents, 58% to 79%, held the opinion that participation of citizens is a good development, can influence decision making and is not a waste of taxpayer's money. In addition, about one third of both groups (36% and 30%) agreed that citizens' participation can enhance trust.

Finally, qualitative analysis of the transcripts of the café meetings showed that café visitors considered the need for societal dialogue important because of the unknown risks a new technology such as nanotechnology can bring [see also Dijkstra and Critchley, 2016]. They agreed that discussion is a way to handle questions that raise concern. Some café visitors assigned a role for science cafés where researchers can inform people, while others saw a bigger role for educational programmes at schools and collecting questions of concern from society. Café visitors showed their interest, in a pleasant tone of voice, in societal

Table 2. Opinions about citizen's participation by both groups (% Café visitors / Occasional visitors).

Citizen's participation	***Completely disagree and disagree***	***Not agree not disagree***	***Agree and completely agree***	***Mean (SD)***	***t-test (group difference)***
	% café visitors (N=233) *% occasional visitors (N=378)*				
…influences decision making	18.2 19.6	14.7 22.3	67.1 58.2	3.64 (1.2) 3.50 (1.1)	t(605)=1.50, NS
…enhances trust	34.8 36.3	28.7 33.6	36.5 30.1	2.90 (1.2) 2.84 (1.2)	t(603)=.55, NS
…is NOT a waste of tax payers' money (recoded)	15.3 15.3	15.7 22.8	69.1 61.8	3.92 (1.2) 3.79 (1.2)	t(602)=.37, NS
…is a good development	12.1 14.6	9.5 20.3	78.4 65.3	4.09 (1.1) 3.72 (1.1)	t(604)=3.89***

NS = not significant; ***p<.001

aspects (of nanotechnology) by asking questions about society-related topics, such as risks and benefits, ethical issues, possible fear for a new technology but, at the same time, they asked questions for clarification of the various issues that were brought up by the speakers.

Organisers and moderators about science cafés

To further explore the science-society relationship and the specific role science cafés can play, qualitative findings from the interviews with organisers and moderators are provided below. In the first part, practical information about organisational aspects is given, while in the second part, various reflective views on science cafés and the science-society relationship are described.

Characteristics interviewees

In total, 11 interviews were conducted. Respondents fulfilled roles as organisers (n=7) and as moderators (n=4) in various science cafés in the Netherlands. Their age ranged from 32 to 69 years. All were actively involved in local science cafés, sometimes also in other roles than organisers or moderators. At least two respondents fulfilled a role as researcher as well, while one respondent mainly contributed to the editorial team.

The respondents who volunteered in the science cafés indicated that they organise or moderate science cafés also for personal reasons such as their own interest in, enjoyment and enthusiasm for science. It is a way of becoming informed about a variety of topics; they welcome hearing pros and cons of developments in science and technology, or, they see it as part of their outreach activities. It can be a personal learning experience, they said, where sometimes either a confirmation of knowledge takes place or discussions about the topic start. The respondent who initiated the first science café in the Netherlands after he had visited a science café in France, pointed out that the lack of these type of meetings in the Netherlands and his interest in scientific research were reasons to start one. He argued as follows:

> "In my view it is important that science is considered in a broader part of society, that its value will be recognised. And that it will be enjoyed. (…) For society, it is also a good development when it becomes part of people's lives." (R7:164)

Most of the respondents not only actively participated as volunteers in the science cafés but were also involved in other volunteering work. Activities varied, ranging from volunteering in other (boards of) societal (and political) organisations and chairing these to contributing to outreach activities or moderating other type of meetings.

Organisational aspects of science cafés

Table 3 provides an overview of various organisational characteristics of the Dutch science cafés. Some differences regard the format. Several science cafés (e.g., Deventer, Harderwijk, Leiden) invite most times one researcher who presents her or his work, with occasionally two researchers presenting, while after a break the discussion is guided by a moderator. Other science cafés (e.g., Enschede, Nijmegen) almost always invite two researchers who each present a half hour, followed by a moderated discussion. In one café (Amsterdam) the format differed strongly as the main researcher is interviewed by the moderator whereupon other researchers are asked to participate in a panel discussion to broaden views on the topic. In this café, also, two spoken columns are presented by a journalist and a museum director. As this café is broadcasted, the organisers decided for the different format. In most cafés it is possible to use visuals to support the presentation, although not everyone does. Often, live music is performed before the meeting starts, during the break and afterwards. Café meetings are well visited with often more than 80 to 100 participants per meeting. Occasionally, a meeting might even attract over 300 people. Frequencies of the meetings in a year may vary per location, ranging from four till ten meetings per year. All but one café (Amsterdam) are open for free for everyone.

The organisers of the cafés are mainly volunteers with different backgrounds while in some university cities employees from the university are involved on a professional base, for example, via the so-called Studium Generale programmes for the research community that universities have been organising for many years. In one café (Amsterdam), only paid professionals are involved in the organisation and moderation because the organisers want to ensure a certain professional level of the meetings. Organisational tasks when organising science café meetings roughly consist of finding topics and presenters, arranging the location, contracting a band or taking care of music otherwise, attracting publicity, finding sponsoring, and hosting the evening. Finding topics and speakers is a task mostly collectively shared, sometimes with help of an editorial board, while other tasks are often divided within the team members. In some cafés volunteers are assigned specific tasks, such as taking care of the finances or organising the publicity; in other cafés one or two volunteers, in turns, take care of all the work related to organising one café meeting, with exception of the finances. All but one of the moderators are not paid while the moderators are often not involved in the practicalities of the meetings on a regular base. Meetings of the team members vary per café in frequency. Budgets for organising the cafés are low, except in the café which is

Table 3. Characteristics of science cafés.

Science café	Amsterdam	Deventer	Enschede	Hardenberg	Leiden	Nijmegen
Format	Interview, panel discussion, experiment, spoken columns	Presentation, moderated discussion after the break	Presentation, moderated discussion after the break, questions only on coasters	Presentation, moderated discussion after the break	Presentation, moderated discussion after the break	Presentation, moderated discussion after the break
Number of presenters	More than 2	1 (or 2)	2 (or 1)	1	1 (or 2)	2
Music (band, other)	no	yes	yes, VJ	yes	yes	yes
Estimated number of visitors per meeting (min-max)	150 (80–150)	130 (80–300)	100 (30–150)	150 (125–175)	100 (40–120)	90 (80–300)
Frequency/year	10	10	6	4	10	10
For free	no (€8.50)	yes	yes	yes	yes	yes
Paid organisers	yes	no	some	no	no	no
Volunteers	no	yes	yes	yes	yes	yes
*Paid researchers**	no	no	no	no	no	no
Tasks team members per meeting	Division of tasks, mainly by professional	Finding speakers is shared; division of tasks	In teams, by professional	Finding speakers is shared; division of tasks	In teams, some tasks assigned	In teams, some tasks assigned
Editorial board	Yes	No	Yes	No	Yes	Yes
Meetings of the team members	Twice per meeting	Once after each meeting, team building day	Few times per year	Once per meeting	Three times per year, informal	Two times per year editorial meeting, informal
Pass the hat	No	Yes	No	Yes	No	No
Topics	Vary broadly, natural sciences	Vary broadly	Natural or life sciences, ethical aspects	Natural or life sciences	Vary broadly	Vary broadly, natural sciences
Topics suggested by visitors	No	Possible	No	Possible	Possible	Possible
Other activities	No	Yes	No	Yes	No	No
Such as		Science-art festival; special evenings		High school students presenting projects		

* Sometimes an exception is made for freelance researchers

organised by professionals only. More generally, costs of organising a café are low, and funding may be received from local sponsors (also via in-kind sponsoring), while universities may contribute if in town. Sometimes the venue is offered for free. To cover costs, in some cafés they pass the hat. In a few cafés the volunteering team organises other activities as well such as a science-art festival or meetings for particular groups such as high school students.

Topics in the science cafés may vary broadly. Key, however, is that research and new developments are brought out into the open with an emphasis on bringing findings that go further than textbook knowledge, it is ongoing research. Topics that are newsworthy attract more attention.

Success factors and drawbacks of science cafés

All respondents agreed that science cafés are at the moment successful and mentioned various factors that contribute to this success, although they discussed these in a slightly different order: science café meetings are for free, easy accessible, often in venues close to the city centre, fun, with researchers who have a good reputation and talk about attractive, trending and interesting topics, with an audience that is interested in the topic, and well organised. The informal ambiance is important according to all interviewees. According to the respondents, researchers contribute to this success because they enjoy telling about their research or see it as their responsibility to do so, as part of their grants. One respondent stated that they treated researchers as stars. The content offered contributes to the success as well; it is often new knowledge but presented in a broader context and more views to topics are discussed. Respondents mentioned that science cafés contribute to the cultural offer of activities for citizens which they appreciate, as is pointed out as follows:

> "A science café contributes to a stronger social engagement. People are proud of the fact that the science café is organised in this city" (R5:120).

According to some respondents, in smaller cities where no university is situated, there is less competition with other activities while in bigger cities competition with other activities and lectures offered by museums, universities and such plays a role in the choice of topics for the meetings.

When asked, respondents mentioned a few drawbacks, most practically related. Occasionally, a topic attracts a lower number of people and sometimes speakers are less gifted. Rarely, researchers have to cancel at short notice. For cafés with two speakers this does not cause a problem. To continue the success, according to more than one of the respondents, it is important that meetings run smoothly, are organised well, and that technical support is optimal, for example, that microphones do work. For this reason, some cafés purchased their own microphones. In addition, it is important that the organisational team exists of enough members who have time to contribute actively.

Informing, learning, discussing and engaging

When asked what science cafés can achieve and why they should be organised respondents pointed out a variety of reasons that could be divided in two key views. On the one hand, respondents argued that science cafés contribute to informing and learning by bringing enjoyment, enthusiasm and diversion. They contribute to general knowledge and increase attention for science. In other words, it is a means for knowledge transfer, or outreach for an interested but wider audience and, according to one respondent, can bring some kind of literacy, and decrease the gap between science and society. However, the knowledge that participants acquire has an incidental character:

> "When people, whether it is really possible to increase your knowledge by attending such a meeting? Undoubtedly, you'll spontaneously pick up something, but the topics often are quite complex" (R3:148).

On the other hand, all respondents found the element of discussion and engagement most important. Science cafés can stimulate participants to consider topics, form and refine their opinions which is more than acquiring knowledge, they enhance discussions. They can stimulate critical consciousness. Its specific role is not only to show pros but also to raise concerns and contribute to engagement and critical reflection, as is explained as follows:

> "Well, a science café is a means for these type of discussions. For me, science cafés are more than science communication sec. In my case, I include reflection on science, to consider the place of science and technology in society" (R8: 129).

Various respondents contrasted the knowledge discussed in science cafés with knowledge provided, for example, on television and stated that knowledge from science cafés has more value. In doing so, they referred to the recent well-watched events in the Netherlands where well-known researchers lecture on television. More than one respondent spontaneously argued that television lectures are typically one-way communication while she or he would prefer discussions such as are possible in science cafés.

By discussing topics and developing a critical attitude, it is possible to make connections between topics that have broader implications for society. Therefore, some respondents stated that the part of the meetings where the discussion takes place is more important than the part where the researcher presents his findings.

Citizens in the science-society relationship

Not surprisingly, all respondents agreed that citizens should be engaged in the broader debate about science and technology, despite that only a small part of the population is reached by science communication activities. At least, the higher educated should develop a broader view on science, according to one respondent while he referred to CP Snows' lecture on the two cultures from 1958 [Snow, 1998]. Other respondents argued that not only the higher educated should do so; developing a broader view on developments in science and technology and being able to raise critical questions, should be something everyone would need to be educated in. This was labelled with the phrase 'Bildung' (German: 'education' or 'formation') by one respondent (R2:89):

> "Bildung refers to much more than knowledge. Bildung includes, so to say, the aspect of the relationship of knowledge with other topics, and, to, develop a frame of thinking which enables you to open up for information, for developments" (R2:97).

Being a good citizen implies that citizens acquire the necessary knowledge, added a respondent. Respondents provided various reasons: there is still a gap between science and society, or, citizens should take an active role in society to counterbalance other stakeholders in society, and it will help to understand the use of scientific research. For some controversial topics, which need political support and are scientifically based, such a critical attitude is important, argued one of the respondents, or even considered necessary (e.g., privacy-related issues, food safety,

sustainability, and, emerging technologies). Therefore, citizens should inform themselves about developments in science and technology, and should not leave that to others. However, they cannot be forced to get motivated to do so, although science cafés can entice and interest them to become informed, argued one respondent as is shown in the following citation:

> "But I disagree that they (citizens) are obliged to motivate themselves to do so. So, there is a kind of gap. . . . I think it is good for people, but what if they are not motivated by themselves, well, a science café can seduce them to, to, motivate and persuade them, to — how do you call that — raise interest in science and technology" (R4:151)

Achievements of science cafés — enabling participation

Science cafés can bring people from science and society together. When both worlds meet, science and technology become more visible and more understandable. In addition, one respondent argued that nowadays too often only economic arguments are used to point out the importance of science and technology. According to this respondent, also cultural motives are reasons to stimulate awareness in science and technology, as science and technology are part of our cultural heritage. One respondent argued that science cafés contribute to social bonding; in this city the science café fulfils a role in the societal domain by offering cultural diversity which was also mentioned by another respondent who argued that people learn from such activities. In a more general sense by offering discussions, cafés, according to another respondent, show that it is possible to participate in discussions which may empower citizens

> "If it relates to societal aspects, then they could participate in discussions which science cafés enable. . . (. . .). People can, become empowered by more knowledge, to, to contribute sensibly and it their choice to do so or not" (R7:226-230).

Influence

Some respondents argued that science cafés play a role in the broader setting of society. Offering insight in research and developments in itself brings 'social enhancement', and 'a variety in the cultural programme of a city'. Other respondents argued that science cafés have social value in itself, it is a unique place where discussions are taken place which are not happening in other situations. However, with regard to the question if science cafés are able to influence policy making or such, unanimously respondents thought this was not possible as such. Not directly, at least. Policy decisions are taken on a more general level in society and single science cafés could never achieve this kind of influence, although sometimes local decision makers also attend the cafés. The respondents also doubted if that should be wanted. More than one respondent argued that science cafés do not fulfil such a role.

At the same time, some respondents were able to provide a few examples where some influence, at a local level was achieved and while being interviewed they

changed their minds a bit. For example, once, after a café meeting the chairman of the local council, stayed to ask questions and exchanged phone numbers with the researcher. Other examples were situations where the city council asked the local science café for advice, or, the person responsible for security working at the local hospital admitted to have learned a lot about cybersecurity which he would be able to apply immediately. As one respondent remarked, more people are attending science cafés than council meetings and decision makers or policy makers also attend science cafés.

Trust in science

When asked about trust, according to some respondents, on the one hand, people put too much trust in science, that is, policy makers argue that their decisions are based on science, but still moral and political aspects that are important are denied. In such cases, science fulfils a role as a new religion. Respondents thus related their remarks to general trust in science. On the other hand, respondents mentioned that distrust plays a role as well, as science costs money or some scientists commit fraud (diminish trustworthiness), and controversial science scares people away. They argued that science and technology do not always benefit society. Science communication can offer context and can try to raise more understanding of the scientific process. "…science is still the best way to reach certainty", was argued (R10:196).

Most other respondents agreed that science cafés can or should play a role in this process. Cafés can decrease the gap between science and society. However, although according to some respondents science sincerely aims to find out how things work, they doubt whether science cafés can really contribute to this process of trust. The people who participate already favour science and absolute numbers of attendants are, despite the successes, not high. The open attitude of researchers who are asked critical questions is valued. Also, respondents argued that people learn to ask questions and to debate issues. It helps that people can approach researchers and get more acquainted. According to them, often distrust relates to ignorance. 'Unknown, unloved' is the saying and that is true for science as well.

Discussion and conclusion

In this study science cafés are analysed as places where dialogue and participation processes are shaped. In analysing these, more understanding of the science-society relationship was aimed at.

As places, science cafés are popular. The format with the informal ambiance, free access, engaged researchers and the possibility for discussion attracts many interested citizens. The quantitative findings show that *visitors* come to broaden or deepen their knowledge, to be introduced informally to science and technology, to learn about topics and to meet others. Visitors find the meetings interesting and informative. They ask questions about risks and societal aspects. In addition, although their own participation (in nanotechnology) was mainly restricted to lower steps on the ladder of participation (e.g. hearing, talking, searching information), they consider the possibility to participate important and think that citizen participation is a good development and can influence decision making, although they are more ambivalent when asked if participation can enhance trust.

Organisers and moderators, who are actively participating citizens on the ladder of participation, argue that cafés are places of learning both for visitors as well as themselves, by hearing pros and cons of techno-scientific issues, but, more importantly, also are places where knowledge can be debated. Moreover, o*rganisers and moderators* all emphasise the importance of discussion in *cafés*. Key in their arguments is that participation in the discussion enables citizens to raise critical questions, and to build confidence in issues of science and technology. Most of them agree that hearing both sides of a question is more important than raising awareness, although some respondents expect that after the discussions citizens become more knowledgeable and base their decisions on this knowledge. They differ in their opinion to what extent science cafés can contribute to trust in science as some respondents argued that cafés attract mainly the already interested publics who have higher levels of trust in science [Priest and Greenhalgh, 2012]. In addition, all respondents agree that, despite the rising popularity of science cafés and the given examples of local influence, policy influence is only possible in an indirect way [cf. Powell and Lee Kleinman, 2008].

By taking perspectives into account from both visitors as well as organisers and moderators, first, it can be concluded that science cafés are places for knowledge sharing and informal learning for citizens in various roles. In cafés it is possible to develop a sense of science as well as hear multiple viewpoints and discuss these. Both visitors as well as organisers and moderators come to learn about and shape their views on techno-scientific issues. Cafés, therefore, may contribute to citizens' competence of science as stated by Mejlgaard [2009] while at the same time they are places of social learning [Davies et al., 2009], because science cafés typically are not aimed at prefixed goals, and organisers and moderators help to bring various views to the fore which help visitors, and themselves, to deliberate developments in science and technology in a comfortable — their own — way [e.g. Bultitude, 2014].

Second, as science cafés are considered places where open deliberation is possible and different viewpoints can be given, as such, these processes help empower people and climb the ladder of participation [cf. Arnstein, 1969; Dijkstra and Gutteling, 2012]. In addition, participation in discussions such as in science cafés may increase visitors' knowledge and efficacy, as has been argued by Powell and Lee Kleinman [2008]. Visitors of science cafés are able to join the discussions and develop their opinions. Organisers and moderators strongly believe science cafés contribute to the enhancement of debate. And, at the same time, visitors themselves have, at least to a certain extent, the feeling that they can engage with and discuss topics they are interested in.

Finally, this paper analysed perspectives of citizens in various roles on participation and dialogue via the means of science cafés and provided interesting insights. The results from this study may inform other informal dialogue processes. Still, science cafés, although highly successful, are visited and organised mainly by attentive publics who already have some interest in and confidence in science and technology [cf. Priest and Greenhalgh, 2012]. Therefore, always, other science communication initiatives will be needed that will stimulate to engage other groups of citizens (e.g., non-attitudinal publics). In addition, this study did not include insights in the researchers' roles in such science communication means as well as it was restricted to a more qualitative and therefore, discursive, analysis. Future research could investigate researchers' perspectives and their roles in the

broader perspective about science communication and engagement, more particular in relation to new developments about responsible research. Differences between cultures may then also be insightful as Mizumachi et al. [2011] found. Also, further quantitative analysis will be helpful to gain more insight into the science-society relationship.

In conclusion, in the broader perspective of the science-society relationship, in science cafés processes of deliberation and participation are moderated; science cafés encourage people to engage with research in an informal way. As such science cafés help to take up more active roles in the science-society relationship, as Arnstein has pointed out with her ladder of citizen participation [Arnstein, 1969]. Cafés provide citizens in various roles with insight and more confidence about science and technology issues and provide more possibilities of communication which according to Árnason [2013] is a neglected part in ideas about deliberation and scientific citizenship.

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