"That’s the discussion, that there is too little attention to creativity, etcetera. Well yes, you could also direct the neurosciences towards that, only it’s not happening right now.”

[educational neuropsychologist]
9 INTRODUCING REFRAMING AS AN APPROACH TO MULTI-STAKEHOLDER DIALOGUE ABOUT NEUROIMAGING

Abstract

Including multi-stakeholder perspectives in technology development in order to contribute to Responsible Research and Innovation (RRI) has proven to be a highly complex undertaking. In a case study about neuroimaging applications in the domain of education and learning, we have designed a deliberative approach that aims to take into account the uncertainty of technology development and plurality of values and expertise amongst stakeholders. Our dialogue session with teachers, potential intermediary parties, neuroscientists and education scientists started with a frame reflective discussion about the definition of good education, followed by a step-by-step exercise in which current societal concerns were “reframed” into areas of desirable research. The process of this deliberative exercise was analysed on the basis of the interaction strategies used by participants during situations of frame conflict. In this article we discuss how the design of the dialogue session contributed to both negative and positive discursive outcomes.

9.1 Introduction

In past years, increased attention has been paid to pluralism and reflexivity in the governance of science and technologies (Stirling, 2007) in the context of Responsible Research and Innovation (RRI) (Owen et al. 2012; Schomberg, 2012). However, inclusion of stakeholder views in scientific and technological development has proven to be challenging due to a number of issues, including but not limited to, the following. First, new technology is subject to the Collingridge (1981) dilemma. Issues relating to new technologies are complex and fraught with factual uncertainty, making it difficult to find the right moment for public engagement. In an early phase, the
effects that a technology will have are unknown, nor is it possible to estimate how society will evaluate these effects (Rip, 2012). During this ‘technical phase’ it is also much more difficult to find stakeholders willing to engage in a deliberation on the technology (Collins et al., 2010). In later phases, the effects of a technology become more clear, but its trajectory is more entrenched and thus more difficult to influence (Collingridge, 1981). Second, new technology is subject to conflicts over values, which are difficult to resolve (Stern et al., 2009). Third, it is complex to design a process in which scientific and societal stakeholders discuss, as equals, the applications of technology. This occurs when some parties are experts with regard to the technology, but often know little about the domain of application, while others are experts with regard to the domain of application, but have limited knowledge of the technology.

Ever since the ‘decade of the brain’ from 1990 to 2000, neuroscience has become a booming business, marked by an increase in the visibility of studies of the brain, behaviour and mind, and an explosive growth in the number of scientists identifying themselves as neuroscientists (Jones & Mendell, 1999). Knowledge of brain function has possible implications for many different domains, including the practice of education, the focus of this chapter. This led to the establishment of new journals such as *Mind, Brain and Education* in 2007 and *Trends in Neuroscience and Education* in 2012. Our case study is specifically about neuroimaging. Neuroimaging technologies such as functional magnetic resonance imaging (fMRI), computed tomography (CT) and electroencephalographs (EEG) contribute to our understanding of neurological processes in brain development and learning. Applications in the practice of education can be envisioned in the form of integration of general insights from neuroimaging into education research (Spitzer, 2012), such as the identification of “critical periods” for optimal learning (Hüsing et al., 2006). Furthermore, individual applications can be imagined, for example in the identification of children at risk for developmental dyslexia (Raschle et al., 2013). Some imaging experts believe the technology has the potential to ‘read minds’ to some extent (Wardlaw et al., 2011).

The possible future applications of neuroimaging in education literally cut to the core of what it is to be human, with many social, ethical and legal considerations that need to be taken into account (see for example Hardiman et al., 2011; Hruby, 2012; Maxwell & Racine, 2012; Sheridan et al., 2006; Zocchi & Pollack, 2013). However, the technical and social contingencies of these applications promote the dimension of
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being an “intractable” (Schön & Rein, 1995) or “wicked” (Rittel & Webber, 1973) issue. Education is a practice that lays the foundation for children’s lives in terms of knowledge, beliefs, attitudes, and well-being, issues clearly subject to value plurality (Sheridan et al., 2006). At the same time, the field of educational neuroscience is in an early phase, and future applications are uncertain (Wardlaw et al., 2011), the spanning of the two fields often being called “a bridge too far” (Ansari et al., 2011). This means that applications of neuroimaging are still a vague idea for most societal stakeholders, as well as it being a topic with which many do not feel a need to engage with yet. However, as Howard Jones (2011) and Leschner (2005) argue, this is not an argument for dismissing a science-society partnership around neuroeducation, but rather a reason for working on it. The project “Neurosciences in Dialogue”, of which this study was a part, has the ambition to contribute to the socially responsible research and innovation (RRI) of neuroimaging in education, by facilitating dialogue between stakeholders from science and society. In this article we share our experience in managing some of the complexity described above in the design and implementation of a dialogue event that aimed to contribute to the reflexivity and mutual understanding between different stakeholders.

9.2 Considerations for dialogue

In order for this dialogue to contribute to RRI, we have taken into account a number of considerations with regard to its design. Firstly, as Pereira (2006) argues, the main challenge in attempts to integrate scientific and societal knowledge is “on one hand, the creation of spaces for knowledge representation and mediation, and, on the other hand, the creation of spaces for knowledge coproduction” (p.40). In the interface between science and society, knowledge integration and assessment often takes place within the framework of research, in which knowledge is represented and shared using scientific concepts and tools (Pereira & Funtowicz, 2006). We aimed, however, to create an environment where all participants can discuss the application of the technology on an equal basis, despite their differences in expertise. This means that the discussion should be accessible to all participants without having in-depth knowledge of the technology and that the deliberation should not be restricted to technological frames of neuroscience applications. At the same time, it is necessary to achieve a balance in paying attention not only to the technology’s pitfalls and risks,
but also to its advantages and benefits. As Williams (2006) argues, this includes the experiences of scientists, who “may not recognize themselves, their imputed authority and goals in some of the more demonized accounts of the emerging of the field” (p. 342). This was also deemed important in regard to false expectations of neuroscience and “neuromyths” present among the public (Pasquinelli, 2012).

This brings us to our second consideration, namely, how to mediate between value differences while simultaneously integrating different types of knowledge. In chapter seven we have argued that stakeholder engagement with such a complex issue cannot be solely done on the basis of values because values do not stand alone as they always relate to a particular aspect of the issue and are relative to other values. For example, in the statement ‘neuroscience research is more objective than other forms of scientific research because you look directly at the brain’, the argument structure is based on what is considered important and relevant to this complex problem. This is what Schön and Rein (1995) would call the “framing” of a controversy. Frames are “the underlying structures of belief, perception and appreciation” which “define the boundary between evidence and noise” (Laws & Rein, 2003, p. 23), noise being all aspects of the issue that are not considered important.

Dewulf and Bouwen (2012, p.176) have created a typology of interaction strategies people use when encountering differences in issue framing identifying five ways in which people “do differences”: frame incorporation, frame accommodation, frame disconnection, frame polarization and frame reconnection, as shown in table 9.1.

These different interaction strategies all have different implications in the managing of favourable and unfavourable discursive implications (Dewulf & Bouwen 2012, p. 186), and thus for the outcome of the dialogue meeting in terms of mutual learning. Wynne (1993) argues that scientists can have difficulty being reflexive towards public framing, showing considerable resistance to recognizing and reconsidering the values and beliefs that structure their scientific discourses. It would therefore be beneficial to design dialogue in a way that encourages reflexivity and positive interaction strategies amongst participants.
Introducing reframing as an approach to multi-stakeholder dialogue about neuroimaging

Table 9.1. Overview of interaction strategies (from Dewulf & Bouwen 2012, p. 179)

<table>
<thead>
<tr>
<th>Type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame incorporation</td>
<td>Incorporating a downgraded reformulation of a challenging element into your own issue framing</td>
</tr>
<tr>
<td>Frame accommodation</td>
<td>Accommodating your own issue framing to the challenging issue element</td>
</tr>
<tr>
<td>Frame disconnection</td>
<td>Disconnecting the challenging element from the ongoing conversation as irrelevant, unimportant or the like</td>
</tr>
<tr>
<td>Frame polarization</td>
<td>Polarizing the difference by reaffirming your own issue framing or an upgraded version of your own issue framing</td>
</tr>
<tr>
<td>Frame reconnection</td>
<td>Reconnecting frames by taking both elements seriously and taking away the incompatibility between them</td>
</tr>
</tbody>
</table>

These considerations have guided the development of our dialogue design. In order for the dialogue to be accessible for all parties present and to disconnect from research-based framing, we decided to take societal concerns with regard to neuroimaging as a starting point. In order to keep the different perspectives balanced and contribute to the coproduction of knowledge, these societal views were used as a platform on which stakeholders built a shared research agenda, which served as a space for knowledge integration. In order to overcome mutual assumptions and problematize technocratic frames that may prevent deeper reflection (Escobar, 2014), this was done within a frame-reflective approach.
Chapter 9

9.3 Methods

9.3.1 Preliminary research

In designing a dialogue process, pre-engagement is important in order to acquire an understanding of the emerging technology and its dynamics, as well as the various expectations with regard to development and application of different stakeholders (Te Kulve & Rip, 2011). The dialogue sessions we describe are part of an on-going project that started in 2010, consisting of three iterative phases. The first, exploratory phase included an exploration of relevant neuroeducation literature, exploratory interviews (n=6) and two expert discussion sessions with neuroscientists (n=11). This was done in order to gain insight into existing guiding visions about desirable future applications that shape technology development. From this data we identified two major visions for the application of neuroimaging for education: (1) to generate general knowledge about brain processes that could inform the educational practice, and (2) to be able to better respond to individual learning needs with the help of individualized neuroimaging (Edelenbosch et al., forthcoming b & Edelenbosch et al., forthcoming c, see also chapters seven and eight).

In the second phase, we conducted interviews with neuroscientists and potential “intermediary parties” about the opportunities and barriers for neuroeducation research and implementation (Edelenbosch et al., forthcoming a, see also chapter six). In addition, we conducted focus groups with teachers and secondary school students. The analysis of these focus groups lead to the identification of different participant frames with regard to the value of evidence of neuroimaging in a school setting and the use of neuroimaging for personalized learning (Edelenbosch et al., forthcoming b & Edelenbosch et al., forthcoming c, see also chapters seven and eight).

In the final phase, these findings were incorporated into a frame-reflective dialogue meeting, consisting of different parallel sessions. Dialogue is more effective when all participants have had the opportunity to form an opinion beforehand (Betten et al., 2013), so we sent invitations to people who were previously involved in our project as focus group participants or as interviewees. At this stage we specifically asked scientists and teachers to participate in a dialogue as producers and end users of neuroimaging respectively. In addition, we invited intermediary parties, or education
professionals with an interest in the brain already playing an intermediary role between neuroscience and educational practice\textsuperscript{20}, to participate as bridge builders. Eight teachers, seven intermediary parties, seven education scientists and six neuroscientists were willing and able to attend the meeting. However, due to non-shows this led to a final attendance of three teachers, five intermediary parties, four education scientists, and four neuroscientists. An overview of participants is provided in table 9.2. One week before the meeting, all participants received a report with a brief description of the results of the interviews with neuroscientists and intermediary parties and an outline of the dialogue session. We did not offer any kind of compensation for attendance.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Registered</th>
<th>Attended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Intermediary parties</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Education scientists</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Neuroscientists</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

\textbf{Table 9.2. Overview of invited participants}

\subsection{Dialogue design}

The dialogue meeting was designed based on the idea of frame reflection. The program lasted for three hours and consisted of two components: (1) a short exercise in which participants were introduced to the different framings of other parties, (2) a reframing exercise in which the participants worked towards a new and integrated frame. These two components will be described in more detail below.

The goal of the first exercise was to warm up within a safe environment, to introduce the participants to others within their own stakeholder group, and to give a quick overview of the similarities and differences in the views on education of the different stakeholder groups, in order to contribute to the reflexivity of the stakeholders. The participants were split into four groups based on their background and asked to make a poster together to illustrate how they conceptualized ‘good education’. The broad

\textsuperscript{20} In chapter six, intermediaries have been referred to as “education professionals”.

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question ‘what is good education’ was deliberately posed in order to give the participants the freedom to express everything they considered to be important to education. In the end, representatives from the groups had one minute to briefly present the posters. Following these short presentations, the main facilitator summarized the similarities and differences between the results of the different groups.

The goal of the second exercise was to create a space conducive for identifying desirable applications of neuroimaging that were in line with the different perspectives present at the table. We started from three key concerns expressed by societal stakeholders in the previous research phases. As Te Kulve and Rip (2011) argue, in the facilitation of deliberations between stakeholders it is necessary to reduce some of the application’s complexity posed by uncertainty and ignorance. These concerns were therefore translated into three statements, and all highlight one specific aspect of the application of neuroimaging to education:

1. Neuroimaging is not desirable because it contributes to the individualisation of the learning climate;
2. Neuroimaging puts too much emphasis on the maximisation of the learning achievement of a child;
3. Neuroimaging cannot contribute much to education because it reduces a child to his or her brain.

These statements are all negative; however we will demonstrate that this actually functions as a way to open up the discussion in a subsequent step. The participants of the session were reorganized into three groups so that all stakeholder backgrounds were represented in each group. In order to contribute to the reflexivity of the participants, we first asked participants to place themselves in the shoes of people issuing this concern and to create a map of underlying ideas they thought could contribute to this idea. This included ideas that could be considered to be “neuromyths”. This step was based on Benammar’s approach to ‘reframing’ (2012) as a way in which stable ideas can be adapted to change. According to Benammar, in order to push beyond fixed frames and underlying presuppositions, it is necessary to “make a move” and somehow fully detach from this idea. We interpreted his approach as follows: after making a map of ideas underlying the statement, the
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The facilitator asked the participants to turn these presuppositions around, formulating their grammatical opposites. For example, the opposite of the idea ‘neuroimaging is only a snapshot in time’ would become ‘neuroimaging is not only a snapshot in time’. This intermediary step led to the final part of the exercise, in which participants identified ways in which research could contribute to or enable this new, reframed idea, which could be research that provides more insight into brain development over time.

In order to flesh these research ideas further, the facilitator then asked the participants to what extent this kind of research was already being conducted, and if not, what would be necessary to make this kind of research possible. Instead of aiming to reach convergence of ideas, this exercise focused more on divergence or thinking “out of the box” with respect to desirable applications of neuroimaging.

At the beginning of the meeting, the participants were asked for permission to record the session and informed that their input would be treated anonymously. All sessions were transcribed verbatim. These transcripts were summarized into a 12-page report, and participants were invited to provide any necessary feedback. The discourse used by the participants during the dialogue session was analysed and assessed for differences and similarities in the framing of “good education” and issues contributing to the gap between neuroscience and educational practice. The transcripts were coded and discussed by the first and second author. Broader analytical categories, based on patterns emerging from the data, were constructed based on frame differences and similarities and the barriers and opportunities mentioned. The final part of the session, in which participants discussed a research agenda that might not contribute to the societal concerns identified, was examined for potential building blocks for an integrated frame. The second reframing exercise was also analysed with regard to the processes within the sessions. To this end, Dewulf and Bouwens’s (2012) typology of interaction strategies in frame differences was used as a coding guide. The interaction strategies used by participants were taken as a measure of frame reflexivity. Finally, the different strategies employed were related to variables within the three different sessions.
9.4 Results

In this section, we first show how the different stakeholder groups framed good education. Next, we give an overview of the different interaction strategies the participants used in their engagement, with the three statements based on concerns within society, about the application of neuroimaging to the domain of learning and education.

9.4.1 “Good education”

Frame differences emerged during the initial discussion of “good education”, and relate to the way participants conceptualize learning, teaching and structures and goals of education. The neuroscientists focused mostly on the conceptualization of learning, which was described as a life-long process, and argued that teaching methods should be adapted to the students’ age and learning possibilities. According to them, the challenge within education was to facilitate learning in such a way that individuals’ capacity for personal reflection is enhanced so they can learn by themselves.

The group of education researchers concentrated more on the goals of education, which they argued was to provide children with the tools with which they can thrive within the culture of our society. In order to achieve this, they discussed the importance of evidence based education in which teachers have an understanding of how learning works. This way they are capable of adapting teaching methods to the needs of individual students.

The teachers placed the student more at the centre of their discussion, stressing the importance of paying attention to both the children’s’ school and home situation. They defined the goal of education as being the schooling of critical and curious students, and to achieve this, an atmosphere must be created in which a child can make mistakes and ask questions. To them, education is not only about achievement, but also about creating a safe and enjoyable environment in which a child can flourish.

Finally, the group of intermediaries described learning as a personal journey of discovery for both the child and the teacher. Students need space to follow their own
path, and education can assist them in this by offering structure, direction and supervision. This means that a range of methods and resources should be available to challenge each individual child.

We see that with the exception of teachers, all parties described personalized learning as being important. However, when we compare these four constructions of what entails “good education” we also see that participants define elements in different ways and bring other elements to the fore within their storylines. The neuroscientists focused mostly on what learning should be, while education scientists were more interested in the way in which research could contribute to schooling children capable of success within society. The teachers brought the experience of the child to the fore, and the intermediaries focused most on how education could facilitate the learning of each individual child.

9.4.2 Interaction strategies for doing differences

In the second part of the dialogue session, participants reflected on underlying ideas about the application of neuroimaging to the practice of education and how they could contribute to the three statements about the desirability of neuroimaging. The results presented here are the strategies participants used in interaction with the three statements and each other’s arguments, using the framework of Dewulf and Bouwens (2012) as a starting point. Situations of frame conflict we have identified provide deeper insight into how these interactive strategies contributed to both negative and positive discursive outcomes.

**Neuroimaging is not desirable because it contributes to the individualization of the learning climate**

Participants had no problem identifying ideas underlying this statement, but constantly formulated arguments against these ideas. We identified instances of frame incorporation, frame accommodation and frame disconnection.

*Frame incorporation.* A central question discussed was whether the quality of education is determined by the process or by the outcome of learning. The participants in this group, for instance, argued that “collectivity” or being part of a
group and learning to work and learn from each other, can in itself be seen as an important goal of education. However, this statement was called into question by one of the intermediaries, who incorporated the element of collectivity into her own frame but gave it a different meaning, as a barrier to achieving “efficient learning”. The discussion that followed from this proposition demonstrated that framing of the goal of education differently has implications on many levels, including the understanding of the role of teachers in schools and the prediction of consequences of applying such a technology to education. One intermediary party, a curriculum developer, argued:

“I go to a lot of places where teachers consider teaching children to work together in a group as their most important job (...) So they see that within the classroom… the group feeling is the most important learning goal in a school. The moment you reduce a teacher to only… the place where you can learn language and math, then collectivity is not a goal anymore.”

She argued that when teachers are facilitators of efficient learning, they become more or less obsolete, especially in the context of digital learning. In this view, it is not the technology of neuroimaging that makes the teacher unnecessary, but the general way of thinking in terms of learning efficiency that neuroimaging and educational neuroscience is grounded in. The intermediary did not agree with this, arguing that personalized learning plans would require more teachers, although their role would change. With this argument, she included the teacher’s role in her frame but used it to bypass the argument of collectivity as an educational goal. We see here that integrating elements of one frame into another frame can obscure difference in argument, and circumvents one of the major questions for educational practice: the function and goal of education and teaching. In the end, the participants went on to another issue, leaving this frame hanging in conflict.

Frame accommodation. Another form of frame interaction encountered during this session was frame accommodation. Participants tried to make their frame acceptable to each other when they worked to find a common definition to a concept central to the statement. For example, the participants discussed the meaning of “individualization” and which aspect of individual learning was deemed undesirable, in order to understand the statement and each other better, and to create room for
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their own idea. Does this concept mean that every child has his own learning plan and thus works mainly alone, does it refer to children working together in smaller subgroups based on their learning level, or can it be defined as the tailoring of a child’s tuition to personal needs? It was for example argued that even in the extreme scenario of all children having a device continuously measuring their learning process, this did not have to be at odds with social interaction. This type of argumentation was beneficial to the discussion as it provided room for both the adaptation of teaching to children’s different and changing needs, and to social interaction.

Frame disconnection. It was not always possible, however, for participants to relate to the underlying ideas they thought gave rise to the given statement, and sometimes it was argued that they were based on misunderstandings and erroneous associations. These are instances of frame disconnection. For example, one of the neuroscientists argued that the underlying fears expressed in this statement had nothing to do with the technology of neuroimaging. Rather, the technology of neuroimaging is inadvertently connected to on-going discussions in the Netherlands about the individualization of education, which is already taking place in the context of digital classrooms. This participant argued that society automatically associates neuroimaging with these developments because the brain is viewed as something inherently individual, even though neuroscientific research provides general insights based on large sample sizes.

A second way that participants discredited the fear for individualization was by putting it in an historical context:

*Education scientist:* “We had similar discussions in the seventies, when the first computers were put in the classroom. And when there is a computer in the classroom, there is no togetherness.”

*Intermediary party:* “Probably it was the same when the first books came. (...) But well, that is fear, and fear rules society, and also the classrooms.”

It was argued that this type of fear is nothing new, has been overcome in the past and therefore should not receive too much attention in the present. Using this argument, participants do not engage with the statement itself, but focus on the irrational fear within society that gives rise to this statement, invalidating the entire discussion.
Neuroimaging puts too much emphasis on the maximization of the learning achievement of a child

Especially during the first part of this session, participants continuously disconnected from the ideas underlying the given statement, sometimes leading to instances of frame polarization. However, in the second part, in which participants had to come up with new research ideas based on the reframed ideas, steps were made towards the reconnection of framing differences. We start with a description of frame conflicts and end with an analysis of how this was partly resolved in the second part of the session.

Frame disconnection. Two participants in particular, a neuroscientist and an educational neuropsychologist, did not seem willing to connect to the statement. These two participants disconnected from the statement in four ways. First, they started from the assumption that ‘the maximization of learning achievement’ was the goal of education and as a result they could not relate in any way as to why others would frame this as a problem. The counterargument given by other participants, that the ends of education are not a given, and that there is a difference between educating a child to go to university and helping a child with his or her development, was met with incomprehension. Second, when the teacher in the group argued that this focus on maximization could be thought to lead to the stigmatization of individuals with lesser intellectual capacities, the education psychologist argued that this issue had nothing to do with neuroimaging. The following discussion evolved:

Teacher: “But that will create resistance among people that just don’t think it is right. There are people that are intelligent and people that are not intelligent. And there are all kinds of intermediate variations, and that is the way it should be. (…) This is a presupposition [speaks slowly, addressing the educational neuropsychologist]. Do you know what a presupposition is? An idea that is not based on facts. So for just a short while, you have to let go of these facts.”
Education neuropsychologist: “I can’t… well, all right…”
Intermediary: “Is it that you don’t believe that anyone would think this?”
Education neuropsychologist: “Well, I don’t understand it.”
Neuroscientist: “No, I don’t understand it either. I don’t understand what’s behind this.”
Third, the two scientists considered it more important to discuss why somehow all the available knowledge about the brain has not been applied within education and both participants continuously tried to redirect the discussion to the topic of barriers in connecting research to practice. When the teacher argued that a possible barrier to the uptake of new knowledge with education could be that education practitioners do not want to be part of this optimization culture, this was not accepted by the scientists. Fourthly, as also seen in the first session, the participants disconnected to the statement by irrationalizing the represented fear, referring to examples in the past of technology giving rise to ungrounded concerns. The underlying ideas were written off as neuromyths, miscommunication and ignorance.

**Frame polarization.** During this session frame polarization was identified in the comparison of education with health care. The neuroscientist used this analogy several times during the focus group:

“**So then health is something we should not desire. Or are people allowed to be sick? Is that ok? The medical science only wants everyone to be better.**”

In response to the underlying concern that neuroimaging developments could be perceived to increase the differences between people, he argued:

“**Yes, but that is also the danger of medical science, you create a divide: sick people and healthy people**”.

When the teacher then argued that some people are simply less intelligent than others and that focusing on intelligence in this way was not desirable, he gave the following response:

“**But there are people that are ill and others that are less ill. Well, then medical science should just stop.**”

This argument was repeated three more times in different ways. When the teacher argued that health and education were different fields because individuals can be judged on the basis of their intelligence level, the same participant replied that this was “a convoluted argument”, without engaging further with the argument.
interaction strategies hampered the possibilities for frame reflection and blocked a mutual learning process. The other participants appeared frustrated on the one hand, trying to give counterarguments in line with the statement, but on the other hand we also saw that nobody was willing to express their personal agreement with the statement, as evident by this teacher’s response to the facilitator’s summary:

Facilitator: “I wrote down something you said. That neuroimaging, the idea that the application of neuroimaging can lead to striving…”
Teacher: “No, I don’t agree with that at all. I don’t want people to think that I would agree with that. I am only trying to explain where the idea is coming from.”

Frame accommodation. Besides the frame conflicts previously described, there were also some instances in which the participants came closer to the presented statement by separately discussing the elements within the frame. One of the underlying ideas discussed at the table was the fear that children will be determined by the information neuroimaging can give about the brain’s potential development. One of the educational neuropsychologists acknowledged this idea but argued that it is based on misrepresentations in the media. He cited examples of slogans like “we are our brains”, giving the impression that brain development is fixed, while neuroscientists have been discovering “that the opposite is the case”. Here he takes the key issue of determination, and shows that because the brain is plastic, neuroimaging can actually contribute to unleashing its potential, thereby making his framing acceptable to the others. The difference of this type of frame interaction with the previous disconnections and polarization is that in this instance, the other’s frame is engaged with by taking it apart into different elements, one of which is argued to be based on a misunderstanding.

This taking apart of the different elements of the frame also created room for a scientific argument to be countered. After the educational neuropsychologist claimed that one of the biggest neuromyths is that a person can be reduced to his/her molecules, a discussion followed about the extent to which there are biological determinants for brain function. The teacher asked questions about brain differences between hetero- and homosexuals, and the scientists at the table told them that there are indeed differences that are anatomical by nature, and therefore they cannot be
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changed by nurture, which was compared by the neuroscientist to the “growing of legs”.

Neuroscientist 1: “Yes, but well, it’s the same with someone without legs, that if he tries to walk a lot, he can grow them. That is of course impossible. These are just the parameters you have to work with.”
Teacher: “But you have to make very clear to what extent this is changeable or not. If I look at society, the discussion about criminality, etcetera. Then I would say yes, partially, aggressiveness is innate, it’s part of your personality. But that doesn’t mean that you are aggressive, that you display aggressive behaviour.”
Neuroscientist 2: “Moreover, it’s the case that... There is a large misunderstanding about genetics. You get handed this [gene set], that doesn’t mean that it cannot change. Even things that are 100% hereditary can be changed.”
Educational neuropsychologist: “The only thing that heredity determines is the range of things you can determine with upbringing, etcetera. But for a number of human characteristics genetics fixes the upper and lower boundaries to some extent. But it is your upbringing that determines where you end up.”

This led the teacher to insist that it has to be made clear to what extent the brain is plastic, because it was evidently not that black and white.

Frame reconnection. During the third step of the exercise, in which participants were asked for neuroimaging research possibilities that would contribute to the reframed issues, some common ground was found in spite of framing differences. For example, one of the underlying ideas identified was that neuroimaging contributes to a narrowly defined form of intelligence based on certain indicators in the brain. One of the neuroscientists came up with the following solution:

“That means [we need] research into the influence of curiosity, creative thinking and those kind of processes in learning. But well, that is part of natural learning, but then the definition of learning becomes different than the one we use here. That’s the point.”
To this, the educational neuropsychologist who had previously only disconnected from the statement responded:

“That’s the discussion, that there is too little attention to creativity etcetera. Well yes, you could also direct the neurosciences towards that, only it’s not happening right now.”

This shows some degree of understanding occurred during this reframing exercise. The participants agreed that intelligence and learning should be defined more broadly within research to include curiosity and creativity in order to make mutually acceptable what it is that we want to understand about the brain.

**Neuroimaging is not desirable because it reduces a child to his/her brain**

Compared to the other two sessions, during the third session participants tried to think more within the given frame, without trying to give too many counterarguments from their own frame. Only instances of frame accommodation, integration, and reconnection were identified.

*Frame accommodation/integration.* Participants argued mostly by making use of the words: “if you think this, then...” followed by an analysis of how the different elements in the frame could be defined. For example, one educational neuroscientist pointed out that the statement conveys the image that neuroimaging is a method that stands apart from other types of research. He asserted that without contextualizing fMRI results within a broader research domain, it can be argued to reduce a child to his/her brain. However, in the perception of the scientists, neuroimaging is one of the many perspectives or methods of research contributing to insights into learning.

During the exercise participants were mostly busy with a conceptual analysis of the statement, slowly untangling the complexity of the issue. This way of separately identifying and defining the different elements in the frame seemed to be beneficial to the proceedings of the session, as nobody seemed to have a vested interest in convincing the others of their truth. The participants discussed the input-output relationship between a child and the results of his/her brain scan. They indicated that this makes people fear the approach of the subject as “an excel file” or a “blueprint” with a number of characteristics, negating the child’s “heart and soul”. The
neuroscientists also expressed their doubts about whether the complexity of the brain can be captured with a brain scan. Furthermore, this group also addressed the fixed view of brain development present in the idea of locating brain functions to specific areas in the brain.

Frame reconnection. Participants were able to learn from each other’s way of framing the benefits of individual versus general insights. At one point, they discussed how neuroimaging “reduced a child to an average brain”. It became clear that, because they were more interested in individual variation, the neuroscientists perceived the fact that neuroimaging measures common factors within large groups as a weakness. Educational practitioners, however, were not interested in knowledge about individual children, as argued here by one of the intermediary parties:

“I can really imagine that teachers become unsettled by the idea that in the future we might be able to measure and know what goes on in the brain. (...) If he has 32 [students] (...) The strength of a good teacher is that he just senses what a student needs, without having to factually know the truth. Because of the journey of discovery that education is.”

Rather, they were looking for insights into how to improve general teaching methods. One of the neuroscientists then started mediating between these two frames:

“It’s really nice, that you both say... you see it as shortcoming, this average, but you see it as a benefit for the education world, (...) you need to know what is good for an average class.”

He pointed out that there was apparently more common ground between neuroscience and education than previously thought, and that individual scanning was therefore not necessarily desirable in the context of education.

9.4.3 An integrated frame for RRI research

In the final phase of the dialogue session, the participants discussed ways in which neuroimaging research can be conducted that may address the societal concerns identified. These discussions served as building blocks for an integrated frame for neuroimaging research. This integrated frame starts from a broad definition of
learning to include, for example, creativity, curiosity, motivation and social processes, and therefore neuroimaging research should pay more attention to these aspects of learning. Neuroimaging researchers should strive to generate general insights that contribute to learning, as this would be most useful within practice, and research into differences puts emphasis on differences. If we want neuroimaging to contribute to personalized learning, this should not refer to an education system in which children learn alone, but to a classroom in which children receive the best education for their needs, which includes learning from others. In order to prevent individualized neuroimaging leading to individualized learning, neuroimaging research into social learning should be put on the top of the research agenda. Furthermore, because the brain is plastic, research subjects should be scanned at different moments in time if we want to be able to say something about learning. However, as the brain is plastic only to a certain extent, the plasticity of the brain should not be used as an argument to stop deliberating how research can be conducted taking into account societal concerns about privacy and discrimination. Finally, neuroimaging is just one of the tools available to researchers, offering one perspective on learning, and neuroimaging findings should be viewed as one part of a complex scientific argument. Therefore, it is important that neuroimaging research is not seen as the golden standard within research, not by educational practice, not by education or neuroscience researchers (and students), nor within policy.

9.5 Conclusion and discussion

As is clear from the interaction strategies that were identified during these three dialogue/frame reflection sessions, the sessions were quite different. In the first group, participants were able to construct underlying ideas that could give rise to the statement, but the session was less constructive because some of the elements causing fear were not deemed relevant or not taken seriously. In the second group participants employed interaction strategies that lead to the least favourable discursive outcomes, less learning, and some frustration among participants. The outcome of the third group was more favourable, the energy was high and the participants were able to learn from each other’s perspectives. Variants to the process were a different statement and a different composition, which could have affected the outcome. These factors will be discussed below.
First, the three statements were different. It is possible that participants were able to relate more to the third statement about the reductionist potential of neuroimaging more than to the other two statements because this statement was more in line with their own concerns and frames. Participants were randomly assigned to a statement and some of the participants in the second group made it apparent that they would rather have discussed one of the other two topics. However, as all three statements were constructed on the basis of societal concerns, they all deserved to be discussed. These results only reflect the extent to which frame differences exist between scientific and societal stakeholders and reveal the importance of these deliberations.

Second, even though participants from the different stakeholder groups were equally distributed amongst the groups, we experienced interaction between the participants as being quite different in the three groups, leading to different group-dynamics. Because there was only one teacher within every group, the way in which that particular participant was able to voice his/her opinion and contribute to the discussion was very important. In the first groups the researchers were quite dominant, and discussions were often about technical possibilities of neuroimaging, with the teacher and intermediary parties mainly asking the researchers questions about the state of neuroscience research. In the second group we observed that two dominant researchers were able to build on each other’s views, which clashed with the perspective of the rest of the group with less scientific expertise. In the third group, the contribution of the participants was more equal. This experience demonstrates the importance of carefully considering the composition of the session in order to achieve an equal balance between different stakeholders. However, participant interactions are complex and not always predictable. With respect to the validation of research results, the best approach to this issue is to conduct multiple sessions about the same topic with different compositions if conditions allow.

How can we measure the success of this dialogue and what can RRI take home from this experience? We used DeWulf and Bouwen’s (2012) typology of interaction strategies to gain insight into how our dialogue approach contributed to frame reflection. The strategies identified cannot be seen as a way of evaluating the frame reflective approach used, and we have seen that the three sessions had very different outcomes. We can, however, learn from the dialogue process.
We reasoned that the benefits of this exercise design could be fourfold. First, by taking this societal view as the central issue in the discussion, the concerns are taken more seriously and all participants would be better able to contribute to the discussion equally. Second, by asking all participants to place themselves in the shoes of someone issuing this statement, reflexivity of all parties is promoted. Third, the conflicting frame is made less personal by the introduction of a ‘virtual participant’, meaning that simultaneously no one and everyone takes ownership of this view, contributing to mutual trust. Fourth, instead of focusing on areas of frame conflict, participants are able to integrate their frames by working on shared desirable applications outside of this area.

We experienced some participants having difficulty placing themselves in the shoes of the virtual participant. It is possible that a virtual participant is not authentic enough to carry a frame by his/herself, and this could have been avoided if more stakeholders representing the view expressed in the statement had been invited, including parents and students. Because the virtual participant was not able to talk back, the framing represented could be taken less seriously. The teachers, who were in a minority, were the only participants who were also part of the focus group on which these statements were based. We witnessed that in response to dominant researchers representing another view, the virtual participant offered them the possibility to distance themselves from the frame, arguing that it was “society’s” perspective rather than their own.

As suggested by DeWulf and Bouwen (2012), doing differences in a constructive way puts high requirements on both facilitators and participants, because differences emerge at any time and decisions on how to approach them have to be made within the moment. Although the method presented has its caveats, we have shown how a transparent step-by-step process facilitated by an experienced facilitator offers participants a way of untangling some of the complexity encountered when deliberating on desirable future research. By defining and reflecting on which aspects of innovation participants can and cannot connect to and why, reflexive insight is gained by stakeholders into frame differences but also into frame similarities. In addition, we have seen that this process can facilitate the formulation of ideas for research outside areas of frame conflict, which can contribute to more responsible research and innovation. A next step in this transparency, which could be
experimented with in future RRI research, could be to make these discursive strategies
to doing differences explicit with the participants during dialogue, making clear when
frames are being disconnected or even polarized.