CHAPTER SEVEN
Neuroimaging and personalized learning: reflections with societal stakeholders

“The scan must know if a child can learn, can talk, can think, can love, can believe, can do, can be creative, unconscious reactions, can do something and can want something. A scan cannot do that. I don’t believe a word of it. (...) All these things, are the essence of a human. A machine cannot do that, in my opinion.”

[parent]
7 NEUROIMAGING AND PERSONALIZED LEARNING: reflections with societal stakeholders

Abstract

The emerging technology of neuroimaging may contribute to personalized learning, the adaptation of teaching methods to individual learning needs. In order to proceed with this application in a socially responsible way, it is necessary to carefully consider the practice of education during the innovation process. In this chapter we discuss the results of focus groups in which we reflected on the opportunities and concerns regarding this application with a selection of societal stakeholders: three focus groups with randomly selected parents of one or more children attending secondary school, three focus groups with randomly selected secondary school teachers and four focus groups with secondary school children attending one particular school. Our analysis shows that a different framing of ‘the learning child’ and ‘neuroimaging’ can lead to a different attitude towards the application of neuroimaging for personalized learning. It is important to anticipate on these different framings in subsequent structuring of science-society dialogue.

7.1 Introduction

The field of neuroscience has developed rapidly the past decades, particularly with regard to neuroimaging. This emerging technology has given rise to potential application to many different domains, including the domain of education. Educational neuroscience or ‘neuroeducation’ offers many possibilities for improved learning, but also meets several concerns, in relation to for example commercial promises (Hardiman et al., 2011) the responsibility of teachers to be critical consumers of neuroscience (Hardiman et al., 2011; Maxwell & Racine, 2012), and the sensitivity of neuroimaging data (Heinrichs, 2011). Ethical issues have been discussed extensively,
for example in a special issue of Neuroethics (2012) focusing specifically on neuroeducation.

An important emerging feature of Responsible Research and Innovation (RRI) is moving beyond conventional ethical review and approval of research, to the institutionalization of research that is inclusive, involving stakeholders in an early stage, and value-sensitive, incorporating multiple values and perspectives (Owen et al., 2012). Researchers within the field of neuroeducation are becoming increasingly aware that this calls for new approaches to ethics, but the facilitation of such an approach can be considered a challenge. First of all, there are many publics and many values that need to be considered. Education in itself is an enterprise with its values in “perpetual dispute” (Sheridan et al., 2006). The field of neuroeducation involves even more different stakeholders; each with their own deeply rooted values and perspectives. These include, but are not limited to, scientists from different disciplines, policy makers, educational developers, teachers, students and their parents. As shown by Bohman (1996), it is difficult for different stakeholders to come to a consensus because the values that underlie ethical discussion cannot simply be negotiated or traded off, as that would compromise the stakeholder’s integrity. Second, the ethical complexity regarding the application of neuroimaging to education is enhanced by the dynamic nature of the application. As with many emerging technologies, neuroimaging is subject to an uncertain future: not only do we not know what potential applications the technology will give rise to, we also do not know the social embedding of these applications (Rip, 2012). Due to the contingency of both the technology and the application itself, the issue cannot clearly be defined and its context is subject to change. These dynamics, together with the value plurality involved, can make it difficult to reach ethical consensus.

As shown by for example Kupper and de Cock Buning (2010), technological controversies characterized by value pluralism and dynamics can benefit from a pragmatic approach to ethics, as monistic approaches fail to grasp the complexity and diversity of real morally problematic situations. The authors argue that the intrinsic nature of the value underlying a moral claim does not determine the “rightness” of that claim. More important is the extent to which it contributes to the resolution of specific morally problematic situations. According to Keulartz et al. (2004), “the moral core of pragmatism revolves around the possibilities for living and working together”
In order to further this goal of cooperation, the process of moral inquiry and deliberation is very important. It should allow for the contribution of all those that have a stake in the matter and decisions to be made on the basis of a careful consideration of all relevant conflicting moral claims (Keulartz et al. 2004).

With the research project Neurosciences in Dialogue, the Athena Institute of the VU University Amsterdam aims to contribute to socially responsible innovation within neuroscience research. We take a pragmatic approach to the ethical issues emerging from the field of neuroeducation, working step-by-step towards the facilitation of dialogue between stakeholders from science and society. In order to facilitate such a process, the following three questions need to be considered: who should be included in such a deliberation, how should this process be designed so that it allows all stakeholders to contribute and how should conflicting moral claims be approached?

The first question is who should be involved in such an ethical deliberation. The role future users can and should play in innovation processes has been receiving more attention in the past years (see for example Oudshoorn & Pinch, 2005; Rohracher, 2003). Racine (2008) argues that within a pragmatic ethical approach to health care, “nurses, social workers and all those who can broaden the ethical perspectives” should be included. Besides scientists and educators, we would stress the importance of including the end-users of this application in this process: the teachers, students and their parents. We agree with Howard Jones and Fenton (2011) that lay people should be included in ethical deliberation so that researchers become aware of public hopes and concerns and do not leave behind human values. Furthermore, we would add that the end-users of neuroimaging have their own knowledge and experience to bring to the table. Not only does their involvement contribute to the fairness of the process of ethical enquiry, they can also improve the products of deliberation by adding knowledge of the contextual aspects of educational practice (Wynne, 1996).

The second question posed relates to how the process can be designed in a way that does justice to different types of knowledge and the contextual interpretations of societal stakeholders. We have decided for an approach in which societal stakeholders reflect separately on neuroscientists’ ideas about future applications of neuroimaging in education. As a starting point, we have followed the example of Roelofsen et al.
Roelofsen et al. started out with the identification of a scientific field's guiding visions, images of the future that scientists consider to be desirable (2010). This approach starts from the assumption that guiding visions guide technology development because they influence the research choices that are made (Grin & Grunwald, 2000). At the same time, they provide a foothold for societal stakeholders' deliberation. By allowing societal stakeholders to reflect on these visions, more insight can be gained into the issues underlying conflicting moral claims.

The third question is how to carefully consider the different moral arguments that are made by stakeholders. For this, we make use of Schön and Rein’s (1995) idea of frame reflection and Kupper et al.’s (2007) interpretation thereof. According to Schön and Rein (1995), difficulties in handling controversy often have less to with how the problem should be solved and more to do with how the problem is set. They argue that different positions regarding an issue arise from differences in underlying structures of belief, perception and appreciation, or “frames”. Kupper et al. (2007) define frames as “the perspectives that actors use to make sense of a complex reality and that guide their actions”. When deliberating about complex or indeterminate problematic situations, stakeholders make a selection of features and relations that are considered important in relation to their own frame (Schön and Rein 1995).

In this chapter we describe the process and results of a deliberation with end-users, societal stakeholders involved in the daily practice of education, on the potential application of neuroimaging for personalized learning in the practice of education. We started with the collection of scientists’ guiding visions for this field, followed by a reflection on these visions with end-users. During this process, we tried to gain more insight into the values at stake by detangling different framings regarding the use of neuroimaging for education. When this application is described as a morally problematic situation, which elements are deemed important and how are these elements interpreted? How does this influence the way in which end-users think neuroimaging should be used in education? By answering these questions, we prepare for a more productive dialogue, necessary for inclusive development and socially responsible implementation of neuroimaging in education.
7.2 Guiding Visions: Neuroimaging and Personalized Learning

In order to determine what future visions to reflect on with societal stakeholders, we organized two discussion sessions with neuroeducation experts from various Dutch universities. During these sessions, the experts discussed which future applications of neuroimaging in education they would find desirable. The visions described by the scientists related to either the use of neuroimaging on a population level, as a tool for gaining more general insight into how the brain works, or the use of neuroimaging on an individual level, to gain more insight into the brains of specific people. The former vision is discussed in more detail in chapter eight of this thesis. In this chapter, we focus on the vision researchers had of a transition of neuroimaging from a population level to the level of individuals, and what that would mean for the field of education. During the expert session, it was discussed that if neuroimaging could be applied in this way, intervention could also take place on an individual level, a form of personalized learning.

In 2008 the Netherlands’ Study Centre for Technological Trends (STT) published the book Brain Visions. In this book ‘personalized learning’ is identified as an important line of future research for the neurosciences, in particular the adaptation of teaching to sensitive periods in the development of children’s brains, the monitoring and assessing of individual abilities, and adaptive cognitive learning systems (Van Keulen, 2008, pp. 260-353). The idea of individualized neuroimaging contributing to personalized learning is also reflected in the Dana Foundation’s Cerebrum, in which experts in brain research present emerging ideas in neuroscience. Here, Gardner and Traub (2010) suggests that:

“in 50 years, our successors will laugh at the notion that there is but a single way to teach and assess. Instead, they will seek the best way to teach this concept or subject to this student and the best way for this student to demonstrate understanding” (pp. 44-45).

This application would be in line with developments of both the neuroimaging technology and the field of education. Neuroimaging holds the promise to contribute to the development of individual diagnosis and personalized treatment, especially in the field of clinical neuroscience (Brammer, 2009; MacQueen, 2010). This could be relevant to the treatment of learning disorders. For example, in dyslexia, the detection
of structural alterations of the brain before a child begins reading could allow for intervention to take place before a dyslexic child starts to get behind in school (Raschle et al., 2011). Furthermore, non-medical examples are also starting to emerge, such as measurement of human ‘brain preparedness to learn’, which could theoretically be applied to education and training (Yoo et al., 2012). At the same time these developments have been going on, personalized learning or tailor-made education has been a trend in the field of education in the Netherlands and the UK, at least for the past decade. Adaptive (digital) learning technologies have the potential to assist teachers in education targeted at students’ needs (The Royal Society, 2011). For example, a recent special issue of Educational Technology and Development (2012) focused specifically on personalized learning.

However, during our expert discussion sessions the idea of neuroimaging contributing to personalized education was a contested ideal. Congruently, a number of concerns were identified in the literature. For example, with regard to personalized education, questions can be raised about the degree of choice and responsibility of teachers and students (Cutler et al., 2007). There is also fear that research about the biological basis of intelligence differences can be misinterpreted as evidence for an individual’s or group’s worth (Gray & Thompson, 2004). Furthermore, the use of neuroimaging technology to generate information about individuals brings on ethical complications of its own, for example with regard to privacy (Heinrichs, 2011).

### 7.3 Focus groups with societal stakeholders

In order to gain insight into these issues from the perspective those involved in the practice of education, we have reflected on the expert vision of individualized neuroimaging and personalized learning with different stakeholder groups. We conducted 10 focus groups with potential end-users: 3 focus groups with randomly selected parents of one or more children attending secondary school at different levels (n=19), 3 focus groups with randomly selected secondary school teachers of different subjects at different levels (n=23) and 4 focus groups with secondary school children attending 5 VWO (n=35), the highest level of secondary education in the Dutch school system. A recruitment agency with a large database in Amsterdam was used to find parents and teachers willing to participate for a small fee (max. 40 euro).
All participating students attended one particular school in Amsterdam, and were selected randomly from four secondary school classes. Students were between 16 and 17 years old. See table 7.1 for an overview of the conducted focus groups.

**Table 7.1. Overview of focus groups**

<table>
<thead>
<tr>
<th>Focus groups</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teachers (120 min): n</strong></td>
<td>8</td>
<td>7</td>
<td>8</td>
<td>-</td>
</tr>
<tr>
<td>M, f</td>
<td>5, 3</td>
<td>1, 6</td>
<td>4, 4</td>
<td>-</td>
</tr>
<tr>
<td>Age</td>
<td>25-58</td>
<td>26-51</td>
<td>27-58</td>
<td>-</td>
</tr>
<tr>
<td>Havo/vwo, vmbo</td>
<td>6, 2</td>
<td>5, 2</td>
<td>5, 3</td>
<td>-</td>
</tr>
<tr>
<td>Subjects (n)</td>
<td>English, art, history (2), theatre (3), Dutch</td>
<td>English, Dutch, Geography (3), physical education, technology</td>
<td>History, French, German, biology, art, technology, social studies</td>
<td>-</td>
</tr>
<tr>
<td><strong>Parents (120 min): n</strong></td>
<td>7</td>
<td>5</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>M, f</td>
<td>3, 4</td>
<td>3, 2</td>
<td>3, 4</td>
<td>-</td>
</tr>
<tr>
<td>Age</td>
<td>32-53</td>
<td>50-58</td>
<td>41-55</td>
<td>-</td>
</tr>
<tr>
<td>Child’s school type:</td>
<td>(vwo, havo, vmbo)</td>
<td>3, 3, 4</td>
<td>3, 2, 3</td>
<td>1, 0, 7</td>
</tr>
<tr>
<td><strong>Students (80 min): n</strong></td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>M, f</td>
<td>3, 4</td>
<td>4, 3</td>
<td>4, 3</td>
<td>3, 4</td>
</tr>
</tbody>
</table>

The focus groups with parents and teachers lasted for two hours. The focus groups with students lasted for 80 minutes, due to time constrictions in their class schedule. All focus groups consisted of two phases. At the start of the first phase, the facilitator asked the participants to write down their associations with “the adaptation of education to individual needs” on post-it notes and made a round to ask participants to explain their writings in more detail, in order to gain insight into the core features of their explanations. These features were written on new post-it notes and clustered by the facilitator on a flip-over. After all post-it notes had been discussed, the participants were asked to name the different categories.
During the second phase of the focus group, the facilitator used a short power-point presentation to introduce neuroimaging as a tool that could be used in the implementation of personalized learning. The participants were asked to make a drawing based on the associations they had with “the use of a brain scan to optimize learning and instruction for each individual child” on a sheet of paper, after which the drawings were discussed. In concurrence with the participants, the facilitator summarized the drawing on a different colour post-it note and added it to the flip chart. Subsequently, the participants were asked to reflect on a scenario that included elements relating to the adaptation of teaching to sensitive periods in the development of children’s brains and the monitoring and assessing of individual abilities by means of a brain scan (see box 7.1). The participants were asked to write down new associations on a third colour post-it note, which was also added to the flip chart. Finally, the participants were asked to write down the conditions under which the use of neuroimaging for personalized learning would be acceptable or desirable. The goal of the second phase of the focus group was to reflect freely on the application of neuroimaging for personalized learning, without being held back by uncertainties and technological limitations.

**Box 7.1. Scenario presented to focus group participants**

Imagine it is the year 2030. John, an enthusiastic maths teacher, has many years experience teaching at a secondary school. At his school, children regularly have a brain scan to (1) determine the child’s learning strategy and (2) assess the degree of brain development. This information serves to adapt the teaching strategy to the individual needs of the student. For example, some children learn more when they receive instructions in a certain way, while others learn better when they find the subject to be very challenging. In addition, children learn at different speeds. The students have a brain scan every three months so that John can adapt the teaching material to what the child needs throughout the year.

Beforehand, all participants were asked for their permission to record the sessions, which were transcribed in full. RE and FK thematically analysed (Braun & Clarke, 2006) the transcripts using Atlas.TI. RE started an iterative process of reading and re-reading, coding, and grouping codes into themes, which were reviewed, defined and
reflected on together with FK. This process led to the establishment of themes in the data relating to the way participants framed “learning”, “the child”, “the brain”, “brain scans” and “personalized learning”. Subsequently, RE and FK constructed a large matrix in which the previously established themes were related back to the storylines of individual participants. This matrix gave further insight into the different patterns of argumentation and how they related to the way participants viewed the application of neuroimaging for personalized learning. In addition, this cycle of interpretation warranted the validity of the data.

7.4 Reflections on personalized learning

Here, we present the results of our analysis of the focus groups with end-users. Generally, the different groups used similar argumentation ways of framing and therefore their reflections are presented together. Where slight deviations or accent differences exist between the groups, they will be discussed later.

At the start of the focus group, the facilitator asked the participants to write down the first associations they had with “the adaptation of education to individual student’s needs”. This exercise showed that many of the participants thought personalized learning was an appealing idea. Possibilities seen by the participants were for example the adaptation of education to the individual’s competences, interests, learning style, learning pace and motivation. According to the participants, these possibilities would contribute to the realization of different values: paying attention to all student’s unique capabilities could contribute to the value of beneficence because learning becomes more efficient, fewer students would drop out of school, and talents would be done justice to. Treating all students in the way that suits their specific condition would contribute to the value of equity.

Differences in position towards personalized learning became visible when, in the course of the focus group, participants’ ideas of personalized learning became more concrete. Participants each had their own vision of how personalized learning would work in practice, varying from changing the entire school system, to more computerized education, to hiring teaching assistants to help regular teachers. Some participants were of the opinion that, although the idea of personalized learning was “wonderful”, it would not be realistic because, for example, “classes are too big” or
“it is outside the comfort zone of teachers”. In this example, the unit of the classroom and the effect on the teacher are important features in the participant’s framing of personalized learning. The idea of personalized learning is “unrealistic” for some participants because it does not fit into their framing of ideal education.

After discussing the idea of personalized learning in general, we introduced neuroimaging as an instrument to help identifying a child’s needs. This made the idea of personalized learning more concrete and intensified the trade-offs participants had to make, bringing differences in framing of certain elements of the application into focus more clearly. In the following sections, we pay attention to two questions central to the participants’ framing of neuroimaging for personalized learning: (1) how to approach the learning child? and (2) what can a brain scan actually measure?

7.4.1  How to approach the learning child?

Three areas of tension were identified in participants’ argumentation regarding how the learning child should be approached. The first relates to the implementation of the values of equity or equality in personalized learning. During the focus groups, participants debated whether all children should be treated equally or unequally, because they all have unique learning needs. A second tension can be seen between personalized learning and social learning, because participants often associated personalized learning with individualized education. Finally, the third area of tension concerns the value of freedom on the one hand, and achievement on the other. Participants deliberated whether the adaptation of education to individual capacities would come at the cost of freedom of choice.

Equity and Equality

During the course of the focus groups, in both the first and the second phase, an argument used by participants was that personalized learning would be tailored to the needs of all children, meaning that all children would benefit. At the basis of this argument are both the principles of equality and equity. Participants who expressed this view argued that everyone is equal as a human being, but at the same time, everyone learns differently. This means that some children are disadvantaged by the
current system: equal treatment leads to inequality. Therefore, children have a right to a more personalized approach, i.e. an equitable approach attuned to their needs.

At the same time, most participants were still of the opinion that all children need to meet the same basic exam requirements at the end of secondary school, mostly because secondary school is viewed as a preparation for the rest of life, teaching children how to function within society. Some participants go a step further in their argumentation: they viewed children as all having innately equal capacities, but needing different learning approaches to reach that capacity. With the following quote, this participant explains that not only do all children have the right to a personalized approach, this approach can also contribute to everyone achieving the same results. The respective teacher here frames the brain as being plastic, a network of pathways that is malleable to a very large extent.

“I think that neurologically, there are already things known, for example about dyslexia. We know that people without dyslexia have a pathway from left to right. A dyslectic person does not have that. But by developing another pathway in neurology, you get to the place that you need to get to, and that is what I like, to be able to do that through neurology. Because then a child can still become professor. Because he learns to go via another pathway. That is a very good development.” [teacher]

**Personalized learning and social learning**

In the first phase of the focus group, but even more so in the second phase of the focus group, participants expressed the fear that personalized learning could go at the cost of the social setting in the classroom and the relationships students have with each other and the teacher. According to these participants, personalized learning focuses on individuals, and the technology of neuroimaging enhances the idea of individuality because it emphasizes that everyone has their own unique style of learning. However, many participants expressed how important they considered it to be for children to learn how to work together. For example, one student mentioned:
“Being social is the only thing you don’t learn explicitly as a subject at school, but I think that is one of the most important things you learn.” [student]

Being social is not only fun, different participants argued that it was necessary for students’ future careers. Moreover, interaction between people was seen as an important component of learning itself. A question that arises here is how a teacher should decide which form of learning to concentrate on, and what beneficence is in that case, with regard to both the student and the teacher.

It is worth pointing out that, at the start of the focus group, when discussing general associations with personalized learning, participants compared the current school system to a factory, the problem being the shortage of individual attention. Personalized learning could be a way of overcoming this situation because it was more personal, referring to the relationship between the child and the teacher. However, when the brain scan was introduced in the second phase of the focus group, some participants felt the “personal” was actually taken out of personalized learning. For example, this parent argued the following:

“A brain scan, I wonder, why do they want this? We all want to keep school personal, and give a child attention. Well, with this you can just send a teacher home. (…) I find it very scary. School is more than only testing.” [parent]

According to participants, neuroimaging would stand in between the child and the teacher and his or her social experience, at the cost of their relationship.

Freedom and determinism

Some participants argued that adapting learning exactly to the needs of students would not be a good development because students need to develop a way to deal with uncertainty in finding their own way. For example, some participants mentioned that children should not know which path they should take to meet the least resistance, the path of “optimized education”. Taking a nosedive, learning from mistakes and “going on adventures” is not only the way that individuals learn the most, it is an essential part of human life. The questions asked by a participant below,
in reaction to the presentation of the scenario in which a teacher uses the results of a personalized brain scan, illustrate this:

“What is important in this life? How important is it that someone achieves optimally and gets all there is out of life? Why would we want that? Why do we want to know everything, why do we need a strategy for everything?” [teacher]

There is a relation with determinism to this way of framing when participants argue there is an optimized path, or the possibility to know everything in advance. Some participants were afraid that the scanner would be used to predict the future development of a child’s brain. These participants did not want to know what their brain looks like or what their talents or weaknesses are. One parent argued:

“You yourself also don’t want to know when you are going to die. No, let’s be honest. I get goose bumps from the idea. (…) because of research into the brain it is determined how your life is going to be. I think enough is determined already.” [parent]

Another example of this is the following quote, which stems from one of the focus groups with parents. At the start of the second phase of the focus group, the facilitator asked one of the participants what he wanted to express with his drawing. He replied:

“Actually, I feel more like angry. (…) When you start to do something like this… You are sentenced for life, you have a criminal record because your brain does or does not function well. Similar to what we have now, a white school and a black school and whatever. You get a stamp with ‘small brain’ or ‘large brain’.” [parent]

Participants were also afraid that this type of determinism would become institutionalized, as described here by one of the teachers:

“What I am afraid of is that [on the basis of a brain scan] different streams will be created. You belong there, you there, you there and you there. […] There is a set route and you almost cannot deviate from the route because you are destined to become like that.” [teacher]
According to some participants, both the loss of a social environment and the emphasis put on achievement would make school treat children less as “humans”. Many robots and conveyor belts were drawn during the drawing exercise. The moral anti-reductionist argument lies at the root of the fear that a lot of participants have of reducing children into achievement machines. For example, one parent argues:

Parent 1: “Achievement, achievement, achievement. It’s really a big reason why many children leave school early, because of that oppression. And if they then also get a stamp with their brain on it, well then…”
Parent 2: “Children that commit suicide.”
Parent 1: “Yes, that is what I mean.”

The anti-reductionist argument for these participants has such significant value that they often do not see any possibility for the application of neuroimaging for personalized learning.

7.4.2 What do brain scans measure?

The second question central to participants’ appreciation of neuroimaging is what can be made visible with a brain scan, and what a brain scan can offer that other types of assessments cannot. On the one hand, some participants argued that neuroimaging was a very objective way of gaining insight into a child’s needs. On the other hand, some participants did not think that neuroimaging could do justice to the child as a human being and some were afraid that this development would limit the definition of intelligence, doing injustice to children who do not measure up to this definition.

Objective measurement

Some participants thought the use of neuroimaging would improve personalized learning because it could be used as an objective instrument, often referring to the common Dutch expression “meten is weten” (to measure is to know). Many participants considered a brain scan to be more “objective” than a written test or the teacher’s perspective. It is a more direct way of measuring, negating the possibility for children to give socially acceptable or “lazy” answers. Teachers make an interpretation of why children behave like they do, simply because they are human beings that have
relationships with the students which can obscure what “really” is going on. Neuroimaging will make it possible to “see” things that remained hidden before, whether that is a good development or not. As one teacher put it:

“I think an important condition is that you cannot force people to do this. Because then I get the image of a school doctor that says: take off your clothes. And then it turns out you have a small one. [other participants laugh]. No but you are just naked, you are simply turned inside out.”

[teacher]

Different applications of neuroimaging relating to this objectivity were mentioned. For example, some participants thought that it would be useful to use neuroimaging to see when a child is underachieving in comparison to his potential. According to these participants, this would make the education system fairer to students who have less opportunity due to their environment at home. Similarly, children who struggle with a particular subject for a long time, have objective proof to show this is the case. This could enable informed decision making about for example the type of education or job a student would have the most aptitude for. Another argument made was that, more importantly than scientifically proving what the capacity of a child is, the scan can give objective insight into why children do what they do, creating the possibility to intervene knowledgeably. Especially when a child is experiencing problems, a brain scan will make it possible for teachers to react on the basis of objective information, where they now often have to work based on an instinctive feeling. According to one of the parents, it will also help in cases were there is a disagreement between for example the teacher and the parents as to what the cause of a learning problem is:

“I don’t see how, as a parent, you can argue with a teacher about the results of a scan. Because a scan is a scan and that’s the way it is”.

[parent]

Reduction of a child to a scan

Some other participants, on the contrary, thought a brain scan would not do justice to the child. This way of framing comprises three elements: (1) a brain scan only captures one moment in time and (2) does not do justice to the complexity of human beings and (3) their environment. During the second phase of the focus group, a number of
participants argued that a brain scan is only a snapshot, a “picture” or “map” that cannot give any insight into the further development of the child. One of the parents reasoned this in the following way:

“I get the feeling that you make a map of someone. Instead of letting a child be a child, you have to make him into a map. And you don’t let a child be determined by his development, everything changes. In the first year, he is like this... It’s all a snapshot. And when you use this [a brain scan], I’m afraid that you only take the first two years with you, for the rest of your life.” [Parent]

Aside from the temporal argument, some participants reason that a scan is not able to capture the essence of what it is to be human because that is something that a machine can only approximate, simply because machines are fundamentally different from humans. Factors participants are afraid to lose are for example the child’s personality, motivation and emotions. One of the parents put it as follows:

“I wrote down the ‘sweet child’. The scan must know if a child can learn, can talk, can think, can love, can believe, can do, can be creative, unconscious reactions, can DO something and can WANT something. A scan cannot do that. I don’t believe a word of it. (...) All these things, are the essence of a human. A machine cannot do that, in my opinion.” [Parent]

This was echoed by one of the students:

“But maths, physics, geography and biology, these are different interests for different people. We need far more technology before we can read all this from the brain, because there are thousands of factors that influence the brain. “[Student]

In addition, some participants argue that a brain scan reduces a child to his brain, ignoring all other factors in the environment that influence the development of the child. The brain image does not say anything about for example the circumstances at home, or the quality of the teacher.
According to these participants, due to the technical reductionism of the brain scan, it has little predictive value. By allowing the scan to determine what kind of education a child needs, participants are afraid to lose the complexity of a child’s development, doing injustice to the human being. This line of argument leads to the conviction that brain scans do not have a part to play in the classroom, unless a child is experiencing problems or is not developing according to expectations. Participants that are afraid of technological reductionism only see the benefit of brain scans in problematic situations that cannot be dealt with by other means.

**Reduction of child performance to the brain**

A second concern some participants had was that the brain scan would more narrowly define intelligence. Some participants explained that a brain scan would change intelligence into a measure that is determined by the size, structure and function of your brain, not by how a child faces problems or what a person achieves in life. Intelligence would thus be reduced to an image. Furthermore, some participants were afraid that scientists would use neuroimaging to look for a very specific kind of intelligence in the brain. One of the students argued:

"How can you measure who is smarter? Is someone smarter who understands economy or someone who understands biology very well? It’s not possible to measure this.” [student]

This would go against their idea of there being different kinds of intelligence. This is also demonstrated by the following discussion, which took place during one of the focus groups with parents:

Parent 3: “You have very intelligent people who are just not that smart and you simply have less intelligent people who are streetwise." 
Parent 4: “A doctor’s reading brain. What is a doctor? He knows, he reads a lot and remembers that, but sometimes they are not able to think creatively.”

13 Dutch translation: “boerenslim”.
Parent 3: “Take a surgeon, he can cut really well, but he doesn’t speak one friendly word, you know.”

According to participants, this development would be immoral for different reasons. First, having the method of education adapted to a narrow definition of normal development could lead to a loss of diversity. This would have negative consequences for society, which needs people with different skills.

A second fear expressed by some participants was that children would be evaluated by their brain scan, not by their actions. Here, the issue of privacy becomes especially important. All parents and teachers agreed that this information should not become common knowledge.

One student argued:

“Well it’s the ultimate breach of privacy, because, well it’s possible to map out your whole... being. If that information becomes public... That must never happen. [student]

Some participants were afraid that children would be labelled by the results of their brain scans, influencing how they are seen and treated by others. For example, participants argued that this information about the brain could be used against them by insurance agencies or by potential employers. In addition, they thought a brain scan might lead to self-stigmatization when a child has insight into his or her capacities.

According to some parents and teachers, this fixed view of the self might lead children to be less inclined to try, as they have an excuse why school is not going well. At the same time, students that have been told that they have certain talents also might not live up to their potential because they feel like they don’t have to work for it. Participants using this frame often argue that neuroimaging should only be used “in a positive way”: only to discover opportunities, like talents that can be stimulated. The technology should not be used to identify problems, since the identification of problems could lead to labelling and stigmatization.
7.4.3 Differences between parents, teachers and students

The different arguments presented above are all visible in the focus groups with parents, students and teachers. When comparing the general trends in the focus groups, the main differences discerned between the different groups was the emphasis laid on some elements compared to others, and the influence the application of personalized learning was thought to have on the stakeholders’ own role. Students put most emphasis on the importance of social learning and the freedom to choose their own path, arguing for example that:

“I don’t think others should be allowed to decide what you are going to do. We all have freedom of choice.” [student]

Many participating parents were worried that their child would be stigmatized if it would be possible to see the capacities of their children on a brain scan. Teachers were most engaged with the practical aspects of the implementation of this application. Many were concerned that personalized learning would change their role in education considerably, from a teacher to a learning supervisor. This is visible in for example the following excerpt, taken from a discussion with teachers about what they would be afraid to lose with the introduction of individualized neuroimaging in the classroom.

Teacher 1: “Passion, telling stories.”
Teacher 2: “No, we mustn’t lose that.”
Teacher 3: “Because that is the power of teachers.”
Teacher 4: “And the professional knowledge, because that has not been included yet. Because if you are a coach... aside from the professional knowledge everyone can be a coach. A teacher has knowledge that is unique for a particular subject.”

In addition, parents and teachers differed in opinion about the issue of privacy and how data should be handled. Some students did not see privacy with regard to learning as that much of an issue, as this student explains:

“With everything that relates to learning I don’t really care, but with other things that have nothing to do with learning I do. (...) A lot of
things at home they [the school or the teacher] really don’t have to know about. But… what I think of certain subjects or what I can do, I don’t mind if they know.” [student]

Teachers mostly thought they should be in charge of the information, which should be a part of the private files on students they manage now. Parents wanted the information to be property of the child or the family and students agreed they themselves should be the owner of the information.

7.5 Conclusion and discussion

In our analysis, a number of tensions have been identified between different values that appear to be conflicting, like the tension between equality and equity, and between freedom and achievement. As discussed, value conflicts are difficult to resolve. However, when we looked more closely at the argumentation patterns around these values, it became clear that in some cases it is not simply the values that are at odds with each other. Sometimes, differences are visible in the way that participants framed the application: which elements were central to their stories, and how were these understood? We have summarized this in table 7.2. Here, we show different areas of tension and the underlying differences in how particular elements are framed.

These different framings also lead to different ideas about potential applications of neuroimaging for personalized learning. The basis of the arguments against neuroimaging for personalized learning was often a rejection of reductionism. However, participants argued against the reduction of different elements in their stories. We have distinguished three different kind of anti-reductionism. The first and second kind both relate to the reduction of a child, the first focusing on what a scan can do, and the second on what a scan should do. The third form of anti-reductionist argument relates to narrowly defining intelligence. Although reductionism is the main issue in all three cases, the arguments are in fact very different, and lead to different ideas about application possibilities.
Table 7.2.a. Areas of tension and elements framed differently when answering the question “How to approach a learning child?”

<table>
<thead>
<tr>
<th>Framework</th>
<th>Learning</th>
<th>Child</th>
<th>Brain</th>
<th>Scan</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equality</td>
<td>Focus on equal process</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Not at the cost of equal treatment</td>
</tr>
<tr>
<td>Equity</td>
<td>Focus on equal outcome</td>
<td>-</td>
<td>Plastic</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Social learning</td>
<td>Focus on social process</td>
<td>Needs social interaction</td>
<td>-</td>
<td>-</td>
<td>Not at the cost of social learning</td>
</tr>
<tr>
<td>Individualized learning</td>
<td>Focus on outcome</td>
<td>Should make most of potential</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Freedom</td>
<td>Focus on freedom to make mistakes</td>
<td>Does not need to be perfect</td>
<td>Fixed</td>
<td>Can make predictions</td>
<td>No application</td>
</tr>
<tr>
<td>Achievement</td>
<td>Focus on outcome</td>
<td>Should make most of potential</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 7.2.b. Areas of tension and elements framed differently when answering the question “What can a brain scan measure?”

<table>
<thead>
<tr>
<th>Framework</th>
<th>Learning</th>
<th>Child</th>
<th>Brain</th>
<th>Scan</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective measurement</td>
<td>-</td>
<td>Can be captured by scan</td>
<td>Is the centre of learning</td>
<td>Objective instrument</td>
<td>Yes</td>
</tr>
<tr>
<td>Reduction of child</td>
<td>-</td>
<td>Is very complex, cannot be captured by scan</td>
<td>Is not the only place where learning occurs</td>
<td>Can capture only one moment in time</td>
<td>Only in case of learning problems</td>
</tr>
<tr>
<td>Narrow definition intelligence</td>
<td>-</td>
<td>Is intelligent in different ways</td>
<td>Intelligence &gt; than what is learned in school</td>
<td>Will narrowly define intelligence</td>
<td>Only to discover opportunities</td>
</tr>
</tbody>
</table>
The first antireductionist argument is that neuroimaging is not able to capture the essence of a child. This tension is part of a larger philosophical discussion about the relation between brain and mind. Participants that came with this argument mostly argued for a brain scan to be done only in case of learning disorders. The second argument is that a scan limits children in their freedom. This discussion is a paradox in the sense that here, images of societal determinism tend to creep in, while at the same time scientific insights are providing more and more evidence for plasticity of the brain. Participants who were of this opinion did not see any application possibilities for neuroimaging in the classroom at all. Finally, the third argument is that a scan would define intelligence too narrowly. This relates to the ethical discussion about how intelligence should be constructed, and what the role of researchers should play in this. Participants using this argument often thought that a scan should be used to create more opportunities for a child, by looking at what a child could do well instead of at problem areas. These three forms of reductionism all need to be addressed and discussed separately in a (future) science-society dialogue setting.

Other issues that need to be further discussed relate to the role that the teacher, parents and students play in this development and the issue of privacy. Sheridan et al. (2006) argue that value conflicts often occur when technological or cultural developments force people to take on new or too many roles in their profession. Increased individualization will create further demands on educators, and in the short term it might become more difficult to align the desires of students, parents and teachers with for example governmental performance standards and teachers’ personal value systems. Regarding privacy, participants argued that it was important that the information would be protected to prevent social or economic harm. Considerations to be made with regard to privacy and the medicalization of intellectual ability are discussed in detail by for example Heinrichs (2011).

Some ethical issues addressed in literature did not arise during the focus groups. According to Gray and Thompson (2004), it is considered “mildly impolite” in the United States to attend to the differences between people, because it undermines the higher ethical principle of social equality. The suggestion that individual differences in ability have a biological basis would be considered “distinctly impolite” because evidence about this could be misused as evidence about an individual’s or group’s social or moral value. This type of argument was not recognized during the focus
groups conducted in the Netherlands. Instead, participants often expressed that everyone was unique in their mental abilities, and that there were many different types of intelligence, all having their own value. They did not express the fear that this type of application would lead to stigmatization of groups based on race or class.

We have seen that participants hold different views on how a learning child should be approached and on what a brain scan can and should measure. This leads to a different attitude towards the application of neuroimaging for personalized learning. Different views indeed have to do with a difference in ‘problem setting’, the defining of the elements that are important in relation to the application. Although arguments encountered during the focus groups were not surprising or novel to ‘new and emerging science and technology’ (NEST)-ethics (Swierstra & Rip, 2007), we have found that the detailed analysis of the societal stakeholders’ different types of framing can be a valuable way of doing a pragmatic ethics. Below, we reflect on the value of this approach and on the different choices we have made during the focus groups.

First of all, we decided to include teachers, students and their parents in this study. There are two issues regarding this selection that we would like to discuss. The first relates to the inclusion of participants that are only involved in one aspect of education, the actual teaching and learning in the classroom. There are a number of other societal stakeholders that have not been included in this study. For example, as mentioned in the introduction, educational designers are already developing and implementing digital technologies for personalized learning, for which neuroimaging could possibly have great potential. However, we would argue that the end-users participating in this study are the ones that have to cope with the most significant changes in the future. In The Netherlands, the past has shown how important it is to include the values of end-users in education innovation, as is shown by the Dutch parliamentary inquiry on educational innovation in 2007-2008 (Bronneman-Helmers, 2008). Second, as Howard Jones and Fenton (2012) mention, it may be argued that the public is not well informed enough to contribute to an informed ethical discussion. However, in complex issues like this uncertainty and uninformedness regarding applications work in all directions, as none of the stakeholders of society or science have knowledge of all aspects of the application. We feel that with this project, we have shown that it is possible to have valuable ethical discussions even with (older) children about the value this application would have for them. Some values, such as
the fear of determinism, are based on assumptions about neuroimaging that are not informed by the results of neuroscience. However, this was only the case for some arguments, and frame analysis makes it possible to separate these arguments from others.

The construction of frames was a way to work with both the value plurality of participants visible within and between stakeholder groups, and the inherent uncertainty of the application. By disentangling the frames in this way, we hope to have shown that the values at stake for stakeholders are to a large extent dependent on the way the problem is set, or the situation is framed. The frame construction was a way of unravelling the mesh of arguments that were put forward during the focus group discussions. More insight was gained into the features of neuroimaging and personalized learning that are problematic for societal stakeholders and more insight was gained into the beliefs, assumptions and appreciations that underlie these features. At the same time the uncertainty of the application was taken into account to a large extent because the discussion was more about the idea of the application than about concrete technical matters.

This round of focus groups serves as a basis for further dialogue on the application of neuroimaging for personalized learning. The frames that have been described in this chapter can be utilized in different ways, as described by Kupper (2009). First, frames can be reflected on in order to reveal implicit assumptions and exclusion effects of current habits, practices and institutions. Second, frames can be used to identify key areas of conflict and misunderstanding: multi-perspectival problem construction. For example, a departure point for dialogue could be the ways that different stakeholders from science and society frame what a child should achieve at school. From there, potential applications of neuroimaging can be discussed in a way that takes these different framings into account. Third, it is possible to organize sessions in which the different frames are used as input for the construction of new, integrated frames.

Finally, we wish to reflect on some limitations of this study. First, we reflect on our own role in this process. In this form of pragmatic ethics, the ethicist becomes facilitator of moral argumentation, rather than the provider of arguments or critiques. Nevertheless, the facilitator still plays an important and active role in the construction of framing, both in the design and conduct of the focus groups. The application of individualized
neuroimaging for personalized learning was a guiding vision constructed during the expert session, and was reflected in the literature. This complex and blurry vision was then taken by our research team and introduced to the stakeholders, possibly taking on new forms during the focus group. It can be argued that our role has been constitutive to the very forming of the future, and therefore not a good example of "managing expectations", as advised by Ansari et al. (2011). At the same time, if we wish to anticipate on future developments, we need to gain insight into the expectations that exist among neuroscientists. These expectations shape the future in the sense that they contribute to the building of research agendas and the attraction of actors that could play a role in this future (Borup et al., 2006). We therefore need to find ways to gain insight into these expectations without creating new hypes. A first step we take here is being explicit and reflexive about our role as facilitators.

Second, the question arises to what extent the results of this study are generalizable, both with respect to the location of the study, and with regard to the innovation of neuroimaging. It needs to be said that The Netherlands has a particular education system with different streams of different levels. Which level a child can attend is determined at the end of primary school, to a large extent by a national test all children take. In addition, the Dutch education system places much emphasis on the freedom and autonomy of students, with the goal of stimulating independent learning\(^\text{14}\). The local values embedded in and outside of educational practice undoubtedly are reflected in the framings of participants, and it is possible that the participants in this study were more fearful of determinism because of this cultural background. However, it is expected that most areas of frame conflict identified in this study also feature in most other welfare states. With regard to the generalizability of the technology studied, it can be argued that the opportunities and concerns identified by participants also have relevance for Responsible Research and Innovation processes involving other technologies that have predictive, diagnostic value and emphasize the differences between individuals, such as (neuro)genomics. Although genomics can be argued to be a step further away from education (Edelenbosch,

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\(^{14}\) For more information secondary school system in the Netherlands, see the website of the Dutch Ministry of Education, Culture and Science, accessible at [http://www.government.nl/ministries/ocw](http://www.government.nl/ministries/ocw). For a comparison of the Netherlands with other European countries, specifically see [http://www.trendsinbeeld.minocw.nl/grafieken/2_1_2.php](http://www.trendsinbeeld.minocw.nl/grafieken/2_1_2.php) (last accessed August 17, 2014)
2012) and research into stakeholder perceptions of the application of genomics to education have not yet been undertaken, we recognize the fear of determinism, labelling and stigma, discrimination and privacy encountered during our focus groups in literature about the social, legal and ethical aspects of genomics (see for example McMahon et al., 2006; McGuire et al., 2008; Illes & Lombera, 2008; Buchman & Illes, 2010).

Irrespective of whether or not the individual brain scan at school lies ahead, it is valuable to understand what this future would mean to participants and why the framings that have been described in this chapter also give insight into the way people perceive more general developments in the neurosciences and the boundaries between applications in health care and education. The technology of neuroimaging can alter the view we have of our minds and ourselves. The question therefore is to what extent this technology should ‘make visible’, and what should be done with this information. It is important to somehow anticipate the potential applications of new technologies, when it is still possible to influence the course of innovation (Collingridge, 1981, p.11). The next step in our deliberation process is the reflection on these different framings with stakeholders in a science-society dialogue. We believe that insight into these framings will make it possible to have more a more constructive interaction in which ethical issues are not reduced to scientific ones and an environment is created in which it is possible to discuss what is at stake.