1. INTRODUCTION

Daily life in the Western World has become intricately interwoven with sophisticated technologies and the application of scientific knowledge. In many ways, these developments have contributed to progress in human well-being, one example being the contribution of medical technologies to the eradication of diseases. Moreover, the problems of the 21st Century, such as poverty, sickness, ageing, crime and environmental deterioration, demand the attention of the scientific community and technology developers. Science and technological innovation are seen as key approaches to solve, or at least mitigate, these problems (EC 2010, 2011a) while also increasingly being seen as sources of global problems, such as global warming and nuclear disasters.

Science and technological innovation have also brought about new ways of experiencing the world and a reconfiguration of responsibilities (Verbeek 2011b). The production of previously unseen images of the body creates new questions of responsibility, for example when those images appear to imply the potential for certain dangerous behaviours of the imaged person. Do we have a responsibility to intervene in this person’s life? Can the person be held accountable? While technology shapes society, society also shapes technology. The development of a technology is not merely goal-directed solving of a problem, following its own inherent momentum (Bijker 1996). Rather, it is a process of choices, conscious or otherwise, taking place in a social context, which affect design, process and outcome. The relationship between technology and society is thus characterised by a process of mutual shaping.

Scientific knowledge is characterised by ‘incertitude’ (Stirling 1999) which cannot be eradicated by the use of statistical methods (Funtowicz and Ravetz 2008). Factual incertitude arises from a lack of knowledge but also because of the indeterminacy of the system underlying technology and scientific knowledge. Furthermore, the stakes involved in the problems and solutions are large. Values need to be taken into account because there is no clear bridge between knowledge and the right action in what is essentially a social choice dilemma. Moreover, the value of the application of scientific knowledge and technology is inherently context-specific: there are situations in which other types of knowledge have more value and potential. The consideration of contextual aspects of application requires thus not only scientific knowledge, but also the involvement of other
‘indigenous’ knowledge systems (Watson-Veran and Turnbull 1995), such as the knowledge of users.

When there are disputes about value, incertitude of facts, high stakes and urgency, a science-society dialogue is called for because these situations cannot be managed by a linear, reductionist approach (Funtowicz and Ravetz 2006). A science-society dialogue entails the facilitation of a mutual learning process between experts and societal stakeholders, both representing different views, needs and ideas. In such a dialogue, various stakeholders participate in decision-making processes on science and technology. In this process of participation, instrumental, normative and substantive motivations can be recognised. If technological innovations are to succeed, they depend on many factors, including societal support. The early inclusion of societal stakeholders can increase the chance of the technology being accepted. The normative dimension refers to considerations of democracy, equity and justice, meaning that participation is the right thing to do. Substantive motivations emphasise achieving better ends, in which the focus is on explicit, socially deliberated, publicly reasoned evaluative criteria for the outcomes.

Science which involves science-society dialogue can be found in a number of scientific traditions, including transdisciplinary research (Thompson Klein et al. 2001), post-normal science (Funtowicz and Ravetz 1993), mode 2 knowledge production (Gibbons et al. 1994, Nowotny et al. 2001), and constructive technology assessment (Rip et al. 1995). However, from 2000 onwards, it is increasingly being captured by the framework of Responsible Research and Innovation (RRI). RRI has gained considerable traction in science policies in the USA and Europe and has recently been consolidated in the €70 billion EU research and development programme Horizon 2020, which started in 2014. Part of the funding is allocated to actions on thematic elements of RRI and its uptake by stakeholders and institutions. Furthermore, RRI is acknowledged as an issue across the Horizon 2020 objectives. A central aim within RRI is to direct natural science and innovation endeavours to address major societal issues while, at the same time, preventing the controversies of the past, such as those surrounding genetically modified organisms. RRI is to stimulate research and innovation activities to take ethical and social considerations into account from the outset and facilitate societally desirable and ethically acceptable outcomes through an exemplary process, characterised by inclusive

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deliberation with wider stakeholders and a willingness among the stakeholders to act and adapt according to new insights. Nevertheless, the framework is still in flux. The aim of this thesis is to contribute to the RRI framework by studying these elements of inclusive deliberation and action. How can we make sense of inclusive deliberation and action, and how can these processes be shaped?

The case under investigation in this thesis is that of neuroimaging in justice and security. With neuroimaging diffusing into new fields, it is an excellent candidate for upstream deliberation efforts from the earliest stages onwards. It is in techno science in-the-making (Latour 1987), rather than in established technologies, that processes of construction, and what is at stake in those processes, are most visible. Furthermore, technology development for the domain of justice and security is full of paradoxical issues, particularly in need of interpretation and resolution. This domain also coincides with one of the seven main ‘Grand Challenges’ formulated in the Horizon 2020 programme: Secure societies – protecting freedom and security of Europe and its citizens (EC 2014).

Innovations within the field of justice and security are inherently morally problematic. This does not mean that they are necessarily immoral. Instead, they entail weighing sets of morals against each other in which it is difficult or impossible to adhere to both. For example, one central moral dilemma is the trade-off between personal autonomy and security. Security is central to the legitimacy of the nation-state because the nation-state can be seen as socially contracted to protect its citizens. Innovations that enable the gathering of personal information of citizens and make it intelligible for security providers can enhance security. However, society also calls for respect for personal autonomy and privacy, as these rights are for example enshrined in the European Human Rights Act. The state ensures protection of the public and private space in all kinds of configurations, also devolving activities and responsibilities to non-state agents. The activities of the latter are inherently far less transparent than those of their state-led counterparts. Innovations can thus be promissory by providing new ways to maximise our security but they can cause peril by facilitating security at the expense of privacy.

The use of neuroimaging technologies for innovations in the field of justice and security demonstrates heightened ethical issues and societal concerns. Neuroimaging has been developed and used over the past twenty years in the fields of medicine, cognitive neuroscience, experimental psychology and neuropsychology. Functional neuroimaging has provided insights into brain function and into the relationship between brain structure, mental functions and behaviour. As such, it touches upon fundamental human
experiences, such as thoughts and emotions. Moreover, it gives rise to questions about the biological underpinnings of who we are (Farah and Wolpe 2004, Pickersgill et al. 2011). Therefore, the development of neuroimaging technologies for application in justice and security would benefit from an RRI approach because such an approach would increase the odds of achieving ethically acceptable, sustainable and societally desirable technologies.

In order to apply the framework of RRI to this case, knowledge is needed on how to shape inclusive deliberation from the early stages, and how to facilitate responsiveness in processes of development so that trajectories can be adjusted? Therefore, the aim of this thesis is to gain insights into inclusive deliberation with stakeholders in the emerging RRI context of neuroimaging in justice and security, and how to act upon such processes.
2. THEORETICAL FRAMEWORK

Neuroimaging refers to a relatively new set of technologies from the domain of medicine, neuroscience and neuropsychology, which visualises the structure, function and metabolism of the intact, living brain. Examples are functional Magnetic Resonance Imaging (fMRI), Positron Emission Tomography (PET), and Electro Encephalogram (EEG). The first two examples make inferences about brain activity by measuring changes in cerebral blood flow and the uptake of sugar, respectively, and have a high spatial resolution of where brain activity is taking place. Both of these technologies measure relative, not absolute, brain activity. EEG detects the brain’s electrical activity, and has a high temporal resolution at the point in time in which brain activity takes place. The combination of these neuroimaging technologies makes it possible to study the brain with both high spatial and temporal resolution. The resulting images of the brain are constructed through complex statistical analysis of data produced by neuroimaging technologies. One of the steps taken, for fMRI for example, is to set a level of statistical significance of differences in brain activity (Wolpe et al. 2005). The lower the cut-off is chosen by the researchers, the more ‘active’ brain regions appear in the picture.

Neuroimaging technologies provide manifold opportunities to increase understanding of the brain and are being applied to addiction, emotion, learning and development, memory, sensation, sleep, brain diseases and psychopathology (Pickering 2013). These technologies have played a pivotal role in the boom in neuroscience in the last decades. Neural correlates of physiological and cognitive processes can now be investigated and, as a consequence, the scope of cognition research has widened from domains of basic and clinical research into new domains, such as neurolaw, neuromarketing and neuroeducation.

The proliferation of neuroscience research has attracted considerable political interest, as testified by the declaration of the 1990s as the ‘Decade of the Brain’ in the USA (Bush 1990) and Europe. In 2013, the Human Brain Project was launched by the European Commission and the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) project commenced in the USA. In addition to political attention, neuroimaging is also highly visible in cultural discourse. Brain images are readily available in magazines, self-help books, popular fiction, TV shows and newspapers (Campbell 2010, Dumit 2004,
Franzen 2001, O’Connor et al. 2012, Schwartz 1997), providing directly accessible knowledge and concrete applications to areas of everyday life such as personality, relationships, career, consumption, emotion, identity and crime. Furthermore, readers are invited to engage in ‘brain-training’ to become better parents, workers, and citizens (Thornton 2011).

The new opportunities to study neural correlates of mental processes and human behaviour has also generated interest from fields dealing with deviant behaviours, such as the law, justice and security. However, neuroimaging is a technology from which it is difficult to obtain individual data. For example, most of the brain activity images in the literature are, in fact, compilations, resulting from the subtraction of an average of the experimental scan data from an average of the control scan data (Illes and Racine 2005). Since decisions and actions in the justice and security context typically concern the individual, such as prison sentencing, single-subject data would be of greater relevance. While the same can be said for other new scientific data and instruments, emerging neuroimaging technologies are still relatively new. As a result, little consensus has yet been reached on methods for producing and interpreting data (Feigenson 2006). Lay people, including judges, policemen and security professionals, are largely unfamiliar with the implications of this.

This Chapter will discuss how neuroimaging is diffusing into the domain of justice and security in the Netherlands and how this domain potentially stands to gain from the application of neuroscientific knowledge and neuroimaging technologies. Subsequently, the framework of RRI will be elaborated upon. In particular, the key elements of inclusive deliberation and action will be discussed. This Chapter closes with a view on the diversity of RRI practices.

### 2.1 The Legacy of Buikhuisen

Although neuroimaging research has been broadly adopted in clinical and basic research in the Netherlands without undue controversy, diffusion into the domain of justice and security has touched upon Dutch sensitivities. Although many ‘neurolaw’ projects have been appearing in the last decade around the globe, the study of neurobiological factors in criminology has been curtailed in the Netherlands since the 1970s because of the Buikhuisen affair which involved a controversial proposal for a biosocial research agenda on criminology (van Swaanningen 2006). Wouter Buikhuisen was a notable criminologist,
trained as an epidemiologically skilled psychologist, at a time when criminality in the Netherlands was largely seen as a societal problem. Dutch criminology was largely sociological in nature and focused on social reactions to crime, rather than the aetiology of crime. Buikhuisen’s proposal lead to a media controversy in which Buikhuisen was portrayed as a crypto-fascist; references to World War II and biological criminology abounded in criticisms of his work. Buikhuisen was threatened and fellow academics shied away from any further collaboration with him, resulting in Buikhuisen’s early retirement in 1989. This effectively put a stop to proposals for this type of research in the Netherlands until after the year 2000. In 2010, the Netherlands Organization for Scientific Research (NWO) started the programme ‘Brain and Cognition – social innovation in health care, education and safety’ (HCMI). One of the program’s three pillars focused on brain and cognition research in the domain of ‘safety’. Main themes comprise youth crime, aggression and the prevention of stress disorders in public safety officials. In the Netherlands, neuroimaging in the domain of justice and security is therefore truly newly emerging.

2.2 NEUROIMAGING IN JUSTICE AND SECURITY

The field of justice refers to legal fields such as criminal law and civil law, but also to the practices of criminal investigation and the detainment and rehabilitation of criminal offenders. Neuroimaging could help elucidate the relations between the activity of specific brain regions and mental processes relevant to reasoning, planning, impulse control, and moral judgement (prefrontal cortex), the control of emotions (amygdala), and empathy (anterior cingulated cortex) (Appelbaum 2009). Neuroimaging technologies offer promise for the appraisal of a suspect’s responsibility for their alleged wrongful actions; the improvement of the assessment of recidivism risks; proper diagnosis of psychiatric disorders associated with criminal behaviour, as well as for the development of novel treatment options for these disorders (Abbott 2007, Belcher and Sinnott-Armstrong 2010, Hughes 2010, Hüsing et al. 2006, Singh and Rose 2009).

Security is an ambiguous term. It generally refers to an absence of danger to individuals or institutions and the condition of being protected against danger or loss (Peissl 2010). In this thesis, security is understood as those activities that secure organisations, people and data by preventing danger and loss in the public and private space. Security activities take place in a large variety of spaces, such as shopping malls and public transport. The
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The security industry is growing internationally (Zedner 2007) and the number of security companies is soaring in the Netherlands (Van Melik and Van Weesep 2006). Security management is characterised by a mentality of prevention rather than retribution. As such, it has an economic rationale of pre-empting, minimizing and displacing of ‘loss’, which refers to damage to material goods, theft of digital data, bodily harm or the disruption of business processes (Shearing and Johnston 2005, Williams 2005). An important paradox within security is that feelings of security among the population tend to decrease with increasing security measures (Coaffee et al. 2009).

How can neuroimaging technologies be of use in this broad domain of security? According to the literature, neuroscientific measures could be employed to both anticipate and intervene in cases of fear, stress or fatigue among security professionals in operational settings (Harrison and Horne 2000, Putman and Roelofs 2011). The augmentation of the cognitive abilities of security professionals is another option, for example for the unconscious detection of threat (DARPA 2003). For the prevention of dangerous situations, the identification of covert mental states could also aid security professionals in their tasks as demonstrated by studies on deception detection (Abootalebi et al. (2009) and the identification of terrorist intentions (Meixner and Rosenfeld (2011)).

Concerns on the use of neuroimaging technologies have also been raised; neuroscientific and technological developments play an important role in recent debates on science and society interactions (Schleim 2012). For example, some commentators have argued that neuroscientific conceptualisations of free will and responsibility may threaten societal institutions concerning accountability and retribution (Greene and Cohen 2004, Sasso 2009, Sie and Wouters 2010). Whether neuroimaging can aid in achieving societally desirable goals pertaining to the domain of justice and security is a difficult question to answer, and depends on a diverse range of contingencies.

2.3 RESPONSIBLE RESEARCH AND INNOVATION

The desire to make responsible choices in research and technology development is reflected in the concept of Responsible Research and Innovation (RRI) which fits within a longer historical shift away from the traditional ‘linear model’ of the innovation process in which science invents, the technological novelty is developed by industry and subsequently adopted by society (Rip et al. 1995), towards new in configurations of the
relationship between science and society (Guston 2000), in which the innovation process and societal processes are considered to be interdependent.

2.3.1 RRI as a multifaceted framework

RRI is envisioned to function as a multi-faceted framework for research and innovation, in the sense that it can be interpreted in and adapted to different contexts. In this light, it is noteworthy that the ambiguity of the terms ‘responsibility’, ‘research’ and ‘innovation’ themselves add to this potential. Research is a broad term referring to deliberate actions in a systematic process of formulating a research question, acquiring new knowledge and deriving new conclusions (Schroeder and Iatridis 2016). Although this does not necessarily only include activities in scientific institutions such as universities and research institutes – it is possible for a non-scientist to engage in research outside of these institutions – RRI tends to focus on research inside such institutions or industries with Research and Development departments. More specifically, it has an interest in the natural sciences and engineering. Innovation, on the other hand, refers to the development of new things. Technology is often seen as interchangeable with innovation, however, the concept of innovation is much broader etymologically and historically speaking (Godin 2008). Innovation can also be immaterial, as innovation processes can yield processes or designs relating to the conceptual world (e.g. software) as well as the institutional world (e.g. organizational structures) (van den Hoven 2013). The implementation of innovations allows new physical or cognitive action to arise: it allows the users to do new things, to improve familiar things or to think about things in new ways (van den Hoven 2013). As I focus on the technology of neuroimaging, technological innovations are on the forefront in this thesis.

The notion of ‘responsibility’ has transformed through the ages. Ancient Greek philosophers, saw responsibility in the light of justice, duty and punishment, which was the dominant interpretation until the eighteenth century, when the term responsibility gained relevance in a political sense (in the relationship between rulers and their constituencies). Since then, the term has diversified and concomitantly gained in importance: Ricoeur (1995, cited in Pellizzoni 2004) has observed a proliferation and dispersion of the concept – now including many types of ‘doing a task’ or ‘honouring a pledge’ – and Strydom (1999) has argued that we have moved into an ‘era of responsibility’ – with responsibility linked to issues of risk, danger, safety and security. Pellizzoni (2004) has provided an analysis of the concept applicable to the context of
emerging science and technologies. He separates responsibility imputed after a certain situation has actually materialised (retrospective) from responsibility imputed before the situation has materialised (anticipatory). The two retrospective dimensions, liability\(^2\) and accountability\(^3\) are relatively problematic compared to the domains of anticipatory responsibility in the context of innovation as an uncertain, collective and future-oriented activity. Although ‘state of the art’ scientific knowledge is rooted in the past, the social use of science introduces novelty in such a way that the picture of the world associated with the state of the art knowledge may no longer exist (Groves 2013). Another resource of responsibility, rule-based responsibility such as duties associated with different roles (as defined by H.L.A. Hart, see for instance Vincent 2011), also has limitations as right and wrong are subject to change in the course of time, but also by shaping effects of the innovation itself.

In light of uncertainty, two anticipatory dimensions of responsibility, care and responsiveness, are considered better instruments for the governance of emerging technologies. Care can be understood as caring about the meaning of our own lives mediated by technologies and care of specific others with whom we feel connected in the now (e.g. family, friends, partners, colleagues) or in the future (e.g. future generations) (Adam and Groves 2011). Responsibility as a duty to care in the context of innovation is a collective rather than individual duty, as innovation involves a network of actors and actions, and entails the process of doing science and innovation as well as their products (Stilgoe et al. 2013). As such, Stilgoe and colleagues (2013, 1570) formulate RRI as “taking care of the future through collective stewardship of science and innovation in the present”. Importantly, this demands a vision on purposes: what kind of future do we want from innovation? This question is value-based rather than duty-based, as it concerns the formulation of the common good. It also demands ways to make the processes of innovation responsive to accommodate the inherent uncertainty (Owen et al. 2012). Pellizzoni (2004, 557) defines responsiveness as “a situation where there is neither presumption of sufficient knowledge and control nor reliance on [retrospective] accounts

\(^{2}\) In case of liability, someone is responsible for an event caused by one’s actions in which it is also considered what prompted this person to act at that time. If these prompts were beyond one’s control, one is not considered liable.

\(^{3}\) In case of accountability, someone is deemed responsible for an event caused by one’s actions in which it is also considered what this person aimed to achieve. How did this person assess expected benefits and foreseeable risks of the behaviour, and should this person have known better based on the information which was present at the time?
and adjustment of self-established courses of action, but rather a receptive attitude to external inputs to help in deciding what to do”.

The different dimensions of responsibility in the context of innovation should not be seen as mutually exclusive but as cumulative, with some dimensions being more appropriate for some contexts than others. In this thesis, responsibility in the context of innovation is mainly conceived as care and responsiveness, as we are dealing here with an emerging technology and emerging RRI practices. However, other dimensions, such as role responsibilities, can also be discerned in this thesis.

2.3.2 The central tenets of RRI

Two central tenets of RRI are: (1) the inclusive deliberation on purposes, processes and products of science and innovation, and (2) the possibility to influence decisions on goals, processes and societal embedding (Grunwald 2011, Owen et al. 2013). In other words, RRI entails early inclusive deliberation and subsequent action. Importantly, RRI not only involves reflection on the technologies under development or specific technological applications, it also comprises reflection on purposes, such as the societal needs that are supposedly addressed by a certain technology. This is different from technology assessment methodologies in which the technology itself has a central place. Moreover, these normative assessments not only cut off certain developments, they also inspire new technological avenues (Wilsdon et al. 2005).

Neuroimaging-related innovations in the field of security and justice could benefit from an RRI approach as is illustrated by two research-funding programmes by the NWO. The programme that is mainly responsible for the funding of Dutch research in the field of functional neuroimaging relevant to the domain of justice and security, called ‘Brain and Cognition: societal innovation’\(^4\), focuses on societal innovation and the explicit inclusion of private and public sector partners. Secondly, within the programme Responsible Innovation, the Neurosciences in Dialogue project specifically focuses on the societal embedding of neuroimaging technologies. This thesis is one of the products of the latter project. The Responsible Innovation programme was shaped by interactions between the applied ethics of technology department of the NWO with several ministries, private sector partners, university based research groups and representatives of non-governmental organisations (NGOs) in The Netherlands (van den Hoven 2014).

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By moving attention upstream to the process of technology development and its embedding, processes of construction come into view and the incertitude of downstream effects becomes more apparent. The construction processes within technology development reflect the notion that technologies (and technology in-the-making) are, at the same time, social and technical in nature. The success of a technological endeavour depends on all actors exerting their influence, pushing and pulling in various directions, and working together. These actors include engineers, scientists, researchers from other scientific disciplines and members of other social groups, such as managers, investors, policy-makers, consumers or end-users and so on. Inventors make assumptions about the social uses of the technology in-the-making which they are informed by their conception of ‘the good life’. Existing social relationships with engineers or scientists of one discipline rather than another can influence the process of technology development. Furthermore, vested interests with respect to careers or the protection of a certain academic disciplines can play a role in the ‘technical’ choices made. These social relations shape the technology (Johnson 2007): investors may exert their influence for a certain pay off; policy-makers may develop regulations in the light of the social problems they need to solve, thereby constraining or supporting research that can be done; reporting on developing technologies can trigger consumers’ fears or fantasies, and so on. As such, social relations, imagined or real, can become ‘hard-wired’ into the technology (Winner 1977).

As technologies get imbedded into society, they can have multiple downstream effects, both intended and unintended. Revolving doors, for example, are intentionally designed for temperature control of the indoor facility but, in practice, they not only keep out cold air, they also exclude persons with wheelchairs (Verbeek 2006). The incertitude regarding downstream effects is not new but, by shifting the focus upstream, the previously obscured incertitude becomes more obvious. There are different kinds of incertitude. There is risk and uncertainty in which ‘risk’ is generally understood as a situation in which potential outcomes are reasonably well-known as well as the probabilities that these outcomes may occur, and ‘uncertainty’ is applied to situations where the outcomes are known but a basis for the associated probabilities is lacking (Stirling 1999, Stirling and Gee 2002, Wynne 1992). Furthermore, ambiguity, ignorance and indeterminacy have been distinguished. ‘Ambiguity’ refers to the existence of value plurality and underlying

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5 There are also different typologies of incertitude. For simplicity’s sake, I will not outline the differences between these typologies here.
assumptions (Klinke and Renn 2002, Stirling and Gee 2002). ‘Ignorance’ relates to ‘we don’t know what we don’t know’ (Wynne 1992) which means that some outcomes and causalties cannot be hypothesised and are therefore not considered. ‘Indeterminacy’ exists because of the intrinsic complexity involved in predicting the outcomes and their associated probabilities, because they depend on a system that is open-ended, namely they depend on how the intermediate actors (researchers, policy-makers, industry) of the complex system will behave, and these future actions are inherently unknown (van Lente 1997, Wynne 1992).

Incertitude therefore does not only call attention to a lack in knowledge but also to contingent social behaviour and perceptions as mediators of downstream effects. Moreover, the normative aspects of the effects of the embedding of a certain technology also depend on the norms and values that are in place at that particular place and time. As technology development can span many years, societal norms and values may have changed in the meantime, yielding another source of incertitude.

2.5 EARLY INCLUSIVE DELIBERATION

For real-life problems which are often inherently complex, scientific incertitude is inevitable as perfect knowledge is not attainable. The challenge is to find methods to act in the face of this incertitude (Jasanoff 2007). This does not involve eradicating different kinds of incertitude but, instead, reflection on the sources of incertitude and complexity from the early stages onwards. This type of reflection benefits from the inclusion of different types of perspectives and world views because weighing of problems and solutions is strongly linked to individual interests, perspectives and world view. By omitting certain types of stakeholders during reflection processes, only a part of the picture can be painted. Forms of stakeholder participation thus need to be facilitated for rich deliberation to take place.

Reflecting upon normative aspects of research, technology development and products at an early stage is important for two reasons in particular: (1) normative choices are then being made which often remain undeliberated (Macnaughten et al. 2005), and (2) there are still possibilities for adjustments to the innovation trajectory as interests have not yet become vested (Rip and Te Kulve 2008). At the early stage, it is possible to intervene before innovation processes become locked-in. However, the ability to see the construction processes does not make it easy to change them in such a way that they
may lead to better ends because of the social networks enabling and constraining human activity (Rip 1989).

Upstream, deliberation efforts cannot concentrate on actual or probable application options as there are no applications and there is too much incertitude on the probable applications. However, deliberation efforts can revolve around those phenomena that shape research and technology development. These ‘imaginaries’ (Macnaghten et al. 2005, Nordmann 2010) tie up implicit assumptions, values and visions of an actor group and are combined with elements of fantasy and evidence. They can be considered as wishes contained in the now, waiting to be fulfilled (Nordmann 2010). Imaginaries are drivers of research and technological development because they influence research agendas and ideas of technical solutions to societal problems. At the same time, these wishes can be products of technological development (Nordmann 2010). Some work has been done on the construction and analysis of possible futures by means of socio-technical scenarios (see for example van Merkerk and Smits (2008)) and of desirable futures by means of vision assessment (see for example Roelofsen (2011)). Nevertheless, more insights are needed into how to shape inclusive deliberation processes in emerging RRI practices in early phases.

2.6 Action

Inclusive deliberation activities create opportunities for new insights to emerge on the purposes, processes and products of science and innovation. However, these insights also need to be translated into action if the insights point towards new decisions to be made, a need for modulation of trajectories, or the necessity to include other stakeholders. RRI as an approach is thus inherently iterative. Emerging RRI practices therefore need a capacity for responsiveness and adaptive change. However, also in early phases, there are tensions in governance mechanisms that regularly inhibit change, such as habits and routines, norms and expectations, or reward systems. Space to respond to new insights therefore needs to be created in emerging RRI practices. However, little is known about what actions can be instigated by inclusive deliberation processes or how they can be systematically evaluated within a framework of RRI. Previous multi-stakeholder experiences have demonstrated that little action is found to follow from inclusive deliberation processes, which is often ascribed to incompatibilities with the incumbent regime (Arentshorst 2014, Hessels 2010, Kloet 2011, Roelofsen 2011). This
points towards a lack of knowledge on how room to manoeuvre can be created in the face of rigid borders posed by institutional barriers.

2.7 **Diversity of RRI practices**

RRI practices themselves can vary considerably. A recent inventory of RRI practices points towards the existence of three categories of RRI practices (Kupper et al. forthcoming), each contributing to RRI in a different way:

1) Learning
2) Governance
3) Action

However, these categories should not be perceived as mutually exclusive.

The first category refers to those activities that aim to create and sustain a responsible research and innovation system via empowered, engaged, and responsible actors across the whole range of socio-technical systems. These activities can be closely related to science education and science communication.

The second category includes a wide range of practices from those that target creation and implementation of policy to practices developing platforms and partnerships between stakeholders to inform policy. Governance bodies have a strong influence on the outcomes of research and innovation because of their multiple roles in the system of research and innovation. They are involved in the setting of research agendas, as well as in the creation of policies that constrain or facilitate responsible research and responsible technology development. Moreover, considering their role in legislation, governance bodies have a strong influence on what is considered ethically acceptable, sustainable and socially desirable. The last category includes practices that ‘do’ responsible research and innovation in order to reach RRI outcomes. These practices are action-oriented and can vary widely with respect to their institutional form (organisations, programmes, projects or tools) or the societal need or challenge they address.

Although this categorisation is helpful to make sense of RRI practices, it is not yet known how to shape inclusive deliberation and action in these categories of RRI practices, and whether this differs per category.
3. Research Design

3.1 Research questions

The aim of this thesis is to gain insights into inclusive deliberation with stakeholders in an emerging RRI context of neuroimaging in justice and security, and how to act upon such processes. This not only involves making sense of inclusive deliberation and action but also gaining insights into how to shape these processes.

The main question that guides this thesis is:

How to make sense of and shape inclusive deliberation and action in the emerging RRI context of neuroimaging in justice and security?

This main question consists of two interrelated elements:

1. How to make sense of inclusive deliberation and action in the emerging context of neuroimaging in justice and security?

2. How to shape inclusive deliberation and action in the emerging context of neuroimaging in justice and security?

Before inclusive deliberation and action processes can be initiated in the context of emerging RRI practices, it is pertinent to know what is seen as appropriate inclusive deliberation and action. Two groups of stakeholders are particularly relevant in this case, namely neuroscientists and, in addition, the scholars propagating the framework of RRI because the conceptualisation of RRI is closely linked to making sense of appropriate inclusive deliberation and action in emerging RRI contexts.

3.2 Research approach

Given the emergent nature of both the RRI framework and the practices for which inclusive deliberation and action is envisioned, a research approach was required that itself was also emergent. Furthermore, the research approach needed to accommodate real-world complexities, facilitate science-society dialogue in early RRI practices and allow for theory-building for the framework of RRI. Therefore, to answer the research questions,
a transdisciplinary approach was taken. Thompson Klein et al. (2001) define transdisciplinarity as:

“A new form of learning and problem solving involving co-operation between different parts of society in order to meet complex challenges of society.” (p.7)

In this study, three key characteristic qualities of transdisciplinary research have been employed (Wickson et al. 2006): (1) a problem focus; (2) an evolving methodology, and (3) collaboration.

Transdisciplinary research takes complex societal challenges as a starting point and aims towards problem solving within its complex system (van de Ven 2007). How inclusive deliberation and action can be shaped in such a way that better outcomes can be achieved for emerging neuroscientific knowledge and associated technologies is a real-world problem, rather than a mere conceptual one, and involves both human and natural systems (Wickson et al. 2006). As societal problems are multidisciplinary in nature, it requires the fusion of different types of knowledge. Thompson Klein et al. (2001) argue that transdisciplinarity entails a process that produces, integrates and manages knowledge in the domains of relevance to the study, in this case involving the scientific, technological and social domains. With its focus on bringing about interactions between science and society, this approach is appropriate for the study of inclusive deliberation within emerging RRI practices.

Emerging RRI practices are complex in the sense that “many interconnected parts that are constantly self-organizing and adapting in response to their environment” (Ramage and Shipp 2009, 241). Therefore, the research design itself also cannot be determined in advance. Rather, it emerges from engaging in it; the research design is emergent. An emergent research design is characterised by an iterative process in which literature review, dialogue with stakeholders and observations play an important role in the acquisition of new insights and determination of research needs. This research, for example, began with a wider exploration of neuroimaging in justice and security by conducting interviews with neuroscientists and with professionals in justice and security, and by conducting focus groups with citizens. Insights from these interactions guided ensuing research choices.

As transdisciplinary research is problem-driven rather than methodology-driven, methods are employed which best help answer the specific research question which can be qualitative, quantitative or a combination of both (Flyvbjerg 2006). Considering its
commitment to empowerment and equal access, critical methods that allow for the analysis of the working of power and construction processes can also be part of the methodology (Mumby 1997). The case study methodology is particularly well-suited to a transdisciplinary approach because it allows for the acknowledgement of contingencies by studying the real-life social world (George and Bennett 2005, Verschuren 2003), and has been found useful for the identification of further research questions, particularly valuable in emergent research designs (Siggelkow 2007). The case study methodology is particularly relevant when studying events or periods which are perceived as critical to explore or explain. For example, Wilson (1979, p. 448) described case studies as:

“A process which tries to describe and analyse some entity in qualitative, complex and comprehensive terms not infrequently as it unfolds over a period of time.”

In this thesis, the critical period is the emerging RRI context which can be recognised in the case of neuroimaging in justice and security.

3.3 Research methods and study questions

In line with the evolving methodology within a transdisciplinary research approach, the first step was to gain insights into what RRI is according to those propagating it and how it is interpreted by the neuroscientists in justice and security themselves, and how this relates to inclusive deliberation and action in an emerging RRI context. These insights allowed for the identification of research questions and research methods for the study of shaping inclusive deliberation in particular cases within justice and security.

3.3.1 Conceptualisations of RRI

Two groups of stakeholders are seen as particularly relevant to this study: the scholars propagating the framework of RRI and neuroscientists. These groups take initiative in the development of the RRI framework and neuroimaging technologies, respectively.

Study 1. The conceptualisation of RRI by scholars propagating the framework of RRI

The following study question was central in the first study:

i. How is RRI conceptualised in academic literature?

Understanding of how RRI is conceptualised in academic literature was expected to contribute to a view on what type of inclusive deliberation and action is appropriate for
emerging RRI contexts. Therefore, a narrative review of the academic literature was conducted with a systematic search strategy. Using academic literature databases (Google Scholar, Web of Science, Scopus, Proquest and EBSCOhost), a total of 71 articles were identified and analysed for the context in which RRI was conceptualised. Literature sources were coded and analysed using qualitative data analysis software (MAXQDA 11) for frames of RRI. More details on the methodology are provided in Chapter 4.

**Study 2. The conceptualisation of RRI by neuroscientists**

In order to set up an RRI process, it is also important to know how actors, in this case the neuroscientists, perceive RRI and the inclusion of other societal stakeholders because inclusive deliberation and action within RRI could be context-specific to a certain degree. Therefore, in the second study, we posed the following study question:

**ii. How is RRI conceptualised by neuroscientists in justice and security?**

A total of 20 semi-structured interviews were conducted with scientists who employ neuroimaging technologies and perform research on topics of relevance to the domain of justice and security. In selecting the interviewees, the aim was to cover the diversity of concepts as much as possible for maximum variation sampling (Patton 1990). These interviews explored how meaning is negotiated on RRI. Semi-structured interviews allow for an in-depth discourse, while providing enough structure to acquire data on pre-established topics. Transcribed interviews were coded and analysed using qualitative data analysis software (MAXQDA 11) for frames of RRI, focusing on perceptions of inclusive deliberation. The resulting frames were compared with those found in the academic literature. More details of the methodology are available in Chapter 4.

Conceptualisations of RRI were found to differ greatly between the neuroscientists and RRI scholars. Furthermore, a substantial proportion of the neuroscientists was highly sceptical of the value of participating in face-to-face inclusive deliberation with the wider public, especially in the early stages of technological development. The neuroscientists considered that the value of inclusive deliberation was to educate society about opportunities and limitations of neuroimaging research in general (not specifically for applications in justice and security) via the popular press (RRI as learning). The aim was to prevent or at least mitigate (neuro)hype, an aim shared with the wider emerging RRI community of scholars. Neuroscientists considered that inclusive deliberation could take place without an external facilitator and, instead, it could be mediated by an institution such as news media. Other questions were also raised during the exploratory interactions
with different stakeholders with respect to shaping inclusive deliberation and action in the emerging RRI context of neuroimaging in justice and security. For example, whether to undertake inclusive deliberation in controversial fields of application, such as private security. Another issue was how to create the opportunity to accommodate acquired insights and translate them into action in a domain characterised by an abundance of institutional barriers. And lastly, how to cope with the potential ‘misuse’ of neuroimaging technologies for certain applications? These observations and questions inspired the conduct of four case studies on the shaping of inclusive deliberation and action.

3.3.2 Case studies of shaping inclusive deliberation & action

Case studies were selected as being illustrative of a phenomenon relevant to the shaping of inclusive deliberation and action in the real-life setting of emerging RRI practices in neuroimaging in justice and security. The phenomenon can be studied holistically in case studies, meaning that the complexity of the particular emerging RRI practice is taken into account and that changing circumstances in the real-life setting are acknowledged, with respect to different actors involved, different events taking place and decisions being taking within the practice. To study the phenomenon holistically, one or more methods may be adopted. In this thesis, we mainly used qualitative methods, ranging from document analysis, interviews, focus groups and dialogue to observation. These were used in combination.

Stake (1995) argues that careful case selection offers the opportunity to maximise learning in a necessarily limited time span. This means that it is justifiable to use convenience selection for the cases and information-oriented selection (Flyvbjerg 2006, Yin 2002). Cases were selected which addressed the second research question and were open and accessible for investigation. The following criteria were used:

- The case should involve the application or intended application of neuroscientific knowledge, a certain neuroimaging modality or a derivative technology, and should preferably be emerging.
- The case should address the shaping of inclusive deliberation and/or action, and should include the political/cultural/institutional environment in which shaping is to take place.
- The individual selected cases should be diverse enough to explore different elements of the shaping of inclusive deliberation and action, containing at least one case per RRI category (learning, governance, action)
The case should be relevant to the application context of justice or security, or also address wider phenomena influencing the context of justice and security.

The case should be illustrative of a need for responsible research or responsible development, or illustrative of certain characteristics considered as a responsible research process or responsible development process.

The case should be accessible to in-depth investigation to provide opportunities for answering the study questions.

Table 3.1 Overview of the case studies.

<table>
<thead>
<tr>
<th>Case study</th>
<th>Research relevance</th>
<th>RRI type</th>
<th>Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The role of news media in inclusive deliberation</td>
<td>Learning</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Does reporting on neuroimaging in news media support societal learning and as such lay a foundation for responsible governance and action?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Shaping inclusive deliberation on responsible applications of neuroimaging in the contentious practice of private security</td>
<td>Governance</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Shaping inclusive deliberation with a pressing need in the landscape of security as a starting point, without inducing a technological fix. The systematic evaluation of instigated action.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>The potential misuse of neuroimaging technologies when applied to detect paedophilic sexual interest among job applicants in child care</td>
<td>Governance</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Problematizing the notion of alignment underlying RRI and providing suggestions on how to deal with problematic alignment in inclusive deliberation processes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>The creation of adaptive space by a heterogeneous collaboration concerning the application of neuroscientific knowledge in juvenile justice institutions</td>
<td>Action</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Identification of facilitators to create room to manoeuvre within the rigid borders posed by institutional barriers.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The selected cases are displayed in Table 3.1. The cases are situated in the Netherlands and concern a variety of elements relevant to the shaping of inclusive deliberation and action in emerging RRI practices of neuroimaging in justice and security. Case studies 1, 2 and 4 were characterised by an interpretative epistemological approach in the sense that the focus was on understanding meanings, contexts and processes as perceived from different perspectives (Stake 1995). The stance was more critical in case study 3 in

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* See paragraph 2.7.
which a reflective perspective was used to take the wider social and political environment into account, heightening the possibility of misuse in this particular case. The case studies are described in more detail below.

Study 3. Framing of neuroimaging research in Dutch news media

Neuroscientists conceptualised RRI predominantly as “learning”. They felt a responsibility to educate the public via the popular press, especially about the possibilities and the limitations of technologies. Neuroscientists had been previously found to fear the influence of the news media in creating hype. Hypes pose a challenge for the responsible governance of emerging technologies and should therefore be prevented or mitigated in favour of more responsible constructions of technological futures (e.g. Simakova and Coenen 2013). At the same time, the neuroscientists see their interactions with the news media as critical for learning about the opportunities and limitations of neuroimaging research. Learning can be envisioned as a premise for the emergence of responsible governance and responsible research and innovation in general, also within the domain of justice and security. Therefore, this case study is positioned in the first RRI category of “Learning” (see §2.7). The question is, however, whether this role of facilitating learning can be bestowed upon the institution of news media, and whether the news media can be considered an RRI practice for learning.

The following study question was central to this study:

iii. How is neuroimaging research framed in Dutch news media and can this contribute to societal learning on neuroimaging research?

Using the LexisNexis Academic database, a sample of 307 unique articles in national and regional newspapers was selected, published between 1992 and 2012, describing neuroimaging research and potential resulting applications. Both quantitative and qualitative methods were used to analyse the data. All articles were read and reread by two researchers and a coding guide was created in consecutive steps. After rounds of independent inductive labelling and discussions of the coded segments and preliminary results, a final coding guide was defined. All texts were then re-coded by the author of this thesis and analysed using qualitative data analysis software (MAXQDA 11). To assess the presence of any statistically significant associations between codes resulting from the qualitative analysis, a Fisher’s Exact Test (two-tailed) was conducted with a p value of
<.05 indicating statistical significance (Mehta and Hilton 1993). More details of the methodology are provided in Chapter 5.

**Study 4. Shaping of inclusive deliberation & action in security management**

Security management was selected for the second case study because neuroimaging technologies can be seen here in the earliest phase, and because private security is particularly controversial. There is potential to create an emerging RRI practice through inclusive deliberation, but also to set things in motion that can turn out to be uncontrollable. This case study revolves around the shaping of responsible imaginary futures by applying neuroimaging technologies in the practice of private security. It brought together security management practitioners and scientists in an iterative manner. The security management professionals are members of a regional division of the largest international organisation for security (management professionals), American Security Industries Association (ASIS International). This association was keen to explore opportunities for neuroimaging in their practice. This case study belongs to the RRI category of “Governance” as it lays the foundation for research agenda setting (see § 2.7). The following study questions were central to this study:

iv. **How do Dutch neuroscientists and security professionals imagine the potential application of neuroimaging in security management?**

v. **Which shared imaginary can be constructed in an upstream inclusive deliberation activity that is likely to inform the innovation process towards a responsible goal?**

vi. **What actions were instigated in the process?**

To answer the study questions, a multi-stakeholder dialogue process called Interactive Learning and Action (ILA) was adopted (Broerse and Bunders 2000). Four key aspects of ILA are the articulation of experiential knowledge, knowledge co-creation, embedding and process facilitation (Betten et al. 2013). The different stakeholders are brought together in a step-by-step process. First, a stakeholder analysis is performed to identify the stakeholders to be involved in the process. Second, needs, perspectives and interests of the identified stakeholders are inventoried using interviews and homogenous focus groups. Different stakeholders are not brought together in this phase because of asymmetries in knowledge and, to some extent, status. Third, integration of the perspectives and knowledge took place in dialogue meetings. Here, the different stakeholders were brought together for mutual learning, facilitating identification of
desirable directions for research and technology development. Subsequently, plans can be made and implemented in later phases.

A total of 20 semi-structured interviews were conducted with neuroscientists employing concepts relevant to the domain of justice and security. The scientists’ perspectives on potential application of neuroimaging for security issues (n=15) were identified, as well as shared imaginaries for neuroimaging research in general (n=20). In addition, key informant interviews (n=3) and three focus groups with security professionals (n=13) were conducted to gain insights into their views on the application of neuroimaging in security management. Subsequently, a dialogue session was designed on the basis of the imaginary futures considered during the focus groups: (1) the recognition of intentions and predicting behaviour, and (2) subsequently influencing behaviour. The actors (n=13) comprised four neuroscientists, six security management professionals, two intermediary technology developing actors and one applied ethicist. Seven months after the dialogue, eight semi-structured telephonic interviews were undertaken with dialogue participants: five security management professionals and three neuroscientists. The 20-minute interviews focused on significant changes after the dialogue with respect to personal actions and the possible emergence of new relations with other stakeholders, as well as their perception of the event itself. Thematic analysis of the transcripts took place using qualitative analysis software MAXQDA 11. Notes taken during the feedback interviews were thematically analysed by hand. A written reaction was obtained from the intermediary technology developer party, and analysed in a similar manner. More details on the methodology are provided in Chapter 6.

Study 5. Shaping of inclusive deliberation & action on the paedoscan

During previous interactions with stakeholders, awareness was raised on potential masking of fact and value diversity in relation to neurotechnology applications for the detection of paedophilic sexual tendencies. This masking of fact and value diversity may be a barrier to inclusive deliberation and action because not all relevant perspectives will be accounted for in inclusive deliberation and action processes. This induces an impression of alignment, rather than actual alignment, and enhances the potential misuse of neuroimaging technologies and irresponsible policies surrounding technology development. This case study is positioned in the RRI category of “Governance” (see § 2.7). The aim was to show how this masking of fact and value diversity occurs, how it relates to the potential misuse of neuroimaging technology, and how this phenomenon complicates inclusive deliberation activities.
CHAPTER 3

The following study question was considered:

vii. How can the masking of fact and value diversity reduce the potential of societally desirable and ethically acceptable outcomes of neurotechnology applications for the detection of paedophilic sexual interests among job applicants?

For this critical analysis, studies of scientific and academic literature were performed. A systematic search of scientific literature was conducted to map the developments relevant to the technological side of this case study. The systematic literature search strategy was adopted as it allowed for a structured analysis of the scientific system producing these scientific articles. For the argumentative side of this case study, a non-systematic search through the scholarly literature was conducted with an iterative approach because a non-systematic iterative search process enabled the exploration of complex dynamics. The databases Web of Science, PubMed, PsycINFO and ScienceDirect were searched, resulting in 28 original data articles and an additional 14 review/meta-analysis articles. For the non-systematic search through the scholarly literature, Google Scholar was also used. The literature searches were not restricted to a certain time period. For recent developments in social policies, news articles were also identified. Here, LexisNexis Academic and Google were used. The identified sources were read and phenomena relevant to the masking of fact or value diversity were noted in a categorisation matrix. Based on this matrix, overarching themes were constructed in conversations between the author of this thesis and another researcher. Thematic data-analysis (Braun and Clarke 2006) took place according to these five themes and was performed by hand. Thematic analysis of the sources identified with the systematic search of the scientific literature took place by using MAXQDA 11. For more details on the methodology see Chapter 7.

Study 6. Shaping of inclusive deliberation & action in an emerging RRI practice in juvenile justice

This case study was selected to observe how members of a heterogeneous collaboration create what is called ‘adaptive space’. Because of its focus on grassroots problems, it is a promising practice of RRI ‘in action’, which potentially may provide interesting lessons on how to create adaptive space. This case study is positioned in the RRI category of “Action” (see § 2.7). Considering the importance attached to different stakeholders interacting in emerging RRI practices, emerging heterogeneous collaborations provide an excellent site for studying inclusive deliberation and action in a real-life setting. This case revolves around a collaboration between researchers and practitioners from juvenile
justice institutions (JJIs) focusing on neurobiological measures for assessing the risk of recidivism and on implicit cognition in relation to substance abuse among detained juvenile offenders. In this collaboration, room to manoeuvre is particularly required, given the high political influence on Dutch JJIs – they have been undergoing major changes in the last decade because of policy reform – but also because of the conflicting nature of the system of science and the system of juvenile justice. Science aims at theoretical development and has its own set of rules and practices, guarded by mechanisms such as peer review. The juvenile justice system is very different: its goals are often more pragmatic and daily routines are heavily regulated and, more often than not, legally enshrined. This collaboration was accessible from the moment of its inception. Furthermore, although not explicitly set up as a RRI practice, the nature of the interaction between the researchers and the practitioners bore resemblance to characteristics of RRI practices. This case study was undertaken to gain insights into how adaptive space can be created as this allows for the accommodation of insights obtained through inclusive deliberation processes. The following study question was considered here:

viii. What factors contribute to the creation and maintenance of ‘adaptive space’ as observed in an emerging RRI practice in the Netherlands?

The collaboration targeted the application of neuroscientific knowledge and techniques in the domain of JJIs. Data was collected using multiple qualitative methods: journal writing; observations of group meetings and site visits; and semi-structured time-line interviews with five participants of the collaboration. This approach supported critical reflection, enhancing and deepening perspective and meanings. The journal and the interview transcriptions were thematically analysed using qualitative data analysis software (MAXQDA 11). More details of the methodology are provided in Chapter 8.

3.4 VALIDITY

Multiple strategies were applied to maximise the validity of the results and conclusions of this study, and to minimise researcher bias.

1. Triangulation took place on two levels. Multiple research methods were adopted, ranging from desk studies, systematic and non-systematic literature reviews, semi-structured interviews, focus groups and participatory observation to dialogue. These methods made it possible to confirm or complement previous
findings. The design of the interviews, focus groups and the dialogue session, as well as the approach to participatory observations, were discussed between multiple researchers.

2. We looked, as much as possible, for saturation of data within the employment of the research methods bearing in mind the small and fragmented field of neuroimaging in the field of justice and security.

3. Researcher bias was minimised by transcribing interviews, focus groups and the dialogue session, and discussing the analysis and results between multiple researchers.

4. We used member checks by sending summaries to participants and asking for their feedback, and by follow-up interviews by telephone.

5. Engagement with stakeholders during the process of knowledge generation is an important reality check for the transdisciplinary research process (Wickson et al. 2006). In this research project, there was interaction with an advisory committee7 and a valorisation panel8 to discuss research choices, research design, methodological choices, the validity of results, the engagement of participants and the dissemination of results. As such, both design and data were valorised. Consultation meetings with the valorisation panel, consisting of societal stakeholders and policy makers, took place once a year. The supervisory committee, consisting of experts on neuroscience and an expert on forensic psychology/psychiatry, was consulted twice a year. Secondly, a symposium titled ‘Neuroimaging meets society’ was organised on 3 July 2014 at which findings of this thesis were presented and discussed.

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7 Members of the advisory committee: prof. dr. Corine de Ruijter, professor forensic psychology (Maastricht University), prof. dr. Lydia Krabbendam, professor of educational neuropsychology (VU University Amsterdam), prof. dr. Serge Rombouts, professor methods of cognitive neuroimaging (Leiden University).

8 Members of the valorisation panel per sub-project:

**Justice and Security**: Tinka Bethlem (Police Amsterdam-Amstelland), Dr. Menke Bol/Ton Coenen (Ministry of Security and Justice), Dr. Frank van Dijk (The Council for the Judiciary), Ap Boom (ASIS Benelux) and dr. Sanne Verwaaijen (GGZ).


**Education**: dr. Ir. Simone de Bakker-Löhner (Education Council of the Netherlands), drs. Ria van Dinteren (Breinwerk, author of Brein in Training), drs. Lucien Kester (Graaf Huyn College, Geleen), ir. Mariken Althuizen (2WICKED).
3.5 RESEARCH TEAM

This thesis, and the work described in it, is part of the wider research project ‘Neurosciences in Dialogue’. The wider project focused on the responsible development and embedding of neuroimaging technologies in an early phase in the fields of a) health care; b) education, and c) security and justice. A complementary goal, d) was to monitor and evaluate the applied RRI approaches in the aforementioned application fields. The project was funded by the now thematic programme, “Responsible Innovation: ethical and societal exploration of science and technology” [grant number 313-99-180]. The sub-project on education received additional funds from The Centre for Society and the Life Sciences (CSG).

The ‘Neurosciences in Dialogue’ research team was supervised by Prof. Dr Jacqueline Broerse (project leader) and Prof. Dr Tjard de Cock Buning. Dr Frank Kupper was involved as a post-doctoral researcher in the monitoring and evaluation of the applied RRI approaches (sub-project d). Dr Marlous Arentshorst, then a PhD candidate, focused on neuroimaging developments in the domain of health care (sub-project a), Dr Rosanne Edelenbosch, then a PhD candidate, focused on neurosciences in the field of education (sub-project b), while the author of this thesis focused on neuroimaging developments in the fields of justice and security (sub-project c). The interviews, focus groups, participatory observations and literature reviews presented in this thesis were conducted and facilitated by the author of this thesis. The dialogue meeting was developed with and facilitated by Frank Kupper and the author. The media analysis was conducted with Marlous Arentshorst. The symposium “Neuroscience meets society” was organised by Marlous Arentshorst with assistance of the rest of the project team.

3.6 STRUCTURE OF THIS THESIS

In Chapters 4-8, the findings of this thesis are presented. Part 1 focuses on the first main research question and comprises Chapter 4 on the conceptualisations of RRI in academic literature and by neuroscientists. Part 2 focuses on the second main research question, the shaping of inclusive deliberation and action in several cases, and comprises Chapters 5-8. Chapter 5 deals with the framing of neuroimaging research in the media. In Chapter 6, new stakeholders are introduced, including corporate security managers, the research team, and the external facilitators of inclusive deliberation and action processes. It deals with the question how to initiate RRI, and the normative questions this arise for the
facilitators. **Chapter 7** focuses on an early heterogeneous collaboration in an emerging RRI practice, and how the partners managed to adapt to each other and to changing circumstances in the restrictive domain of juvenile justice. **Chapter 8** postulates that RRI has a role in science and technology development on topics which are currently taboo. By studying the case of the paedoscan, **Chapter 8** explored how mechanisms of early closure can greatly diminish the potential of inclusive deliberation and action to attain ethically acceptable and societally desirable technologies. In **Chapter 9**, the main research questions are revisited and the findings are synthesised and placed in a broader context. Opportunities for further research are discussed.