Constructing embryos, constructing politics: Connecting politics and technology in the Netherlands and Germany

Govert Valkenburg[a]* and Erik Aarden[b]

[a]Maastricht University, Faculty of Arts and Social Sciences, P.O. Box 616, 6200 MD Maastricht, the Netherlands. E-mail: ac@govertvalkenburg.nl
[b]RWTH Aachen University, Institute of Political Science, Mies-van-der-Rohe-Straße 10, 52074 Aachen, Germany. E-mail: Erik.aarden@ipw.rwth-aachen.de
*Corresponding author

Abstract

This article presents an innovative approach to interpreting and mending political discussions on sensitive medical-ethical issues. It adopts the idiom of *co-production*, which presumes that technological and political choices shape our world simultaneously, and in turn cannot be seen apart from the background that they themselves help shape. By developing the idea of a *nexus*, this connection between technological and political practices is further conceptualised. Through an analysis of debates on pre-implantation genetic diagnosis (PGD), this article describes the constitution of the embryo in two countries. In Germany, the embryo is seen as a full member of the human community. In contrast, in the Netherlands the embryo is largely invisible. This difference connects to radically divergent moral decisions, technological configurations, and political arrangements. In turn, these different configurations reproduce particular constitutions of the embryo. The article concludes that discussions about PGD gain transparency by breaking down the relations between political and technological practices into various levels. Each of these levels offers its own way to see the embryo as a nexus between practices of politics and practices of science and technology.

Keywords: nexus; PGD; embryo politics; co-production; autonomy; public debate

Co-production of a Nexus

In the summer of 2008, news media, politicians and the broader public in the Netherlands were absorbed by a brief but vehement debate on the moral status of *pre-implantation genetic diagnosis* (PGD). This medical technology allows prenatal testing and selection of embryo created in vitro before implantation into the mother's womb. At the start of this controversy, PGD had already been utilised for more than ten years. Hence, the debate in 2008 centred around moral limits to its use, rather than engaging with the configuration of the technology as such. The debate was posterior to the development of the technology. Various

parliamentary parties, as well as their constituencies, were in a state of profound disagreement about the use of PGD. They disagreed on whether PGD should be allowed in prevention of diseases with so-called *incomplete penetrance*: that is, diseases that are more likely, but not certain, to develop, even if a person is a carrier of the genetic mutation. This notion is relatively abstract, but can be illustrated by the example of hereditary breast cancer. Specifically, women with this genetic mutation have a significantly increased risk of developing cancer, but they are not certain to develop the disease. The sudden preoccupation with legislation on PGD was a somewhat surprising topic in the Dutch public debate. However, the way the disagreement further unfolded and was resolved was rather typical of Dutch political culture.

The shaping of PGD legislation in the Netherlands offers a sharp contrast with other countries, many of which have had lengthy public debates about embryo research and PGD. Such debate had hitherto been virtually absent in the Netherlands. By contrast, in Germany, embryo research has been legally restricted since the Embryo Protection Act of 1990. Many debates, primarily inside policy making, advisory and medical professional organisations and institutions, have been conducted against this background ever since. However, a fiery public debate on PGD like the one in the Netherlands in 2008 is harder to pinpoint in Germany. Instead, there is an ongoing awareness of the problematic nature of embryo research and PGD. Controversies around regulation in these areas occasionally gain momentum in various forms. These cross-national differences are central to this article.

As various studies of political controversies and decision-making about technical developments have shown, countries can differ considerably with respect to their political cultures as well as to the technologies they develop (Daemmrich, 2004; Jasanoff, 2005; Aarden, 2010). Taking these two aspects together, our analysis will build on the idea of *co-*

production as developed by Jasanoff. She argues that 'the ways in which we know and represent the world, both nature and society, are inseparable from the ways in which we choose to live in it' (Jasanoff, 2004, p. 2). Thus, the social and the technical, as well as knowledge concerning both, mutually and seamlessly shape each other. Here, we will use this notion of co-production as a heuristic device, rather than a fully-fledged ontology of how technoscience and politics relate. This perspective steers our gaze to the phenomena under investigation, providing a starting point rather than the conclusion for understanding variation in the debates on PGD.

Taking this vocabulary as a starting position, we will develop the notion of *nexus* as a material-discursive assemblage that connects to both the technical and the social. In the cases discussed below, the embryo figures as a nexus, embodying the link between politics on the one hand, and science and technology on the other. We will closely examine the contrasting definitions of the embryo and the connections between those differently defined embryos and the surrounding politics and technologies. This will provide a convincing account of the differences between the two countries. In fact, it provides an elegant solution to the chicken-or-the-egg problem that is naturally raised against accounts that only describe the reconfiguration of the social by the technical or vice versa.

Mulkay (1994, 1997) has extensively studied the social construction of a definition of the embryo, in the context of the embryo research debate in the United Kingdom. His research shows, first, how legislation was eventually produced by evolving coalitions of parliamentarians, researchers and other figures of public authority. Second, it describes the significant role of changing conceptions of the embryo. In particular, Mulkay points towards the role of the concept of the *pre-embryo* that came into use in the course of the debate. It served to make embryo research morally acceptable (Mulkay, 1994). In a cross-national

comparison, Baylis and Krahn (2009) argue even more radically that the moral status of the embryo is a matter of moral construction, contingent on the purposes for which the embryo is created. In our analysis, we will connect this attribution of meaning to the material arrangements of medical practices. Through this connection, it becomes clear how the embryo serves as a nexus to stabilise and connect the political and technical domains.

We will further develop this symmetrical outlook in a comparison between the Netherlands and Germany. Moreover, we will connect it explicitly to the shaping and the governance of technologies in both countries. The particular constitution of the embryo in both countries offers clarity explaining the different developments of the debates in Germany and the Netherlands, as well as the different technological arrangements around PGD.

This article will continue with a brief description of PGD and its ethical challenges. Subsequently, a generic conceptualisation of the relation between politics and technology will be elaborated. This will provide the framework in which both the German and Dutch cases are studied. Between the two cases, the meanings attributed to the embryo will be shown to be radically different. In conclusion, the notion of nexus will be fleshed out and we will explain how it can help in aligning politics with science and technology.

Pre-implantation genetic diagnostics

In essence, PGD is the selection of human embryos based on their genetic profile. In the course of an *in vitro fertilisation* (IVF) procedure, a number of embryos prepared for implantation into the mother's womb are subjected to biopsy. Most commonly when the embryos are between six and eight cells in size, one or two cells are removed to have their genetic profile analysed. Typically, such analysis is aimed at identifying mutations associated with severe medical conditions such as Steinert's and Huntington's diseases. To prevent these

conditions, only those embryos without the specific genetic markers are implanted (Braude *et al*, 2002; Kanavakis and Traeger-Synodinos, 2002).

Throughout Europe, PGD is increasingly becoming established as a routine medical procedure. Recent numbers from the PGD Consortium of the European Society of Human Reproduction and Embryology (ESHRE), which includes 57 centres from the continent, show a rising trend in the number of procedures. In 2006, the consortium analysed data of 5,858 cycles, which resulted in 1,437 pregnancies and 1,206 babies (Goossens *et al*, 2009). At present, PGD is predominantly used to prevent carriers of mutations responsible for Huntington's and Steiner's diseases and heritable breast cancer from being transferred into a mother's womb. However, the specifics of both application and regulation are different between countries. The difference between Germany and the Netherlands will be investigated in this article.

PGD has raised, and continues to raise, many ethical issues (see for example, Cameron and Williamson, 2003; Landeweerd, 2009; Shenfield *et al*, 2003). An extensive discussion of these issues and various philosophical positions concerning them is beyond the scope of this article. However, it is helpful to summarise four major ethical concerns about PGD to provide a background to the debates embedded in the national political cultures that we will discuss below. One argument made against PGD is that the selection of disease-free embryos and destruction of non-implanted embryos does, in effect, amount to the destruction of a human life. Along similar lines, it is sometimes argued that PGD leads to increased discrimination against disabled and chronically ill people and their parents, based on the idea that their condition (and life) 'could have been prevented'. A third ethical issue is whether the use of PGD can, in practice, be limited to medical applications or will instead be used by parents to 'design' perfect children (Sandel, 2007), which in turn would lead to new forms of eugenics

(King, 1999). (Opponents of PGD consider it unlikely that effective limits could or would be applied, and summarily describe this problem as being the 'slippery slope' of PGD applications.) A final issue concerns the acceptability of PGD, and questions whether the benefits of PGD in terms of disease prevention and successful pregnancy rates outweigh costs of the procedure (be they, for example, financial, emotional, or psychological). Clearly, how these issues are interpreted and weighted depends to a large extent on one's philosophical point of departure. Moreover, and central to our argument, there appear to be significant cross-national differences not only in political decision-making around a technology such as PGD (see for example, Bleiklie *et al*, 2004) but also in the ethical lines of argumentation that are dominant.

In general terms, the Dutch and German debates relate as follows. Both debates revolve around the tension between the dignity of embryonic human life, and the freedom of choice made increasingly available to parents by technological change. In both cases, a fundamental respect for the human embryo is reflected by either the law itself, or in accompanying documents, explanations, and guidelines. At the same time, both countries highly value the autonomy of parents. In the Netherlands, the law is geared towards ensuring autonomy. In Germany, the primary argument launched against a prohibition of PGD is that its application should be a concern for the couples at risk of genetic disease. As we will show, countries differ in how the balance between autonomy and dignity is tipped. These perspectives on autonomy also figure in the debate differently, even if they are apparently similar at the superficial level of the arguments themselves. The different valuing of autonomy (for the parents) and dignity (for the embryo) will form the starting point of our analysis.

We will seek additional explanation at a level less overt than the mere arguments and their structure. We assume that concepts and structures are always ambiguous and flexible. This implies that underlying different moral discussions, different conceptions may be found, not only regarding moral principles but also regarding entities that are not straightforwardly moral: that is, for example, technologies, regulations, and in this case, the embryo. In the Dutch and German discussions we will describe the specific framings of the embryo and its relation to technology. Thus, the moral struggles appear as more than a matter of moral disagreement or diverging worldviews. Instead, we argue, they are intimately connected to the different *ways of speaking about embryos* that are dominant in a particular political community. Furthermore, they appear connected as well to the different technological configurations and practices that are found within the respective countries and debates (Jasanoff, 2005, p. 25). We thus move into the realm of technological configurations, expanding the argument by Sperling (2008), who describes discursive exchanges and rearrangements between political and scientific practices.

In the following case studies, we will see that in the debate in the Netherlands, the most important argument against using PGD in prevention of heritable breast cancer is that it would deny the right to life of an embryo with the potential for a healthy life. As we will show, this argument is unconvincing against a cultural background that has no particular regard for the embryo as a human subject. The constitution of the embryo as reflected by law and regulations is one of invisibility. Despite moral concerns and a general regard for the dignity of the embryo, regulations focus predominantly on parental autonomy in the Netherlands. Technologies and practices are arranged accordingly, and the embryo becomes an anathema to politics. Thus, the technology of PGD could emerge behind the front doors of laboratories, without arousing much controversy. In fact, as we will show, it was not actually the technology or procedure itself that stirred controversy, but that positions were voiced that

were incompatible with this invisible embryo – the invisibility of which has long been consolidated in existing (and deployed) technologies, laws and regulations.

Circumstances are different in Germany. Rather than being 'invisible', the status of the embryo is the focus of debate particularly where the question whether human dignity and inviolability of human life apply before birth is concerned. As we will see, the dignity of human lives provides arguments for both supporters and opponents of pre-implantation genetic testing of IVF embryos – albeit in different forms. The dominant position to date in Germany is the one that conceives of the embryo as a human being and, as such, inviolable. This position is also reinforced in the (practically) absolute legal ban on embryo research. In response to this ban, a variation on the standard practice of PGD has developed. This practice performs PGD on the fringes of German legislation, and has specific temporal and technical limitations. Interestingly, the application of this specific form of PGD is legitimated with arguments that maintain the dignity of human life, but claim that PGD can be used to promote a better life after birth. Consequently, the discussion about the technology PGD in Germany is also a discussion about how to define the boundaries of inviolability and dignity of human life.

These different sociotechnical arrangements provide different backdrops against which political discussions take place. Thus, different styles of argumentation emerge, each being subject to different limits: how we talk and what we are allowed to say differs from country to country. Consequently, different limits are set to the application of PGD and different arrangements prevail in the practices in which PGD is applied. Our aim is not to show how cultural differences simply dictate different technological arrangements, nor the other way round. Rather, we will show that both the cultural and the technical are the result of active

shaping and that this is hard work. The idea of *nexus* conceptualizes the object of this work; in this case the embryo, connecting to both the law and the lab.

Material Politics, Political Materials

For the present argument, we will use a conception of politics that comprises of elements that are not usually combined in mainstream ideas of politics. We see politics as a practice of contestation and articulation of irreconcilable ideas and ideologies (Mouffe, 2005). For a democratic system to offer its constituency genuine opportunities of choice, it is necessary to expose different ideas and standpoints, which are themselves not presented in pursuit of consensus. Simultaneously though, we recognize in the same politics the need to arrive at collective decisions (Weale, 2004). This is not to say that we accept all the assumptions underlying such consensus-oriented accounts of politics, particularly the assumption that rational and reasonable political subjects may be expected to achieve consensus. It is, however, to say that people in politics act *as if* they were pursuing agreement. These two poles of contestation and the seeming pursuit of consensus offer the primary ingredients for our investigation of politics.

We approach politics in a descriptive way. That is, we are not, or at least not *a priori*, framing criteria that a proper political decision should meet. Rather, we investigate how politics is actually conducted and how decisions are framed and justified. By entertaining a relatively open conception of politics, we intend to do justice to the many guises in which politics comes, and not to risk selecting one that is particularly inept to connect to the nexus concept. Even though our stance is primarily descriptive, we will specify in our conclusions some potential improvements for democratic debate. As we will show, the concept of *nexus*

implies a revision of the balance between politics as contestation and politics as consensus-seeking.

In our investigation of politics, we will use a three-tier operationalization. We will split it into the general dimensions of scope, justification and content (Valkenburg, 2009). The first dimension, *scope*, specifies the limits of issues that are eligible for politics to decide upon. For example, laws, but not vacation destinations, are within the scope of politics. The second dimension, *justification*, specifies limits to what can be deemed to justify and support the position people take on those issues. When proposing commonly binding rules, the prevention of harm is generally a convincing argument in their support. An appeal to taste is usually not a valid justification. The third dimension, *content*, concerns the actual decision that is made. For example, a nation may engage in a war in Afghanistan; or it may prohibit consumption of chewing gum in public – provided of course, that such consumption is agreed upon to fall within the *scope*, and that a constituency can find acceptable *justifications* for such a prohibition. These three dimensions of scope, justification and content should be understood as underdetermined categories, the exact specification of which evolves in practical situations. At this point, we do not specify them normatively, but use them heuristically, just as we do with the notion of co-production.

The value of this conceptualisation lies in the fact that each of the three dimensions offers a way to connect technology and politics. Moreover, each of the dimensions facilitates this connection in a bidirectional way. The idea of scope connects to the question whether technologies bring about a transformation of what can rightfully be considered subject to political decision or not, and conversely, a transformation of whether a certain technological issue is itself considered part of the scope. Similarly, as to justification, the question is whether technological change opens up new arguments or brings about transformations in

existing arguments, and whether specific technological issues are rightly addressed by accepted ways of argumentation. Finally, technology relates to content in the sense that a decision of whatever kind is potentially consolidated in technological configurations. Conversely, of course, the content of a political decision may also pertain to technological configurations.

The idea of co-production (Jasanoff, 2004) provides the general model for our analysis, while it is at the same time extended by the concept of nexus and the dissection of political decisions into scope, justification and content. We will argue that the connection between political and technical choices is located at the specific constitution of the embryo, which shows considerable differences between the Netherlands and Germany. This entails different scopes, different justifications, and thus different contents. In Germany, it connects to an idea of scope that encompasses the prohibition of PGD. In the Netherlands, the invisible embryo is, in line with PGD, being regulated outside the public sphere and assigned to the personal responsibility of parents and clinicians. For justification and content, similar mechanisms will be discussed.

Thus, the embryo forms a nexus between politics and technology. It will appear not as just another element that all persons involved superficially relate to, but instead as one that takes a central position between political and technological ensembles. It exerts influence while at the same time being subject to construction and rearrangement. This rearrangement is hard work, both on the political and on the technological side. This hard work, which is partly material and partly discursive, thus offers an additional layer to mere discursive approaches. Where Gottweis (2008) identifies important parallels between technological design and the governance of practices of democratic politics, we extend this by situating and materializing these parallels in the nexus.

Germany: The Potential Person

Embryo research, and consequently PGD, is subject to severe legal restrictions in Germany. Under the Embryo Protection Act (*Embryonenschutzgesetz)* of 1990, embryos conceived in vitro can only be used to establish a pregnancy and may not be destroyed for purposes of research or prenatal testing. Even though the Act does not mention PGD explicitly (since it was still at a developmental stage at the time) and there is some debate about the pluripotency (and thus legal inviolability) of cells biopsied for genetic testing in the procedure, there is a broadly shared understanding of the (internationally) most common form of PGD as being forbidden in Germany (Kollek, 2002; Schwinger, 2003). However, as we will see below, the Act sets specific boundaries in its definition of an embryo that allow for a particular technical form of PGD. The existence of this form of PGD and its technical shortcomings have, in all likelihood, contributed to a situation where the legal *status quo* is occasionally questioned. It was most recently discussed by the Federal Court of Justice in July 2010 – albeit in professional rather than broad public circles (Wüstner, 2006).

For the purpose of this article, we analysed two episodes of debates on PGD in depth. These episodes can be considered as contemporaneous and central to the ongoing debate regarding PGD in Germany. For example, an overview of the quarrels concerning the legal status of PGD published in the esteemed *Frankfurter Algemeine Zeitung* in November 2010, explicitly refers to these two debates (Dietrich, 2010). Specifically, it discusses a Federal Court of Justice ruling allowing PGD under specific circumstances and the subsequent decision of the Christian-Democrat Party CDU (*Christlich Demokratische Union*) to argue for an explicit legal ban on the procedure. The first episode of these debates occurred from 2000 onwards in response to a publication by the scientific council of the Federal Chamber of

Physicians (Bundesärztekammer, 2000). In early 2000, this council published a 'concept-guideline' for the application of PGD in Germany's main medical journal. In line with the proceedings of the Bioethics Committee in the State of Rheinland-Pfalz, the council called into question whether legislative conditions at the time should actually be interpreted as prohibiting PGD. The council therefore initiated a discussion on how to proceed if the procedure were to be allowed. It clearly indicated that it considers the choice whether or not to undergo PGD is primarily a concern for couples at risk. It also pointed out the moral responsibility of physicians to ascertain that application of the procedure remained within moral boundaries. Furthermore, the council emphasised that its plea for allowing PGD must not be interpreted as a first step towards granting permission to clone cells or embryos. In supporting PGD, it proposed strict conditions to the application of the procedure. Finally, the council mentioned that the concept-guideline should not be seen as an attempt to influence decision-making about whether PGD should be allowed in the first place. Instead, the council believed this to be a matter for debate in the general public, which was *de facto* a remark concerning scope.

Despite this disclaimer and the meticulous wording of criteria for the application of PGD, the ensuing debate in the medical journal focused exactly on the issue of whether PGD should be legal or not. As our analysis of the various responses to this publication shows, different arguments were put forward against this proposal, a few of which appeared repeatedly. One of those recurring arguments was the strategy of describing PGD as a form of 'eugenic selection', and of presenting PGD as a step down a slippery slope leading inevitably back to the Nazi crimes of the 1930s and 1940s (Jachertz, 2000; Wagner, 2000). Similarly, it was claimed repeatedly that individual life, including the unborn life, needs to be protected – a position ultimately assumed by the Federal Ministry of Health (Riedel, 2000). These are particular examples of the forms that justification can take.

A second challenge of the *status quo* consisted of the different forms of policy advice offered to the German Parliament. In 2002, the Parliament's own 'Enquete Commission on Law and Ethics in Modern Medicine' published a report covering many ethically sensitive areas of medicine, including PGD (Enquete-Kommission Deutscher Bundestag, 2002). The commission consisted of members of parliament as well as external experts. Not only did the Commission argue that the existing ban on PGD should persist, but it also advised that the Embryo Protection Act should be revised so that the ban would become more explicit. One year later though, the National Ethics Council (another ethical advisory body), also published a report. This report entirely focused on genetic testing before and during pregnancy (Nationaler Ethikrat, 2003). This Council had been installed by Mr. Schröder, Chancellor at the time, and was meant to serve as a prestigious part of his legacy. The Council, consisting of external experts (but without political mandate), by majority, proposed to rescind the ban on PGD. The arguments used by either side were not all that different from the ones already voiced in the aftermath of the Chamber of Physicians' concept guideline. On another level, the contrasting reports reflected a competition for authority over medical-ethical issues between the two advisory bodies and, by extension, between Parliament and the Chancellor. Ironically, the consequence of the advisory disagreement was that the regulatory *status quo* persisted.

In the course of these events, the constitution of the embryo became a strategic site of politics. Indeed as previously mentioned, the German Embryo Protection Act contains a very specific definition of what is an embryo. Remarkably, this definition does not include the entity existing before maternal and paternal genetic materials have merged to form a new, individual genotype. During the process of constituting a new genotype, genetic material from the mother is separated from the egg into so-called polar bodies. During this phase, the entity is strictly speaking not an embryo as defined by the Embryo Protection Act. In drawing a

boundary that would both permit IVF and protect the embryo at the same time, the legal definition of the embryo is situated at the point of merger of the two parental cellular nuclei.

True enough, there was no need to include the entity prior to merger into the legal definition. When the Act was first adopted, this definition sufficed for several political actors' calls for restrictive legislation. In fact, technical irrelevance initially made the fertilized embryo irrelevant in a political and moral sense as well. However, as a corollary, this created a moral no man's land that first became relevant in the course of newly established technoscientific arrangements. As the entity at hand is strictly speaking not defined as an embryo, diagnosis of the polar bodies was allowed under the Embryo Protection Act: the intervention neatly fits in the no man's land just identified. It only became relevant when testing of polar bodies became an inferior option for identifying disease risks before implantation.

Performing diagnosis on these polar bodies is usually referred to in Germany as 'pre-fertilisation diagnostics', to discern it from regular PGD. Although there are no legal limitations to this form of testing, it is relatively marginal, most importantly because it is subject to tight time-related restrictions. Moreover, through the polar bodies only the maternal half of the genome can be diagnosed. As the expression of sex-linked and recessive diseases results from the genetic input of both parents, the essential paternal half of the information is missing. Therefore, it is necessary that all maternally-imbued carriers are discarded. As one clinician told us, this means that the Act, meant to protect embryos, forces clinicians to prevent cells from forming embryos (and thereby discarding those very cells), even if they could have developed into (carrying) healthy girls. This is identified as an ethical problem of its own, which interestingly results from the particular techno-legal assemblage that constitutes PGD in Germany.

Germany shows a specific arrangement of politics and technology, connected by a specific idea of the embryo. Politics creates laws and circumstances that enable the embryo to be included in the community of human beings. Technologies are configured such that they comply with this vision of the embryo. Thus, content is fixed by both political practices and technological configurations. A similar fix is visible regarding the justification. In the dispute between the two advisory bodies, both camps appeal to the value of individuality. Below the surface, however, they connect radically different subjects to this individuality. Supporters of PGD take the subject to be a living or future person, that is, a parent or a future child. They apparently do not see the embryo, being only potentially a person, as a subject. In contrast, the opponents of PGD include the embryo explicitly in the community of subjects, and often even award it extra protection as it cannot speak for itself. While the value of individuality first appears unquestionably as a valid argument, in the end, only the version survives that connects to the 'proper' constitution of the embryo. Regarding scope, finally, the constitution of the embryo as a member of humankind makes it into a potential sufferer of harm, entailing that PGD is necessarily a political object.

The Netherlands: The Invisible Embryo

What a difference a single border can make! In perfect contrast with the German Embryo Protection Act (1990), the Dutch Embryo Law (2002) confers considerably more freedom to the parents than the German law. In general, the Dutch law is interpreted by lawyers, politicians and scholars as not including the embryo in the community of human subjects (Derckx and Hondius, 2002; Leenen, 1994). For example, unlike the German law, the Dutch law allows parents to donate their embryos to other couples in case the embryos are no longer needed for their own pursuit of pregnancy. Moreover, it is permitted to donate embryos to

scientific research and education. In the earlier (1981), and current, abortion law the embryo and the foetus are absent. Neither the embryo nor the foetus is even mentioned. Apart from a number of measures of caution, the law only demands that the situation must be one of serious emergency as to justify the abortion – that is, urgency for mothers(Abortion Law, 1981).

Remarkably, both the German and Dutch laws see a 'cell with the potential to develop into a human being' as an embryo. However, in the Dutch case, the consequences of this view are radically different from the consequences of the German law. The Dutch system supports the progressive legal protection of the embryo. Three phases are discerned: between conception and nidation, between nidation and viability, and between viability and birth (Dorscheidt, 2010; Leenen, 1994). Restrictions are relaxed in the phase before nidation. In this phase, the embryo is occasionally defined as a pre-embryo. According to Dutch law, a pre-embryo can be up to fourteen days old, whether inside or outside the mother's body. PGD pertains only to this first stage before nidation, and is therefore not straightforwardly covered by laws meant to protect unborn children. As stated previously, this is significantly different from the German law which does not make these distinctions.

Regarding PGD specifically, relevant legislation was only passed well after the procedure had evolved technically. The relevant pieces of legislation do not apply to PGD explicitly or exclusively, and the law does not impose strict limitations on PGD. The procedure is covered by the Act of Special Medical Treatments of 1997. This Act specifies a number of treatments that require licensing from the Dutch Ministry of Health. This list generically includes genetic interventions. By a so-called Planning Decree (2003), these treatments have been limited to the eight university hospitals in the Netherlands. In particular, PGD has been licensed to only one of them, Maastricht University Hospital. PGD is thus not

regulated on the basis of its interference in the development of human embryos, but for its highly specialised and experimental character.

The non-directive character of counselling and the emphasis on parental autonomy is also reflected by clinical-genetic practice. The hospital does not refer to a fixed list of disorders that qualify for PGD, nor do legal arrangements specify or demand such a list. Thus, the hospital offering PGD is largely left free to establish its decision making procedures, including procedures to determine whether PGD can be applied for a specific disease. The hospital offering PGD employs an interdisciplinary task force that evaluates requests for PGD on a case-by-case basis. This task force primarily addresses issues such as the burdens for the prospective parents, technical chances of success, and the question of whether PGD for certain diseases are cost-effective. Furthermore, the decision on PGD is made on a case-by-case basis by medical and ethical professionals, in close consultation with the parents (Aarden *et al*, 2009). Importantly, conditions for which PGD can be applied include genetic predispositions that do not necessarily come to expression, the so-called incomplete-penetrance mutations.

In a wider sense, parental autonomy is the norm in Dutch medical culture. As De Joode (2001) reports, patients approach medical professionals with the presumption that they are unconditionally entitled to everything available. If professionals express their reservations about the particular application of reproductive technologies, they often face strong disagreement from the patient. This is partly due to the mere availability of the technologies, but also to the positive exposure given to technologies in the media. Similarly, Kirejczyk *et al* (2001) observe that couples are *de facto* entitled to IVF, because they consider this included in their right to self-determination. Also, Kirejczyk (1999) observes an 'opaque' vocabulary around such issues in the Netherlands, constructing a discourse that speaks about embryos in a

way that hardly resembles the discussion on human beings. Much in line with our idea of technologies as nexuses, these observations confirm that it was virtually impossible for governing bodies to discuss the potential downsides of IVF, even if severe and purely technical , as its acceptance had already pervaded Dutch medical culture.

Against this background of an invisible embryo, a fiery discussion on the regulation of PGD took place in early 2008 (see also Huijer, 2009, for a different discussion of the topic). On the 26th May, Deputy Minister of Health Care, Mrs Bussemaker, issued a letter announcing that PGD in prevention of heritable breast cancer would be allowed (Bussemaker, 2008a). Remarkably, this application of PGD was already implicitly permitted by the guidelines as issued in 2003. Moreover, the Maastricht University Medical Centre had already used PGD in the detection and prevention of heritable breast cancer.

Even though the letter remained close to actual practice, Vice Premier Mr. Rouvoet took grave offence to it. He was severely discontented and argued that the letter should never have been sent to parliament (Peeperkorn, 2008). The situation was one of touchiness, as both Rouvoet and Bussemaker were in the same government coalition at the time. While Bussemaker belonged to a social-liberal party, Rouvoet belonged to a traditional Christian party. (A third, Christian-Democratic Party was also in the coalition as well. Even though it was actually the largest party, its role in this controversy was so marginal that we omit it henceforth.) Under different circumstances, the disagreement between Rouvoet and Bussemaker would have been drowned out in the course of parliamentary quarrel. However, their coalition required them to take responsibility together for the decisions to be made. Thus, they were condemned to operate in unison and to publicly endorse whatever policy was issued.

Rouvoet and his party are against PGD in general, and in particular against this specific application. Their general argument against PGD is that it amounts to the disposal of embryos. In their view, such disposal is beyond the jurisdiction of what humans can decide upon. That is, humans do not have the moral (or spiritual) authority to permit the destruction of an embryo. Their particular objection against PGD in prevention of heritable breast cancer is that this specific disease is not fully penetrant. Contrary to diseases like Huntington's and Steinert's, a genetic mutation for heritable breast cancer is not necessarily expressed. The chances of actually developing breast cancer are between 60 and 90 per cent (Foulkes, 2008).This means that if an embryo carrying the mutation for breast cancer is screened out, this may, *de facto,* be the elimination of a healthy human being.

What followed was a debate rousing both parliament and the public. For a full reprise of that debate, see Valkenburg (2009). Of particular importance for our line of argument is that a broad spectrum of political parties accused Rouvoet and his party of abusing the power they owed to their coalition membership. Specifically, they alleged that Rouvoet and his party tried to impose a Christian morality upon a majority that does not care much for Christian arguments (Etty, 2008).

This is remarkable. If one pleads for a ban on robbery because such a ban would be consistent with the Ten Commandments, one would not expect so many people to be so deeply offended. Rather, we may expect that people will endorse the ban – each from what Rawls (1993) has called, their comprehensive doctrine: their widest set of moral beliefs of what is of value in human life. That is to say, even if people do not share the Christian justification of the ban, their particular worldview is likely to disapprove of something such as robbery.

One explanation for the disagreement could thus be that the ban on PGD is apparently not in line with the comprehensive doctrines of the vast majority, and thus it is a justification that is regarded as inappropriate by the majority. However, this fails to explain the heated nature of the debate. Indeed, while we may straightforwardly agree about robbery, everyday politics is in fact entrenched with disagreements between comprehensive doctrines. Politics is essentially the game of coping with such differences when public issues are concerned. In fact, delegating decisions on abortion, PGD and embryo donation to the parents is one arrangement of bridging those differences, as it allows each citizen to pursue their own idea of the good without bothering others.

This leads to another explanation that we believe is more plausible. Our contention is to explain opposition to the Christian argument as rooted in fear of a perceived threat to autonomy; more specifically, a threat to the particular idea of autonomy that has been shaped by the (legal) invisibility of the embryo. Rouvoet's position is not just poorly aligned with majority opinion but also its justification. First, it was poorly aligned with the practice of PGD, as shaped as a realm of parental autonomy embodied in technological configurations and medical practices. Second, it was poorly aligned with the concept of parental autonomy as embedded in established laws. Third, as a point of culmination between the first and the second, it was poorly aligned with the incumbent conception of the embryo as not a member of the human subject community. It takes some courage to challenge this ensemble, and Rouvoet learned the hard way.

Against this short history of turmoil, the ultimate settling of the controversy was remarkable. Deputy Minister Bussemaker recalled the letter she sent to Parliament. After several weeks, and after several rounds of discussion within the Cabinet, she sent a new letter. Rather than being more restrictive, as one might expect, the new policy was even more

relaxed – at least in the sense that no conclusive list of diseases qualifying for PGD is given at all. In principle, heritable breast cancer and any other severe disease would from that moment onwards qualify for PGD. However, much attention was paid to procedures of assessment, caution and counselling (Bussemaker, 2008b). This way, the Cabinet members of traditional Christian denomination could at least claim some victory – a pyrrhic one if you like. Nevertheless, the new situation is ultimately compatible with the invisible embryo and with autonomy for prospective parents. Much like in Germany, the *status quo* is continued – albeit a radically different *status quo*.

Selecting Politics

In the previous sections we have described the debates on PGD in Germany and the Netherlands and the way different conceptions of the embryo figure in those. We will conclude this paper in two steps. First, we will wrap up our most important observations and reframe them in terms of the nexus concept. Second, we will explore its consequences for how debates on new technologies may be conducted.

Identifying the embryo as a nexus shows how technological and political categories are connected. As the Netherlands and Germany have a specific political and technological history, they treat the embryo in specific ways. In turn, these specific conceptions of the embryo steer political decisions in different ways, and lead to different configurations of technology. In the Netherlands, PGD prevails as a medical technology, whereas in Germany it does not. Instead, polar-body analysis or pre-fertilization diagnosis is accepted and practiced. Each technology is in line with the specific conception of the embryo as either being or not

being a member of the community of human subjects. In both cases, the embryo forms both a source of stabilization and a site of contestation. This is what a nexus does.

The debates had different dynamics, and even though they took place in different arenas – parliament and the broader public in the Netherlands, the medical community and government advisory councils in Germany – the role played by the constitution of the embryo was strikingly similar: one of stabilization, or even one of (political) conservatism. In the Netherlands, it proved impossible to shape the definition of the embryo to be more in line with a traditional Christian view. In Germany, the embryo is predominantly seen as a form of human life worthy of protection. Thus, in Germany this rules out the kind of autonomy that is common for parents in the Netherlands.

In both the German and Dutch cases, one way to understand the ensuing situation is to see it as an extension or continuation of the *status quo*. Though this is a somewhat fatalistic interpretation it appears to be accurate as considerable efforts to change legislation seemed to have little or no effect. Alternatively, we prefer the interpretation that substantive values are materialized in technological arrangements, thereby becoming, to some extent, rigid and inescapable. Thus, co-production is also reproduction of hegemonic values. Feenberg (2002) has argued on this hegemony of values at length. However, while Feenberg argues against a general hegemony of capitalist efficiency as a guiding principle in technology design, our analysis shows that indeed different values may materialize, and that these values need not be particularly related to capitalism. Our analysis leads to agreeing that values can be locally hegemonic within a country, but it gives no indication that a universal or capitalist criterion applies to all countries.

Even though path dependency must be regarded as a serious constraint for changes, our analysis also shows possible interventions. While nexuses are among the elements in

networks (cf. Latour, 1987) that secure stability, they also offer a site of contestation and potential for change. In our cases, we observe an effort to change the dominant conception of the embryo in two opposing directions: towards further inclusion in the community of human beings, and towards further exclusion. The efforts do not suffice to tip the balance, but they are efforts of co-production nonetheless. Indeed, the shaping and reshaping of nexuses is hard work, and originates in both socio-political and technoscientific practices.

The nexus concept implies a specific balance between politics as consensus-seeking and politics as contestation as explained earlier. Contestation not only concerns irreconcilable ideologies, but also collisions between ideologies and particular conservatisms as materialized in nexuses. If a nexus is fixed in place, it will make particular consensual outcomes more likely than others, and it does so in a *visible* way. A nexus thus stands in the way of a level playing field upon which reasonable politics can seek consensus. Therefore, if we want politics to be able to at least pretend to pursue consensus, we will need to somehow cultivate the collisions between ideologies and nexuses, for they are unlikely to pass by unnoticed.

In conclusion, our analysis gives rise to the following recommendations concerning the conduct of debates on medical-ethical issues – their extension beyond the medical domains being left to the reader. Recalling the PGD debates, it is clear that the embryo on the one hand plays a determining role, while on the other hand receiving fairly little attention. As it implicitly serves to exclude deviant positions, increasing the focus on the embryo and its role as a nexus is likely to be beneficial for democracy in a general sense. Engaging with a nexus offers both a site for contestation and a device for alignment between different realms.

Thus, we first need to identify any potential nexus. While we focused on the constitution of a biological entity and its relation to medical-technological and political practices, it is also conceivable that a nexus may take the form of, for example, a material

entity, law, or social stratification. Essentially, for its constitution and its stability, it must be dependent on multiple domains. Change within one domain will necessarily extend into other domains, and most likely feed resistance back. Thus, the notion of nexus is different from the notion of a boundary object (Star and Griesemer, 1989), for which its most important quality is its flexibility that allows it to travel between different practices.

We have elaborated the embryo in this sense. Another example could be the clinical definition of death. In a study of organ transplants and the related conceptualisation of death in the contexts of Japan and the US, it was shown that the concept of 'brain death' was widely used in the US, but rarely in Japan. As a consequence, the exact moment of death has become somewhat 'fuzzy' in the US. This entails some malleability, which in turn offers the possibility to align different interests. In particular, death can be strategically redefined in a way that benefits the practice of transplantation. In Japan, in contrast, the strict definition of death does not allow for such an alignment between the opposing moral values of saving lives and respecting people in their last hours. It is suggested that this is one important reason why Japan faces a shortage of transplantable organs (Lock, 2002). Thus, like the embryo, the definition of death fixes technological configurations as well as political and moral evaluations. A change in either realm will affect the other.

Similarly, the analysis by Prainsack and Siegal (2006) identifies two different arrangements in genetic testing in Israel and Cyprus. The Orthodox-Jewish practice in Israel tests at the level of couples, whereas the Cypriot practice tests individuals. The former renders a genetic defect a less individual issue, whereas the latter actually makes it more a matter of individual concern. Prainsack and Siegal discuss this difference in a predominantly discursive sense: a matter of social interaction, and meanings given in speech. Identification of nexuses in such arrangements would help articulate the connection between those discursive elements

and the technoscientific ones. Our expectation would be that particular conceptions of genetic risk (namely individual versus couple-related) are clearly recognizable in the technical arrangements, which thus induce a rigidity and resilience that remain unexplained from a merely discursive perspective.

The second step is to ask what moral or otherwise normative *content* is compatible with the particular constitution of the nexus. What exactly is death in a clinical context determines the interventions that may or must be made at a certain stage. It also determines how interventions are morally and politically evaluated at those stages. What the embryo is, determines what the moral category of autonomy exactly means. And the other way round, political decisions on moral categories bear on the constitution of the embryo, which in turn influences the course of technology development.

Third, we must ask what particular forms of *justification* are compatible with the constitution of the nexus. An embryo as a human being allows for different arguments and consequences than the embryo as an invisible being. We clearly saw that the dignity of human life for an embryo is a valid argument in Germany, whereas it is not in the Netherlands. Moral arguments, whether in favour or against PGD, are not so difficult to find. Moral philosophy has extensively elaborated them over the years, and indeed the arguments appearing in the debates were themselves not very original. With the present elaboration, the persuasive power of those arguments can be anticipated by assessing them against the stabilizing power of the nexus. Importantly, this allows for the inclusion of unfairly excluded arguments. Such unjust exclusion may be the case if it actually results from a different domain than where the exclusion takes place. If moral arguments are excluded as a result of technological configurations, not of their internal moral structure, then the nexus concept allows for the articulation and correction of such unjust exclusion.

Fourth, it must be asked with what particular boundaries of the political realm the nexus is compatible: that is, what *scope* it embodies. An invisible embryo will push politics out of the Dutch examination room. In contrast, in Germany, the embryo as a full human being will entail that politics takes responsibility for its protection, even in the lab or test tube. Thus, the Dutch invisible embryo is compatible with the doctor's office being outside the scope of politics, while the German embryo is compatible with it being inside the scope. Before raising any argument, it is informative to know whether the arguments will be found relevant in the first place.

In conclusion, the focus on nexuses that we added to the idea of co-production provides a method for breaking down discussions that would otherwise remain awkward. It presents topics for discussion that were hitherto, at best, implicit assumptions underlying the debate, but moreover assumptions that favoured particular arguments over others. By closely examining nexuses and opening them up for debate, contestation and alignment, new sites of democracy are presented in a way that offers more transparency.

Epilogue

Neither the notion of a nexus nor the idea of co-production of politics and technology imply that regulation or clinical practice remain static. This became abundantly clear on 7th July 2011, when the German Bundestag voted on three proposals for the regulation of PGD. Surprisingly, it was decided to allow the procedure 'in exceptional cases' (Spiegel, 2011). This is remarkable, considering that an interview respondent, who was closely connected to

policy making, indicated in 2005 that he did not foresee any change in the legal status of PGD for at least the next ten years.

Nonetheless, the recent legislative change became a realistic possibility after the Federal Court of Justice in Germany exonerated a physician who had turned himself in after creating and testing embryos in vitro – without implanting them. In response to the Court's verdict, German politicians felt an urgent need for a legislation specific to PGD. Various proposals were debated and voted on in Parliament, and included permissions as well as bans on the procedure. Both sides received support from across the parties represented in Parliament.

What does this sudden change in German legislation mean for the description of the embryo as a nexus? Does it imply that the conception of 'embryos-as-persons' was abandoned overnight? We would argue that it does not. Quite the contrary, the concept of a nexus remains useful for understanding the new situation in Germany. First, the formulation of the proposal that gained a parliamentary majority is remarkably similar to the way Germany has handled abortion. It makes PGD legal under a number of particular, restricted circumstances, but maintains a ban in principle. Second, the criteria established in the accepted proposal, revolve mainly around application of PGD in cases of stillbirth and severe inherited disorders. Through this particular focus, the choice for or against PGD largely becomes one between embryos that are able to be born alive and those that are not. This choice extends the understanding of an embryo as a (future) person beyond birth. Finally, even though it is difficult to foresee what this entails for the practice of PGD in Germany, understanding the embryo as a nexus between politics and technology suggests that the legal status of PGD and its application in clinics will continue to develop through context-specific mutual interdependencies.

Acknowledgements

The authors thank the editors and three anonymous referees for their invaluable comments, and Thomas Fuller for improving the English usage. The research leading to this article was partly funded by the programme 'The Societal Component of Genomics Research' of the Netherlands Organisation for Scientific Research, grant numbers 050-32-013 and 050-32-560.

About the Authors

Govert Valkenburg is a postdoctoral researcher at Maastricht University. In his dissertation *Politics by All Means* (2009), he focused on the incommensurability of liberal thought as associated with John Rawls and actor-network oriented philosophy of technology as associated with Bruno Latour. The Dutch controversy on PGD provided one case study.

Erik Aarden is a postdoctoral researcher at RWTH Aachen University. He is involved in developing research and teaching in the area of futures studies and science, technology, and society. His dissertation consisted of a comparative analysis of the incorporation of genetic technologies in health care delivery in the Netherlands, Germany and the UK.

References

Aarden, E. (2010) *Politics of Provision: The co-production of genetic technologies and health care arrangements in Germany, the Netherlands and the United Kingdom.* Maastricht: Maastricht University.

Aarden, E., Van Hoyweghen, I., Vos, R. and Horstman, K. (2009) Providing primplantation genetic diagnosis in the United Kingdom, the Netherlands and Germany: A comparative in-depth analysis of health-care access. *Human Reproduction* 24 (7): 1542-1547.

Abortion Law (1981) Wet van 1 mei 1981, houdende regelen met betrekking tot het afbreken van zwangerschap.

Baylis, F. and Krahn, T. (2009) The trouble with embryos. *Science Studies* 22(2): 31-54.

Bleiklie, I., Goggin, M. and Rothmayr, C. (eds.) (2004) *Comparative Biomedical Policy. Governing Assisted Reproductive Technologies*. London: Routledge.

Braude, P., Pickering, S., Flinter, F. and Ogilvie, C. (2002) Preimplantation Genetic Diagnosis. *Nature Reviews Genetics* 3(December): 941-953.

Bundesärztekammer (2000) Diskussionsentwurf zu einer Richtlinie zur Präimplantationsdiagnostik. *Deutsches Ärzteblatt* 97(9): A 525-528.

Bussemaker, M. (2008a) 1e Brief van de staatssecretaris aan de Tweede Kamer (26th May 2008). *Kamerstuk (Proceedings of the Lower House,* 31 200 xvi (147).

Bussemaker, M. (2008b) 3e Brief van de staatssecretaris aan de Tweede Kamer (27th June 2008). *Kamerstuk (Proceedings of the Lower House)* 29 323 (46).

Cameron, C. and Williamson, R. (2003) Is there an ethical difference between preimplantation genetic diagnosis and abortion? *Journal of Medical Ethics* 29: 90-92.

Daemmrich, A. (2004) *Pharmacopolitics: Drug Regulation in the United States and Germany*. Chapel Hill NC: University of North Carolina Press.

De Joode, S. (2001) *Zwanger van de kinderwens: Visies, feiten en vragen over voortplantingstechnologie*. The Hague: Rathenau Institute.

Derckx, V. and Hondius, E. (2002) The Rights of the Embryo and the Foetus under Dutch Law. *Electronic Journal of Comparative Law* 6(4): 391-406.

Dietrich, S. (2010) Debatte über PID: Grenzen sind schon überschritten. *Frankfurter Algemeine Zeitung* (16th November).

Dorscheidt, J. H. H. M. (2010) Developments in Legal and Medical Practice Regarding the Unborn Child and the Need to Expand Prenatal Legal Protection. *European Journal of Health Law* 17(5): 433-454.

Embryo Law (2002) Wet van 20 juni 2002, houdende regels inzake handelingen met geslachtscellen en embryo's (Embryowet).

Enquete-Kommission Deutscher Bundestag (2002) *Schlussbericht der Enquete-Kommission "Recht und Ethik der modernen Medizin"*.

Etty, E. (2008) Krijg dan maar borstkanker. *NRC Handelsblad* (3rd June).

Feenberg, A. (2002) *Transforming technology: A critical theory revisited*. New York: Oxford University Press.

Foulkes, W. (2008) Inherited Susceptibility to Common Cancers. *New England Journal of Medicine* 359(20): 2143-2153.

Goossens, V., Harton, G., Moutou, C., Traeger-Synodinos, J., Rij, M. V. and Harper, J. C. (2009) ESHRE PGD Consortium data collection IX: Cycles from January to December 2006 with pregnancy follow-up to October 2007. *Human Reproduction* 24(8):1786-1810.

Gottweis, H. (2008) Participation and the New Governance of Life. *BioSocieties* 3(3): 265-286.

Huijer, M. (2009) Storytelling to Enrich the Democratic Debate: The Dutch Discussion on Embryo Selection for Hereditary Breast Cancer. *BioSocieties* 4(2-3): 223-238.

Jachertz, N. (2000) Am Rande der schiefen Bahn. *Deutsches Ärzteblatt* 97(9):A 507.

Jasanoff, S. (2005) *Designs on Nature: Science and Democracy in Europe and the United States*. Princeton: Princeton University Press.

Jasanoff, S. (ed.) (2004) *States of Knowledge: The co-production of science and social order.* London: Routledge.

Kanavakis, E. and Traeger-Synodinos, J. (2002) Preimplantation genetic diagnosis in clinical practice. *Journal of Medical Genetics* 39:6-11.

King, D. (1999) Preimplantation genetic diagnosis and the 'new' eugenics. *Journal of Medical Ethics* 25: 176-182.

Kirejczyk, M. (1999) Parliamentary Cultures and Human Embryos: The Dutch and British Debates Compared. *Social Studies of Science 29*(6): 889-912.

Kirejczyk, M., Van Berkel, D. and Swierstra, T. E. (2001) *Nieuwe voortplanting: Afscheid van de ooievaar*. The Hague: Rathenau Institute.

Kollek, R. (2002) *Präimplantationsdiagnostik: Embryonenselektion, weibliche Autonomie und Recht.* Tübingen: Francke Verlag.

Landeweerd, L. (2009) *Reconstructing the Self: Problems of Chocie, Fate, and Justification in the Eugenics Debate*. Maastricht: Maastricht University.

Latour, B. (1987) *Science in action: How to follow scientists and engineers through society*. Cambridge MA: Harvard University Press.

Leenen, H. J. J. (1994) De juridische status van het (pre)embryo: Ficties over een juridische fictie. *Tijdschrift voor Gezondheidsrecht, 18*(7): 141-144.

Lock, M. (2002) *Twice Dead: Organ Transplants and the Reinvention of Death.* Berkeley: University of California Press.

Mouffe, C. (2005) *On the political*. London, New York: Routledge.

Mulkay, M. (1994) The Triumph of the Pre-Embryo: Interpretations of the Human Embryo in Parliamentary Debate over Embryo Research. *Social Studies of Science* 24(4): 611-639.

Mulkay, M. (1997) *The embryo research debate: Science and the politics of reproduction.* Cambridge: Cambridge University Press.

Nationaler Ethikrat (2003) *Genetische Diagnostik vor und während der Schwangerschaft: Stellungnahme.* Berlin: Nationaler Ethikrat.

Peeperkorn, M. (2008). Rouvoet eist intrekken brief over selectie van embryo's. *De Volkskrant* (30th May).

Planning Decree (2003). Planningsbesluit klinisch genetisch onderzoek en erfelijkheidsadvisering.

Prainsack, B. and Siegal, G. (2006) The Rise of Genetic Couplehood? A Comparative View of Premarital Genetic Testing. *Biosocieties* 1(1):17-36.

Rawls, J. (1993) Political Liberalism (paperback edition). New York, Chichester: Columbia University Press.

Riedel, U. (2000) Plädoyer für eine unvoreingenommene, offene Debatte. *Deutsches Ärzteblatt* 97(10): 586-588.

Sandel, M. J. (2007) *The case against perfection: Ethics in the age of genetic engineering*. Cambridge MA: Belknap Press of Harvard University Press.

Schwinger, E. (2003) *Präimplantationsdiagnostik: Medizinische Indikation oder unzulässige Selektion?* Bonn: Friedrich Ebert Stiftung.

Shenfield, F., Pennings, G., Devroey, P., Sureau, C., Tarlatzis, T. and Cohen, J. (2003) The ESHRE Ethics Taskforce, Taskforce 5: Preimplantation genetic diagnosis. *Human Reproduction* 18 (3): 649-651.

Sperling, S. (2008) Converting Ethics into Reason: German Stem Cell Policy between Science and the Law. *Science as Culture* 17(4): 363-375.

Spiegel (2011) Bundestag erlaubt Gentests bei Embros. *Spiegel Online, http://www.spiegel.de/wissenschaft/medizin/0,1518,772905,00.html* (7th July 2011, last accessed 26th July 2011).

Star, S. and Griesemer, J. (1989) Institutional ecology,'translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science* 19(3): 387-420.

Valkenburg, G. (2009) *Politics by All Means: An Enquiry into Technological Liberalism*. Enschede: University of Twente / 3TU Ethics Centre.

Wagner, W. (2000) Wir befinden uns mitten auf der schiefen Bahn. *Deutsches Ärzteblatt* 97(17): 1126.

Weale, A. (2004) Politics as collective choice. In A. Leftwich (ed.) *What is Politics?* Cambridge: Polity Press, pp.86-99.

Wüstner, K. (2006) Technological Development and Society: The Discourse on PGD in Germany. In P. Law, L. Fortunati and S. Yang (eds.) *New Technologies in Global Societies*. Singapore: World Scientific Publishing, pp.75-103.