Sci Eng Ethics (2014) 20:111–133
DOI 10.1007/s11948-013-9438-3

ORIGINAL PAPER

Sharing in or Benefiting from Scientific Advancement?

Cristian Timmermann

Received: 19 November 2012 / Accepted: 15 March 2013 / Published online: 12 April 2013

Abstract The intellectual property regimes we have currently in place are heavily under attack. One of the points of criticism is the interaction between two elements of article 27 of the Universal Declaration of Human Rights, the widely discussed issue of being able to benefit from scientific progress and the less argued for position of having a right to take part in scientific enterprises. To shine light on the question if we should balance the two elements or prioritize one of them, an exploration will be offered on how benefiting from scientific progress and the ability to participate in the advancement of science relate to securing human capabilities. A different perspective to the question will be gained by identifying the problem as an issue of misrecognition, especially the failure to recognize many willing collaboration partners in scientific research as peers. Lastly, I will argue that cooperative justice requires that if we have an innovation incentive system that disproportionally benefits one particular group, a certain duty to counterbalance this advantage exists when we are relying on mutual cooperation for the recognition of intellectual property rights.

Keywords Scientific participation · Objects of innovation · Development · Global justice · Human rights · Human capabilities · Recognition as peers

Article 27 of the Universal Declaration of Human Rights (1948, hereinafter UDHR) states "[e]veryone has the right freely to participate in the cultural life of the

C. Timmermann (✉)
Applied Philosophy Group, Department of Social Sciences, Wageningen University,
Hollandseweg 1, 6706 KN Wageningen, The Netherlands
e-mail: cristian.timmermann@wur.nl

C. Timmermann
Centre for Society and the Life Sciences, PO-box 9010, 6500 GL Nijmegen, The Netherlands

community, to enjoy the arts and to share in scientific advancement and its benefits." In the following I will concentrate in the last section of this article, the right to share in and benefit from scientific advancement. This part of article 27 contains two elements, the idea of sharing in a particular endeavour and the possibility of enjoying the benefits of such type of enterprises. In this article I will conceptualize the relation of the two elements to (1) human capabilities and (2) ensuring recognition, then (3) discuss the effects on global justice caused by pursuing any of the two elements independently, and lastly (4) analyse the problem of cooperative justice with a special emphasis on the way we have chosen to incentivize innovation: intellectual property.

The purpose of this examination is to highlight the effects on the fulfilment of human rights in general a potential prioritization of any of the two elements of this right may have. Hereby I will take the intellectual property regimes we have now established as the background condition in order to better judge the existing incentive system and to serve as a tool to analyse any proposed alternative system. A brief overview to those regimes and their effect on the rights enshrined in article 27 will serve as an introduction.

Introduction

Many, but certainly not all inventions we have nowadays on our shelves and surroundings came to existence due to the possibility of recouping expensive research and development costs. Patents, most prominently, but also plant breeders' rights, trademarks and, in some jurisdictions database rights, enable researchers to make their investigations lucrative. These exclusive rights have become globally increasingly important after the Agreement on Trade-related Aspects of Intellectual Property Rights (TRIPS) progressively started to become effective worldwide from 1994 onward. The TRIPS agreement made it binding for all World Trade Organization member states to recognize intellectual property rights and allows trade sanctions for countries where violations of those rights are commonplace. Nowadays patent rights have a validity of mostly 20 years, while copyright lasts commonly 70 years after the author's death.

Granting a temporary exclusive right to innovators on their invention may allow them to recoup their prior expenses (including advertising costs) by preventing competitors to free-ride on their creative effort. For this however to be successful, a number of conditions apply: (i) the fruits of their labour have to attract a given number of customers with sufficient purchasing power, (ii) the developed objects should not contradict public morals,[1] and (iii) meet certain minimum inventiveness and novelty criteria to be granted exclusive rights. Further, (iv) the possibility to attract a sufficient number of paying customers is higher for objects that cannot be

[1] Cf. TRIPS agreement (1994), article 27(2): "Members may exclude from patentability inventions, the prevention within their territory of the commercial exploitation of which is necessary to protect *ordre public* or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment, provided that such exclusion is not made merely because the exploitation is prohibited by their law".

independently reproduced. Objects of innovation that do not meet these criteria will have a hard time recouping their research and development costs.

Relying primarily on this instrument for incentivizing research has two negative consequences: one, fundamental research and indigenous innovation are insufficiently incentivized, and two, refraining from using exclusive rights to recoup research and development costs has become a luxury many cannot afford.

The first problem leads to future undersupply, something that has to be addressed using different incentive mechanisms. This is the case with fundamental research, which predominantly in the developed world is financed by governmental grants. Fomenting the creation of new tools for their industry constitutes a main motive for continuing to do so (Stephan 2012). The case of traditional knowledge (here encompassing indigenous, tribal and grassroots innovation) is less fortunate, a lobby demanding funds seems unable to recruit sufficient political influence for this branch of innovation, leaving the support for a stimulating infrastructure and network in a precarious state. To add to this problem, it has been argued that many people are so poor that they can only make use of technological advancement if the inventions can be reproduced using spare local resources (Gupta 2010). Inaccessibility to the benefits of scientific progress becomes inevitable when this is not deliberately taken into account. If research agendas are dictated according to market demands, being defined by the monetary size of the market, not the number of customers, the huge purchasing power disparities will greatly misrepresent *per capita* demand and thus people's basic necessities. There will be no democratic setting of research agendas, which will leave the needs of the poor systematically unfulfilled when they fail to match the ones of the economically prosperous (Korthals and Timmermann 2012). Necessity may also oblige the global poor to use technologies that are deemed culturally unacceptable (Chapman 2009) or socially inadequate. This is a problem from which citizens of countries with strong democratic commitments do not escape either. People had no alternative than to accept certain technologies, an example being the wide use of genetically modified crops for animal feed, despite the wide public rejection of genetically modified organisms.[2] In a globalization context, Elizabeth Anderson (2007) notes that the effectiveness of contraceptive policies is in jeopardy in societies where women do not see themselves as agents who actively choose to have sex, which make contraception methods that require planning and daily use socially inadequate. This omission has far-reaching effects on population control and career development for women, particularly in non-Western societies.

While the first problem has been greatly discussed as a matter of global justice (cf. Pogge 2008), the second problem, concerning the direction research is taking, has gathered less attention. Perhaps most prominently the latter has been addressed by the free/libre and open source software movement (Schoonmaker 2007).

As mentioned earlier, the societal recognition of intellectual property enables inventors and their financial backers or supporters to recoup their research expenses

[2] For Europe, see TNS Opinion and Social (2010). While the rejection of genetically modified organisms is less fierce in other parts of the world, the recent ballot on California's Proposition 37 show that a great percentage of the state's population wants to know which foods contain genetically modified organisms.

by applying for temporary exclusive rights. Those rights are, as the name clearly states, exclusive—by definition some people will not have access to the protected object for the limited period that the patentee is granted a monopoly use of his or her invention. While the open source software movement is primarily concerned with the malleability of the objects of innovation, particularly their adaptability to personal needs, the impact of exclusive rights on science and technological development is of much greater scope. Hesitation to reveal early findings has increased in order to ensure patentability of subject matter, thus limiting scientific discussion and the spontaneous sharing of samples (Eisenberg 2008). Using exclusive rights for sales creates artificial scarcity, leaving some people without the benefits of scientific progress. Those classical economic dead-weights are literary dead-weights when it comes to vital medicines (Pogge 2008) or specific crops destined for harsh environments. If research can only be undertaken by being subject to the use of market incentives that rely on intellectual property rights, it will inevitably restrict some people from enjoying the benefits of scientific advancement. As the excluded group consists primarily of the global poor, people with certain moral convictions might find it objectionable in itself to add to greater inequality by leaving the worst off people in a relative inferior position.[3] Promoting scientific advancement would under such conditions contradict some types of egalitarian notions of justice.

Relying on market mechanisms in a world of extreme inequalities does not only shape research agendas towards a very particular, not democratically chosen, direction, but attracts the overwhelming amount of resources to one small section of science: the development of saleable technological products.

The more scientists and engineers manage to recoup their research and development costs by making use of exclusive rights and thus become self-sustained, the higher the pressure for others to follow the same procedure. Scientists and engineers who are not self-sustained become the exception rather than the rule. Choosing to practice science that does not aim at making profits, or generally seeking for openness, becomes a luxury that is increasingly harder to defend. To escape this burden scientists and researchers continuously switch to research lines and methods that appear commercially valuable—doing so reinforces societal expectancies of science being self-sustainable. This endangers cognitive diversity and we have to remember that science has benefited greatly from the few rational agents who due to stubbornness or self-confidence have insisted on less prominent rival theories who have proven to turn out accurate (cf. Kitcher 1990). A good example is Alfred Wegener, who after publishing his groundwork on plate tectonics 1912 spent the remaining time of his life fighting for support, disregarding the hostility with which his theory was received. He only received wide recognition for his great contribution in the early 70s, over three decades after his death (Greene 1984).

[3] An interesting example is the technological progress in fuel efficiency for vehicles. If the rise of fuel prices is (at least slightly) counterbalanced by the availability of more fuel-efficient cars, public outrage due to the unavailability of options is dampened. However this option is only available for countries whom themselves are producing technologies. Poorer countries have to continue to rely on the older fuel-inefficient alternatives while paying proportionally much more for fuel.

On the Legal History of the Article 27

The dominant reading among legal scholars of article 27 of the UDHR sees it as the basis of the human right to benefit from scientific progress.[4] The emphasis on this specific dimension has pushed the right to participate in scientific endeavours into obscurity. One reason for such reading might have been the phrasing of what is considered the corresponding article to the UDHR article 27, the International Covenant on Economic, Social and Cultural Rights (1966, hereinafter ICESCR) article 15.1.[5] This article does not mention scientific participation unambiguously by name:

> The States Parties to the present Covenant recognize the right of everyone:
>
> (a) To take part in cultural life;
> (b) To enjoy the benefits of scientific progress and its applications;
> (c) To benefit from the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author.

To see scientific life as part of being able to participate in enlarging the cultural heritage of humankind might require more interpretative work than legal scholarship commonly allows. First, one has to consider science as part of the cultural heritage of humankind. Conceding that, one has to understand a right to “take part” as having not only a passive connotation (being a spectator or a recipient) but also an active element (being an actor or contributor). This however seems to have been the thought of the Chinese delegate during the drafting sessions of the Universal Declaration. Peng-chun Chang noted that “not only must the right to share in the benefits of scientific advancement be guaranteed to everyone but also the right to participate in work of scientific creation. In the arts, letters and sciences alike, aesthetic enjoyment had a dual aspect: a purely passive aspect when man appreciates beauty and an active aspect when he creates it” (quoted in United Nations 1948, transcribed).

A contribution to science is required to take into critical consideration previous scientific knowledge and to do so in a more systematic manner than is generally prevalent in other areas of cultural life. In science originality is not a virtue in itself, a laudable contribution has to consist in either a major revision of existing theory or exploring the previously unknown. Therefore familiarity with the state-of-the-art is virtually a prerequisite. Due to those differences capacity building becomes mandatory to enable people to participate in scientific life.

---

4 Examples of this interpretation are offered by cf. Chapman (2009), Marks (2011), Donders (2011), and Plomer (2012). The reading I defend hereafter is in part shared by Shaver (2010).

5 In relation to food production, ICESCR article 11.2(a) foresees that “States Parties … individually and through international co-operation … [shall take measures to] improve methods of production, conservation and distribution of food by making full use of technical and scientific knowledge, by disseminating knowledge of the principles of nutrition and by developing or reforming agrarian systems in such a way as to achieve the most efficient development and utilization of natural resources”.

Understanding human rights primarily as a set of negative duties will favour a reading that at the most prohibits unjustifiable exclusion of people from cultural life. The history of the drafting of ICESCR article 15.1 suggests however that more was on the mind of human rights legislators than this minimum constraint. An initial draft[6] submitted by the UNESCO contained the following elements:

> The Signatory States undertake to encourage the preservation, development and propagation of science and culture by every appropriate means:
>
> (a) By facilitating for all access to manifestations of national and international cultural life, such as books, publications and works of art, and also the enjoyment of the benefits resulting from scientific progress and its applications;
> (b) By preserving and protecting the inheritance of books, works of art and other monuments and objects of historic, scientific and cultural interest;
> (c) By assuring liberty and security to scholars and artists in their work and seeing that they enjoy material conditions necessary for research and creation;
> (d) By guaranteeing the free cultural development of racial and linguistic minorities.

The UNESCO draft is far more explicit in identifying positive duties and a dichotomy between scientific and cultural life becomes harder to defend. This passage does also not lead us to think that being identified as a scholars or artist is a prospect limited to an exclusive group of people. Together with clauses that forbid discrimination, section (c) of the cited draft article gives us to understand that ensuring the basic circumstances for being able to participate in scholarly activities was an ambition early human rights legislators indeed had in mind. The Venice Statement on the Right to Enjoy the Benefits of Scientific Progress and its Applications issued 2009 by the UNESCO reaffirms this position, by raising awareness on the huge disparities in research capacities between the developed and the developing world. Among the negative effects of a lacking research infrastructure count the inability to influence the direction of scientific progress and the capacity to hold governments accountable for it, the lack of participation opportunities for citizens and difficulties in assessing the impact of science and technological development (UNESCO 2009).

The sections that follow will provide philosophical arguments on why this suggested reading should be adopted. While I will continuously address the influence of intellectual property, this should not be understood as it being the only factor or the most significant issue at stake. Loss of resources due to corruption in educational and research institutes, the widespread refusal to educate women, missing or inaccessible day-care facilities for children particularly limiting the career opportunities of young mothers, plus the huge inequalities in income, are factors that might have a far greater influence for scientific participation.

[6] Quoted in Green (2000).

Additionally, securing the freedom to move and communicate beyond national borders thus facilitating social encounters that can materialize in future collaborations is a key element to foster scientific advancement.

A Human Capabilities Perspective

The link between scientific advancement and human capabilities is twofold. Participating in scientific endeavours can help people reach certain capabilities and the fruits of such undertakings can provide technologies as well as knowledge that can play a substantial role in expanding human functioning.[7] The first aspect falls under the human rights element of sharing in scientific advancement, the second under benefiting from scientific enterprises.[8]

Some objects of innovation help people to attain capabilities that their personal condition would not have allowed, e.g. a wheelchair greatly enhances the possibilities of free movement for a person with certain types of disabilities. Other objects allow people to restore their functioning to the original state, e.g. recover from a disease or rehabilitate one's damaged natural environment.[9] A third category of objects substantially facilitates daily life interactions and meliorates living conditions. We may think of the invention of sanitation systems, facilitating the provision of clean water and the adequate disposal of sewage, leaving people with substantially more spare time for leisure activities. Cheap and readily available paediatric vaccines have reduced the time having to be spent caring for sick children. Women, who are disproportionally overburdened with such tasks, have gained substantially with such improvements by having more time to pursue other goals in their lives. Communication technologies allow people to participate in political discussions with up-to-date knowledge. In sum, scientific knowledge coupled with engineering skills and understanding allow people to achieve, restore and facilitate the enjoyment of objects covered by human rights clauses and identified as central human capabilities. Nonetheless, we should be critical to what we empower people to do, science can be put both at service but also to the detriment of society.

The sustainable development of new technologies through scientific advancement inevitably raises the bar of what may be considered normal human functioning.[10] To take an example, scientific progress in the area of nutrition has

[7] The capability approach distinguishes between functionings and capabilities. Functionings relates to what one can do and be, e.g. being creative and contribute to knowledge. Capabilities refer to the opportunities to achieve the mentioned beings and doings, e.g. choosing to develop one's creativity or having the freedom to undertake the necessary tasks to be able to contribute knowledge (Robeyns 2011).

[8] The link between capabilities and the right to benefit from the scientific advancement has been discussed by Marks (2011) at great length.

[9] In order to ensure that objects of innovation are indeed converted into capabilities or functioning, not only personal conversion factors (i.e. individual limitations or special talents) have to be taken into consideration, but also social and environmental conversion factors, cf. Robeyns (2005). Here design can play a bridging function to facilitate an effective conversion, cf. Oosterlaken (2009).

[10] Non-sustainable development will have the opposite effect. With environmental degradation, or deterioration of health in general, lesser functioning can be expected. A more sedentary life style has already lowered the threshold line of what was considered normal bodily functioning in the past.

shown us that many of the disorders once thought inevitable are traceable to specific micronutrients deficiencies, shifting many of those widespread disorders to the category of that which is preventable. Knowledge on what constitutes a better diet and the safer handling of food, such as refrigeration, hygiene and pasteurization, has triggered the search for technological solutions to overcome existing shortcomings. The development and widespread use of those technological solutions raised the level of what is considered normal human functioning by a greater satisfaction of physiological needs. However this improvement demands further research, as new scientific knowledge and technical knowhow is again needed to overcome the negative effects of this change, as well as to maintain and regulate the technological products implemented (cf. Baulcombe et al. 2009). Generally we can say that the advancement of science and the availability of new technologies allows us, or even obliges us, to periodically reconsider which capabilities society can reasonably facilitate for people.

The capabilities approach can justify both a claim to have access to the objects of innovation and inclusion in their development. Access to those objects may expand human functioning and thus is of instrumental importance. With regard to inclusion in scientific research and technological development, the capabilities approach requires a longer line of argument. Here participation can be justified instrumentally as it fosters the full use of one's senses, imagination and thoughts, to use Nussbaum's terminology (cf. Nussbaum 1997). Arguing for a right to scientific participation opportunities would have a weak foundation if it is solely based on being a vehicle for using or promoting one's mental faculties. As a philosopher, I can escape the charge of narcissism by arguing that participation in scientific endeavours facilitates the use of one's mental faculties in a *meaningful* manner.[11] Not being limited to engage in meaningless endeavours alone can be considered as a prerequisite to claim that one enjoys full human functioning. Nowadays it is inevitable that wanting it or not, some daily activities will be devoid of meaning or purpose, as some tedious tasks still have to be completed to meet our basic needs. We can nevertheless argue that being able to enjoy a good life requires that at least some aspects of life have meaning. A prosperous society that seeks to ensure human capabilities will have to grant some liberty in where a person wants to find meaning in her daily undertakings. While some can content themselves in finding meaning in personal relationships, other people need a certain social infrastructure to find meaning in their life. One of those social constructs where a series of people are bound to find meaning in their lives are scientific enterprises.[12] That being true, we could stipulate that a certain duty to enable those people to take part in such initiatives will fall to scientific enterprises in general by virtue of being the sole

[11] To define "meaningful" in this context, we can borrow from a definition of "meaningful work" provided by Arneson (1987). He identifies the following characteristics: work has to be interesting, calling for intelligence and initiative, allow the worker a considerable freedom to determine how the work is to be done and having a democratic say on the work process as well as employer's policies. I would further add that one's work should be subjectively identifiable as a contribution to the well functioning of society (provided this is a freedom one wants to pursue).

[12] Alternatively, we can frame a demand of being included by recognizing that some people identify a scientific career as a calling or vocation (*sich zur Wissenschaft berufen fühlen*), cf. Weber (1919/2002).

locus where those people could realize their concept of a good life. That the right to work is commonly understood as one being able to find an adequate job supports this perspective (cf. Steinvorth 2009). Recognizing a societal duty to facilitate meaningful interactions would direct all types of socially meaningful endeavours with a call for inclusion. Here we can think of duties of non-discrimination among groups of people with comparable scientific abilities,[13] as well as positive duties in terms of engaging underrepresented groups in scientific activities.

Conceding a right to participate in science will raise certain demands for not only being able to undertake trivial research, but also to take also part in advanced scientific enterprises. Scientific work is one of the tasks that is affected by the Aristotelian Principle as identified by Rawls, meaning that while practicing science one continuously develops certain skills and this may lead to high virtuosity in a given field.[14] As Rawls (1999) states, "… human beings enjoy the exercise of their realized capacities (their innate or trained abilities), and this enjoyment increases the more the capacity is realized, or the greater the complexity"—in science encouraging the realization of those capacities will have to be linked to capacity-building efforts as well as guaranteeing basic material needs, otherwise people with few means would be systematically left out.[15] In addition, it has been repeatedly argued that prolonged repetitive and dull work limits the possibilities to successfully engage in creative work in the future, and this not only professionally but also during one's spare time (see Sayer 2011, with accompanying references).

More interesting is it to see inclusion in innovative enterprises as having the additional capability to actively care for one's society, nature or a particular individual, while seeking for a solution by making use of one's reason.

There are two elements in showing concern, one being the possibility to express an emotion, e.g. sorrow, or being able to protest. While this is something Western societies now take for granted, we should not forget that this has been a societal achievement. However the possibility to express dissatisfaction with the current level of welfare or a case of misfortune should not be limited to the emotional level for the majority of the world population. Nowadays, most people in the world can only change their current situation or the situation of the people they are concerned about by physical labour or by making use of their bodies. People that are unskilfull with their bodies or whose body manifest endowments of scarce social appreciation, have hardly an option to do something to promote their cause. Here I do not want to put emphasis on actually succeeding, but merely on being able to undertake a considerable effort in that direction or, more colloquially, the possibility of "giving it a good try".

[13] E.g. if our goal is food security and that is our main valuation criteria, a promising seed variety should not be judged based on its origin but on proven efficacy. Brand labels should not play a role in the assessment.

[14] Cf. Rawls (1999), here I rely strongly on the interpretation of Taylor (2004) and Dumitru (2008).

[15] If we acknowledge John Harris' arguments to consider scientific participation as a duty (Harris 2005; Chan and Harris 2009), providing the necessary infrastructure will allow a broader range of people to discharge such duty, and this not only as research subjects but also as researching entities.

The great majority of the world's population could do significantly more in helping the people they care about if they work in an environment that promotes the use of their intellectual faculties and facilitates peer evaluation of resulting ideas. The actual value of traditional knowledge, or parallel knowledge systems in general, for industrial and academic science is heavily debated (cf. ICSU Study Group on Science and Traditional Knowledge 2002). However, treating as non-existent contributions that are not using standardized nomenclature and written in customary "scientific style" obstructs the efforts of millions to increase social welfare. It also suggests that industrial and academic science has a far greater role in solving today's problems than one should legitimately attribute it.

Justifying inclusion from a capability "to actively care for others" perspective has also an additional advantage. Being motivated by wanting to help others, driven by a sense of fraternity, and choosing science as a vehicle to manifest concerns makes science a social enterprise. Practicing science for such a purpose has to be interwoven with the social context, demanding up-to-date knowledge of prior art as well as extensive research networks. Herewith the demand is to not understand science as a solitary occupation but emphasize its interactional character. While a sophisticated computer simulator could in theory secure the capability to use one's senses and imagination, the possibility to have an impact on society is a prerequisite for ensuring the capability to actively care for others by using one's intellect.[16]

However the use of this capability has some shortcomings. First, if scientific participation possibilities are grounded on fulfilling the capability "to actively care for others", those scientific enterprises will have to be bound to delivering products that directly benefit society. Scientists will thus not be able to pursue their curiosity as they like—a traditional scientific liberty will have to be given up. Second, if we ground inclusion in scientific enterprises on a capability "to actively care for others" we do not specify up to what level people have a right to be scientifically educated nor to which type of infrastructure they should have access to. At a minimum level, any contributor of a piece of knowledge that is absorbed by the scientific community is sharing in the advancement of science, thus enlarging the pool of knowledge from which socially relevant innovation can be developed. An indigenous community who has been victim of biopiracy is sharing in scientific advancement, even if deprived from moral interests such as attribution of authorship and eventual financial benefits.

Since the obligations bound to securing the right to participate in scientific advancement will differ so drastically if society has to secure equality of

[16] We might consider facilitating wide scale migration of talented scientists to the developed world as a possible solution to the problem. However, we should test this solution with the liberty of being able to live in one's social and cultural environment. Having to choose between the set of goods "family life, cultural and natural environment" and the possibility of practising science on a higher level will question the real freedom involved in that choice. Living in a world of limited resources demands a certain type of flexibility on the scientist's behalf, which has to be commensurate to the sophistication of the demanded infrastructure. We can thus ask people to move from a rural to an urban area for some highly specialized careers, in some cases even from one country to the other. Capacity-building on tight budgets should aim at serving the greatest number of people, the selection of urban or rural locations for setting up research infrastructure should underlie this principle.

opportunity in scientific careers while offering the necessary infrastructure, or merely a fair scientific assessment of contributions of knowledge, we will try to gain additional insights using recognition theories.

Recognizing the Developing World as a Partner

Let us assume that we could have a much higher rate of innovation if the developed world would be the sole provider of technological solutions. Any effort for capacity-building in developing countries would be relinquished in order to increase efficiency in scientific production in the developed world, and this under the benevolent argument, that the given distribution of research and development facilities leads to more people being able to enjoy the fruits of scientific progress worldwide. Conceding that there would be substantial welfare gains, some injustices would still be left unresolved.

The resulting type of contentious relationship fits normatively under the rubric of the social problems of misrecognition, particularly the sort identified by Nancy Fraser under failing to recognize someone or a community as a peer (cf. Fraser 1998).

The controversial issues surrounding the problem of recognition and its response are legion. First, global hazards are currently only tackled by a highly select section of the global community. This leads to the second problem, when people cannot mutually influence each other a biased perception of dependency is developed. Third, this feeling of dependency is not fully justified; humans by nature tend to skilfully adapt tools to their needs while using them. Innovation occurs everywhere—recognition thereof not. And lastly, some changes in distribution have to take place in order to ensure future recognition as peers.

I will start with the first two points. The world we share with poor and rich alike as well as our bodies that share a common constitution are vulnerable to a variety of similar threats. Climate change and AIDS/HIV are perhaps two of the most prominent global hazards we currently face. While those hazards are global, the development of technological solutions occurs only in limited and exclusive communities. As those objects of innovation often facilitate the fulfilment of basic needs, the resulting relationship can be labelled as one of dependency. A picture of the developed world rescuing over and over again the global poor from naturally occurring and self-inflicted problems becomes inevitable. This can hardly be identified as a relationship among equals. If people are not able to mutually assist each other they will inevitably fail to see each other as peers. Especially in the area of science and engineering we have a huge potential to assist each other notwithstanding cultural differences. The objective treatment of knowledge permits a dialogue that in other areas of culture would be much more difficult to attain.

The provision of a technical solution by one part of the world, i.e. the deliberate creation of a public good, may engender in the other part of the world a wish to reciprocate that will be difficult, if not impossible, to realize. Being without means might alleviate this felt burden, but nevertheless perpetuate a unilateral sense of debt.

In a certain way, it is inevitable that some dependency endures. The mere existence of exclusive rights for inventions allows temporary monopolies. If the invention is a necessity—an object that helps people to secure their basic needs—dependency is the outcome. Nevertheless, we should still question a global social structure that systematically favours a specific type of innovation (i.e. the ones that are patentable) and innovating (proprietary research models) at the cost of grassroots innovation, advances in traditional farming and generally non-proprietary research practices. Therefore, the traditional methods of incremental improvements may be a more beneficial approach, especially if they are the only ones feasible for the major part of the world's population.

There is a substantial difference between sustaining a group in need and perpetuating dependency. Situations of dependency that are preventable should not be judged on the same basis as inevitable dependency. Any policies that deliberately retard or hinder the efforts of some groups in gaining self-sustainability should be judged as an attempt to limit self-determination.

Awareness of one's own or the other parties' dependency has also some major effects in the economy, especially when bargaining agreements or settling sales contracts. The history of political economy has shown us that by fostering technological development states can gain a much stronger advantage in increasing the exchange ratio of their people's labour hours than by continuing to produce or extract traditional goods (cf. Drahos and Braithwaite 2003; Galeano 1971/2008). This will leave people who abstain from technological innovation in a permanent position of disadvantage.

We can nevertheless think of institutional arrangements that could lift this disadvantage, leaving questions of feasibility completely aside. A world where such disadvantages are neutralized would still be a place where one society can offer products that the other society will not be able to produce, as it will lack the infrastructure and necessary know-how. It will be a place where one group is obliged to engage in exchanges while the other can trade just if it sees an advantage in doing so. Intellectual property, creating artificial scarcity, not only grants exclusive rights, but also counts as a publicly documented proof of being the sole legal provider of a given asset. This is an advantage natural resources generally do not have—something that comes at quite a high price when bargaining for a fairer deal and for felt indispensability. In terms of productive capacity, some states could vanish altogether without causing disruption in the others' daily life.

Continuing with the third point. There is a huge amount of unacknowledged reciprocity for inventions placed in technology-dependent societies. Developers of technologies gain many insights from their users. It lies in human nature to develop and adapt tools. When people start using inventions made by others, it will not take much time until they find new uses. In order for it to be true that a community is solely a technology receiver, and not a co-inventor or technology adapter, inventiveness would not only have to be neglected, but even prohibited and severely sanctioned. As this is hardly enforceable, leaving aside its desirability as a target, the distinction between technology receivers and technology producers will always be artificial in absolute terms. Maintaining such labels inevitably leads to a situation where some inventiveness is not recognized as such.

Furthermore, inventions are not placed in an abstract environment. Knowledge and innovative potential will be available in the habitat in which a technology is released. Rarely inventions are released in an environment where no predecessors are available. Generally in agriculture, new methods and seed varieties replace local practices and this is not always superseding the performance of earlier established systems. This tendency to ignore indigenous knowledge, or regard it in advance as inferior, is felt as an insult for many indigenous innovators. Often local knowledge is denied as a result of power differentials, the stronger party having the ability to decide whose knowledge counts as significant—an issue overly present in development projects (Dübgen 2012). This problem is accentuated with the tendency to treat indigenous knowledge as one type of knowledge system, while industrial and academic knowledge represent another system. It is common to see the two as strictly separated systems; that those systems may overlap or be of porous transition is something few take notice off. The idea that knowledge production systems outside academia and industry have to be first checked using scientific method is widespread in the developed world (cf. Agrawal 1995).

Identifying one part of the world as the one that advances science and develops technology and the other part of the world as mere recipient, nurtures an atmosphere where any person coming from outside the established circles is perceived as being less worthy of attention. When academic or industry emblems make a much stronger case for judging the time one should invest in critically analysing a new proposal, than past performances or knowledge of the local environment, we can speak of discrimination.

And finally, setting aside enough resources for capacity-building in order to distribute more evenly research and development facilities around the world could help remedy the here denounced situation of injustice. This would lead to a situation where every society can offer the other something that they momentarily will not be able to produce themselves. Even if what a society is producing amounts to little, this might be enough to lose the stigma of being labelled (or identifying oneself) as strictly dependent to the less uncomfortable position of being in the need of assistance (cf. Fraser and Gordon 1994).

Capacity-building will also have to tackle another very broad problem: the issue of testimonial justice as identified by Miranda Fricker (2007). Scientists and technology developers in academia and industry adjust their work not only towards financial incentives, but also to reach peer recognition and gain group identity. The pursuit of this latter goal has the effect that a special jargon and working methods are developed. People not communicating in this jargon or using different methods become for established scientists harder to understand and to dialogue with than their habitual peers. Familiarity with certain subject matters creates a feeling of expertise, which completely new approaches do not provide. Radical changes demand much more concentration from the recipient. In order to guarantee fair evaluation, we not only have to stop depending exclusively on established practices, but also consciously dedicate more time to evaluate unfamiliar forms of expression.

There is another element why participation in science is an important issue. By being able to participate in science one asserts a certain influence in its form and direction. Science and the products that become available with its progress, shape profoundly our daily lives; consistency with democratic values demands that those principles are dispersed into this sphere too. The direction research agendas take will have a strong effect on the shape of the future world. There is a democratic interest in having a say regarding what role technology should play in the future and not completely surrendered to decisions made by others.

Proprietary science has made it almost impossible for economically poor aspiring participants to access the tools and fruits of scientific research and practice. At the same time it has become the predominant mode of practicing science and with the help of digital technologies this type of science has also become enormously networked. Despite the mentioned deficiencies, the protection of intellectual property rights has created incentives for investing in research and development, as well as created the necessary guarantees for industry to be able to disclose information related to an invention. The patent system's novelty and non-obviousness requirements however are constantly pushing scientific research towards its limits. Science under this incentive mechanism moves towards meeting in the most cost-effective manner a specific range of research targets that are compatible with the aim of reaching patentability requirements and ultimately market value. This has the consequence that many research interests that are scientific, but fall outside the reach of the incentives of proprietary science, are left unattended or do not receive proper care. The lack of attention given to those research fields is vulnerable to being perceived and interpreted as not being of equivalent merit. Here the market has become the entity that selects research agendas (cf. O'Neill 1990)—in a world of extreme economic inequalities, a strongly undemocratic mechanism. As so few people can influence research agendas through scientific participation, we have to consider alternative models or at least offer a strong enough parallel system that is able to rebalance the overall innovation system to add democratic legitimacy to it. Recent scholarship offers a variety of amelioration proposals (examples are Hollis and Pogge 2008; Love and Hubbard 2007; Gupta 2006) and open innovation models have greatly enhanced the input possibilities of different communities and individuals, such as amateur and retired scientists and indigenous innovators. Especially the global poor are in dire need of a system that reviews science and the resulting end-products with social welfare as the judging parameter and not with a sole emphasis on possible marketability.

In the spirit of democratic principles, people should have the right to participate on equal terms in the decision over what rights they should have over the access possibilities, shape and direction of future technologies and science. Having a larger circle of participants will provide a higher diversity in end products.[17] Without this higher diversity people will be limited in having to accept products (and methods) that were already preselected by others who not necessarily live up to the same set of values—a situation where "real choice" has limited meaning. As a last point, any active exclusion of people will be felt as an offense.[18] Here it is crucial to remove any unnecessary barriers that could hinder participation possibilities. Some barriers

[17] Here we may think of the reintroduction of Chinese traditional medicine and the new willingness to assess unfamiliar treatment methods after the monopoly standing of Western medicine was broken.

[18] In this passage my argumentation is strongly influenced by Waldron (1998).

might still be necessary to maintain a high level of scientific output; here we can count elements such as having common nominators for naming natural and artificial objects and the freedom to treat knowledge instrumentally (something that might interfere with the notion of sacred knowledge) as necessary for a swifter progress.

Science, as mentioned, can play a vital role in improving the situation of the world's poorest, and also the wealthiest, people. Due to this capacity, there is a risk in seeing science as having a purely instrumental function. When perceiving science as a societal tool, we have to acknowledge that we affect the dynamic of scientific progress. The recognition-seeking scientist generally adapts her behaviour to match the expectations of the agent whose recognition is aimed for (cf. O'Neill 1998). Nowadays, most scientists are seeking the recognition of researchers from industry and academia. The moment scientists start to seek societal recognition, rather than only close peer recognition, research agendas change in order to aim at satisfying any diverging expectations.

Prioritizing Participation or Access

Enjoying the benefits of scientific advancement does not constitute a single-standing right, but allows up to a certain extent the fulfilment of other human rights, particularly the right to health and the right to food. Further, being able to share in the advancement of science for a prolonged time presupposes that the two latter rights have been met. A very sick person suffering hunger can contribute little to science. It can be said that one right is dependent upon having the other rights satisfied (cf. Shue 1996). We can go even a step further and say that in most cases people need to have benefited from science before being able to take part in science. This prerequisite being twofold, one not only needs to have access to medicines, to take an example, but also have access to prior scientific knowledge for one's input to be meaningful, this being increasingly dependent on being able to access research networks and scientific infrastructure. Exceptions to this rule are extremely rare.

Let us imagine three possible worlds. One, where any effort in incentivizing people to engage in science is put aside in order to use all available resources to ensure that every person can enjoy the benefits of existing fruits of innovation. The second is a world where it is held to be more efficient to enhance global social welfare if only one particular group of the world concentrates in taking part in science while everybody is allowed to benefit from this group's contribution. The third scenario is a world where a special emphasis is made on building up scientific infrastructure, while neglecting efforts to make the fruits of scientific progress promptly available to the poor. Elaborating those theoretical worlds can give us some insights on how to judge proposals and movements that aim to alleviate the negative effects of intellectual property regimes.

To clarify the controversy of prioritization, I will elaborate on the effects of such worlds starting with the first one. This position considers large-scale scientific projects, examples often referred to are the International Space Station and particle accelerators, as luxuries civil society should condemn while people are massively dying from hunger and disease. Often ignored is that the efficacy and usefulness of a technology depends upon the environment it is placed into. Weeds, bacteria and other organisms develop resistance to agents that attempt to combat them—a phenomenon most prominently characterized by pathogens developing resistance to antibiotics (cf. Outterson 2005). Then we also have changing natural habitats due to climate change and raising pollutants levels. Stalling scientific progress means for a variety of technologies retrogression in the long term.

This policy is particularly demanding for the better-off circle of people among the current generation. They will not be able to improve their well-being by developing new tools through scientific methods and this partly due to the previous generations' policies of not taking sufficient regard for the situation of the worse-off. The more time is needed to ensure widespread enjoyment of the benefits of science the more demanding this position becomes for the better-off. Such a standpoint limits a higher aggregate welfare in order to increase the welfare of the worst-off (cf. Parfit 1997). The ICESCR states in article 11.1 however, that being able to work towards the "continuous improvement of living conditions" is a fundamental right. Arguably, this article would give the individual scientist enough room to better her own position, even in cases where strict prioritarianism would morally demand to focus one's efforts on the needs of the worst-off.

The second situation is a world that aims at leaving people above a certain threshold line in terms of welfare. It can have two moral justifications. A sufficientarian explanation that welcomes the needy to benefit from the advancement of science, but sees participation in scientific enterprises as something beyond basic necessities—to put it bluntly, as a luxury people can be excluded from without moral scruple. Or, more benignly, explained by a strict appeal to urgency towards alleviating the position of the worst off while perceiving the availability of resources as limited. In this case capacity-building in the poor regions of the world is seen as a luxury one cannot justify while people are starving or suffering diseases that science could cure or prevent. This position relies strongly on the assumptions that resources are limited and limited to a particular level. However one should differentiate between resources that are limited *per se* and resources that are limited due to resource allocation decisions that especially developed countries can influence or have previously made.[19] Even if efficiency is the sole determinant for such a policy decision, one cannot escape as a society from having to defend why one has chosen to allocate insufficient resources to address both distresses.

Our third hypothetical scenario is a world in which capacity-building is prioritized over a widespread access to the objects of innovation. For such position to survive Rawls' Difference Principle capacity-building has to lead to enough fruits to leave the worst-off in a better position. As ensuring access is neglected under this approach a strong emphasis on the production of public goods has to be set to ensure that enough benefits reach the worst-off, something that again will limit the freedom to take part in scientific advancement by having to carefully select research agendas. Capacity-building will also have to lead to a substantial number of inventions which can be either acquired or duplicated by the global poor.

[19] Timmermann and Belt (2012, 2013) criticize the Health Impact Fund proposal on this point for making a too broad commitment towards political feasibility.

This position becomes highly controversial, if we take into consideration that enjoying the benefits of science in order to stay healthy or ensure one's nutritional requirements is something necessary to be able to enjoy other rights and a prosperous life. Millions of people will never be able to share in science as malnutrition in the first years of their lives hampered their full brain development. In addition to that, taking part in scientific progress is a freedom only few people make use of, an even a tinier group would consider it as an essential part for the pursuit of one's ideal of a good life.

An outright reality check impedes us to believe that science on its own, even if heavily subsidized, could significantly improve the situation of the world's poorest inhabitants. Great initiatives that foster grassroots innovation and open science will still have to be supported by organizations that make previous innovations accessible to the poorest members of society.

Practicing science and being involved in product development encourages an active use of one's mental capacities and builds up a critical mass of people that become aware of unknown consequences and also potentials of technologies in use. While asking oneself the question of which element should be prioritized, access to the benefits or inclusion in meaningful projects, one has to keep in mind the huge inequalities and levels of deprivation people in the world face. Further, we should also consider the possibility of refusing to prioritize any of the two elements as a strategy. Facilitating the prospects of participating in scientific projects will primarily benefit people in the social middle class.[20] Those people are not the very poor, however they are also not the main beneficiaries of existing inequalities nor do they share the full responsibility for the world's institutional injustices. Developing and building up research infrastructure can help a significant number of those people to pursue their conception of a good life. However, the level of deprivation we currently face is extreme, making it justifiable to set aside such efforts in an attempt to ensure a wider access to the benefits of science. Such benefits however have to match the needs of the global poor, a situation we are currently very far away from, as the so-called "10/90 gap" in pharmaceutical research epitomizes.[21] Sharing benefits that only show welfare-improving characteristics for people who already have a high standard of living would not substantially meliorate the situation of the worst-off. A prioritarian position permits restricting scientific participation possibilities as long as doing so effectively raises the position of the worst-off. Urgency makes high reductions of aggregate welfare acceptable, e.g. by lowering the position of best-off, if this is the only way to ensure a higher percentage of people with basic needs met.

[20] Here I understand "social middle class" as the group of people who have their basic needs met and enjoy a small surplus that enables them to undertake risks (i.e. to try out new possibilities) without too much distress. An example would be a small farmer that after securing her basic necessities has still some additional seeds left to test a new agricultural method.

[21] This is the situation where only 10 % of the world's resources are used to address the problems that primarily affect 90 % of the earth's population, cf. Drugs for Neglected Diseases Working Group (2001).

Justifying Capacity-Building: Cooperative Justice

One of the goals of extending intellectual property protection globally is to make people be able to benefit from the fruits of their intellectual labour. We could even consider the possibility of doing so as a new global public good. This statement may arouse immediate controversies from different parties. Only a minority of intellectual labourers are able to live from the fruits of what they produce. Which inventions will become lucrative, and who will be able to live from them, has less to do with desert than with circumstances the individual has no control over. Coming up independently with the same invention the day later bears no fruits one has claims on (Nozick 1974). Closer to reality would be to claim that the recognition of intellectual property amounts to a common good, since it merely allows *some* scientist to live from *some* of their work.

The possibility of being able to generate income from scientific work has some great benefits for scientific independence and industry, but the practical effectuation of this freedom by some has considerable negative effects on others. What are the negative externalities of people enjoying on massive scale this opportunity? Here it becomes critical to establish if those negative externalities are due to lack of adaptation to new possibilities, i.e. the price of maintaining antiquated practices, or indeed amount to unfair advantage taking.

Economic poverty, as mentioned throughout this article, limits participation under proprietary science models, thus hiding to the world the real potential the economic poor have to bring out innovative ideas and disclose their scientific observations. There are strong arguments to claim that the use of intellectual property rights as introduced with the TRIPS Agreement (1994) does not only amount to unfair advantage taking but that the advantageous position that came with the imposition of the agreement was foreseeable and some would even argue premeditated (cf. Drahos and Braithwaite 2003). The treaty comes at a high price for grassroots innovators and people choosing to participate in science under a different set of principles. Many of those researchers are actively engaged in developing technical solutions for the problems of the poor. As fairer methods of incentivizing innovation are conceivable (such as prize systems, see Love and Hubbard 2007), but have not been institutionalized, keeping our patent regime demands a justification to the people suffering its negative consequences. Those people are scientists and technology developers of resource-scarce countries and, most severely, the global poor.

Apart from the above-mentioned problems that affect the liberties of the individual person, there are some specific global justice concerns that require a structural reform. The intellectual property regimes as they stand, face the charge of harming the global poor and as we—the affluent citizens of the world—have established those regimes, we owe the global poor compensation (Pogge 2009). The two most apparent harms, as discussed earlier, are caused by high prices to objects of innovation secured by the enforcement of exclusive rights on a worldwide scale, and by research agendas set to satisfy the wishes of the rich. Here harm is understood as imposing (and maintaining) a less favourable incentive system and this with the intention of gaining additional competitive advantages. Excluding ourselves from being part of the harming "we" is hardly possible as we strongly rely on the innovation system in our daily lives.[22] Nevertheless, as citizens of democratic countries we can counter this harm by protesting. As scientists and researchers we can also help by refusing to blindly rely on "big names" and being much more open to new currents of thoughts, even when format and label does not correspond to our image of professionalism. Living life as usual continues to strengthen institutional injustices.

Further burdens on the global poor are the following:

Patents are harsh on latecomers. The patent system is a winner-take-all arrangement; the first one to invent (or in many jurisdictions, to file a patent) gets all the benefits. The inventive-step (or non-obviousness) requirement of patentability is in relation to the state of the art. It is relative to what the top of the field have achieved. This improves patent quality, but almost solely at the cost of the researchers that are somewhat behind. We can assume that in both cases the latecomers will mostly consist of researchers with less access to costly journals and expensive infrastructure. Any possible advantages one may come across as a latecomer will vanish if one is not capable to play under the same rules of the game than preceding researchers or is not endowed with a comparable set of starting tools. The so-called "evergreening of patents", the ability to continue to delay the moment generic manufacturers can enter the market without seeking a license, is something that has increasingly come into criticism (cf. Dwivedi et al. 2010).

Patent expenses and purchasing power parity. About half of the world population live beneath the two-dollar a day poverty line. This line takes into consideration purchasing power parity, that is the fact that some products are much cheaper in poorer countries than in richer countries (cf. Pogge 2010). Notwithstanding this being false for many medicines, it is not true at all for the costs of patent protection. Developed world companies can seek exclusive rights for their inventions at comparable much lower cost for themselves in developing countries than companies from developing countries in the developed world. Industry and research institutes situated in the developing world have to acquire (with few exceptions) licenses for follow-up research or product development at world market prices, despite the huge purchasing power differences. Here we can generally question the patent holder's right to have full control over the conditions to grant licenses.

Harmonization of safety standards. Safety standards can be held very high without objections as long as there are cheaper alternatives for the poor or people with fewer resources are not excluded from the high standard products. This is not the case with much technological advancement in agriculture and medicine. Having worldwide standards that are in line with welfare levels experienced in developed countries leads to a situation where many less safe, but still quite cost-effective and beneficent products, are not developed. Many research leads that are feared to not pass safety regulations are dismissed, even though they could lead to welfare enhancing products for resource poor settings—generally solutions that are much better than nothing are put aside.

[22] Pogge (2008) accuses the citizens of the developed world of complicity in the institutional harm done to the poor. Others are more hesitant in inculpating the average citizens, e.g. Steinhoff (2012).

The worldwide recognition of the current intellectual property standards has also a row of benefits. There is a set of goods—generally identified under the label "luxury goods"—for which excluding people appears to have no unacceptable consequences. The knowledge gained while developing and researching for those objects listed in patent documents ultimately becomes part of the public domain after a transition time. The diversity of technological extravagancies incentivized by rewards secured by intellectual property leads to an enlargement of the pool of knowledge. In addition to that, people who justify intellectual property on desert-based principles can argue that, on utilitarian terms, the more intellectuals can live from the fruits of their labour the better. Libertarians welcome lower taxation by not having to finance science programs that can sustain themselves through the sales of their developed products.

Even after summing up the global benefits of intellectual property, we can still maintain that the developed world has imposed an innovation incentive system that disproportionally favours the world's richest people. If there are some overall benefits of having this type of regimes established, justice demands that burdens and benefits are to be distributed fairly. In order for intellectual property to be recognized as such, members of society have to accept this method of incentivizing innovation as a necessity that leads to everyone's advantage. This demands a clear balance between private and public interests, with both parties satisfied with the concessions made. When this is not the case intellectual property has to be safeguarded by extortive measures, something that has to be paid for by making the products of innovation even more difficult to access. Further, if we see global trade as a cooperative endeavour where everybody should benefit, cooperative justice would demand a serious effort in capacity-building and a system that fairly evaluates grassroots innovation, as well as compensatory measures like the Health Impact Fund (Hollis and Pogge 2008). Meeting one's side of a cooperative arrangement puts us in a much better position for demanding help in times of distress on terms of reciprocity and motivates the other partner in exploring further cooperation possibilities.

Where we can rely on past and on-going positive experiences, as with the cases of vaccine development and large-scale immunization efforts, the establishment of new programs and the reaffirming of existing commitments have shown great success, as the Global Alliance for Vaccination and Immunization (GAVI) exemplifies. However, raised population levels, extreme poverty and increased mobility demand urgently an even stronger commitment to work constructively together, since many of the global hazards we now face demand organized action at a global scale. Controlling antibiotic resistance (cf. Anomaly 2010) and speeding up the sharing of samples in times of epidemic outbreaks (cf. Langat et al. 2011) are two of the many critical targets.

Perhaps the human rights framework and the capabilities approach do not yield enough argumentative strength to establish claim rights that would assist people in becoming a scientist. However, analysing the huge gap in research potential between the developed and developing world, we have a series of arguments that lead us to condemn current distributions of scientific capacities. If one party feels or is perceived as dependent, dispensable, or even as a burden, we are certainly failing to meet the social goal of people living on equal standing. Enabling people to make a meaningful contribution helps to overcome this problem and this in a way in which both—developed and developing countries—can profit in the long run. Providing scientific infrastructure, education and access to research networks is a certain path to do so.

Acknowledgments Earlier versions of this article were presented at the CSG researchers' day June 2012 in Utrecht, the Political Philosophy Conference in Vejle and the Global Justice and International Economic Institutions Workshop in Leuven (both August 2012) where I gratefully received valuable feedback. I am also indebted to critical comments and suggestions made by Henk van den Belt, Michiel Korthals, Annabelle Lever, John O'Neill, Zofia Stemplowska, two anonymous reviewers and the editor. The present version was finalized during a researcher stay at the Fondation Brocher. This article is result of a research project of the Centre for Society and the Life Sciences in The Netherlands, funded by the Netherlands Genomics Initiative.

References

Agrawal, A. (1995). Dismantling the divide between indigenous and scientific knowledge. *Development and Change, 26*, 413–439.

Anderson, E. (2007). Fair opportunity in education: A democratic equality perspective. *Ethics, 117*(4), 595–622.

Anomaly, J. (2010). Combating resistance: The case for a global antibiotics treaty. *Public Health Ethics, 3*(1), 13–22.

Arneson, R. (1987). Meaningful work and market socialism. *Ethics, 97*(3), 517–545.

Baulcombe, D., Crute, I., Davies, B., Dunwell, J., Gale, M., Jones, J., et al. (2009). *Reaping the benefits: Science and the sustainable intensification of global agriculture*. London, UK: The Royal Society.

Chan, S., & Harris, J. (2009). Free riders and pious sons—why science research remains obligatory. *Bioethics, 23*(3), 161–171.

Chapman, A. R. (2009). Towards an understanding of the right to enjoy the benefits of scientific progress and its applications. *Journal of Human Rights, 8*(1), 1–36.

Donders, Y. (2011). The right to enjoy the benefits of scientific progress: in search of the state obligations in relation to health. *Medicine, Health Care and Philosophy, 14*, 371–381.

Drahos, P., & Braithwaite, J. (2003). *Information feudalism : Who owns the knowledge economy?*. New York: New Press.

Drugs for Neglected Diseases Working Group. (2001). *Fatal imbalance: The crisis in research and development for drugs for neglected diseases*. Geneva: Médecins Sans Frontières.

Dübgen, F. (2012). Africa humiliated? Misrecognition in development aid. *Res Publica, 18*, 65–77.

Dumitru, S. (2008). Are rawlsians entitled to monopoly rights? In A. Gosseries, A. Strowel, & A. Marciano (Eds.), *Intellectual property and theories of justice* (pp. 57–72). Houndmills, New York: Palgrave Macmillan.

Dwivedi, G., Hallihosur, S., & Rangan, L. (2010). Evergreening: A deceptive device in patent rights. *Technology in Society, 32*(4), 324–330.

Eisenberg, R. S. (2008). Noncompliance, nonenforcement, nonproblem? Rethinking the anticommons in biomedical research. *Houston Law Review, 45*(4), 1059–1099.

Fraser, N. (1998). Social justice in the age of identity politics: redistribution, recognition, and participation. In G. B. Peterson (Ed.), *The Tanner lectures of human values* (Vol. 19, pp. 1–67). Salt Lake City: The University of Utah Press.

Fraser, N., & Gordon, L. (1994). "Dependency" demystified: inscriptions of power in a keyword of the welfare state. *Social politics: International studies in gender, state & society, 1*(1), 4–31.

Fricker, M. (2007). *Epistemic injustice: Power and the ethics of knowing*. Oxford & New York: Oxford University Press.

Galeano, E. (1971/2008). *Las venas abiertas de América Latina*. Madrid: Siglo XXI.

Green, M. (2000). Substantive issues arising in the implementation of the International Covenant on Economic, Social and Cultural Rights: Day of General Discussion "The right of everyone to benefit from the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author (article 15.1 (c) of the Covenant)" organized in cooperation with the World Intellectual Property Organization (WIPO). In Committee on Economic Social and Cultural Rights (Ed.), *E/C.12/2000/15*. Geneva.

Greene, M. T. (1984). Alfred Wegener. *Social Research, 51*(3), 739–761.

Gupta, A. K. (2006). From sink to source: The Honey Bee Network documents indigenous knowledge and innovations in India. *Innovations, (summer)*, 49–66.

Gupta, A. K. (2010). Grassroots green innovations for inclusive, sustainable development. In A. Lopez-Claros (Ed.), *The innovation for development report 2009–2010, strengthening innovation for the prosperity of the nations* (pp. 137–146). Houndmills, New York: Palgrave Macmillan.

Harris, J. (2005). Scientific research is a moral duty. *Journal of Medical Ethics, 31*(4), 242–248.

Hollis, A., & Pogge, T. W. (2008). *The health impact fund: Making new medicines accessible for all.* Oslo, New Haven: Incentives for Global Health.

ICSU Study Group on Science and Traditional Knowledge (2002). Science and traditional knowledge: Report from the ICSU study group on science and traditional knowledge.

Kitcher, P. (1990). The division of cognitive labor. *The Journal of Philosophy, 87*(1), 5–22.

Korthals, M., & Timmermann, C. (2012). Reflections on the International Networking Conference "Ethical and Social Aspects of Intellectual Property Rights—Agrifood and Health" held in Brussels, September 2011. *Synesis, 3*, G66–G73.

Langat, P., Pisartchik, D., Silva, D., Bernard, C., Olsen, K., Smith, M., et al. (2011). Is there a duty to share? Ethics of sharing research data in the context of public health emergencies. *Public Health Ethics, 4*(1), 4–11.

Love, J., & Hubbard, T. (2007). The big idea: Prizes to stimulate R&D for new medicines. *Chicago-Kent Law Review, 82*(3), 1519–1554.

Marks, S. P. (2011). *The neglected human right to benefit from scientific progress: implications for human development.* Paper presented at the Human Development and Capabilities Association 2011 International Conference, Den Haag, September 6–8.

Nozick, R. (1974). *Anarchy, state, and Utopia*. Malden, Oxford: Blackwell.

Nussbaum, M. C. (1997). Capabilities and human rights. *Fordham Law Review, 66*(2), 273–300.

O'Neill, J. (1990). Property in science and the market. *The Monist, 73*(4), 601–620.

O'Neill, J. (1998). The politics of recognition. In J. O'Neill (Ed.), *The market: Ethics, knowledge and politics* (pp. 102–111). London: Routledge.

Oosterlaken, I. (2009). Design for development: A capability approach. *Design Issues, 25*(4), 91–102.

Outterson, K. (2005). The vanishing public domain: Antibiotic resistance, pharmaceutical innovation and intellectual property law. *University of Pittsburgh Law Review, 67*, 67–123.

Parfit, D. (1997). Equality and priority. *Ratio, 10*(3), 202–221.

Plomer, A. (2012). The right to access the benefits of science and intellectual property rights. In R. Bin, S. Lorenzon, & N. Lucchi (Eds.), *Biotech innovations and fundamental rights* (pp. 45–68). Milan: Springer-Verlag Italia.

Pogge, T. W. (2008). *World poverty and human rights : Cosmopolitan responsibilities and reforms* (2nd ed.). Cambridge and Malden: Polity.

Pogge, T. W. (2009). The health impact fund and its justification by appeal to human rights. *Journal of Social Philosophy, 40*(4), 542–569.

Pogge, T. W. (2010). *Politics as usual : What lies behind the pro-poor rhetoric*. Cambridge, UK, Malden, MA: Polity.

Rawls, J. (1999). *A theory of justice (Rev. ed.).* Cambridge, Mass: Belknap Press of Harvard University Press.

Robeyns, I. (2005). The capability approach: A theoretical survey. *Journal of Human Development, 6*(1), 93–114.

Robeyns, I. (2011). The capability approach. In Zalta, E. N. (Ed.), *Stanford encyclopedia of philosophy (Summer 2011 Edition).*

Sayer, A. (2011). Habitus, work and contributive justice. *Sociology, 45*(1), 7–21.

Schoonmaker, S. (2007). Globalization from below: Free software and alternatives to neoliberalism. *Development and Change, 38*(6), 999–1020.

Shaver, L. (2010). The right to science and culture. *Wisconsin Law Review, 121*, 121–184.

Shue, H. (1996). *Basic rights : Subsistance, affluence, and U.S. foreign policy* (2nd ed.). Princeton, N.J.: Princeton University Press.

Steinhoff, U. (2012). Why 'we' are not harming the global poor: A critique of Pogge's leap from state to individual responsibility. *Public Reason, 4*(1–2), 119–138.

Steinvorth, U. (2009). The right to work and the right to develop one's capabilities. *Analyse & Kritik* (1), 101–113.

Stephan, P. E. (2012). *How economics shapes science*. Cambridge, MA, London: Harvard University Press.

Taylor, R. (2004). Self-realization and the priority of fair equality of opportunity. *Journal of Moral Philosophy, 1*(3), 333–347.

Timmermann, C., & van den Belt, H. (2012). Global justice considerations for a proposed "climate impact fund". *Public Reason*, *4*(1–2), 182–196.

Timmermann, C., & van den Belt, H. (2013). Intellectual property and global health: from corporate social responsibility to the access to knowledge movement. *Liverpool Law Review*, *34* (1), 47–73.

TNS Opinion & Social (2010). Eurobarometer 73.1: Biotechnology. Brussels: European Commission.

UNESCO. (2009). *The right to enjoy the benefits of scientific progress and its applications*. Paris: UNESCO.

United Nations (1948). 151st Meeting, held on Monday, 22 November 1948 (A/C.3/SR.151). *General Assembly, 3rd Session, 3rd Committee*. Paris: United Nations.

Waldron, J. (1998). Participation: The right of rights. *Proceedings of the Aristotelian Society, 98*(3), 307–337.

Weber, M. (1919/2002). Wissenschaft als Beruf. In D. Kaesler (Ed.), *Max Weber Schriften 1894–1922* (pp. 473–511). Stuttgart: Kröner.