

Fiction lagging behind or non-fiction defending the indefensible? University-industry (et al.) interaction in science fiction

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ABSTRACT

University-industry interaction has supporters and detractors in the scholarly literature. Whereas policymakers have mainly joined the former, science fiction authors have predominantly enrolled the latter. We illustrate how the genre has been critical to university-industry interaction via the analysis of the most positively acclaimed novels from the 1970s to date. We distinguish the analytical dimensions of type of conflict, and innovation helices involved other than university (industry, government, society). By doing so, we merge two streams of literature that had not encountered before: university-industry interaction and representations of science in popular culture. A methodological novelty is the creation of an objective corpus of the literature to increase external validity. Insights include the relevance of the time context, with milder views or disinterest on university-industry interaction in science fiction works after the passage of the Bayh-Dole Act; and the lack of an academic or policy narrative about the benefits of university-industry interaction so convincing as to permeate into popular culture. Discourse is crucial for legitimising ideas, and university-industry interaction may have not found the most appropriate yet.

Keywords: university-industry interaction, conflicts, representations of science

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1. Introduction

University-industry interaction (UII) is a source of conflict, with advantages and disadvantages. It is a typical object of analysis in the field of Innovation Studies, which so far has offered inconclusive evidence about its benefits. However, the approach has always been to study UII in the ‘real world’. Could the study of ‘fiction’ shed any light on the debate?

The study of ‘representations’ of socioeconomic phenomena in fiction can enrich their analysis, as the concomitant field of Organization Studies acknowledges: Borges’ short stories or science fiction novels can offer lessons to researchers in the field (De Cock 2000; Pick 2016). Fiction is a laboratory for experimenting with many plausible situations, unconstrained by real limits, but shaped according to creators’ mental models. Thus, fictional representations of socioeconomic phenomena produce empirical evidence that is connected with (and sometimes mimics) reality. Even superheroes create networks with similar topographic properties to those of humans (Alberich et al. 2002)!

Innovation Studies have incipiently used fiction (specifically, science fiction) to establish analogies with typical objects of analysis in the field, namely the sources of innovation (Basset et al. 2013) or its rate and direction (Archibugi 2017; Steinmueller 2017). However, the field has not analysed the representations of these objects per se. Cultural Studies are ‘the best proxy’ for this type of analysis. The usual work includes representations of researchers in popular culture, e.g. in literature (Haynes 1989), in specific types of literature, e.g. Victorian and Edwardian novels (Russell 2007) or science fiction novels (Bowman 2007), in movies (Weingart 2003), in specific types of movies, e.g. Hollywood comedies (Terzian and Grunzke 2007), or in superhero comics (Locke 2005). The characteristic result is an ambivalent portrayal of researchers, from the archetypal dichotomy between the harmless absent-minded professor and the mad genius, to more complex distinctions. This resonates with the

ambivalent understanding of university-industry interaction, but the typical work in Cultural Studies deals with the world of science in isolation, without considering its interaction with industry. These works understand that literature shapes contemporary attitudes to science and scientists as much as it is shaped by them (Huxford 2000).

The question is still open: how is UII depicted in popular culture? We hereby analyse the representation of UII, paying particular attention to its (perceived) advantages and disadvantages as depicted in science fiction works. Our expectation is that we will discern an evolution towards more complex ambivalence in contemporary works.

2. Advantages and disadvantages of university-industry interaction

2.1. Advantages of university-industry (et al.) interaction

University-industry interaction is useful for academics, firms and the economy. It makes academics earn personal income, gain awareness of general economic needs and orient their research towards applied goals. It may connect them to industrial researchers with specialised frontier knowledge, and widen their network so that more opportunities to raise funding and find professional exits for their students and collaborators arise (Meyer-Krahmer and Schmoch, 1998; Balconi and Laboranti, 2006; Meng et al., 2019; Henningsson and Geschwind, 2019). For firms, interaction with universities may bring familiarity with state-of-the-art ideas, the chance to sub-contract specialised scientific work which would be too costly to develop in-house, or indirect benefits derived from signalling the ability to collaborate: attraction of good scientists, strategic alliances with other firms and a better position to get R&D grants (Santoro and Chakrabarti, 2002; Maietta, 2015; Guerrero et al., 2019). This mutual reinforcement between universities and companies impulses the value of academic activities for the region and the country, legitimises the role of universities and translates into

economic growth (Etzkowitz and Zhou, 2017; Ghio et al., 2019). This may explain that many conceptual models of the 1990s about the innovation process incorporated university-industry interaction among the motors of well-functioning societies, e.g., national systems of innovation (Freeman, 1987; Lundvall, 1988), the Mode 2 of knowledge production (Gibbons et al., 1994), the Triple Helix (Etzkowitz and Leydesdorff, 1996) or the entrepreneurial university (Clark, 1998; Etzkowitz, 1998). These approaches differ in the importance granted to universities in the innovation process, but do not question that some degree of interaction with firms should exist. In a similar fashion, national governments, and the European Commission typically mention university-industry interaction as a necessary condition for growth and welfare.

Some sort of synthesis has underscored that benefits and costs of university-industry interaction are undeniable, so the question is how to overcome the barriers that prevent successful interaction (Barnes et al., 2002; Bruneel et al., 2010; Bjursell and Engström, 2019; Kunttu and Neuvo, 2019). Another line of synthesis differentiates between types of interactions (D'Este and Patel, 2007), grouped in two broad types: university-industry commercialization and academic engagement (Perkmann et al., 2013). The former would comprise interaction mechanisms like patents and spin-off companies, whereas the latter would rely on others like joint R&D, exchange and mobility of researchers, informal connections, etc. Academic commercialisation would therefore gather the most polemic aspects of interaction with firms, and would be less recommendable than academic engagement –a more accommodated way for faculty members to continue with their academic standards and serve practical means at the same time. Hence, both syntheses establish that university-industry interaction is not inherently bad, but has disadvantages that, properly managed, can turn into advantages.

This view impregnates most current conceptual frameworks, which tend to assume that the underlying tension in university-industry interaction is ultimately solvable: the ‘productive interactions’ approach argues that if there is learning during the course of a relationship between researchers and other stakeholders, this learning can account for social impact of research (Spaapen and Van Drooge, 2011: notably, most of the examples given by this authors involve university researchers and industry stakeholders). The literature on ‘societal impact of research’ cares about the problem of measuring and assessing the returns of public science, but largely relies on the assumption that the impact is positive if leading to innovation (Bornmann, 2013). Similarly, the ‘responsible research and innovation’ (RRI) approach conceives scientific impact through interaction with industry and society as the basis for innovation, another ‘anchor points’ and the ‘Grand Challenges’ (Von Schomberg, 2013). The ‘transformative change’ frame revises how much innovation policy and innovation actors’ perspectives should change to achieve socio-technical system transitions towards sustainable growth, but admits that the public-private interactions were well conducted by previous theoretical approaches or by contemporary ones, like ‘societal impact of research’ or ‘RRI’ (Schot and Steinmueller, 2018). University-industry interaction as a precondition of ‘sustainable’ knowledge production is widely acknowledged (Bjursell and Engström, 2019; Saviano et al., 2019).

Notice that most of these approaches prefer the term ‘stakeholders’ of the science system to ‘university-industry interaction’. This emphasises how the relevance of public researchers transcends their impact on industry to cover other sectors of performance, notably society, citizenship or cultural agents (as also acknowledged by the Quadruple Helix framework: Carayannis and Campbell, 2009), but also hospitals, the military, non-governmental organizations, etc. To our knowledge, there has not been a literature on the disadvantages of university interactions with organizations other than firms, equivalent to that of university-

industry interactions. For our purposes, we are open to identify the same kind of conflicts in both types of stakeholders.

2.2. University-industry interaction: neutral views?

Consequently, the typical paper on university-industry interaction takes its benefits for granted and cares about its promoting factors: managerial practices conducive to clear proprietary benefit (Barnes et al., 2002; Leischnig and Geigenmüller, 2018); geographical proximity, be it unimportant (Vedovello, 1997), or important according to the type of R&D project (Broström, 2010) or geographic proximity of other firms (Giunta et al., 2016), quality of the university and radicalness of innovation (Tang et al., 2019); individual characteristics of academic researchers such as age and academic status (D'Este and Patel, 2007); characteristics of the firms such as the choice between exploitation and exploration, and absorptive capacity (Fernández-Esquinas et al., 2016), social capital (Al-Tabbaa and Ankrah, 2018) or phase of the interaction process (initiation or management: Goel et al., 2017), phase of the economic cycle (Azagra-Caro et al., 2019), the presence of successful project leaders (Takanashi and Lee, 2019), sectoral characteristics (de Moraes Silva et al., 2018), government subsidies (Scandura, 2016), business funding (Yegros-Yegros et al., 2016), etc.

2.3. Disadvantages of university-industry interaction and a typology of conflicts

So far, the bright side of university-industry interaction. Critiques challenging this idealised view of what can be considered 'academic capitalism' (Slaughter et al., 2004) have been numerous. The academic reward system, based on the importance of scientific findings, is enough to guarantee a continuous flux of useful knowledge (David et al., 1992; Partha and David, 1994). The intromission of external stakeholders with their own private agendas may deteriorate the quality of the academic work, and do nothing for the welfare of faculty

members (Bozeman and Gaughan, 2011). Companies will have a tendency to ask for short-term, value-in-hand deliverables, which are at odds with fundamental understanding of nature and breakthrough discoveries. They will try to retain the property of the results, thus obscuring academic contributions to open science. Academics involved in contacts with firms will devote less time to teaching and publishing, endangering their performance in those domains (Manjarrés et al., 2008; Banal-Estañol et al., 2015)¹, and similarly for deans (McClure and Teitelbaum, 2016). They may even bias their results to please their private sponsors (Chiles et al., 2018), or use postdocs as visible boundary spanners, to safeguard their image (Johnson, 2018). Long standing university-industry interaction can lead to less valuable science-based innovations because of the inertia of these relationships, that cause both partners not to be aware of better existing technical solutions (Meyer-Krahmer and Schmoch, 1998). University-industry interaction is dominated by power (male faculty members, holding an administrative position, and large firms) and may cause regional imbalances, since local interactions occur only where firms have high absorptive capacity (Azagra-Caro, 2007). Under the lens of the ‘striving universities’ approach, the fact that faculty can overcome the conflicts of involvement with industry is trivial: it hides that the cost is resignation, free time consumption and energy deprivation, not intrinsic motivation, and that only the auspices of a neoliberal ideology can justify that (Gonzales et al., 2014).

Studies about UII have exposed many of its potential conflicts, but typologies of those conflicts are scarce. We need one to establish analytical categories, while remaining open to others that may emerge from the works analysed. Campbell and Slaughter’s (1999) typology of UII conflicts is one of the most comprehensive. The authors distinguish between conflicts of interest, commitment and equity. We can summarise their respective meaning as dangers to the public service, lack of reporting to the academic organization and academic promotion

¹ The evidence on the relation between university-industry interaction and scientific excellence is mixed: some works report a positive relationship (Balconi and Laboranti, 2006, Van Looy et al., 2011).

based on relationships with industry. Within conflicts of interest (the first type), there are two sub-types: those due to enhanced entrepreneurship and those due to fostering intellectual property rights². We will use this typology to organise the empirical evidence.

3. Methods

Our corpus is composed of the novels that were concurrent winners of the Locus, Nebula and Hugo Awards, plus Frank Herbert's *Dune*. We take these to be the most-representative texts, inasmuch as a triple-awardee embodies wide critical and popular acclaim. The former prizes are the three most prestigious awards in the SF community, together covering the views of both experts and the public. The Locus Awards are conferred by the science fiction and fantasy magazine *Locus* (based in Oakland, CA), selecting winners via a readers' poll. The Nebula Awards are given by the Science Fiction and Fantasy Writers of America (SFWA); nominees and winners are chosen by published authors who are members of the association. The Hugo Awards are organized by the World Science Fiction Society; awardees are chosen by attending members of the annual World Science Fiction Convention. The inclusion of *Dune*, winner of two prizes only (Nebula and Hugo) obeys to its being the world's best-selling science fiction novel, which systematically makes it to the top in science fiction recommendation lists. Table 1 compiles the information.

² The crown of these contradicting views is the enforcement of intellectual property rights at university. Some consider academic patenting as a natural consequence of applied orientation of universities, and academic patent licensing as a legitimate alternative to alleviate the pressure on others sources of funding. Moreover, academic patenting signals the technological and industrial capabilities of university research and the willingness to be useful to the community. However, others consider that academic patenting directly clashes with the philosophy of open science: it privatises the use of university technology and controls who can benefit from it. It also aims at producing revenue through licensing, which introduces a commercial mentality among researchers and administrators and deviates time from research, with bad repercussion on research quality. Moreover, paradoxically, it may deteriorate knowledge transfer, given that corporations will have to engage into costly negotiations with university, which may overestimate the value of their proprietary technologies.

All in all, as in the case of other interaction channels, the typical research on academic patenting assumes its benefits and focuses on how to foster it, e.g. effective technology transfer offices' management practices (Backs et al., 2019), quality of other interactions (Fischer et al., 2018).

There are 15 books, ranging from 1966 to 2013. New Wave science fiction is dominant, whereas contemporary subgenres such as steampunk are rare (Basset et al., 2013; Hrotic, 2014). They have 14 authors, since one of them repeated the triplet (Connie Willis). They are all Anglo-Saxon, as a natural consequence of the three prizes being for English language books. 10 authors are men and 4 are women, which reflects the overrepresentation of males in the science fiction genre (Thelwall, 2017).

We analysed their contents as follows: Laura and Pedro split and read the books, produced fiches and extracted literal quotations. Joaquín read the summaries and other complementary information from online sources and discussed with Laura and Pedro whether the books provided evidence regarding university-industry interaction and how to classify it.

Table 1 Joint winners of the Locus, Nebula and Hugo Awards

1 Year	2 Novel	3 Author	4 University represented?*	5 Interaction with other sectors represented?	6 View on interactions	7 Internal conflicts represented?
1966/1965	Dune ^a	Frank Herbert	Yes	Yes: industry, government	Conflictive	No
1971/1970	Ringworld	Larry Niven	Yes (symbolically)	Yes: industry	Neutral	No
1973/1972	The Gods Themselves	Isaac Asimov	Yes	Yes: society, government	Conflictive	Yes
1974/1973	Rendezvous with Rama	Arthur C. Clarke	Yes	Yes: industry, government	Conflictive	Yes
1975/1974	The Dispossessed	Ursula K. Le Guin	Yes	Yes: state, society	Conflictive	Yes
1976/1975	The Forever War	Joe Haldeman	Yes (symbolically)	Yes: military	Conflictive	No
1978/1977	Gateway	Frederik Pohl	Yes	Yes (secondary): industry	Neutral	No
1979/1978	Dreamsnake	Vonda McIntyre	Yes (symbolically)	Yes: industry	Conflictive	No
1984/1983	Startide Rising	David Brin	Yes (symbolically)	Yes: government	Neutral	Yes
1987/1986	Speaker for the Dead	Orson Scott Card	Yes	Yes: government	Conflictive	Yes
1993/1992	The Doomsday Book	Connie Willis	Yes	Yes (secondary): public	Conflictive	Yes
2008/2007	The Yiddish Policemen's Union	Michael Chabon	No	-	-	-
2010/2009	The Windup Girl ^b	Paolo Bacigalupi	Yes	Yes (secondary): industry)	Conflictive	Yes
2011/2010	Blackout/All Clear	Connie Willis				
2014/2013	Ancillary Justice ^b	Ann Leckie	No	-	-	-

Source: Own elaboration. ^a Joint Winner of Nebula and Hugo only. ^b Locus Award for Best *First* Novel. * Also included: public research organisation/government lab.

We found university represented in most of the works (Column 4). Of course our methodological choices matter: First, we equated public research organisations (also known as government labs) with universities, since they experience similar conflicts from interaction with industry (Azagra-Caro et al., 2007; Arza, 2010). Second, we included not only the often explicit but also the occasional symbolic representations of university, e.g. organized explorers (*Ringworld*) or health bodies (*Dreamsnake*).

Debates about interaction with industry were represented so often as university (Column 5). Again, one methodological choice facilitated finding them: to include sectors other than industry: government/state, society/public, military (Carayannis and Campbell 2009's Quadruple Helix Model loosely inspired labelling the sectors). A key reason is that the views on interaction were indistinguishable from one another, as the results section will make clear: the narratives seem to have chosen industry or other sectors for coherence with the plot, not because of clearly distinctive conflicts with university. However, we have excluded debates without an organizational perspective, e.g. conflicts between the public and the private good, or between science and technology. We have also excluded critiques to corporate science, when they involved no interaction with university, even if the type of conflicts were similar, e.g. the lack of freedom of the industrial researcher, or the sacrifice of ethics for money.

In Column 5 we also specify whether the representation of the interaction is secondary to the plot (if not specified, it is most important). It means that the plot does not rely on it, usually because university characters are not protagonists. We realised this was an important distinction, because of a temporary pattern: the topic becomes less important as time goes by. We will later develop this issue.

We qualified the views on interactions as positive, conflictive or neutral, but we could never apply the category 'positive' –that is already a surprising result (Column 6). We will develop these views in detail in the next section. Let us indicate first that the representation of

internal conflicts in the university system is the norm rather than the exception, e.g. the pursuit of scientific prestige at the expense of the public service and the quest for trust is a recurrent topic. We included Column 7 in Table 1 to show that most works do not depict a Manichean dichotomy between the purity of the university and the dirtiness of industry, but are critical to both worlds. However, internal conflicts are not the target of our study, so we do not develop them unless indispensable.

4. Results

4.1. Importance of the topic and the two-period divide

In 5 out of the 6 books there are representations of the conflicts between university and external actors, i.e. the topic has been important for influential science fiction works.

Time seems to play a role: 4 books are from the 60s-70s, and in all of them the topic is core to the plot. 2 books are from the 90s-00s, and in one of them it is not so important (*The Doomsday Book*), and in the other one it is not represented (*The Yiddish Policemen's Union*). We can take this as a symptom that initial fears against excessive intromission of third parties in academic research agendas have given rise to milder views or disaffection to the subject. We tentatively attribute it to changes in the public opinion after the passing of the Bayh-Dole Act (Mowery et al. 2001), which fostered commercialisation at universities, although we will verify so by reading all the books in the sample. In any case, sci-fi authors have not replaced scepticism by a positive depiction of UII (broadly defined).

4.2. Conflict of interest with the public service (a): threats to sustainability

This category is the more populated with examples, starting with the oldest novel in the sample: *Dune*. It narrates the story of a galactic economy based on the traffic of *melange*, a spice produced only in one planet, Arrakis, inhabited by the Fremen. The Emperor granted the non-local Harkonnen family the management of Arrakis. Kynes, an Imperial Planetologist who conducts research in Arrakis, is critical to the way the Harkonnens have exploited it for their own benefit and in detriment to the Fremen. He oversees the transition between the outgoing Harkonnens and another family, the Atreides, who have been granted domain over the planet. Duke Leto Atreides then gives Kynes permission to study the spice, research that the Harkonnens had prevented in the past, and the Emperor himself does not seem to support either:

*I don't care if you study the spice as long as I share what you discover
[...]. The Harkonnens discouraged investigation of the spice, didn't
they?*

In fact, the Emperor has allowed this transaction between families in connivance with the Harkonnens, in order to set a trap to the Atreides –a representation of a conglomerate of industrial-government interests. The Harkonnens, back in charge, target and eventually succeed in killing Leto Atreides and Kynes:

*–Have the Man [Kynes] killed.
–M'Lord! Kynes is the Imperial Planetologist, His Majesty's own
ser—
–Make it look like an accident.*

The careless exploitation of natural resources in the planet restarts.

The Gods Themselves tells a similar threat, this time to planet Earth. Radiochemist Frederick Hallam develops a cheap, clean, and apparently endless source of energy: the

“Pump”. Physicist Peter Lamont and archaeologist and linguist Mike Bronowski discover that the Pump increases the strong nuclear force inside the Sun, bound to eventually explode. Hallam is totally closed to accepting this, and Lamont attempts to demonstrate it to a senator, who refuses his request:

Young man, my powers, on paper, are enormous, but I can only succeed when the public is willing to let me. It is a mistake... to suppose that the public wants... the environment protected or their lives saved and that they will be grateful to any idealist who will fight for such ends. What the public wants is their own individual comfort... You have a theory but a theory by itself is meaningless.

The moral is that everyone is driven by self-interest: the public, who does not want to believe in inconvenient truths (such as the Pump, which provides free energy to everyone, but could potentially be harmful); as well as politicians, who do not want to risk their reputation.

In the words of another character, ex-physicist Denison, briefly introduced in Part 1 as the colleague and rival of Hallam:

The easiest way to solve a problem is to deny it exists.

We find similar examples in *Rendezvous with Rama*. An alien starship enters the Solar System, named Rama. Survey vessel *Endeavour* is sent to explore and study it. A committee of scientists and representatives of the United Planets (Mercury, Earth, Luna, Ganymede, Titan and Triton), based on the moon, monitors events and gives feedback. Various conflicts dominate the dynamics between both groups, in the form of impossible problem-solving requests, and constant demands of cost-benefit analysis, from politicians to scientists.

However, the ultimate challenge for scientific quest is that from Mercury, who embodies the concept of “technological barbarism” (in the words of one character): with vast engineering skills, Hermians (natives from Mercury) are the Solar System top exporters of

metal, metal manufactures and energy. They are used to living in “survival mode” due to the brutal conditions of their planet: isolated, and constantly weighing the risks against the benefits. The citizens from all the other planets, on the other hand, have a “thrive mindset”: they value art, and lean towards a respectful pursuit of knowledge that takes into account others’ needs as well as one’s own. It is easy to see in this dichotomy between Mercury and the others a representation of the conflict between challenge-driven and frontier research. Hermians conclude that the risk Rama poses is not worth the potential gains, so they unilaterally launch a missile to destroy it, but one of the astronauts neutralises the rocket. The mission commander puts it this way:

The human race has to live with its conscience. Whatever the Hermians argue, survival is not everything.

The threat is even more palpable when the boundaries between the state and the military blur. In *The Forever War*, there is a war between Earth and Taurus. National and international governments orient their economies towards armed fighting –science at the forefront. The United Nations recruit the most brilliant college students, including the main character, William Mandella, for their elite battle forces. We see here a parallel with reports of university students’ pro-industry bias after receiving gifts by companies (Lieb and Koch, 2013). The war lasts for hundreds of years, and Mandella finally discovers its futility: it started by accident, but Earth’s public-private forces in power made it look like the result of Taurans deliberate hostility.

We find a similar example in *The Doomsday Book*, in which time-travel is an ordinary practice for historians at the University of Oxford, until some sceptics seem to think that it has something to do with a current epidemic. Gilchrist, Acting Head of the History Faculty, closes the laboratory, even though there is no scientific basis for that belief:

Our position in the community [...] depends on maintaining the goodwill of the townspeople. I felt it important to calm the public's fears by closing the laboratory until the sequencing arrives. I felt it important to calm the public's fears by closing the laboratory until the sequencing arrives. If it indicates that the virus is from South Carolina, then of course the laboratory will be reopened immediately.

There seems to be a dependence on public opinion and approval, even though their fear is without foundation.³ Keeping the public content is a priority, even to the expense of scientific endeavor, and the safety of the scientists themselves: with the decision to close the laboratory, Gilchrist puts in danger the life of the main character, Kivrin, another scientist who has travelled to the past and is stranded there.

In *The Windup Girl*, people die of starvation worldwide. Large corporations control food supply and are responsible for plagues, depletion of natural resources and subsequent food scarcity that come with their engineered products. However, Thailand has managed to resist subjugation by maintaining its own reserve of seeds and restricting imports, which need to pass tight inspection. Companies such as AgriGen, seek to find and seize the Thai seedbank, a sort of public laboratory, so that the country is forced to buy and depend on their products (a situation that may resemble conflicts raised by Chiles et al., 2018).

A secondary character, Gibbons, is in charge of the seedbank, where he conducts research on food processing. He used to work for AgriGen but moved to the public sector, renouncing a higher salary and access to better resources in favour of more intellectually challenging tasks. These motivations are already suggesting that potential tensions of university-industry interaction may arise because of the different incentives of each sector. More explicitly, when

³ A researcher opposed to Gilchrist ironizes against him with a highly topical issue at the time of writing this paper: "There has been 'considerable public concern,' as you call it, that the virus was caused by liberal immigration laws," he said. "*Do you intend to secede from the EC as well?*" (italics are ours). It could have been written today in reference to the Brexit.

a new plague threatens the seedbank, Gibbons helps one of the protagonists to find that AgriGen has caused the plague, so he utterly engages with the public sector (even if he usually acts with ironic distance).

4.3. Conflict of interest with the public service (b): keeping ownership of ideas

Although there is no explicit mention of legal mechanisms to enforce intellectual property rights, *The Dispossessed* uses the concept of intellectual property as dramatic material. Physicist Shevek accepts a position as a professor at an Urrasti university, in the capitalist state of A-Io. However, Shevek finds this state is closer to a “private”, profit-maximising institution (although it is supposed to be democratic, it is not), as the government monetizes and selfishly profits from publicly-funded research. What Shevek wants is to make his knowledge available to everyone: knowledge belongs to the people; not the government, not a group of elite individuals, but everyone.

I came here from Anarres because I thought that here I could do the work and publish it. I didn't understand that here an idea is a property of the State. I don't work for a State. I can't take the money and the things they give me. I want to get out [...]. I was to be kept from the populace, to live among scholars and the rich. Not to see the poor. Not to see anything ugly... There I was to be happy and do my work, the work I could not do on Anarres. And when it was done I was give it to them, so they could threaten you with it.

In *Dreamsnake*, the main character, Snake, is a member of the Healers, a community organized like academics: their mission is to pursue and apply knowledge for the sake of practising medicine. Mentors guide students until they are worth of holding the title of Healers; and Healers can lose their title in case of misbehaviour, as judged by their peers. The

novel poses a curious situation of technological lock-in: Healers use ‘dreamsnakes’, an extra-terrestrial species of snakes whose poison relieves pain, but do not know how to breed them. That is to say, Healers possess applied knowledge that guarantees usability of resources, but not the basic knowledge for ensuring their constant supply.

Because of a sort of imprudence, Snake’s dreamsnake dies. She needs to replace it in order not to lose her Healer title, and she has two possibilities, but faces obstacles due to ownership restrictions:

- Inhabitants of Central City, notable traders, get new dreamsnakes from commercial exchange with the Otherworlders, the extra-terrestrial race that breeds them. Central Citizens have not made public how to make contact with Otherworlders, keep dreamsnakes for their own consumption and are particularly reluctant to share dreamsnakes with Snake and the Healers, who use them for the public good. One can see here a metaphor of capitalism preventing knowledge diffusion.
- North, a researcher-like individual who hates Healers, finds the way to breed dreamsnakes. He keeps the secret for his own benefit, since he gets the adoration of followers who have become addicted to the drug secreted by dreamsnakes, and he even tries to kill Snake. This could be a representation of the ‘entrepreneurial’ scientist, separated from the disinterested academic community.

In both cases, as in *The Dispossessed*, there is no mention to formal retention instruments, but of course Central Citizens and North have put in place some sort of secrecy mechanism to retain ownership of basic knowledge for commercial interests.⁴

⁴ There are explicit mentions to knowledge diffusion in *Dreamsnake*. The main character reflects upon how network fragmentation hinders knowledge diffusion.

4.4. *No conflict of interest? Academics teaching and consulting for industry*

In *Gateway*, humans find an extra-terrestrial technology that allows for space travel. Success is not guaranteed and space travellers face a chance of dying, but also of getting new artefacts and knowledge. The Gateway Corporation is the publicly sanctioned monopoly in charge for the use of the alien technology, and it hires college professors referred to as the *Corporation Science Research Division* or the *R&D people*: they teach travellers about the space, and analyse the possible discoveries. This is very secondary in the plot, but we highlight it as one of the few non-critical approaches to university-industry interaction. The story narrates how academics work for industry with neutrality, without any obvious clues to judge its advantages or disadvantages.⁵

4.5. *Conflict of commitment (I): non-disclosure of information as a problem*

Yet another character from *Dune* (see section 4.2) exemplifies the corruption of scientists who serve private interests. Doctor Yueh is a physician from a Suk School, which imposes Imperial Conditioning –a sort of unbreakable Hippocratic Oath that renders them incapable of inflicting harm. The Harkonnens kidnap Yueh’s wife, coercing him into betraying the Atreides, whom he serves. Yueh, a wise and good man of science, is not reliable any longer for his ‘organization’, due to the external pressures of ‘industrial’ stakeholders (represented by the Harkonnen).

Speaker for the Dead covers another angle of secrecy: one motivated by ethical concerns. In this novel, a family of xenologists analyse the second alien species ever found by humans, the *Pequeninos*. *Pequeninos* suffer disease and hunger, and the xenologists can help them, but an Earth government body, the Starways Congress, forbids it. Humans unduly caused the

⁵ However, in the book, the only existing science is science at the service of the economy, which may contain an implicit critique, but too subtle for us to be conclusive.

extinction of the first alien race they encountered, and their sense of guilt has become so strong as to ban sharing science and technology with extra-terrestrials, to protect the latter from any unintended harm. Hence, although external imposition of secrecy endangers the free pursuit of science, this is not at odds with sustainability and life, unlike in other novels. However, the main character, Ender, ally of the xenologists, suspects that the Starways Congress overprotects other species interestedly:

At that moment Ender saw clearly that the rules governing human contact with the piggies [another name for Pequeninos] did not really function to protect the piggies at all. They functioned to guarantee human superiority and power [...]. Why are we so anxious to keep them from any influence from our culture? It isn't just in the interest of science. It isn't just good xenological procedure. Remember, please, that our discovery of the ansible, of starflight, of partial gravity control, even of the weapon we used to destroy the buggers [the first, extinguished, alien race] –all of them came as a direct result of our contact with the buggers [...] in only a few generations, we took their machines, surpassed them, and destroyed them [...] –we're afraid the piggies will do the same to us.

Because the reader sympathises with Ender, it is difficult not to adopt his point of view and feel that unethical concerns counterbalance ethical ones, so the notion that secrecy is detrimental to science prevails.

4.6. Conflict of commitment (II): non-disclosure of information as an acceptable evil

Ringworld provides a neutral piece of evidence regarding non-disclosure of information (neither positive, nor negative). University and industry are represented by the two main

characters of the novel: Louis Wu, an Earth adventurer whose goal is to pursue knowledge for its own sake; and Nessus, from the alien race of the Puppeteers, rulers of a galactic mercantile empire. The latter hires the former to explore a space structure called *Ringworld*, and promises the spaceship in which both travel as payment, establishing a pecuniary reward that is reminiscent of a university-industry contract. One interesting point for this research is that Nessus recruits two other crewmembers, Speaker (an alien from the Kzin race) and Teela (a particularly lucky Earth Human). During the expedition, Nessus unveils that Puppeteers have genetically engineered Kzin and lucky Humans like Teela to manipulate them. On the one hand, the crewmembers get angry, but on the other hand Nessus's revelations occur because of comradeship out of having lived adventures together. This suggests that communication and trust may alleviate the tension raised by secrecy, as in the case of university-industry interaction.

The final resolution adds an extra layer of complexity and is even more relevant for our purpose. When the mission finishes, on the way back to their planets, Louis and Speaker decide not to disclose the Puppeteers' manipulation of Humans and Kzinti, because it would be too disturbing for their races, putting peace at risk and potentially leading to their annihilation, since Puppeteers are more technologically capable. This indicates that 'state pacts' are necessary to cope with the advantages and disadvantages of inter-institutional relationships, and that individuals can micro-manage unresolved conflicts.

A somewhat similar ambiguity is present in *Startide Rising*. Here, the Council of the Five Galaxies regulates the coexistence of most known races, in unstable equilibrium. The Council relies on the Library, an aeons-old institution that (supposedly) stores all available knowledge and makes it publicly accessible. Most species use it to build further advances. Earthlings, on the other hand, prefer research-based development instead, which sets them apart. Humans represent then the closest depiction of university endeavor in this fictional universe.

In this context, the Earth's government sends spaceship *Streaker* to explore the galaxy, i.e. a possible representation of university researchers. Its crew finds evidence of the existence of the Progenitors, the mythical creators of life: the location of a derelict fleet, some artifacts and an alien body. The *Streaker*'s crew mission becomes to deliver this information to their government, but other races that want to take possession of the secret soon pursue them, and the crew tries to escape. They could 'sell' their secret to some races in exchange for their life, but they run away and fight if necessary for loyalty to their government. Hence, this represents an act of non-disclosure of information for nationalistic reasons: the secret belongs to the 'heroes'' homeland, not to others.⁶ As one of the members of the crew puts it:

Our discovery will be given only to the Galactic Institutes, and only by our Terragens Council leaders themselves.

Thus, the crew does not completely deny the convenience of submitting the secret to the Library Institute to make it publicly available, but concludes that the decision corresponds to the Terran government. Their commitment to waiting to share the information instead of broadcasting it immediately to the Library is actually quite understandable, and seems to obey other than purely selfish reasons. Throughout the novel, it is repeatedly established that the Library's records have been manipulated, which renders this repository of knowledge unreliable: thus another source of ambiguity is introduced. It could be argued that, again, non-disclosure of information is a better option, justified by lack of trust in international institutions.

Overall, *Startide Rising* shares with *Ringworld* a neutral view of universities' non-disclosure of information generated for others. It does not lead to clear advantages, but may avoid worse scenarios.

⁶ The novel does not offer particular reasons to despise other races, but the fact that the main characters are humans (like, most likely, the reader), humans are the most curious race in the galaxy and they have been discoverers in a 'quest for truth' predispose the reader to take sides with them.

4.7. Conflict of equity: lower promotion of 'disengaged' academics

Should scientists be able to research whatever they are interested in, or should society dictate that according to its own needs? Before moving to Urras, in *The Dispossessed* (see section 4.3), Shevek lives in Anarres, where he is frowned at for not focusing on the problems his society considers more important. He joins the university to develop his theory, but Sabul, a jealous superior, blocks his work. He is accused of putting his personal desires and intellectual interests before society's needs. He loses his job at the university, effectively being forced to perform agricultural labour, instead of working on his research. Sabul explains it to Shevek:

What worked against you was a combination of things. The abstruse, irrelevant nature of the research you've done these last several years. Plus a certain feeling, not necessarily justified, but existing among many student and teaching members of the Institute, that your teaching and behaviour both reflect a certain disaffection, a degree of privatism, of non-altruism.

The Doomsday Book provides another piece of evidence. As mentioned in section 4.2, the Oxford History Department customarily sends students and researchers to the past, to do field work. Periods have a danger rating (out of ten) and the most risky ones are off-limits. This has been the case of the medieval period (which has a rating of 10): no one has been allowed to travel to the Medieval Ages because of the potential risks. Gilchrist, Acting Head of the History Faculty, coaxes authorities to open the fourteenth century, in hopes he will score a point orchestrating this ground-breaking operation, and sends Kivrin (an enthusiastic History student) to study the Black Death. He even skips several protocols that would ensure the student's safety to speed things up. However, when problems arise, the present suffers an epidemic and the public blames time travel for that, despite the lack of convincing proofs (see

section 4.2), Gilchrist refuses to take any responsibility and blames others instead. Symbolically, Kivrin had many promotion opportunities when the evaluation criteria were scientific (for her pioneering and risky field research on the Black Death) but she is left out of academia when the evaluation criteria take into account societal impact (literally left out: she remains isolated in the past).

5. Conclusions

The influence between literary representation and society is thus reciprocal: fictional depictions of scientific research reflect, at least to some extent, society's opinions and fears. At the same time, literature has the power to shape public opinion, be it for the best or for the worst.

In this paper, we merge university-industry interaction studies with the literature on representations of science in popular culture. By doing so, we expect to have contributed to university-industry interaction studies by signalling that: (a) most disadvantages of university-industry interaction are extendable to university interactions with other sectors of performance (government and society); (b) the predominant popular view of university-industry interactions is negative, and not even the rise of university-industry interaction in the last four decades has changed it. This suggests that policymakers have not focused on the importance of discourse for legitimising action (McCloskey 2002).

Our aim is also to have contributed to the literature on representations of science in popular culture by putting the focus not on the depiction of the isolated scientist but on her relationships with others.

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