

Possibility conditions for Open Access

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Abstract

This is an attempt to describe the conditions of possibility for free, libre, open access to scientific knowledge. The challenge is to enunciate the terms under which agents participating in the "Grand conversation" of science would be willing to open share, exchange, negotiate or surrender their corresponding contributions, considering their corresponding intentions, goals, beliefs and expected utilities. Many conclusions can be drawn from the game here described. We have made many simplifying decisions along the modelling process that must be taken into account as a determining context for those conclusions, of course. It can be safely state, however, that under the current conditions of the game, Editors will keep betting on Toll Access, knowledge distribution models even if the whole set of Academics goes for Open Access.

Keywords: Open Access, Game Theory.

1 Introducción

This is an attempt to describe the conditions of possibility for free, libre, open access to scientific knowledge. The challenge is to enunciate the terms under

which agents participating in the "Grand conversation" of science would be willing to open share, exchange, negotiate or surrender their corresponding contributions, considering their corresponding intentions, goals, beliefs and expected utilities.

We have been studying the possibility, suitability and possible success of modeling the forms of advocacy of, and resistance to, Open Access to the scientific literature according to game theory methodology. While this approach was deemed to be both highly innovative and original, the simplifications need to make this approach work were judged to be too extensive to design a realistic model with the available information. As an alternative, it was decided that doing a thorough survey of points and terms of resistance as they appear according to the stakeholders, namely researchers, graduate students, junior faculty, senior faculty, administrators, funders of research, publishers, libraries and politicians, would form a useful first step toward the original objective. Also, it has been deemed crucial to distinguish between developing, emergent and developed countries, hoping to address complexities and accounting for local idiosyncracies in the process. Having done so, however, we were faced with the enormous complexity of the global situation and were forced to make the simplifications that are used and discussed in this paper.

The paper is organized as follows: Firstly, an update on the history of science and technology, particularly with regard to scientific publishing. In section 3 we summarize the development of a definition for open access. Section 4 develops the view of open access in science as a game of interests. The last section presents the conclusions.

2 A brief update on the history of scientific publishing.

Publishing is a crucial action for the existing setup of global science. In a very simplified view, it correspond to the stage in which the results of research and experimentation are communicate to everybody with the primary objective of enlightening people and, therefore, helping to solve their problems. Seeing science as a open and global enterprise entails, however, a secondary objective for publishing: the results must be verified and validated by other scientists all over the world, so as to establish the quality and general validity of those results. And a third objective in this sequence is to allow those results to be made available for further research, to empower those that are willing to

keep researching the corresponding family of problems.

This simplified view of the processes of science related to publishing, which is almost all that is taught about the history of science to most new scientist, is actually too simple in many ways. In the most established of western views, for once, science do not simply progress by validation of general results, but it also advanced by refutation of hypothesis aspiring to be general results Lakatos et al. (1976). The urge to check on somebody' else results is not (only) to do the good deed of validating that it is a work that can be trusted, but an interest in finding lacks or cracks in their proposed explanation. That is to refute them and establish their conclusion (and their model) as invalid and, therefore, to force the search for a new model. This has the further implication of establishing that positive and negative results are both very important for the advancement of science. All this interaction over positive and negative results creates the layout for the grand conversation of science that must be published for it own sake.

But there is another dimension in which that view is too simple. It is the implicit assumption that there are equally meaningful families of problems to which scientists suscribe and try to solve as a team for the benefit of everybody. It is equivalent to the very naïve assumption that there exist a supreme, neutral goal for science and that scientist should and will be equally motivated to work in their chosen family of problems disregarding the local circumstances in which their (the scientists and their poblems) are embedded.

The truth is that science is heavily influenced by technological, economics and political dynamics. In the western societies, for instance, it is normally expected that a scientific development will turn into a technological solution and, eventually, a product or a service that the public can consume to solve their needs. And which needs must be solved first is, of course, a collective choice. A market choice for some, but in any case, a political decision (which is not the same as a decision made by politicians, even though it can be).

Scientific publishing, in particular, has been influenced by economical concerns since very early in its history. As explained in Guedón (2001), the very origins of the concept of **intellectual property** can be traced back to a (very succesful) attempt to extend the concept of landed property: “This bit of legal creativity was actually motivated by the stationers who needed to establish legally viable claims over the texts they printed, if only to protect their trade from imitation and piracy. To them, this meant exclusive and perpetual ownership, as is the case for land property. But **they were not the only players** and, as a result of various court actions, the definition

of what they actually claimed to own remained murky for several decades, almost a century, actually”(ibid, chapter 3, our emphasis).

We will not say more about the history of printed documents, except to say that with the arrival of Internet and the XXI century electronic technology, making a copy of a book became a process of almost zero cost (apart from the costs of producing the book in the first place). In this context, the actual value of the text (images included) can be almost completely mapped to its content and, eventually, to its authors. This new situation has apparently triggers a wave of questions about the origins of that value and of who are entitled to use and enjoy each contribution. A line of questioning that is particularly striking for the scientific practice, where scientists constantly look for accessing ideas and proposals by other scientists while trying to solve scientific problems.

3 The development of a definition for open access.

Peter Suber in Suber (2012) explains the effects of that shift from ink on paper into digital or electronic texts. This book relates that ideal conditions for the grand conversation of science: authors that are free to read and share their ideas in the process of designing, establishing, reporting and refuting theories and experiments. Those conditions we call Open Access, OA, and they can be summarized like this:

“What is open access? Open access means that scientific literature should be publicly available, free of charge on the Internet so that those who are interested can read, download, copy, distribute, print, search, refer to and, in any other conceivable legal way, use full texts without encountering any financial, legal or technical barriers other than those associated with Internet access itself”¹.

What, in turn, makes OA possible? Suber kindly summarizes an answer like this: “OA is made possible by the internet and copyright-holder consent. (ibid, pg 9)”. He goes on to make clear what OA is not intended for: “OA isn’t an attempt to bypass peer review [..]. OA isn’t an attempt to reform, violate, or abolish copyright [..]. OA isn’t an attempt to deprive royalty-earning authors of income [..]. OA isn’t an attempt to deny the reality of costs [..]. OA isn’t an attempt to reduce authors’ rights over their work [..]. OA isn’t an attempt to reduce academic freedom [..]. OA isn’t an

¹ <http://openaccess.mpg.de/2365/en>

attempt to relax rules against plagiarism [..]. OA isn't an attempt to punish or undermine conventional publishers [..]. OA doesn't require boycotting any kind of literature or publisher [..]. OA isn't primarily about bringing access to lay readers [..]. Finally, OA isn't universal access [..]" (.ibid, pg 20-27).

From this brief account it must be clear that copyright-holders' interests are crucial for the possibility of OA. This is the reason why we have chosen to study the problem as a game of interests.

4 Open Access in science as a game of interests. Conditions of possibility for equilibrium.

Let us formally define the game we are analyzing. From mathematical game theory Leyton-Brown and Shoham (2008), a game is a tuple (N,A,u) where:

- N is a finite set of n players, indexed by i ;
- $A = A_1 \otimes \dots \otimes A_n$, where A_i is a finite set of actions available to player i . Each vector $a = (a_1, \dots, a_n)$ in A is called an action profile;
- $u = (u_1, \dots, u_n)$ where $u_i: A \rightarrow \mathbb{R}$ is a real-valued utility (or payoff) function for player i .

The amount of players and the number of possible actions for each one is important for combinatorial reasons. Thus, let us start by listing the actual agents involved in the target problem and see if that that list and the lists of their actions can be simplified. Agents in the game of scientific knowledge include, at least, the following:

1. Researchers
2. Graduate students
3. Junior faculty
4. Senior faculty
5. Librarians
6. Administrators

7. Funders of research

8. Editors

9. Politicians

These are, of course, groups of people distributed all over the world and with many other particular characteristics. Thus, this is already a reduction of complexity. We believe, however, that for the problem of scientific knowledge generation and distribution, those categories would suffice. But they are still too many when one considers the number of possible actions for each agent group. So, let us try another symplification together with the listing of those action possibilities:

Agents	Actions
Academics	Publish TA Publish OA Perish
Administrators	Support TA Support OA Support Both
Funders	Demand publications Demand OA publications Don't demand anything
Editors	Grant TA Grant OA Grant big deals Grant OA with embargoes
Politicians	Permit TA Demand green OA Demand gold OA Demand some OA

Table 1: Players and their actions, second approximation

In Table 1, we reduce the list of agents to 5 and present some actions for each agent type. With this proposal, we are still dealing with $3^3 \times 4^2 = 432$ possibilities. But at this point we can discuss some general features of

this game. We are simplifying the actual game in another aspect. By concentrating on actions related to the issue of access to scientific communications, papers in particular, we manage to reduce the number of possible actions, but also, let us called it, the timeframe of the game. It is like an instantaneous game. Although actions can take extended and different times to be executed, we will be focused on the net effect of an agent making a move at time that coincides or overlaps other moves by other agents in the game. This is, of course, another simplification.

Let us insist that, in this game, each agent represents a group of people. This is particularly important because it allows us to take modelling advantage of a normally obscured concept in game theory: the concept of **mixed strategy**. A mixed strategy is a linear combination of pure strategies. And a pure strategy correspond to a choice of one particular action by the agent.

For example, “publish OA” correspond to the actions of academics publishing their research as open access documents. It is also, as such, a pure strategy for the agent Academics in table 1. What would it be a linear combination of pure strategies?. Some weighted decisions about those actions. For example, one could say that “Academics” selects “publish TA” with a probability of 0.8 (80%), “publish OA” with 0.2 (20%) and never selects “perish”. In simple agents game theory, these probabilities are hard to imagine (who is her/his right mind would play a lottery to make an important decision), but in our context of groups as agents one could easily attribute those probabilities to some polling over the members of that game. In the last example, this would mean that 80 percent of the members of the group “Academics” publish their research as so-called toll access, 20% as open access and nobody refrain from publish (as this would be suicidal).

We were tempted to further simplifying with the assumption that funders and politicians are one and the same group of people. We have to refrain from this after noticing that important effects of the actions, also known as outcomes in game theory, would be underrepresented. In particular, there is a important reduction in the model which have to be balanced: there is no explicit representation of the whole society, an allegedly important component of the academic ecosystem as the final receptor or consumer or, at least, user of knowledge generated by the other components (a reduction itself, as knowledge could come from other sources). We decided to deal with this by keeping the politician agent and modelling the expected outcomes as discrete fields of selected variables, as shown in table 2:

Agents	Actions	Outcomes
Academics	Publish TA Publish OA Perish	Opportunity {Maximal, Minimal}
		Visibility {More, Less}
		Prestige {More, Less}
		Promotion {More, Less}
Administrators	Support TA Support OA Support Both	Savings {More, Less}
		Quality results {More, Less}
		Income {More, Less}
Funders	Demand publications Demand OA publications Don't demand anything	Societal impact & relevance {More, Less}
		Income {More, Less}
		Income {More, Less}
Editors	Grant TA Grant OA Grant big deals Grant OA with embargoes	Societal impact & relevance {More, Less}
		Income {More, Less}
		Income {More, Less}
		Income {More, Less}
Politicians	Permit TA Demand green OA Demand gold OA Demand some OA	Societal impact & relevance {More, Less}
		Income {More, Less}
		Income {More, Less}
		Income {More, Less}

Table 2: Players, actions and outcomes (in variables with the sets of possible values)

Table 2 describes outcomes with a set of variables that can be associated to the actions of each agent-group. We have chosen the variables that we believe involved in determining the utility for each agent but, instead of consolidating a mathematical expression of it, we assign a finite set of possible values to each variable and, thus, define a discrete universe of possibilities to explore. As a reference, let us indicate a couple of possibilities to describe the current situation and an ideal situation, from the point of view of Open Access. Let us depict those along with the explanation of the variables and assigned values.

Agents	Actions	Outcomes			
Academics	Publish TA	Opportunity	Minimal		
		Visibility	Less		
		Prestige	More		
		Promotion	More		
Administrators	Support TA	Savings	Less		
Funders	Demand publications	Quality results	Less		
Editors	Grant TA	Income	More		
Politicians	Permit TA	Societal impact & relevance		Less	

Table 3: Interesting case 1, the pure current model

Agents	Actions	Outcomes			
Academics	Publish OA	Opportunity	Maximal		
		Visibility	More		
		Prestige	More		
		Promotion	More		
Administrators	Support OA	Savings	More		
Funders	Demand OA publications	Quality results	More		
Editors	Grant OA	Income	Less		
Politicians	Demand green OA	Societal impact & relevance		More	

Table 4: Interesting case 2, the pure ideal model

Table 3 presents what we believe is characteristic of the current situation. With everyone stuck to the TA option in their actions, academics are very limited in their abilities to learn from contributions of others (as nobody can afford to buy them all) and, therefore, their opportunity to get published and participate in the grand conversation is minimal. Their visibility is, by the same reasoning, compromised (less), whereas for those who can actually get published (possibly by balancing other interests not shown in this model) prestige and promotion are guaranteed (more). Toll access, TA, forces administrators to pay more than they could for accessing collections. So, if they actually support TA, their institutional savings would be less. Funders who do request publications as outcomes of the projects they fund would definitely have less quality results. The only group clearly favored in this

setup is editors who sustain more income than otherwise possible. Finally, by restricting opportunities to academics and other members of the public to learn about contributions which remain behind a paywall, politicians will see that the actual impact and relevance of those contributions to society is lesser than possible.

Table 4 paints a contrasting picture. Academic commits their publications to OA, empowering others to consult and use those publications to support their own. Thus, the opportunity to publish is maximal. But, of course, visibility, prestige and promotion are favored with more opportunities for all. By encouraging and supporting OA, administrators contribute to more budget savings at their institutions. Funders will see more quality results by demanding OA publications, not only because more publications will actually be made, but also because more people, academics included, will have opportunities to see and judge those results. This configuration, of course, also determines that politicians will see more impact and relevance of results for society. Again, the dissonants are the editors who would more likely see less net income in their regular bussiness.

We must, of course, swiftly admit that we just made another simplifying exercise very unusual in game theory. Instead of jumping to numerical estimates of utilities, which could then be used to balance expected utilities for the agents' strategies, by resorting to discrete domains for the variables, we are doing a more qualitative analysis which could be enlighting and does not rules out a traditional equilibrium study. The resulting search space, however, it is still huge. There are $110592=(3^3* 4^2* 2^8)$ possible combinations of those variables-values. But not all the combinations are meaningful in reality.

We introduced some meaningful connections between the variables in this model by devising a set of rules and constraint among their values and running a tailored made constraint logic program on them. By these means, we reduced the set to 3136 combinations. Some (26) of them are shown in figure 4.

This set of 26 action profiles is special for a number of reasons. But before explaining, let us show the rules used to generate the whole set. We do this with some mathematical expressions to avoid ambiguity:

Academics	Administrators	Funders	Editors	Politicians
'Publish TA'	'Support OA'	'Demand publications'	'Grant TA'	'Permit TA'
'Publish TA'	'Support OA'	'Demand publications'	'Grant TA'	'Permit TA'
'Publish TA'	'Support OA'	'Demand publications'	'Grant big deals'	'Permit TA'
'Publish TA'	'Support OA'	'Demand publications'	'Grant big deals'	'Permit TA'
'Publish TA'	'Support OA'	'Demand OA publications'	'Grant big deals'	'Permit TA'
'Publish TA'	'Support OA'	'Demand OA publications'	'Grant big deals'	'Permit TA'
'Publish OA'	'Support OA'	'Demand publications'	'Grant TA'	'Permit TA'
'Publish OA'	'Support OA'	'Demand publications'	'Grant TA'	'Permit TA'
'Publish OA'	'Support OA'	'Demand publications'	'Grant big deals'	'Permit TA'
'Publish OA'	'Support OA'	'Demand publications'	'Grant big deals'	'Permit TA'
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant big deals'	'Permit TA'
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant big deals'	'Permit TA'
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant big deals'	'Permit TA'
'Publish OA'	'Support OA'	'Demand publications'	'Grant OA'	'Permit TA'
'Publish OA'	'Support OA'	'Demand publications'	'Grant OA'	'Demand green OA'
'Publish OA'	'Support OA'	'Demand publications'	'Grant OA'	'Demand green OA'
'Publish OA'	'Support OA'	'Demand publications'	'Grant OA'	'Demand gold OA'
'Publish OA'	'Support OA'	'Demand publications'	'Grant OA'	'Demand some OA'
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Permit TA'
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Permit TA'
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand green OA'
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand green OA'
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand green OA'
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand gold OA'
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand gold OA'
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand some OA'
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand some OA'

Fig. 1: Some combinations of actions

if Academics = 'Publish TA' and Editors = 'Grant TA' then Academics' Opportunity = 'Less' and Visibility = 'Less'

if Academics = 'Publish OA' and Editors = 'Grant OA' then Academics' Opportunity = 'More' and Visibility = 'More'

if Administrators = 'Support OA' then Savings = 'More', otherwise Savings = 'Less'.

if Funder = 'Demand publications', Editors = 'Grant TA' and Politicians = 'Permit TA' then Editor's Income = 'More'.

if Editors = 'Grant OA' then Editor's Income = 'Less'.

if Editors = 'Grant big deals' and Politicians = 'Permit TA' then Editor's Income = 'More'.

if Funder = 'Demand publications', Editors = 'Grant TA' and Politicians = 'Permit TA' then Editor's Income = 'More'.

if Editors='Grant OA with embargoes' then Editor's Income = 'Less'.

if Funder='Demand OA publications' then Editor's Income = 'Less'.

if Politicians='Demand green OA' then Editor's Income = 'Less'.

if Visibility='More' then Quality Results='More' and Impact and Relevance='More'

Over the thus reduced set of possibility, we move to consider the regular next step in game theory modelling. Utility functions are required for each agent to be able to compared strategy profiles and search of equilibrium conditions. Once again, we try a very simple approach taking advantage of the very simplified domains we have assigned to the values of variables used to describe game's outcomes. Let us assume that 'More' values correspond to one (1) and 'Less' values to zero (0). A global utility function for this system could be:

$$GU = Opportunity + Visibility + Prestige + Promotion + Savings + Results + Income + Impact and Relevance$$

A global utility function, however, is disregarded by the foundational assumptions in game theory, which state that agents in a game could not agree on a common, global set of preferences (and therefore utilities) and must be assigned independent criteria for each. Otherwise, the game would reduce to a standard optimization problem.

Before we complain, let us point out that this global utility function is, nevertheless, meaningful and it could indicate in our case, a situation in which all the agent reach their higher benefits (GU=8 in our simplified model). In fact, the 26 combinations in figure 4 are the only ones that correspond to a GU=7, the highest value observed in the whole set of 3136 pure strategic profiles. This fact is important, as it makes us wonder whether all the agents in this game can be satisfied and reach their highest levels of benefits. To answer this, we need their particular utility functions.

Let us follow the simplified approach suggested by tables 2 to 4 and define the corresponding utilities like this:

$$U_{Academics} = Opportunity + Visibility + Prestige + Promotion$$

$$U_{Administrators} = Savings$$

$$U_{Funders} = Results$$

$$U_{Editors} = Income$$

$U_{Politicians} = Impact\ and\ Relevance$

Figure 2 shows the actions profiles in the previous figure 4 together with their outcome's values and utilities.

4.1 Equilibrium conditions

Are there conditions for equilibrium in this game?. Let us consider the more common approach to equilibrium in game theory: Nash Equilibrium, starting from the definition of best response by a player (From (Leyton-Shoham, 2012)):

(Best Response) Player i 's best response to the strategy profile s_{-i} is a mixed strategy $s_i^* \in S_i$ such that $u(s_i^*, s_{-i}) \geq u(s_i, s_{-i})$ for all strategies $s_i \in S_i$

In this context, each agent, a player, must be analyzed separately and by means of strategy profiles which, in their purest form, are the action combinations shown above (an pure profile is precisely a row in figure 4). The set of all strategy profiles (which includes all the possible action combinations, but also mixed strategies as explained above) is S_i . The variable s_i refers to the actions (possibly mixed strategy) of the player under scrutiny and s_{-i} are the actions (or strategies) of the other agents in the game. Thus, a best response for agent i is an action (or strategy) that produces the greatest utility (for agent i , of course) among all its actions (or strategies) given the same set of actions (or strategies) for the rest of the agents.

We are now prepared for the definition of Nash Equilibrium:

(Nash equilibrium) A strategy profile $s = (s_1, \dots, s_n)$ is a Nash equilibrium if for all agents i , s_i is a best response to s_{-i}

The reader must bear in mind that all these cumbersome references to strategies instead of actions is due to the fact that the former also include those mixed linear combinations of actions.

Let us now try to analyze our game seeking Nash equilibria. As noticed before, one of the practical difficulties in this game is that we are dealing with a big set of agents and actions. However, one can take further step of reduction and transform the game into many two-players games, each of which would look like shown in table 5.

Academics	Administrators	Funders	Editors	Politicians	Opportunity	Visibility	Prestige	Promotion	Savings	Results	Income	and Ret.	UG	U Academics	U Administrators	U Funders	U Editors	U Politicians
'Publish TA'	'Support OA'	'Demand publications'	'Grant TA'	'Permit TA'	0	0	1	1	1	1	1	1	7	3	1	1	1	1
'Publish TA'	'Support OA'	'Demand publications'	'Grant TA'	'Permit TA'	0	0	1	1	1	1	1	1	7	3	1	1	1	1
'Publish TA'	'Support OA'	'Demand publications'	'Grant big deals'	'Permit TA'	1	0	1	1	1	1	1	1	7	3	1	1	1	1
'Publish TA'	'Support OA'	'Demand OA publications'	'Grant big deals'	'Permit TA'	0	0	1	1	1	1	1	1	7	3	1	1	1	1
'Publish TA'	'Support OA'	'Demand OA publications'	'Grant TA'	'Permit TA'	0	0	1	1	1	1	1	1	7	3	1	1	1	1
'Publish OA'	'Support OA'	'Demand publications'	'Grant big deals'	'Permit TA'	1	0	1	1	1	1	1	1	7	3	1	1	1	1
'Publish OA'	'Support OA'	'Demand publications'	'Grant big deals'	'Permit TA'	0	1	1	1	1	1	1	1	7	3	1	1	1	1
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant big deals'	'Permit TA'	0	1	1	1	1	1	1	1	7	3	1	1	1	1
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Permit TA'	0	1	1	1	1	1	0	1	7	4	1	1	0	1
'Publish OA'	'Support OA'	'Demand publications'	'Grant OA'	'Demand green OA'	1	1	1	1	1	1	0	1	7	4	1	1	0	1
'Publish OA'	'Support OA'	'Demand publications'	'Grant OA'	'Demand green OA'	1	1	1	1	1	1	0	1	7	4	1	1	0	1
'Publish OA'	'Support OA'	'Demand publications'	'Grant OA'	'Demand gold OA'	1	1	1	1	1	1	0	1	7	4	1	1	0	1
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand some OA'	1	1	1	1	1	1	0	1	7	4	1	1	0	1
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Permit TA'	1	1	1	1	1	1	0	1	7	4	1	1	0	1
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand green OA'	1	1	1	1	1	1	0	1	7	4	1	1	0	1
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand green OA'	1	1	1	1	1	1	0	1	7	4	1	1	0	1
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand gold OA'	1	1	1	1	1	1	0	1	7	4	1	1	0	1
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand gold OA'	1	1	1	1	1	1	0	1	7	4	1	1	0	1
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand some OA'	1	1	1	1	1	1	0	1	7	4	1	1	0	1
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand some OA'	1	1	1	1	1	1	0	1	7	4	1	1	0	1
'Publish OA'	'Support OA'	'Demand OA publications'	'Grant OA'	'Demand some OA'	1	1	1	1	1	1	0	1	7	4	1	1	0	1

Fig. 2:

		Editors			
		Grant big deals	Grant TA	Grant OA	Grant OA with embargoes
Academics	Publish TA	(3,1)	(3,1)	<i>(3,0)</i>	<i>(3,0)</i>
	Publish OA	(3,1)	(3,1)	(4,0)	<i>(3,0)</i>

Table 5

The outcomes values in table 5 has been obtained from the actual utility computations of the original game. The ones shown in bold correspond to profiles in which the global utility, as we defined above, is 7. Whereas the ones in italic corresponds to profiles where that utility is 6, as there no such kind of combination reaching 7.

To make things clearer, let try one last simplification transforming table 5 to an even simpler version:

		Editors		
		TA	OA	$EU_{Academics}$
Academics	TA	(3,1)	(3,0)	$3q$
	OA	{3,1}	(4,0)	$3q + 4(1 - q)$
	$EU_{Editors}$	p	0	

Table 6

In table 6, we use q to represent the probability that Editors play for TA action, that is one of Grant big deals or Grant TA, leaving $(1-q)$ to indicate a OA action (Grant OA or Grant OA with embargoes). We could have use p to model the probabilities for Academics, but, as the reader can verify, it is no necessary.

In this game, the simple actions, strategy profile (Academics = OA, Editors =TA) is a Nash equilibrium. It is made of the best responses from each agent to the other.

4.2 Searching for a new game and new equilibria

From the previous result, it must be clear that this game cannot be satisfying for society considered as a stakeholder. Not only it is suboptimal for the whole society, but it also entails a solid dependency on Editors as controllers of the game. The game must change if the tenets of Open Access are to be assumed by the community as meaningful and important.

This is the rationale of a proposal that is increasingly popular among activists and OA organizations. An explicit mandate (Sale et al., 2010) for whoever holds the political power (either Funders, Politicians or Administrators) to demand immediate deposit of contributions in public repository, even if the contributions themselves must wait until they can be legally left open. By this device, authors may provide a perfectly legal service to the community: accepting requests from the public, via the same repository, to send out electronic copies of their papers. The OA button is a variant of the service which is being embedded in the most used repository platforms (namely DSpace and E-Print).

This simple, legal and technical device entails the power to change the structure of the game, but forcing Editors to the OA option. Editors, however, may still play that other extra game strategy they have been playing: to insist that only traditionally commercial Toll Access could possibly work to provide the best quality service. This is, already, another game: a political game.

5 Conclusions

Many conclusions can be drawn from the game here described. We have made many simplifying decisions along the modelling process that must be taken into account as a determining context for those conclusions, of course. It can be safely state, however, that under the current conditions of the game, Editors will keep betting on Toll Access, knowledge distribution models even if the whole set of Academics goes for Open Access. If this is regarded as unacceptable, the only choice seems to be to look for another games, some of which may already being played.

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