Intermediation in Open Development:

A Knowledge Stewardship Approach *

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Abstract:

Open Development (OD) is a subset of ICT4D that studies the potential of IT-enabled openness to support social change among poor or marginalized populations. Early OD work examined the potential of IT-enabled openness to decentralize power and enable public engagement by disintermediating knowledge production and dissemination. However, in practice, intermediaries have emerged to facilitate open data and related knowledge production activities in development processes. We identify five models of intermediation in OD work: decentralized, arterial, ecosystem, bridging, and communities of practice and examine the implications of each for stewardship of open processes. We conclude that studying OD through these five forms of intermediation is a productive way of understanding whether and how different patterns of knowledge stewardship influence development outcomes. We also offer suggestions for future research that can improve our understanding of how to sustain openness, facilitate public engagement, and ensure that intermediation contributes to open development.

Keywords: ICT4D; Intermediation; Mediation; Open Data; Open Development; Public Engagement; Stewardship

Résumé:

Le développement ouvert (DO) est un sous-ensemble de l'ICT4D qui étudie le potentiel d'ouverture IT-permettant de soutenir le changement social au sein des populations pauvres ou marginalisées. Les premiers travaux sur le DO ont examiné le potentiel d'ouverture IT-permettant de décentraliser le pouvoir et permettre la participation du public en désintermédiant la production et la diffusion des connaissances. Cependant, en pratique, des intermédiaires ont vu le jour pour faciliter les données ouvertes et les activités de production de connaissances liées aux processus de développement. Nous identifions cinq modèles d'intermédiation dans le travail de DO: décentralisée, artérielle, écosystème, pontage, et les communautés de pratique, nous examinons les implications de chacun pour l'intendance des processus ouverts. Nous concluons que l'étude OD à travers ces cinq formes d'intermédiation est une façon productive de comprendre si et comment les différents modèles de résultats en matière de développement de l'influence de l'intendance des connaissances. Nous proposons également des suggestions pour la recherche future qui peuvent améliorer notre compréhension afin de maintenir l'ouverture, de faciliter la participation du public, et de veiller à ce que l'intermédiation contribue à ouvrir le développement.

Mots-clés: Développement ouvert; Données ouvertes; Engagement public; ICT4D; Intendance; Intermédiation; La médiation

Introduction

Open government, open educational resources, open science, open healthcare, and open publishing are all actively pursued as approaches to development in countries and communities around the world. These approaches, which fall under the umbrella term Open Development (OD), part from the idea that openly networked Information and Communication Technologies (ICTs) create the potential for people to collaborate in the production, organization, and sharing of information in ways that lead to improvements in the lives of poor and marginalized peoples. However, as with all development approaches, OD needs to be theorized, tested, and validated. As such, the central goal of OD *research* is to identify whether, how, and why open initiatives "make a difference" by redressing systemic marginalization, inequality, or conflict in global peripheries through transformed access to knowledge (e.g., Bentley, 2014; Bentley & Chib, 2016; Braybrooke, Nissila & Vuorikivi, 2013; Cyranek, 2014; Girard & Perini, 2013; Smith & Elder, 2011; Smith & Reilly, 2013).

Early OD work was premised on the assumption that IT-enabled open data would decentralize power and enable public engagement by disintermediating knowledge intensive processes such as education, decision-making, innovation, cultural production, healthcare, and publishing (Smith, Elder & Emdon, 2011). However, in practice, public engagement has been lacking (Mutuku & Mahihu, 2014), asymmetrical, or inequitable (Benjamin, Bhuvaneswari &

Manjunatha, 2007) in developing country settings. This has led to growing interest in the role of intermediaries in facilitating open knowledge production processes.

This work has taken on a particular urgency of late as exemplified by Benkler's (2016, January 15) recent review in *The Guardian* of the 2016 World Development Report. Benkler argues that the report overlooks the growing power of platforms to mediate our access to economically productive digital resources. Rather than giving people the skills necessary to access, use, and appropriate open data, says Benkler, governments need to start creating regulation that prevents these platforms from controlling the economic, social, and political opportunities available to citizens through open processes. Meanwhile, given the rise of big data and the creation of the new Sustainable Development Goals, there is growing recognition that "data Intermediaries will play a critical role in the post-2015 development agenda" (Tyson, 2015, July 17).

Research about intermediation is emergent, and there is little theoretical work to inform investigations about this issue (van Schalkwyk et al., 2015). To fill this lacuna, we introduce a stewardship approach to intermediation of public engagement in open processes. We arrived at this theorization by way of a high level scan of the knowledge society literature and of case studies in the areas of open government, open education resources, and open science. This approach contrasts with that of a systemic literature review, which uses well-defined methodologies, search terms, and databases to ensure the identification of all relevant literature and to assess the quality of the works. We make no claim to the latter because our objective is merely to demonstrate the *existence* of different models, and to establish a baseline for debate and empirical work about an emerging concern.

In what follows, we first explain what stewardship of open data is and then explain its relationship to intermediation. We then describe five possible models of intermediation at play in OD processes, as identified through our literature review: decentralized, arterial, ecosystem, bridging, and communities of practice. We subsequently explain how they differ in terms of their approach to the stewardship of open processes. We also verify these categories against "real world" examples of OD activities across three domains of openness work: open government, open education, and open science. We conclude that studying OD through these five forms of intermediation is a productive way of understanding how different patterns of stewardship shape public engagement as well as larger development outcomes. We also offer suggestions for future research that can improve our understanding of how to sustain openness, facilitate public engagement, and ensure that intermediation of open knowledge processes contributes to development.

A Knowledge Stewardship Approach to Intermediation

While stewardship, in general terms, is the management, safeguarding, and enhancement of goods that belong to others, data stewardship is a specialized field of data management that ensures the quality of data by creating systems that are in compliance with regulatory obligations (Plotkin, 2013). When it comes to open data we need to push this definition a bit further. First, open data is defined as data that is openly available and that can be re-used and re-distributed (Open Knowledge International, 2016). In order for it to be considered "open" not only the data, but also the social networks surrounding that data, need to be addressed in models of stewardship. So in effect, a steward of open data is really a steward of open processes of knowledge production. Second, open data is a public good (or sometimes a common pool

resource), and in the case of public goods, stewardship is about responsibilities, rather than just commitments. As such, it prioritizes the common good as well as private return (e.g., Block, 2013; Wagner, 2013). With this in mind, Block defines stewardship as "the choice to preside over the orderly distribution of power" (2013: xxiv). In the case of *open* public goods, stewardship suggests a larger conversation about the nature of information systems, their stakeholders, and beneficiaries.

A major assumption of OD is that openness will result in more resilient social processes and a more equitable distribution of use value or social value. Achieving a positive result, however, depends on the type of stewardship model that is put in place—in other words, the types of incentive systems, conventions, cultural understandings, institutional mechanisms, and moral contracts put in place to steward open knowledge production processes. These stewardship arrangements will shape the distribution of responsibilities for production, maintenance, and use of open informational resources, as well as flows of use value and social value that emerge from them. We can better understand whether and how openness initiatives "make a difference" by studying arrangements to steward open knowledge, and the effects of these arrangements on the distribution of value from those goods. In doing so, we can arrive at a better understanding of the factors that link openness to social change outcomes.

We often assume that open resources are necessarily a public good (or common pool resource) given that openness initiatives can arise in situations where information is non-excludable and also sometimes non-rivalrous (Tennison, 2015). However, this is not entirely accurate, because even assuming ubiquitous, cheap, and open computer networks, information is subject to controls (e.g., state secrecy), capture (e.g., intellectual property), and investment costs (e.g., production and maintenance). Also, even though information may be non-rivalrous, user time and audience attention most certainly is. As a result, openness initiatives are better thought of as a deliberate choice. What is more, it is possible to make choices about how information is stewarded within openness initiatives.

Stewardship, therefore, demands careful consideration of how—through what arrangements—open resources can best be provided, and how best to maximize the quality, sustainability, buy-in, and uptake of those resources. For example, peer production licenses (Bauwens, 2013, July 9) aim to ensure that public goods are used in ways that sustain the knowledge commons, while also reallocating resources from the private sector to the maintenance of that commons. In this case, the debate over public provision versus private provision takes a back seat to strategies that socialize the use value and social value generated through joint production of an informational good (e.g., Bollier, 2014; Meng & Wu, 2013). The question then is how to ensure that actors extract and share the use and social value of that good in ways that also sustain and enhance the commons.

Stewardship also challenges us to think about how—through what arrangements—different actors become *engaged* in openness initiatives. Public engagement is different from public participation (Bovaird, 2007). Participation implies that targeted invitations are extended to people who can contribute in preconceived ways. In this sense, participation tends to be "transactional" in nature. Engagement, however, implies motivated and reflexive contributions to a jointly produced, and therefore evolutionary, space. It recognizes the dissolution of the boundary between user and producer in the management of the resource, as well as the shifting balance of costs and benefits between different user groups, which might include a wide range of actors (Gencer & Oba, 2011). As a result, engagement is said to be "transformative" in nature. In openness initiatives, stewardship should contemplate active public engagement, both at the level

of governance decisions, and at the level of data production and management, to maintain the openness of the initiative.

The Role of Intermediaries in Stewardship

Once we accept stewardship as a valid approach through which to understand open knowledge production processes, the role of intermediaries naturally comes to the foreground.

An initial response to poor uptake or unanticipated effects of openness initiatives in developing countries was to enhance the quality and accessibility of the data being provided, often through capacity building initiatives (Reilly & McMahon, 2015). This work emphasized the importance of offering data in appropriate formats, and, as a result, it is now widely accepted that open data needs to be machine-readable, provided in an open format, in a timely manner, and free of charge.

However, providing good quality, accessible data has not ensured strong uptake or engagement with openly published materials. Thus, researchers have turned their attention to the actors and technologies that promote, aggregate, deliver, translate, or "localize" open materials (van Schalkwyk et al., 2015). These (inter)mediating forces include both technological platforms and social mechanisms that transmit information, add meaning, or help audiences with uptake. In the case of open education, they might include online courseware or educational repositories, as well as educators themselves (Orr, Rimini & Van Damme, 2015). For open government, they might include service portals as well as a variety of governmental and nongovernmental groups (Magalhaes, Roseira & Strover, 2013). In open science, they might include data repositories or science communicators (e.g., Hicks et al., 2015; Jarreau, 2015).

Intermediation, mediation, and "info-mediation" are not new topics. However, our understanding of intermediation in openness initiatives is emergent (Orr, Rimini & Van Damme, 2015), precisely because the OD community believed that the Internet and openness removed the need for mediation. In addition, it is clear that we lack a good understanding of audience needs and desires around open information (e.g., Buckler et al., 2014; Carolan et al., 2015; Mokua, 2014). As new work in this area emerges, it becomes clear that intermediaries are pivotal actors in the stewardship of open information, and that different patterns of intermediation affect the goals, outcomes, and social value of openness initiatives, as well as levels and types of public engagement, and their implications for poverty reduction or marginalized populations. An important first step is to identify how intermediaries work to steward open knowledge production processes in developing country contexts.

A review of knowledge society literature as well as case studies of open government, open educational resources, and open science reveals five different schools of thought on intermediation (*Table 1*). In this literature, the words *intermediation* and *mediation* are used somewhat interchangeably. Intermediary tends to be used when authors are focusing on brokerage of data or information flows, while mediary tends to be used when authors are emphasizing meaning-making roles, as in science communication or reconciliation of different ways of knowing. Having said this, information flows and meanings are closely intertwined so this distinction might not be all that useful, and at any rate, it is not strictly followed in the literature.

It is useful to draw some distinctions, or at least attempt to, when thinking about intermediaries. The focus of this literature review is on what we might call "primary" or "first-order" information intermediaries. These are distinct from other types of intermediaries that

either produce data, or are the subject of data. For example, open data about aid flows can be used to track the effectiveness of intermediary organizations in international development, and these intermediaries do themselves produce data. However, these organizations are not themselves *info*-mediaries, even though they do have a role in producing data. This can be a difficult distinction to maintain; Davies (2016) highlights just how difficult.

Table 1: **Schools of Thought about Intermediation**

	Central Assumption	*Groups Involved*	*Central Aim*	*Tools & Methods*
Decentralization School	Knowledge can be openly available thanks to the Internet.	Users; systems designers; coders	Open access to information; dis-intermediation; democratization	Open publishing; open standards; open data literacy
Arterial School	Intervention is required to assure flows from producers/holders to users	Info-mediaries	Information flow from holders to users	Public access computing; open analytics; training; education and awareness campaigns
Ecosystems School	Open data comes from many places, and is used in many ways, so you need a complex array of innovators to extract value	Civic start-ups; open data services; data-mediaries; data wranglers	Innovation; value added; more broadly, problem solving, economic growth, and institutional development	Aggregation; hackathons; data jams; crowd-sourcing; ledgers; linked data
Bridging School	Raw materials difficult to make sense of; mediators work to "make data actionable"	Journalists; advocates; programmers; technical or science communicators	Bridging social values with foreign, scientific, or bureaucratic logics	Translation; facilitation; localization
Communities of Practice	Strong norms are required to mediate the management of open knowledge for learning, innovation, etc.	Organizations; networks; epistemic communities	Facilitate productive collaboration; maintain data commons	Information architecture; norms of governance

These primary intermediaries are also distinct from the larger "secondary" forces that mediate information flows. We recognize that policy, the media, culture, institutions, language, and technology all work to "mediate" (or create the context for) the knowledge society, but these are not the focus of this paper. For example, where does the Internet end and where do platforms begin? Again, this is a very difficult distinction to maintain. ICTs are a particularly difficult case, given that the policies and business models that structure Internet service providers, search engines, and social networking platforms often directly influence the work of information or data intermediaries. Furthermore, open data presumes access to technologies, and the ability to use them, and the nature of that access or use significantly shapes the openness and flow of open resources. All the same, our focus is on technology actors or technology effects rather than the technology itself.

Finally, this literature review takes a broad approach to thinking about knowledge, and as such addresses data, information, *and* knowledge, at times somewhat interchangeably. It would certainly be possible to produce a literature review that focused only on intermediation of data, however: 1) data is already prefigured through its collection processes; 2) open data is more prevalent in some areas of OD work, while open information dominates in others; and 3) many intermediaries work across different forms of data (e.g., budget numbers) and information (e.g., wikileaks files). Indeed, intermediaries may bring these different kinds of materials into conversation with each other in the stewardship work that they do.

Having outlined these distinctions, we now turn to five different schools of thought identified in a review of knowledge society literature.

Decentralization School

The decentralization school starts from the assumption that the Internet allows knowledge to be openly available. Incumbent institutions that rely on proprietary knowledge should relinquish their power given the new possibilities offered by the information age. Proponents of this school focus their attention on ensuring that both the Internet and the knowledge commons remain open, because openness empowers citizens, consumers, knowledge producers, and similarly decentralized "user" groups (Kopstein, 2013, December 12). An open knowledge commons driven by the Internet will disempower gatekeepers and disintermediate relationships in ways that decentralize power and bring people on the peripheries of networks into contact with each other (Baack, 2015).

Thus, for example, when discussing open government data, the Open Data Handbook argues that:

> [U]ntapped potential can be unleashed if we turn public government data into open data. This will only happen, however, if it is really open, i.e. if there are no restrictions (legal, financial or technological) to its re-use by others. Every restriction will exclude people from re-using the public data, and make it harder to find valuable ways of doing that. For the potential to be realized, public data needs to be open data.
>
> (Open Knowledge International, 2016)

Similarly, within the open access literature, it is argued that "disseminating knowledge is only half complete if the information is not made widely and readily available to society" (Open Access, 2003).

In some ways this school could be seen as a rejection of intermediation in the stewardship of open resources, however this is not exactly the case. Rather, this school prioritizes code or systems design as the means to decentralize knowledge production. This school can be seen as an expression of early libertarian views about cyberspace, such as John Perry Barlow's 1996 manifesto "A Declaration of the Independence of Cyberspace", which argued that netizens could self-govern and, as a result, old sovereignties should fade away. Also, open source and hacker culture helps us to understand this school of thought, given the prioritization of decentralized forms of organization, free and open information, and the emphasis on individual freedoms in the realization of epistemic contributions. In particular, Powles argues that:

> We citizens, often derogated as "users" or "consumers", have much to win in a global communication space. That is much more than simply a "neutral network". Instead, it is a truly open, distributed network where everyone's fundamental rights are respected. Not having our access providers acting as interested gatekeepers may be a step in the right direction, but it is by no means an end. Many other distortive factors remain and we will not have an open space until we get rid of them all.
>
> (Powles, 2015, February 26)

It is important to recognize this approach to intermediation because it is historical (i.e., an early approach to thinking about the stewardship of openness), because it offers a baseline for other ways of thinking about intermediation, and because we must always remind ourselves that no intermediation is also a valid choice with regards to stewardship. However many scholars now recognize that active intermediation is required to realize the decentralization and empowerment promised by the Internet and open knowledge, particularly in social justice, social change, or development spaces, giving rise to the arterial school of intermediation.

Arterial School

The arterial school recognizes that even when data or information is made freely available on the Internet, people often face obstacles to access it—that there are blockages in the informational arteries that reach out into society. Often commentators point out that just opening up the data is not enough to ensure awareness, use, or engagement. Intermediaries or "info-mediaries" are prescribed as a means to overcome barriers.

Originally this discussion focused on supporting "access, use and appropriation" of ICTs through public access computing at libraries, cybercafés, and telecentres (e.g., Gomez, Fawcett & Turner, 2012; Sein & Furuholt, 2012) or the work of community organizations (Beck, Madon & Sundeep, 2004). This work has also been explored within specific domains of stewardship. For example, Al-Sobhi, Weerakkody, and Kamal (2010) research the intermediary organizations that facilitate coordination between public services and users. As they point out, "[t]he intermediary provides a trusted information channel gateway and also provides help and support, which may have an impact on citizens' usage toward e-government services" (Al-Sobhi, Weerakkody & Kamal, 2010: 2).

More recently, as attention has become turned to open data, the emphasis has shifted towards platforms and tools that help people make sense of open information (such as data visualization tools). Gurstein (2011) argues, for example, that in order to overcome the data divide, it is necessary to ensure that "those for whom access is being provided are in a position to actually make use of the now available access (to the Internet or to data) in ways that are meaningful and beneficial for them". He worries that open data "empowers those with access to the basic infrastructure and the background knowledge and skills to make use of the data for specific ends" and that it may "further empower and enrich the already empowered and the well provided for rather than those most in need of the benefits of such new developments". He advocates for an effective use approach to open data, which would use training programs to ensure that "opportunities and resources for translating this open data into useful outcomes would be available (and adapted) for the widest possible range of users".

Similarly, Janssen and colleagues argue that it "cannot be expected that the public has the same amount of knowledge and capabilities as researchers do. Lowering the knowledge level required for use is key to large-scale dissemination" (2012: 264). Tools exist to lower barriers, such as data visualization. However, they require "that current efforts take the user's perspective into account and monitor the need, ultimately helping users and lowering the threshold to using open data" (Janssen et al., 2012: 265). And, Baack argues that "[e]ven though the idea behind the democratization of information is to *potentially* allow *everybody* to interpret raw data, activists are well aware that the average citizen does not have the time and expert knowledge to do so" (2015: 6, *emphasis in original*). With this in mind, Baack calls for "empowering intermediaries" that are:

> [*D*]*ata-driven*, which means that they should be able to handle large and complex datasets to make them accessible to others . . . *open*, which means that they should make the data from which they generate stories or build applications available to their audiences . . . *engaging*, which means that they should actively involve citizens in public issues.
>
> <div align="right">(Baack, 2015: 6, emphasis in original)</div>

This school is sometimes referred to as the "one way street" model of intermediation (Pollock, 2011), because much of the literature focuses on ensuring that marginalized users gain access to information that comes from centralized information sources. Also, this school is often more concerned with making data flow outwards from centres of power than creating information feedback loops. So, for example, the discussion often revolves around ensuring that citizens are able to access and make sense of government information, but less attention is paid to how the data work of citizens can flow back into decision-making processes. This need not necessarily be the case—info-mediaries could facilitate flows of information from citizens to governments, or between different stakeholders—but all the same, this line of critique gives rise to the ecosystem school of stewardship.

Ecosystems School

The ecosystems school observes that in complex institutional relationships, as between a government and its stakeholders, data is generated by many different information systems that are attached to a wide variety of different social processes. The goal of the ecosystem school is to

ensure the production of quality data or information, which will produce value. This requires careful analysis of a variety of different intermediaries, and the many different ways in which they add value within the ecosystem, as well as the policies and systems that support those intermediaries (e.g., Harrison, Pardo & Cook, 2012; Heimstädt, Saunderson & Heath, 2014). As Harrison, Pardo, and Cook point out, in a data ecosystem "leaders must engage in a kind of strategic ecosystem thinking" (2012: 4) aimed at managing intentionality, value creation and sustainability. "Ultimately", they say, "the value of open data rests on whether or not it enables us to solve problems and meet important needs of individuals, communities, or society writ large" (Harrison, Pardo & Cook, 2012: 4). This approach is a welcome advance on arterial approaches, which are too simplistic to capture the contemporary reality of data intermediation, however it raises important questions about what constitutes "value creation" in open data stewardship.

Early works on information intermediaries arose in the industrial management literature. So, for example, Rose (1999) tells us that

> [i]nformation intermediaries are economic agents supporting the production, exchange, and utilization of information in order to increase the value of the information for its end-user or to reduce the costs of information acquisition. . . . The aim to make profit is the origin of their activities. The information processing activities of information intermediaries can generate an informational surplus or added value.
>
> (Rose, 1999: 76)

This line of thinking became significant in the fall-out of the 2008 financial crisis as governments, particularly the UK government, sought new foundations for economic growth. In this context, open government data came to be seen as a possible stimulant for information age industrial productivity. So, for example, in a piece named "Open Growth: Stimulating Demand for Open Data in the UK", Janowski, Holm, and Estevez (2012) suggest that intermediaries are the supporting industries such as data management and storage companies, platform and software providers, crowdsourcing hosts and advisory services, plus app developers and businesses that occupy the space between open data suppliers and final consumers. The latter take open data and "enrich it" and add services to it so that governments, business, and individuals can use it. This benefits the wider economy by providing economic growth, increased innovation, and efficiency savings.

This thinking has shaped literature about partnerships between governments and the business community. For example, Sorrentino and Niehaves argue that, in the future, "eGovernment will be increasingly built on public-private partnerships and will introduce new intermediaries to the public service delivery chain and democratic processes" (2010: 1). With this in mind, they address e-government as an open system in which "rational or efficiency-based forces are not the only drivers at work" (Sorrentino & Niehaves, 2010: 2). They note that in some studies, the focus is on providing access to public services. However, in other cases, intermediaries are associated with "the ability to process, generate and (re)combine data and information" (Ibid: 3) with the realization of a specific social value in mind. This kind of thinking gives rise to studies on different business models for open data intermediation (Janssen & Zuiderwijk, 2014).

This literature has influenced work on data intermediation in developing country contexts (Chattapadhyay, 2014). For example, van Schalkwyk and colleagues (2015) observe that

> [T]he ICT ecosystem is driven by innovation (i.e. the injection of new knowledge into the ecosystem). Firms compete and co-operate symbiotically, and the interaction between firms and consumers (that is, between knowledge creators and knowledge consumers) generates new knowledge which leads to innovation in the ecosystem. It is the pursuit of innovation that keeps the ICT ecosystem in motion.
>
> (van Schalkwyk et al., 2015: 4)

These works stand in contrast with pieces like MacKinnon and colleagues's (2014) UNESCO study on the role of intermediaries in fostering freedom of expression. In their work they found that "Internet intermediaries are heavily influenced by the legal and policy environments of states" (MacKinnon et al., 2014: 10) and "many state policies, laws, and regulations are—to varying degrees—poorly aligned with the duty to promote and protect intermediaries' respect for freedom of expression" (MacKinnon et al., 2014: 180).

These works raise questions about the kinds of value that can result from open data ecosystems. At times this literature seems to suggest that a healthy open data ecosystem is necessary to support solutions to complex social problems. At other times, this literature expresses a need for industrial policy to ensure the viability, innovativeness, and economic productivity of open data ecosystems. Innovation is a common theme within this literature, however it is often unclear whether the literature is referring to new forms of intermediation, new approaches to social entrepreneurship, or the creation of new tech clusters. As a result, this model of the stewardship of open data can become politicized and prone to capture by groups with different interests.

Bridging School

The bridging school recognizes that it can be difficult for people to make sense of open data. Mediators may be required to help "make data actionable", or reconcile different types of information. Where the arterial school gives people tools to help them arrive at their own conclusions, in this case, mediators help to create consonance between disparate pieces of information, as when they work to bridge foreign, scientific, or bureaucratic logics, historical context, and specific social values. Bridging activities might include translation of information between languages or formats, or facilitation of conversations between data experts and concerned citizens. Bridging also encompasses "localization" of open resources within specific cultural contexts, something that teachers who work with open educational resources must often do (Li, Nesbit & Richards, 2006).

These mediators bring a unique set of skills to the stewardship of open data. Their work can often tend more towards the consolidation or consensuation of meaning, than to the facilitation of decentralized meaning making processes. As a result, this school may be controversial among proponents of decentralization. If the original purpose of openness was disintermediation, then bridging may be seen as a re-centralization of knowledge power. Nonetheless, it is important to recognize that actors such as journalists, activists, and science

communicators facilitate processes of meaning making (e.g., Grabill & Simmons, 1998; Tauberer, 2014). As Tauberer (2014) points out:

> The iconic mediators of the 20th century were the radio and television anchors. . . . Today's mediators include traditional journalists, but also issue advocates, organizers, and app builders—not just programmers, but statisticians, designers, and entrepreneurs—who make information actionable.
>
> (Tauberer, 2014)

Supporters of decentralization may recognize that this is necessary, however they would likely recommend that bridging actors reveal their sources and processes so that citizens are able to make their own assessments about the quality of the analysis. While this is certainly a good idea, the situation is more complex. Bridging actors may prefigure the production or analysis of data by setting the social, political, or economic agenda, as when a teacher sets the agenda for learning in a course. The bridging school reminds us that social realities are always constructed and that mediators are active in stewarding these knowledge-intensive processes where open data in concerned.

Communities of Practice

The communities of practice literature addresses situations in which intermediaries steward common pool resources (rather than public goods). This school takes its inspiration from the work of institutional economist Elinor Ostrom (Hess & Ostrom, 2006). In some situations, there is little incentive for people to share data or information, and yet the benefits of sharing would be high. For example, data associated with research is often tightly controlled because it requires a great deal of expertise and specialized infrastructure to produce, it would be difficult to secure the information once it was leaked, and everyone is racing to be the first to extract benefits from the data (Borgman, 2015). However, it is widely recognized that data sharing can create efficiencies in the research process, and also generate collaborations that could increase the rate of innovation resulting from research processes.

An excellent example of a communities of practice approach to stewardship of open data is offered by Map Kibera, a crowd-sourced mapping project in a slum neighborhood of Nairobi, Kenya. In her analysis of this project, Berdou (2011) explores the challenges involved in governing the map as an information commons that requires the active input of community members, and also aims to produce benefits for that same community.

Indeed, governance of common pool resources can be tricky. The goal is to facilitate productive collaborations on the basis of quality, collaboratively produced data. But, potential participants may not feel motivated to contribute, or may lack trust in the initiative, and:

> The success of the knowledge commons depends on the ability to limit enclosure, to make exclusion difficult, and to sustain effective governance models. Libraries, archives, data repositories, and other shared-information resources are under continuous threat of free riders, enclosure, and sustainability.
>
> (Borgman, 2015: 73)

It may be easier to realize effective governance arrangements when there is a cohesive community of actors who share a knowledge production goal, and see immediate benefits from sharing their resources. This implies limiting the scope of the openness of data.

Discussion and Conclusions

Approaching OD through the lens of intermediation brings forth the realization and understanding of the need for the stewardship of open knowledge in the first place. We also learn that there are different ways of organizing the stewardship of open knowledge, and that each approach fundamentally shapes the patterns of rights and responsibilities. These patterns of stewardship shape who does the work, and also who gets the rewards from digital production, and will therefore determine the impact of open development initiatives on poor or marginalized populations.

This realization is borne out in our literature review on intermediation, which reveals some general trends. There tends to be, for example, a gradual shift from "linear" to "complex" thinking about intermediation that is rooted in an "access, use, and appropriation" model. Access to technology prefigures ability to use the Internet, and access to data prefigures efforts to influence the stewardship of open information systems. Thus, there also tends to be a gradual shift from "linear" to "complex" models of intermediation. Often the first job of an intermediary is to simply provide access to technologies or information. Once this is in place, intermediaries can become involved in larger efforts such as building an ecology of interrelated actors, bridging between different ways of knowing, or forming a community of practice. This highlights our earlier point that stewardship of open data involves not just stewardship of data, but also stewardship of a wider set of processes and relations that encourage public engagement in knowledge-intensive processes.

However, we also note that the type of value created varies widely in each case, as can the goal of stewardship in general. In communities of practice, for example, the value of data is collectively realized, but commercial measures of value (exchange value) tend to prevail in the ecosystem model. Meanwhile, while each model could be used, in theory, to achieve any number of different ends, the immediate purpose of each model is different (i.e., reconciliation of differing ways of knowing in the case of bridging; information flow in the case of the arterial model; open access in the decentralization school). Unfortunately, the effects of each type of stewardship are still not well understood, as OD work has not yet widely embraced the role of knowledge stewardship, nor has it studied it in depth.

We believe that research on this theme is sorely needed, and that it can profit from comparing mechanisms of intermediation across different areas of openness practice (i.e., open government, open educational resources, and open science). Since the mechanisms that different areas use to produce openness overlap significantly (Smith, 2014), we hypothesize that a close examination of these mechanisms will demonstrate convergence in patterns of stewardship across the three fields. If such patterns can be identified, this would justify more in-depth research, and suggest best practices around the maintenance or promotion of openness.

Table 2: **Examples of Intermediation in Three Areas of Open Development**

	Open Government	*Open Education*	*Open Science*
Decentralization School	Government portals	MOOCs; open educational resources	Open journals; citizen science; openly published data or information
Arterial School	Outreach and training; advocacy on ATI and privacy laws; apps, services and platforms; marketing and advertising; data standards	Training and workshops; advocacy on educational policy; systems and devices for access (e.g., tablets)	Training; advocacy on intellectual property rights; advocacy on tenure and promotion; data standards
Ecosystems School	Data curation and mediation; data visualization tools; fostering open data community	Open education resource producers, aggregators, and resellers	Crowdsourcing data or analysis; tools and platforms for data collection and analysis
Bridging School	Investigative journalism; data infused advocacy work	Adaptation or localization of educational resources; content customization; translation	Innovation intermediaries; joint scientist-policy-practitioner work; science bloggers
Communities of Practice	Community trusts that provide public services (e.g., MapKibera)	Professional learning communities (e.g., of teachers—data is used for continuous improvement)	Open data repositories and platforms

Source: Builds on the work of Ackah and colleagues (2016).

We have begun preliminary work in this area, and have found that work in the area of open government data, open education, and open science shares common mechanisms or techniques of intermediation (*Table 2*). For example, outreach and training are common to all three as expressions of the arterial school. The emergence of an ecosystem of actors is common to all three, raising questions about the kinds of value added by their interventions, and who pays or

who benefits from this work. Bridging work also appears in all three cases, raising questions about just how "open" bridging practices are, how much meaning intermediaries bring to this work, and how this work is valued by different actors. Finally, communities of practice are also active in all three spaces; however, it is possible that professional learning communities are underdeveloped in some parts of the world. These commonalities and differences suggest that cross-cutting research can shed light on questions such as:

- Whose responsibility is it to intermediate?
- Who are intermediaries accountable to?
- How do intermediaries add value, for whom, and where is this value accruing?
- Does intermediation serve to maintain openness and facilitate public engagement?
- Does intermediation create new power structures, or sustain the power of incumbent knowledge producers?
- What happens when mediation is not present?

We believe that the study of OD through a stewardship framework opens us to the possibility of different patterns of intermediation, and allows us to study their implications for processes of social change. Answers to these questions will illuminate the implications of different models of stewardship for poverty or marginalization. As Livingstone points out, the larger question is "whether the mediation of micro processes of social interaction influences macro-historical shifts in institutional relations of power" (2009: 8). We can achieve this result by examining the business models and policies that shape stewardship, the networks of stakeholders involved in these processes, and also the discourses that influence our thinking about intermediation and stewardship of open information. The results of this work can support policy decisions about the management of informational resources. As Benkler points out, when thinking about Internet for development today, "[i]t's not about skills and productivity, it's about power" (2016, January 16). Understanding how that power is best stewarded is key to opening up future development potential.

Notes

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