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Value Capture in Science – The exchange value paradox

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Abstract

Capturing value from scientific knowledge has been described in the context of university-industry collaborations and science-based entrepreneurship. Value capture mechanisms aim to ensure a mainly monetary reward from the exchange of the value created (e.g., by patenting or licensing). However, most common knowledge dissemination mechanisms in science do not directly result into capturing monetary value. This leads to the paradoxical situation that scientists engage in value creation (i.e., scientific knowledge production) without anticipating to capture value. This study doubts that scientists act economically irrational. We explore how value capture principles work in science and how this affects the willingness to engage in value creation by distinguishing between use value and exchange value. Our findings show that the realized exchange value for scientists does not only consist of an objective monetary part, but also of a subjective part. This subjective exchange value is considered as valuable due to scientists needs (i.e., academic survival, ego-identity status validation, and societal impact). The desire to satisfy these needs drives scientists' willingness to engage in scientific knowledge production. Our findings entail three theoretical contributions. First, we add to the understanding of value capture in science by exploring the scientists-specific relationship between value creation, value capture and their realized use and exchange value, as well as the underlying reasons why the realized exchange value is considered as valuable. Second, we discuss these findings in the light of open science. Third, we point on the importance to consider individual-level factors to assess value capture in science.

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Capturing value from scientific knowledge has been described in the context of university-industry collaborations and science-based entrepreneurship. Value capture mechanisms aim to ensure a mainly monetary reward from the exchange of the value created (e.g., by patenting or licensing). However, most common knowledge dissemination mechanisms in science do not directly result into capturing monetary value. This leads to the paradoxical situation that scientists engage in value creation (i.e., scientific knowledge production) without anticipating to capture value. This study doubts that scientists act economically irrational. We explore how value capture principles work in science and how this affects the willingness to engage in value creation by distinguishing between use value and exchange value. Our findings show that the realized exchange value for scientists does not only consist of an objective monetary part, but also of a subjective part. This subjective exchange value is considered as valuable due to scientists needs (i.e., academic survival, ego-identity status validation, and societal impact). The desire to satisfy these needs drives scientists' willingness to engage in scientific knowledge production. Our findings entail three theoretical contributions. First, we add to the understanding of value capture in science by exploring the scientists-specific relationship between value creation, value capture and their realized use and exchange value, as well as the underlying reasons why the realized exchange value is considered as valuable. Second, we discuss these findings in the light of open science. Third, we point on the importance to consider individual-level factors to assess value capture in science.

Keywords:

Value capture, scientific value capture mechanisms, open innovation in science, subjective exchange value, exchange value, open science

1. Introduction

Although knowledge dissemination is a main and crucial part of scientists' job, little is known about the value scientists receive in exchange of for their created knowledge besides the salary. Strategies for capturing value from scientific knowledge have been described in the context of university-industry collaborations and science-based entrepreneurship (e.g., Bozeman & Rogers, 2002; Dedrick & Kraemer, 2015; Perkmann et al., 2013). Such value capture mechanisms mainly consist of formal transfer mechanisms like collaboration agreements, patenting, licensing or consultancy that create royalty fees in the short- or long-term. However, most of the scientific knowledge dissemination happens through paper or book publications, conferences, or teaching. Since the current literature considers value captured from scientific knowledge in exchange of a value created to be monetary only (Bowman & Ambrosini, 2000; Chesbrough & Appleyard, 2007; Lepak, Smith, & Taylor, 2007), these major dissemination mechanisms would paradoxically not lead to any value captured for the knowledge creating scientists[1]. Consequently, scientists are either irrational economic actors or the application of value capture theory in the scientific context bears inefficiencies in explaining what value scientists receive in exchange for their work and subsequently, why scientists engage in the value creation process in the first place. Therefore, we want to explore the following main research question: *How do scientists capture value from their scientific knowledge creation?*

Drawing on the knowledge-based view, we consider scientific knowledge as value created (Felin & Hesterly, 2007) on an individual-level by one or more scientists (Lepak et al., 2007).

[1] We consider the salary to be not directly related to the actual value creation process and thus, not part of the value captured.

The value received in exchange of the scientific knowledge creation is called “realized exchange value” (Bowman & Ambrosini, 2000; Lepak et al., 2007). Therefore, a first sub-question that needs to be explored to approximate the main research question is: *What is the realized exchange value of scientific knowledge creation from the scientist’s perspective?*

Furthermore, value creation requires the investment of resources and is associated with uncertainty - whether value can be captured at all (Bowman & Ambrosini, 2000; Chesbrough & Appleyard, 2007; Lepak et al., 2007; Windsor, 2017). One aspect driving the willingness to engage in the value creation process is the anticipated exchange value (Bowman & Ambrosini, 2000; Lepak et al., 2007). However, knowledge about what is considered as valuable by scientists remains scars (Dedrick & Kraemer, 2015; Ryan, 2014). Therefore, a second part of the main research question is: W*hy is the anticipated exchange value considered as a sufficient driver for scientists to engage in value creation processes*? Hence, we want to explore, why the realized exchange value – beyond the monetary value – is valued by scientists.

To explore these questions, we applied a qualitative approach gathering data from two comprehensive workshops with scientists, each lasting several days in Denmark and Austria and eleven semi-structured interviews scientists of twelve different nationalities. Based on our findings, we claim that scientists receive monetary as well as non-monetary value from disseminating their knowledge. Thereby, they do not only consider monetary rewards as exchange value. For scientists, the exchange value consists of an objective and an additional subjective dimension. Our data indicates that this subjective value is non-monetary and mainly driven by cognitive factors such as social recognition, reputation, or social acceptance. Hence, we propose that in the context of science, these factors should be part of understanding the exchange value needs for scientists. Furthermore, the subjective exchange value is considered as valuable by scientists due to their individual needs that we summarize in a scientists' need pyramid. These needs are identified to be struggle for academic survival (e.g., a position), ego-identity needs (e.g., social desirability) as well as the desire to make societal impact. Our data further indicate how these needs are met by the objective and the subjective exchange value, explaining scientists' willingness to further engage in the scientific knowledge creation process. Based on these findings, we discuss consequences for open science outlining meaningful inefficiencies in today's scientific system.

Our contributions are threefold. First, we contribute to improving our understanding of value capture processes in science. We identify what scientists consider as valuable beyond the monetary reward and hence, add to an important and still under-researched aspect to the exchange value of science (Allee, 2000; Lam, 2015). In doing so, we enable better insights into what is important for scientists, what influences their willingness to engage in knowledge creation. Moreover, we add to the understanding why the subjective exchange value is considered as valuable by scientists and drives them to engage in the value creation process. Furthermore, by creating scientific knowledge scientists enable users of the knowledge to capture use (Ahuja, Lampert, & Novelli, 2013; Alexy, George, & Salter, 2013; Allee, 2000; Bowman & Ambrosini, 2000; Bozeman & Rogers, 2002; Lepak et al., 2007). Second, by applying and extending value capture principles, our findings contribute to the discussion about open science. Opening the knowledge dissemination (e.g., through open access) transforms scientific knowledge into a commodity good (Bozeman & Rogers, 2002; Dasgupta & David, 1994; Nelson, 1959) with substantial consequences for the use value that can be captured from the scientific knowledge exchange. However, these effects (on use value and exchange value) need to be considered separately. The recognition of a subjective dimension in the realized exchange value allows to rethink incentive structures for open knowledge dissemination as well as for open knowledge production in the science context and with the ultimate goal to successfully translate science into innovation. Third, we add to the small body of literature studying individuals as the unit of analysis in the science context and how their cognitive and emotional behaviors play a role in the context of open science (Lepak et al., 2007). Our findings underline that researching value creation and value capture principles requires paying attention not only to macro level factors but micro level elements as individuals (e.g., scientists) are the main decision makers.

This paper holds meaningful implications for individual scientists as well as university managers and policy makers. For individual scientists, it allows for identifying new opportunities related to increasing the value captured by disseminating their scientific knowledge. For university managers and policy makers, our insights are helpful in creating incentive structures to advance open science in a way that increases both use value as well as exchange value. In summary, this paper opens the pathway to not only realize a larger piece of the "scientific knowledge cake" but also to increase the overall size of this cake.

2. Theoretical Background

This section starts by briefly reviewing literature on value creation and value capture in the context of scientific knowledge creation. In this vein, use value and exchange value are outlined. Afterwards an intent is undertaken to depict the value creation and value capture process in the context of scientific knowledge creation and dissemination. Thereby, we identify inefficiencies that lead to our exploratory research question.

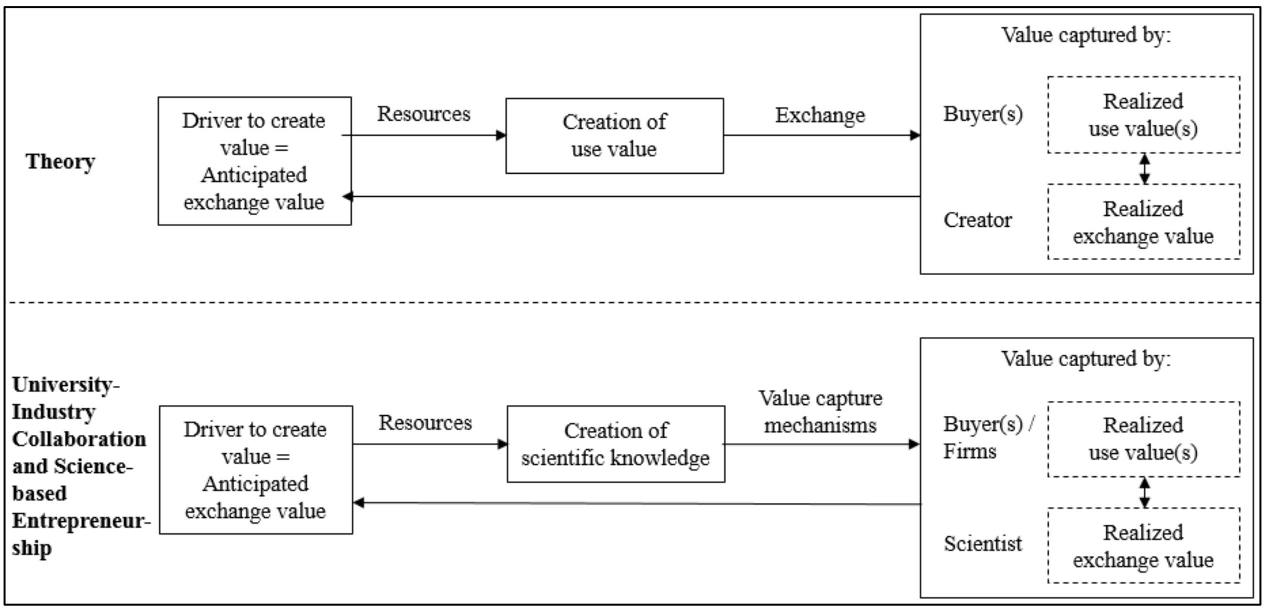
2.1. Creating and capturing value from scientific knowledge production

The understanding of value creation and value capture has received considerable attention in management research (e.g., Bonakdar, Frankenberger, Bader, & Gassmann, 2017; Bowman & Ambrosini, 2000; Chesbrough & Appleyard, 2007; Lepak et al., 2007). The underlying assumption is that innovations create value that is distributed among different stakeholders (Teece, 1986, 1998). Thereby, value creation and value capture must be understood as interdependent processes (Bowman & Ambrosini, 2000; Chesbrough & Appleyard, 2007). To capture value from its innovations firms need to apply value capture mechanisms (e.g., licensing, patenting, sales) that allow them to realize innovation rents from that particular and subsequent innovations (Ahuja et al., 2013; Pisano & Teece, 2007).

Value cannot only be created on a firm level, but also on an individual, collective, and societal level (Felin & Hesterly, 2007; Lepak et al., 2007). Building on the understanding of the knowledge-based view, knowledge from individuals can be considered as important resource to create value (Felin & Hesterly, 2007). In accordance, the scientific knowledge production has been considered as value creation process in the past (Dasgupta & David, 1994; Dedrick & Kraemer, 2015; Felin & Hesterly, 2007). In the following we consider scientific knowledge as the value created by an individual scientist (Dedrick & Kraemer, 2015; Lepak et al., 2007). Thus, we focus on value creation on an individual level in the context of scientific knowledge production.

Capturing value from scientific knowledge production has received comparably less attention. One way to capture value from scientific research for society, the economy and the scientists themselves (Bowman & Ambrosini, 2000; Dasgupta & David, 1994; Lepak et al., 2007) is its transformation into innovation (i.e., new products, services, or processes). This transformation has been addressed by two major literature streams. First, university-industry collaboration, and second, science-based entrepreneurship (Perkmann et al., 2013). While in the first case scientific knowledge (value created) is exchanged with another economic actor (e.g., a firm), it might be transformed into an innovation by the scientists her-/himself. Figure 1 graphically depicts the theoretical understanding of value creation and value capture in general and in the context of university-industry collaboration and science-based entrepreneurship.

Figure 1:Graphical summary of the process of value creation and value capture in general and in science



Source: adapted from Bowman and Ambrosini (2000).

Value is captured when it is exchanged. While in the case of an innovation this might be the buyer of a new product or service (Bowman & Ambrosini, 2000) in the context of scientific knowledge these might be firms that decide to collaborate with a scientist.

But to describe value capture mechanisms and strategies requires the definition of value. Building upon Teece’s model (1986, 1998) of the overall value captured by an innovation, Bowman and Ambrosini (2000) differentiate between use value and exchange value. While the latter is the (monetary) price paid to obtain a good, the first is the buyer’s surplus. The surplus describes the comparisons buyers make between products, their needs and feasibility of other offerings as well comparisons that resource suppliers make between the deal with the firm and possible other deals. As these authors focus on the organizational level Lepak et al. (2007) broaden this understanding by accounting for a societal and individual-level perspective as well. Value creation thereby "depends on the relative amount of value that is subjectively realized by a target user (or buyer) who is the focus of value creation—whether individual, organization, or society—and that this subjective value realization must at least translate into the user's willingness to exchange a monetary amount for the value received" (Lepak et al., 2007: 182). The value created must thereby be a contribution that is perceived to be valuable by members of a target group (Felin & Hesterly, 2007; Lepak et al., 2007). Hence, the value created must exceed the perceived utility of any other alternative presented to the target group by either lowering the cost or creating a higher value. While the use value is considered to be subjectively perceived, the exchange value lacks such a subjective aspect (Bowman & Ambrosini, 2000).

The exchange of scientific knowledge happens through different knowledge dissemination mechanisms. Typically, scientific knowledge dissemination happens typically through scientific publications, conference presentations, book presentations, interviews, and so forth. However, also commercial value capture mechanisms are applied by scientists that allow them to commercialize their knowledge such as patenting, licensing, consulting, or academic entrepreneurship (D'este & Perkmann, 2011; Perkmann et al., 2013). In the context of university-industry collaboration and science-based entrepreneurship this means that the right to use the knowledge is exchanged (e.g., through licensing, consulting, patenting) for money. Thereby, whatever utility the buyer perceives is the uniquely realized use value. This use value can be different for any actor who uses the scientific knowledge. The monetary value received by the scientists can further be considered as realized exchange value. Hence, in the case of a publication, every reader realizes an individual use value, as well as the publisher who normally owns the rights. The realized exchange value is the royalty fee the scientists gets from the publisher based on the sales of the publication, if any. In the case of a licensing-deal, the firm that licenses the scientific knowledge can create new innovations (=use value in terms of future realized exchange value) while the scientists received the licensing fees paid by the firm (=exchange value). However, whether a scientist is willing to engage in the value creation process in the first place depends on the anticipated exchange value (Lepak et al., 2007). Thus, whether parties engage in value creation depends on the anticipated value capture for this effort and not only the pure ability to engage.

Value capture mechanisms therefore describe actions that allow scientists to capture exchange value from their scientific knowledge production. These mechanisms can be structured regarding their level of formalization (Bonakdar et al., 2017). Thereby, formal mechanisms include but are not limited to patenting, collaborative research, consultancy, or licensing and informal mechanisms describe networking activities or ad-hoc advices for practitioners (Perkmann et al., 2013). By applying these mechanisms scientists are able to realize exchange value from the scientific knowledge created.

However, only a fraction of the dissemination mechanisms for scientific knowledge allow the scientist to capture exchange value. Scientific knowledge is a durable public good (Dasgupta & David, 1994). It's dissemination is a necessary condition for the exchange of information (Dasgupta & David, 1994) and hence for the realization of use value and exchange value (Bowman & Ambrosini, 2000). Recognizing the low anticipated exchange value raises the question, why scientists continue to create value. This is further conceptualized in the next section uncovering inefficiencies.

2.2. Theoretical framework for analyzing the dilemma

Despite commercialization through university-industry collaborations and science-based entrepreneurship scientist most usually disseminate their scientific knowledge through publications, conferences, or teaching. Understanding the exchange value as monetary rents in exchange of the scientific knowledge leads to a paradoxical situation. Such dissemination strategies lead to no or only very limited exchange value. However, the anticipated exchange value needs to exceed a critical threshold for scientists to be willing to (further) create scientific knowledge and thus, use value for individuals, organizations, and society. Consequently, scientists either act irrational because they engage in a value creation process where the costs exceed the anticipated exchange value, finally leading to self-destruction. Or the exchange value for scientific knowledge consists of more than monetary rewards.

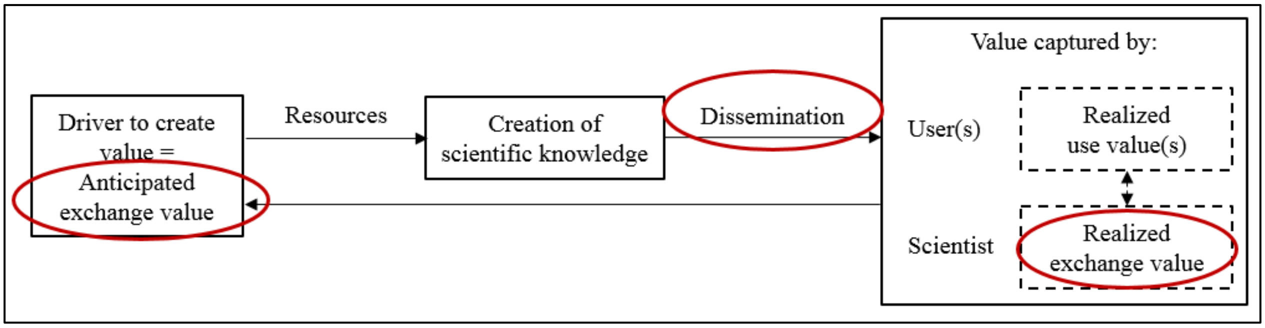
The value of scientific knowledge has received considerable attention (e.g., Bozeman & Rogers, 2002; Dasgupta & David, 1994; Dedrick & Kraemer, 2015; Nelson, 1959). Interestingly, most authors have focused on the description of the (realized) use value of scientific knowledge. Hence, they argue what value applied vs. basic scientific knowledge has for society and organizations (Nelson, 1959) or describe why economic actors invest in the creation of scientific knowledge (Dasgupta & David, 1994). One pioneering exception is Dedrick and Kraemer (2015) describing how the value creation by science-based innovation is distributed among all stakeholders – including the national ecosystems and the scientists. Interestingly, they pointed out that awarded prizes and prestige can be considered as rewarding for scientists.

However, knowledge about what is considered as valuable by scientists remains scars (Dedrick & Kraemer, 2015). Considering the pursued values of scientists, only a scarce amount of research is available. The largest body of research focusses on the challenging environment for young scientists (see for example a special issue of the Journal *Science* in September 1999). It is no secret that the job decision to stay in academia is related to several sacrifices such as job insecurity due to short-term employment, limited work-life balance, lower average wages, above average working hours, and a hostile environment for family development especially for female scientists (Bland & Schmitz, 1986; Mason, Goulden, & Frasch, 2009; Weijden, Teelken, Boer, & Drost, 2016). Some pioneering study, however, researched scientists' work motivation (Feist & Gorman, 1998; Gibbs & Griffin, 2013; Kamalanabhan, Uma, & Vasanthi, 1999; Ryan, 2014). For example, Gibbs and Griffin (2013) explored that the main reason to stay in academia is the flexibility and freedom to research. Furthermore, the ability to engage in externally focused values (e.g., improving the societal status quo) were mentioned as well as the influence on students. Building upon these few available studies we suggest that the exchange value also consists of a non-monetary component.

Therefore, in the following we want to explore what scientists consider as desirable exchange value, i.e., what they receive in exchange of the scientific knowledge they have created, and what value capture mechanisms they apply to achieve this. Identifying what is considered as exchange value also allows to understand what the anticipated exchange value driving the scientist's willingness to (further) engage in the value creation (i.e., knowledge creation). Accordingly, the want to address the following main research question: *How do scientists capture value from their scientific knowledge creation?* To answer this question, we further need to explore and understand *what the realized exchange value of scientific knowledge creation from the scientist's perspective* (sub-question 1) and *why the exchange value is considered as a sufficient driver for scientists to engage in value creation processes* (sub-question 2).

Figure 2 depicts the process of value creation and value capture with the red circles highlight the foci of the study as outlined by the research question. We want to explore first, what mechanisms scientists apply to capture value from their knowledge. Second, what value is captured by the scientists, and third, why do they consider the realized exchange value as valuable.

Figure 2: Theoretical conceptualization including the foci of this exploratory study



3. **Methodology**

Because of the explorative nature of this study and the abovementioned research question, a qualitative approach was applied. This approach was selected to gather in-depth data and rich information on the phenomenon (Yin, 2003). Qualitative approach is known to underlie the rationale or theory underlying emerged relationship in data (Eisenhardt, 1989). In our case, exploratory research could be the best option since the inner content of value creation and value capture process –what is happening in real science life- is an underexplored research domain that would potentially shape a new understanding of the phenomenon (Birley, 2002). Therefore, given the “how” nature of the research questions and the focus on underlying factors associated with value creation value capture in science rather than studying them in isolation, a single case study consist of multiple phases of data collection can be justified (Yin, 2003).

3.1. Data collection and research context

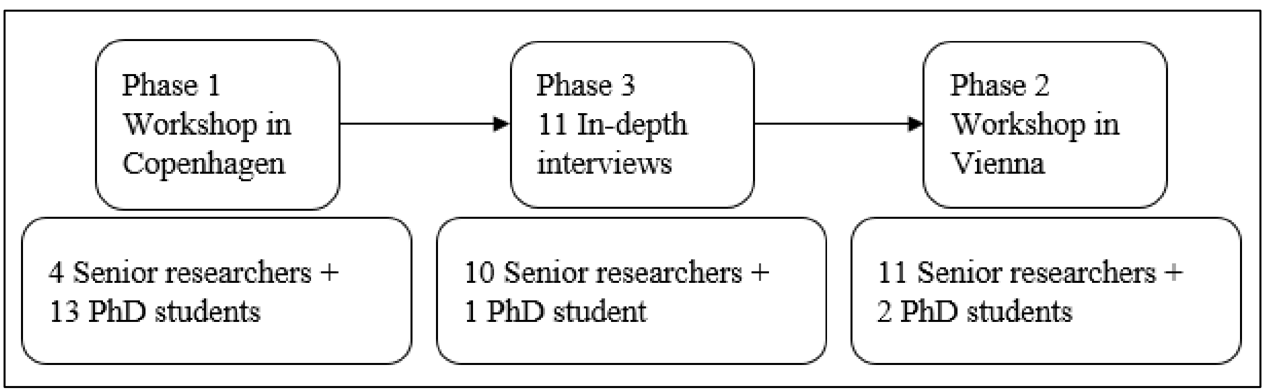
Data were collected during 2017 using two inquiry techniques and three phases (see Figure 3):

Workshops (2 workshops): These workshops aimed at providing participants with frameworks and tools to develop and implement mechanisms and processes of how to capture value from the scientific knowledge. The workshop was meant as an opportunity for participants to work on their own institutes' future approach to value capturing.

In-depth interviews (11 scientists): The interviews aimed at better understanding the process of value capture and diving deep into different mechanisms, antecedents and outcomes from scientists' perspective.

The data were collected in three different phases:

Figure 3: Phases of data collection



Phase 1: The first workshop was designed to inform and educate participants about value capturing in science, and it helped the research team to get a better understanding of phenomenon of value capture in science from scientists' perspective. The information gathered in the first workshop helped constructing an interview guideline for the second phase based on a deeper and a more practical level of understanding the phenomenon.

Phase 2: Building upon phase 1, we invited potential future participants of the third workshop to participate in an in-depth interview prior to participate in the workshop. In total, in the second phase we performed 11 interviews with scientists, each took between 1 hour to 1.5 hour. Interviewees information is presented in Table 1.

Interview participants were scientists working in different discipline and different institutes. They were all a part of bigger research institution with a thematic focus in medicine, the life sciences, social sciences and cultural studies. Participants were from 7 different countries including Austria, Belgium, Bosnia and Herzegovina, Hungary, Italy, Poland, and UK. This institute is one of the largest research institute in Austria with 550 employees and total average budget of 30 million euros (30% of the budget is publicly funded).

Table 1: Interviewee characteristics

Interviewee	Position	Research field	Years after PhD	Working place
A	Administrative head	Health/life	5	Vienna
B	Group leader	Health/life	16	Graz
C	Senior scientist	Humanities	8	Vienna
D	Scientist/PhD	Health/life	Last year PhD	Vienna
E	Postdoc	Health/life	3.5	Vienna
F	Group leader	Health/life	8	Vienna
G	Group leader	Health/life	15	Vienna
H	Group leader	Health/life	13	Vienna
I	Key researcher	Humanities	3	Innsbruck
J	Key researcher	Humanities	7	Innsbruck
K	Group leader	Health/life	3	Tulln

Note: None of the interviewees had a permanent position.

The interview protocol consists of three sections. In the first part the interviewees discussed in detail the value capture mechanisms they employ, then going more detail into the antecedents of implementing such mechanisms and the expected outcomes. These sections include open ended questions but not limited to:

- Participants unique career (projects, research line, perspectives, experiences, and technical details of their research)
- Identifying mechanisms and elaborating on each mentioned mechanism in detail (When, experiences, successes, challenges before, during and after implementing each mechanisms)
- Considering different mentioned mechanisms:
    - Why do you consider *[mechanism]* to be valuable?
    - What do you perceive as satisfactory about *[mechanism]*?
    - How do you think scientific and non-scientific communities evaluate *[mechanism]*?
    - In your opinion, can you measure the value of *[mechanism]* and if yes, how? *[Mechanisms]* Outcome/reward?

Phase 3: In the last phase, research team discussed the results of the interviews with participants and validate the main understandings of value capture processes in science,

The main topics were discussed in this phase with the participants were:

- Capturing value from science
- Open Innovation search and collaboration approaches to creating and capturing value from science
- Intellectual property (IP), IP rights and strategies in Open Innovation
- Opportunities, risks and contingency factors related to applying Open Innovation as a scientist

- Identification and selection of external partners for commercializing science
- Opportunities and challenges involved in partnering with externals
- The role and value of tech-transfer offices in supporting the commercialization of science
- Working with/using intermediaries and platforms for commercialization science (e.g., scientists as suppliers to platform challenges)
- Good-practice examples and case studies related to external partnering in the commercialization of science

The data of the second workshop was gathered and analyzed in a systematic way to help scientists in triangulation process.

In total, our dataset consists of 16 hours of workshop and 15 hours of in-depth interviews with scientist (approximately 300 pages of transcribed raw data).

3.2. Data analysis procedure

The transcribed data then processed to represent a clean case for each participant. The initial analysis took place mainly by two researchers based on triangulation of data sources (workshops, documents, observations and interviews) for each scientist. The first round of analysis was structured based on the guideline used for data collection. In other words, categorizing the individual answers according to the thematic open-ended questions. This open coding approach helped two analysts to obtain a comprehensive and general picture of process of value capture mechanisms in science. All transcripts were read again multiple times with the questions: what mechanisms are used for capturing value from research? Why and how these mechanisms were used?

The second round of analysis contained a more detailed and analytical approach for each transcript. By iteratively analyzing data, literature and concepts, different categories started to emerge (Locke, 2001). We used descriptive codes to identify, and cluster data related to each existing and emerged concept. Then we drew on a set of theoretical concepts that reflect the interplays between main concepts emerged such as value, human behaviors, motivations and actions.

Since the main purpose of our research was opening the black boxes of value capture process (anticipated exchange value, dissemination and realized exchange value) in science, we started to interpret what considered to be valuable for scientists. Finally, as for the last analytical task, existing code concepts and emerged ones were categorized and shaped patterns related to different stages of value capture process in science.

3.3. Validity and reliability of the data

Although, our cases were selected from different disciplines with different nationality background the issue of generalizability has been always present in doing case study research. It is therefore worthwhile to mention that the main purpose of our research is to broaden the theory and reflect on the phenomenon rather than generalizing from sample to population. In addition, pilot interviews were done to construct a safe and reliable basis in terms of the content and duration for formal data collection process. Finally, one of the two data analysts did not participate in the data collection process and started the analysis from raw transcripts, this gave a non-biased interpretation of raw data which was aligned with the first analyst interpretations.

4. Analysis

This section first highlights the design of value capture mechanisms in relation to their monetary and non-monetary outcomes. Then, we move beyond these mechanism by shedding light on how they contribute to the value that scientists capture and "why" these mechanisms have been used by scientists as antecedents of value capture mechanisms. Our empirical data indicate that dissemination mechanisms in science can be considered as value capture mechanisms as well. This is because of the characteristics of the exchange value that is realized by disseminating the scientific knowledge. Our data indicate that the realized exchange value is not only on monetary but also non-monetary nature. The non-monetary exchange value is considered by scientists as valuable due to the 'scientists' needs pyramid'. Therefore, we open three black boxes of scientists' value capture process: their dissemination mechanisms, their realized exchange value, and the underlying reasons why the value captured is considered valuable.

4.1. Mechanisms for value capture in science

Analyzing our dataset, we found *formal* and *informal* sets of value capture mechanisms scientists employ to capture value from their research. Formal sets of mechanisms can be identified as mechanisms that naturally have a formal structure. By formal structures we mean employment of dissemination mechanism that bring in monetary and non-monetary outcomes to individuals, institutions and society. These mechanisms are often concrete and predetermined tasks of scientists within the science-specific environment. Our interviewees reported sets of formal mechanisms such as patents, publications, conferences and teaching. These formal mechanisms found out to have both monetary and non-monetary outcomes for scientists. It is however notable to mention that formal mechanisms are discipline-dependent.

According to our interviews, in institutions with life and health science discipline institutions effect the choice of value capture mechanisms while in humanities and social science this decision (choosing a formal mechanism) is more individual and flexible.

> *"Towards the research community, they are disseminated almost exclusively in conference talks, article publications, book publications, and book reviews, so I guess literary studies produces literature. Then, to the non-research community, we do things like book presentations, or exhibitions in museums." (Interviewee I)*

> *"[we disseminate] by publications, obviously. Then going to conferences. […] We have the aim that everybody is able to go to the major conferences, and to present. […] We always published consensus manuscript, as a result of this conference, like our recommendation how to classify a disease, what a stem cell is, or sometimes to recommend certain modifications of the standard treatment." (Interviewee A)*

> *"[...] If there is a new method, which can be patented, and it can be used later by the scientific community, I think it can be interpreted as it was directed to the scientific community." (Interviewee B)*

Publication is the mostly used formal mechanism to capture value from research due to firstly the scientists' position in the scientific network and secondly the indirect monetary exchange value this mechanism creates for scientists. By indirect we mean this mechanism bring a better position for scientists in their scientific community, thus promotion and career opportunities.

In addition to formal sets of mechanisms, scientists reported to disseminate their knowledge employing various informal mechanisms. Informal sets of mechanisms are identified as sets of mechanisms driven from either informal structure or no-structure. Informal structures are structures that are encouraged by institutions but are not predetermined tasks of scientists while mechanisms with no structure in their basis are solely driven by scientist with no involvement of scientists' institutions or environment.

> *"Yesterday I got an invitation for this Science Slam in November. I should also present my project there; let's see if I can realize it." (Interviewee D)*

While formal sets of mechanism result in monetary and non-monetary outcomes, our data shows that informal mechanism to capture value from research mostly have non-monetary outcomes. Non-monetary outcomes are outcomes that have a mostly indirect impact on scientists' survival in academia.

Table 2 shows various formal and informal mechanisms that are used to capture value from scientific knowledge and their monetary and non-monetary outcomes for the creator of the scientific knowledge. For example, while the primary (**) outcome of patents is monetary (e.g., license is bought) it also includes a secondary (*) indirect non-monetary outcome (e.g., future career opportunities). Another example, while the primary (**) outcome of media use is non-monetary (e.g., visibility by public organization), it doesn't have a monetary outcome.

Table 2: Value capture mechanisms in science

		Monetary	Non-monetary
Formal	Patent	Direct ** (e.g., license)	Indirect * (e.g., career opportunities)
	Publication	Indirect * (e.g., career promotion)	Direct ** (e.g., career promotion)
	Conferences	Indirect * (e.g., career promotion)	Direct ** (e.g., network recognition)
	Teaching	Direct ** (e.g., pay check increase)	Indirect* (e.g., career promotion)
Informal	Collaboration	-	Direct ** (e.g., Network recognition)
	Book presentation	Indirect * (e.g., career promotion)	Direct ** (e.g., Social recognition)
	Media	-	Direct ** (e.g., public organization visibility)
	Public lectures	-	Direct ** (e.g., Social recognition)
	Patient visits	-	Direct ** (e.g., Research ideas)
	Science nights	-	Direct ** (e.g., Social recognition)

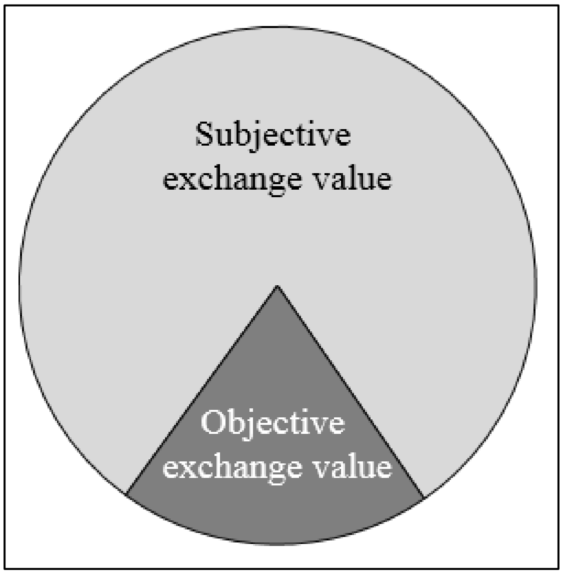
Note: Asterisks indicate the strength of the relationship: ** Primary influence, *secondary influence. The type of outcome presented in the table are not exhaustive.

4.2. Exchange value from the scientist' perspective

Our results indicate that the exchange value structure in science seems to be more complex as previously assumed in the commercialization of scientific knowledge. Although it mirrors the typical structure of value capture mechanisms in terms of monetary outcomes, new insights into what scientists perceive as sufficient to engage in the knowledge (i.e., value) creation and dissemination evolve. Besides the monetary outcomes, that we term objective exchange value, scientists recognize non-monetary-rewards that we term subjective exchange value (see Figure 4).

Narratives of scientists' value capture mechanisms in their specific context are therefore considered to represent a dynamic structure that weaves subjective exchange value to objective exchange value that indicates what individuals consider as desirable exchange value implementing any mechanisms.

Figure 4: The realized objective and subjective part of the realized exchange value in science



All interviews in our study showed subjective exchange values are a prevalent but unconscious part of the bigger image of exchange value structure in science. This means that when scientists interpret/perceive the value resulting from an action, simultaneously they acknowledge the subjective nature of value. This expands the current approach of treating value and its dependence on monetary metrics specially in the science context.

Hence, scientists' desire to capture value from their knowledge dissemination using formal and informal mechanisms could be considered as a reflection of their recognition to satisfy the needs that ultimately is drawn from subjective value rather than objective value they receive.

4.2.1. Scientists' objective exchange value

Based on our interviews with scientists we identify small proportion of exchange value structure that determines those outcomes that can be objectified into monetary rewards. Objective values are those related to measurable output they perceive implementing value capture mechanisms, such as increase in salary, career promotions and research funding.

> *"[...] then of course it promotes the career, because you need publications in order to be able to apply for additional funding, or in this case for the prolongation of the cluster for example, and then depending on the topic. Again, it's the contribution to the scientific field, so that you gain recognition, but you're also able to promote the work of others that can build up on your work." (Interviewee A)*

> *"Whatever draws attention to your research helps you because these are the things that are quantified, citations [...]" (Interviewee C)*

We found that individuals received less objective values compared to what they expect when capturing value from employing formal and informal mechanisms. When scientists implement value capture mechanisms to pursue an objective exchange value in that process. However, there still might be a subjective judgement on what is perceived as objective value for scientists.

> *"For example, if you're looking for a new job or if you're writing proposals, the reviewers would see if you're really good. If you're fit into this project, if you're the right person to work on this project. And then they look in the publications." (Interviewee E)*

4.2.2. Scientists' subjective exchange value

In the context of science subjective exchange value is driven from cognitive and socio-psychological factors that individual receive in exchange of what they offer when disseminating their research. The concept of subjective exchange value however is a broader term for non-monetary or intrinsic rewards resulting from an action in science domain. Subjective value is by nature something positive (e.g., 'feeling of satisfaction', confidence, pride, etc.) (Curhan, Elfenbein, & Eisenkraft, 2010). In our study, we found that mostly the subjective exchange value or the subjective judgement of an objective value satisfies scientists' cognitive and socio-psychological needs. Subjective value can be seen as the best available intuition about an objective action (Curhan et al., 2010). Therefore, in our study it is not surprising to see that objective actions (formal and informal mechanisms) firstly are evaluated through subjective exchange value. For example, one's willingness to appear in social media validate her-/his ego-identity status which in return result in feeling of satisfaction and being recognized.

> *"With the general, how to say, environment, the feeling of the public towards your research, if this research is important for the well-being of the people, or if this research is just important for itself. Of course, it's always much better, if the people feel, and know that in the end, there will be something that affects their lives, or our lives in this case." (Interviewee A)*

> *"I think that is very satisfactory. Also then to get responses, and yeah, visibility I think is very satisfactory. It's a requirement. So you're judged based on your publications. Whatever you've published is kind of yours, so to say. So your publication list will always be your publication list. It's kind of like your output, your personal out of your personal value. It's*

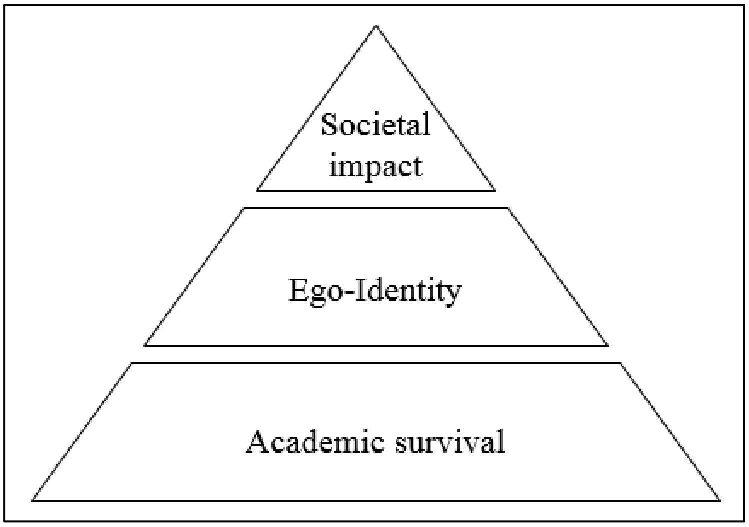
the way to sell yourself, of course, to people. This is how people are going to evaluate you, based on what you published." (Interviewee G)

Based on our interviews we therefore argue that subjective value in value capture in science pays off the objective value perceived by scientists implementing any dissemination mechanism. This might as well be explained by the cognitive aspects of ones' behavior which is largely determined by how one feels prior to the gain. Hence, we in the following we explore why abovementioned subjective and objective exchange value is considered as a sufficient driver for scientists to engage in value creation processes.

4.3. Scientists' Need Pyramid

We go beyond describing research dissemination mechanisms and value capture in isolation and we address why the realized exchange value drives individual scientists to engage in knowledge creation and to apply dissemination mechanisms. We identified three categories of antecedents that derive mechanisms namely: survival in academia, ego-identity status validation, and societal impact. These needs form a pyramid in our results labeled as "scientists' need pyramid" (see Figure 5). In the pyramidic shape, the different sizes are intended to express different amounts of exchange value required to satisfy the needs.

Figure 5: Scientists' needs pyramid



4.3.1. Academic survival

Our interviews with scientists show that the main driver for creating knowledge and applying dissemination mechanisms is survival. We found scientists' first and most important driver to use both formal and informal strategies is to survive in their academic life and continue research of their core interest. The desire to meet academic career goals serves as the basis of value capture from scientific knowledge (e.g., through research funds or promotion).

For example, disseminating knowledge by means of attending to conferences secures the individual unique position in their network and therefore signals the competitors and enhancing individual's bargaining power when it comes to opportunities. In the context of science considering individuals as separate entity explains how this strategy create an isolation mechanism in individuals own network.

> *"Well, the conferences are something really, really big and we don't have articles despite maybe the first idea would be to connect it with exhibitions. […] It's really an important*

moment for the life of a scholar. In a conference my research is evaluated by my colleagues, and also it's the situation, it's the moment where I can make relationships with other colleagues, other scholars. Maybe organize another conference in two years, or a collaboration, or a book together. Conferences are absolutely one of the most important aspects of our research, absolutely." (Interviewee J)

"Sometimes it's very valuable to have international partners. Also in some cases, like we have also been able to found societies, for example, that are international societies, for example placenta stem cells. We kind of bring the community closer, so to say. There's few people working in this field worldwide, it's a way to bring them closer together. Then it's a nice way of meeting them again at conferences or make our own meetings and conferences." (Interviewee G)

Interestingly, most of our interviewees reported to use publications as a method to disseminate their research output to society not because primary it might be a tool to share the impact of their research but it makes individuals identified by their peers and thus open career opportunities.

"It's always good to be recognized by the simple fact that somebody considered your work valuable of publishing, and we of course look into it to publish either in top journals […] then of course it promotes the career, because you need publications in order to be able to apply for additional funding, or in this case for the prolongation of the cluster for example." (Interviewee G)

Interestingly, the story is similar for informal mechanisms, one interviewee reported the ultimate driver for presenting a book to public is not only getting noticed by larger community but absorbing public funds to continue research.

"If we consider that our research is important, and we ask money for that because we need money, less than positions, but we still need money, and we ask societies, companies, or governments to fund our research, we should demonstrate that this research is important. I know that it's important but it's not enough that I know, I have to demonstrate it. The only way to demonstrate that our research is important is to show an interest among the society." (Interviewee J)

From the resource-based view, the survival and performance of an entity depends strongly on entities'' ability to leverage on distinctive capability that lead to competitive advantages (Barney, 1991). In the context of science these capabilities are translated to research output for each individual thus their survival in their scientific community (market). In our explorative case study, disseminating research through formal and informal mechanisms first and foremost serve as creating entry barrier for other individuals thus surviving in the career.

Taking the attention from macro level factors such as institutions and economy, individuals develop their own survival mechanisms to sustain in the science industry. Capturing value from science strongly influence individuals' survival. However, the big question arises here: should survival in science community be the main motivator of utilizing value capture mechanisms?

4.3.2. Scientists' ego-identity status validation

Our interviews with scientists revealed that the second category as underlying reasons why subjective exchange value is considered as valuable is scientists' own ego-identity status validation. In our interviews, we found that two types of ego-identity validation processes have a direct impact in utilization of value capture mechanisms among scientists: personal ego-identity status and professional ego-identity status. Personal ego-identity refers individuals own definition of “who I am” while professional ego-identity status explains both one's awareness of being an employee doing a particular job and one's identification with its own group and social categories to which individual relates by means of their job (Mancini, Caricati, Panari, & Tonarelli, 2015).

Recognition firstly by scientific community and then society found out to be one of the main pillars in ego-identity status validation when it comes to utilization of value capture mechanisms. Especially in employing informal mechanisms, scientists’ work being recognized by public was the main antecedent.

> *“They [book presentations] should help people to get to know my name, and they should get people to know my research, “Oh, I did a book presentation," to people.” (Interviewee I)*

> *“It's important that the public knows what research is doing or what it can actually do. Yeah, it's always tricky to find something that we could present there because many topics are not good to, yeah, as I said, grab the attention within a few seconds or minutes. But it's always very nice to go there and talk to mainly kids or teenagers.” (Interviewee E)*

Our data shows that appearing on public places, giving public talks, presenting research to public and appearing on media satisfied individuals’ desire for social approval. The reason behind these types of behaviors are explained as normative social behaviors of beings: “To the extent that injunctive norms are based on individuals’ perceptions about social approval, an underlying assumption in the influence of injunctive norms is that behaviours are guided, in part, by a desire to do the appropriate thing” (Rimal & Real, 2005)

For example, and interviewee claimed the reason why publishing a book considered to be valuable is the "ego-booster" effect of the action:

> *"[…] And then I thought, okay maybe for my habilitation*[2] *I can really start writing a book, and I've already few very big book chapters. […] this is like an ego booster for me, to know that ... yeah, I can honestly say this, I don't know if you have written a book, yeah I find this ... because it's an intellectual challenge." (Interviewee C)*

Another important factor identified in our explorative study that is associated strongly with ego-identity status is self-efficacy. Self-efficacy is defined as a personal judgement of "how well one can execute courses of action required to deal with prospective situations" (Bandura, 1982). Moreover, according to Cervone (2000), individuals actively evaluate the relation between their perceived skills and the demands of tasks when thinking about their capabilities for performance. We observe various elements of self-efficacy when scientists explain their motives for involvement in dissemination activities.

> *"But by putting words on the piece of paper, you have to make sure that you're certain about what you're writing. So I do a lot of research to make sure that what I'm writing is waterproof ... is watertight, is foolproof […]And by doing this, I also educate myself a lot, because I read about things that I otherwise maybe would not read, just to be really sure, and this gives me a lot of satisfaction because I'm constantly educating myself and I really enjoy writing my own paper, or correcting somebody else's paper, to make that the structure is really perfect, because I really enjoy" (Interviewee C, formal mechanism)*

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[2] A habilitation is the highest qualification level issued by universities and requirement for full professorship in many European countries.

"Probably, because it's just again a skill training for presentations but finally if you get to the audience, the testimony then you have to show them that you are the man for the project. That could be quite good." (Interviewee G, informal mechanism)

As can be seen, some scientists apply various types of dissemination mechanisms to have a self-evaluation of their performance and their capabilities. In previous studies, self-efficacy found out to construct the motivation of scientists to perform research. Bandura (1997) claims that research done by faculty needs noticeable creativity and scientists' motivation built on strong sense of efficacy that their efforts considered to be successful. In our case, self-efficacy found to be strongly relevant in disseminating the research results.

4.3.3. Societal impact

In the context of science, we tend to assume having a societal impact is potentially an antecedent of implementation of value capture mechanisms while in our data we found limited evidences for this. Our interviewees indicate that in the desire to make a societal impact was not a primary driver for scientists when they answer the question of "why do you use certain mechanisms".

Leaving societal impact mainly is driven by individuals' personal belief in research as a public good so the outcome of research must directly benefit the society. In our dataset two scientists reported to utilize media to create societal impact:

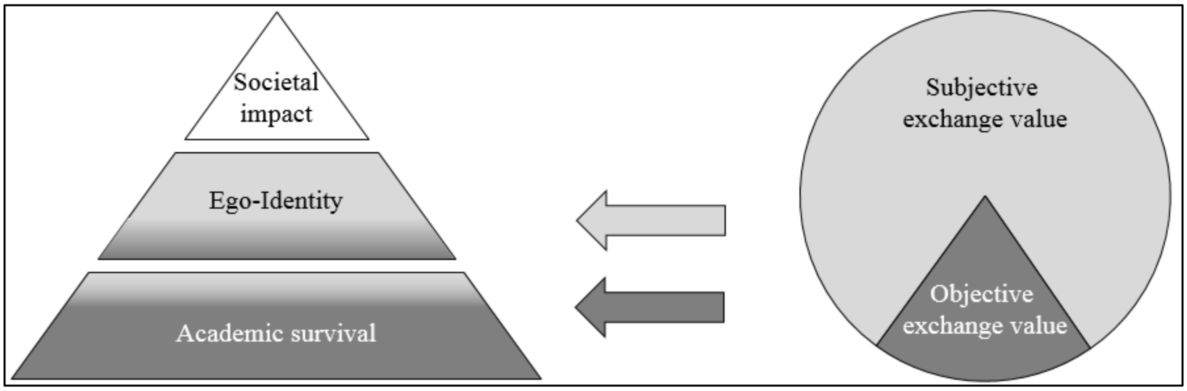
"[…] So, to bring awareness to the public. But the content, what we're actually doing. Well at the end it's public money that we use. And yeah. Especially when there are elections like there have been now. There might be changes in how big the share is that goes to research.

And then if people have no clue what research is actually doing for them they can't understand why they should give us a share." (Interviewee E)

5. Results and discussion

This section first summarizes our main findings, before theoretical contributions as well as practical implications for scientists and policy makers are outlined. The qualitative study lead to five major findings. First, scientists use dissemination mechanisms to capture value from the scientific knowledge they have created. By disseminating their scientific knowledge scientists create use value if it is picked-up by further academic or non-academic actors (e.g., public, firms). Second, the realized exchange value consists not only of a monetary dimension as conceptualized by previous studies (e.g., Bowman & Ambrosini, 2000) but also of a subjective dimension that includes social recognition, reputation and further ego-identity validating rewards. This finding is in line with prior research indicating that softer factors such as access to knowledge, reputation, or other non-monetary rewards might represent resources and thus, values, on its own (Allee, 2000). Third, the realized subjective exchange value is considered as valuable due to scientists' needs. Figure 6 illustrates that relationship. While the objective exchange value (monetary rewards) serves primarily to satisfy scientists' need to academic survival it also satisfies ego-identity needs. Receiving a meaningful grant can, for example, provide the scientists with the desired funding to increase the chance for academic survival, while at the same time it pushes scientists' self-efficacy need. Furthermore, while the realized exchange value can be clearly differentiated into monetary and non-monetary rewards, the rewards' effect on satisfying the needs is subjective (indicated by the blurred line in the needs' pyramid). Based on our data we argue that some scientists ascribe a different utility for different types on non-monetary rewards (e.g., while some scientists might ascribe a high utility to social recognition, others might not.

Figure 6: Effects of subjective and objective exchange value

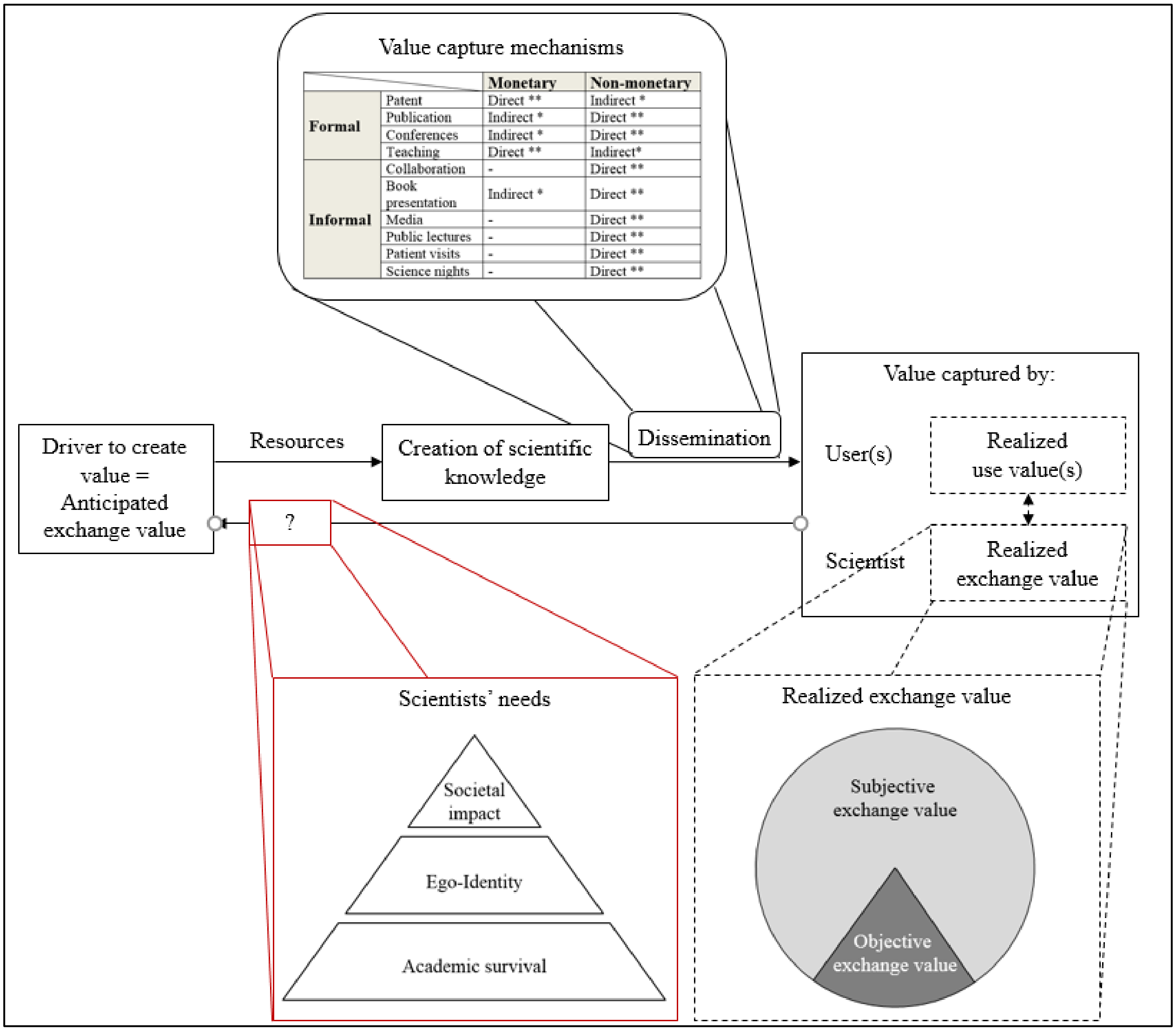


Fourth, based on the aforementioned findings we can say that not only the traditional mechanisms (e.g., patenting, licensing) can be seen as value capture mechanisms but that rather all kinds of dissemination mechanisms are able to realize exchange value – both objective and subjective exchange value to different degrees. Thus, the overall picture of value capture mechanisms and realized exchange value needs to be considered as more heterogeneous than previously assumed.

Fifth, as indicated in section 4, neither the subjective nor the objective exchange value triggered the societal impact. Societal impact was not mentioned as underlying need. We see two reasons for this result. First, it is possible that societal impact shifts more into the background compared to academic survival and ego-identity needs so that the effects of the realized exchange value are not consciously seen. Another reason might be, that the realized exchange value simply does not increase societal impact. Building upon the latter reason and theoretical rationales from value capture, societal impact might be realized through use value.

These findings lead to two theoretical contributions as well as two practical implications for scientists and policy makers. First, our findings contribute to the theoretical understanding of value capture in science while focusing on the dissemination mechanisms, the realized exchange value, as well as the circle relationship with the engagement to create value. If value capture rationales are applied in the context of scientific research, realized exchange value cannot be considered in monetary terms only. This would lead to an insufficient driver to further engage in value creation. For scientists, the largest fraction of realized value is subjective. As the realized exchange value influences the anticipated exchange value (Lepak et al., 2007), that is a major driver to engage in knowledge creation (i.e., value creation processes) it is important, whether the realized exchange value is able to satisfy the underlying needs. Our findings uncover scientists' underlying needs (e.g., academic survival, ego-identity, and societal impact) that impact the individual utility ascribed to the realized subjective exchange value. This individual utility in turn depends not only on the personal needs' structure but environmental factors such as disciplinary habits. Support for these findings can be found in the work motivation literature pointing on the importance for scientists to meet basic needs before their strong need for self-actualization can be pursued (Kamalanabhan et al., 1999; Ryan, 2014). Therefore, we also argue that scientists do not act economically irrational as they perceive enough value to further engage in scientific knowledge creation. Moreover, we propose a categorization of value capturing mechanisms in the context of science. All kind of dissemination mechanisms common on science need to be considered as value capture mechanisms. This increases the negotiation opportunities leading to a successful exchange. This exchange in turn is essential for the both – the realization of exchange value as well as use value. Please see Figure 7 as a summary of our contributions to the understanding of value capture in science.

Figure 7: Conceptual model of value capture in science



		Monetary	Non-monetary
Formal	Patent	Direct **	Indirect *
	Publication	Indirect *	Direct **
	Conferences	Indirect *	Direct **
	Teaching	Direct **	Indirect*
Informal	Collaboration	-	Direct **
	Book presentation	Indirect *	Direct **
	Media	-	Direct **
	Public lectures	-	Direct **
	Patient visits	-	Direct **
	Science nights	-	Direct **

Second, the new rationales derived from this study add to the discussion about open science. Thereby, we considering open science in terms of open knowledge creation (e.g., citizen science) and open knowledge dissemination (open access journals) (Franzoni & Sauermann, 2014). Thus, open science can be described by a degree of openness based on the possibility to participate and on the disclosure of the intermediate inputs (Franzoni & Sauermann, 2014). There is an increasing amount of evidence that the dissemination of scientific knowledge in terms of open science, i.e., sharing, reusing, recombining, and accumulating knowledge is more rewardable for individuals, institutes, a research field, and organizations compared to disclosed knowledge (e.g., Furman & Stern, 2011; Murray & O'Mahony, 2007). Discussing this reward behind the background of differentiating use value and exchange value allows for a more precise incentivization for value creation and a better understanding of what type of value can be captured at all and who captures what part of the value created. Considering scientific knowledge as commodity good allows to disconnect realized use value from the exchange value. If the knowledge is freely available each additional user of the knowledge increases the accumulated use value without increasing the exchange value. But considering the subjective dimension of the exchange value opens opportunities to safe scientists a part of the value – without decreasing the utility and value for users. Such a tool that is already applied are citations with no costs for the user, but subjective exchange value for the scientists. By making transparent the subjective value it becomes a currency that scientists can use to meet their need for academic survival. This in turn, leads to further engagement to create value that can be captured as use value for societies, companies and individual users. In line with the understanding of generative appropriability (Ahuja et al., 2013), users of the scientific knowledge can then create value on their own. In terms of open knowledge creation, the depicted findings may be able to lower barriers to openly collaborate and share data or intermediate results. If scientists can be sure to capture an appropriate piece of the value cake, their fear to not meet their needs for academic survival and ego-identity can be decreased. Understanding the subjective exchange value as commodity as well, allows to include more actors in the value creation process, as they do not need to share the realized subjective exchange value. The subjective exchange value thereby depends on their own utility function. As sharing scientific knowledge amongst other scientists makes problem solving more likely and efficient (Lakhani, Jeppesen, Lohse, & Panetta, 2007) this simultaneously reduces the necessary effort and resources (e.g., time) to create use value (e.g., knowledge). Concluding, based on our findings we argue that openly creating and disseminating knowledge does not only increase the use value of scientific knowledge but also the realized exchange value. Nevertheless, appropriate ways to make this subjective value more tangible are required.

Third, the findings of this exploratory study indicate the importance to considered individual-level factors when researching value creation and value capture processes. This adds to the understanding of Lepak et al. (2007). Individuals, in this case scientists, are the ones deciding to further engage in value creation processes or which value capture mechanism to apply. Hence, their cognitive and emotional processes play an important role for the overall scientific system. Our findings underline the importance and relevance to consider not only macro level factors but also micro level elements such as individuals.

Our findings bear interesting implications for scientists as well as for policy makers. First, for scientists the awareness of this subjective exchange value might help them to recognize the value they receive for their work. The awareness that the subjective exchange value is dependent on the individual utility function implies more control and options to receive value in exchange of the knowledge creation process. Furthermore, it allows a more precise estimation of the anticipated exchange value. In other words, being consciously aware of the subjective exchange value increases the actual exchange value scientists receive in exchange of their knowledge. This might increase their willingness to engage in value creation processes in the first place and affects the perception about competition arising from open science policies. As the size of the use value is not directly related to the scientist's exchange value captured, new negotiation potential can be exploited.

For policy-makers and university managers these findings make apparent a high responsibility. That scientists' willingness to create value is mainly driven by their need for academic survival is alarming. Although we do not want to draw any conclusions on scientists' performance, the current incentive system evokes pictures of gladiatorial combat. While many scientists drop out of the system due to a lack of objective exchange value (i.e., money, job) the subjective exchange value is not considered as valuable by outsiders neither. Whether objective or subjective exchange value is realized seems to strongly depend on the dissemination strategy. However, what type of exchange value is realized is not related to the quality of the scientist's work or the use value created. Therefore, policy makers should be aware of the relationship between value creation, value capture, and the underlying scientists' needs. Scientists that create strong use value might still drop out of academia due to a lack of sufficient objective exchange value to survive in their academic career. From the value creation and value capture perspective scientists can be rather considered as entrepreneurs than employees. Based on the argument that their salary is not directly linked to the knowledge creation and hence, value capture, this opens negotiation potential for appropriate payment that reduces the need to struggle for academic survival.

6. Limitations and Future Research

This study also holds some limitations that hopefully motivate future research efforts. First, the study at hand is an exploratory and hence, qualitative study. As next step, a large-scale validation study is required to test strategic patterns as well as contingencies influencing the scientists' strategic selections for appropriate value capture mechanisms. Identifying direct and indirect effects of different dissemination mechanisms on use and exchange value might provide deeper insights for scientists and policy-makers. The simultaneous assessment of the consequences of certain mechanisms for the use value and the exchange value can provide meaningful insights for the creation of future incentive structures to foster open science.

This study's sample covers a large variety of different nationalities, scientists at different career stages and perspectives as well as disciplines. Despite some participants from humanities and social sciences, most of participants come from fields related to biomedical scientific disciplines. This disciplinary concentration was suitable to observe heterogeneity in the applied value capture strategies. But the observed differences between scientists from this field compared to scientists from the humanities and social sciences require further studies focusing on the contingencies resulting from research field related differences. That the participants have a rich background regarding their nationalities is considered as less limiting (comparted to their disciplines) due to the high mobility among scientists and an increasing homogeneity regarding dissemination strategies across the world (e.g., publications in the same publishing houses). Also related to the participants, we focus on all kinds of scientists without a permanent position. Considering the importance for academic survival that scientists in our sample expressed, we urge future studies to consider scientists that already have a permanent position. It would be highly interesting how the scientist's needs and consequently, what they consider as valuable, change with this event. It is very likely, that there is also an effect on the selection patterns for value capture mechanisms and different valorizations for objective and subjective exchange value. This might add to shedding light on the different findings in research articles analyzing the scientist's feelings regarding the commercialization of their work. While some ascribe a high utility to commercializing activities. Others don't because their more prominent needs are not satisfied (academic survival, ego-identity status validation). Lastly, we want to point out that our paper makes no claims regarding the research performance.

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