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An Evaluation of Formative Influences and Perspectives of Early-Career Transdisciplinary Researchers

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An Evaluation of Formative Influences and Perspectives of Early-Career Transdisciplinary Researchers

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Integrated Natural Resource Management

Abstract: This study develops an evaluation of early career transdisciplinary researchers in the context of their motivations and personal views. Emerging from contemporary works is our theoretical understanding of transdisciplinarity as a conceptual research methodology that (a) aims to provide sustainably useful solutions to real-world problems; (b) recognizes the importance of a wide range of knowledge sets and thought-styles; (c) provides and encourages equal participation of academic and non-academic stakeholders at all societal levels. Combining this academic standing with the practical framework developed from the works of Barry and Born, we seek to understand questions relating to the subjective and embodied experiences of transdisciplinary academics. In addition to data supporting the three logics of accountability, innovation, and ontology in our initial framework, we have found two additional logics intertwined in engagement rationalizations. Our study has discovered the sense of self of personal identity as an influential factor that aligns early career academics with a transdisciplinary mindset. Experiences and processes beyond academic boundaries explain a sense of self. The second, new logic, took the form of a radical moral code of ethics that emerged from participants' desire to take an active role in making the world a better place. The radical nature of this logic is in its active struggle against the impositions of historically cognitive authority. Further research on early career academic researchers is needed to strengthen our findings on what drives an academic to engage in transdisciplinary behaviors and what collective thought-styles might exist among a larger sample group.

Keywords: Transdisciplinarity, early career researchers, academics, motivations, thought-styles, rationalizations, researchers' perspectives

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Abbreviations

CIRET - Centre International de Recherches et Études Transdisciplinaire

GEM - Greater ethical morality

IIR - Institute for Interdisciplinary Research

INIT - International Network for Inter and Transdisciplinarity

IRI THESys - Integrative Research Institute on Transformations of Human-Environment Systems

OECD - Organization of Economic Cooperation and Development

TD - Transdisciplinary

Td-net - Swiss-based Network for Transdisciplinary Research

TDR - Transdisciplinary Research

1. Introduction

1.1 Background

Approaches to the interwoven complexity of global problems such as climate change require tangible solution-producing methods that can be adopted by a wide variety of participants. This need for adaptive methodologies has led to a renegotiation of interactions between society and science. Pressures from stakeholders outside academia for more successful research methods reflect a more extraordinary societal cognizance of complex problems (Nowotny et al., 2001). As science and knowledge become more interactive due to technological advancements, so does participation. Social movements and other non-academic stakeholders working alongside scientists can profoundly affect how and why research is conducted. Knowledge shaping participation comes from not only societal actors but academic researchers and institutions. Academics are moving away from traditional research methods that quarantine disciplines, preferring approaches that set out to erase boundaries of thought-styles, and bridge gaps between disciplines and knowledge sets. This preference change comes from realizations that being considered an expert in one particular field still means an amateur status in another area and understanding the world system as a whole (Huutoniemi and Tapio, 2014). Including this precursory preference, the complexities of how and why academics conduct research are not limited to their approaches to methodological processes or theoretical knowledge. Motivations of engagement can have vastly different connotations depending on the discipline and the individual. The importance of a standard definition of critical elements in research among researchers is not a new concept. We seek to understand this within research in connection with behaviors, attitudes, and perspectives.

For this study, the context of influential understanding factors affecting behavior is found through a research concept that reflects complex situations and stakeholder engagement. Transdisciplinary research (TDR) is a flexible, inclusive approach that seeks to create solutions for complex societal and scientific problems through the use of a wide array of knowledge sets and collaboration of stakeholders (Jahn et al., 2012; Lang et al., 2012; Pohl, 2011). In literature, it has been heralded by institutions and societal actors alike as a potential savior for addressing the interwoven complexities of

global problems that transcend traditional disciplines. According to Klein (1990), the use of the transdisciplinary (TD) concept *"... is or should be motivated by the desire to implement solutions to complex real-life problems"*. Theoretically, the concept of transdisciplinarity is much more readily available in literature than it's practical, applicable frameworks. Forging the research pathway requires a synthesis of understanding and intention, which is all the more difficult with a concept like TDR. Not only are the problems being solved multi-faceted, but the approaches, participants, and institutions are also based on varied foundations of knowledge sets.

To add to TDR's theoretical study, we must present an analysis of the concept in action. TDR has been studied to create potential templates for future research, but research on the actors involved in its conceptualization, organization, and achievement is not complete. Taking a look at the theoretical understanding of those conducting this work can highlight what elements of the conceptual theory remain on paper and which features are steadfast in practice. Further questioning why research actors engage in this research leads us to understand the possible implications of TDR. Understanding how and why transdisciplinary researchers are motivated, we gain a better understanding of an integral piece of this complex research concept. Better understanding leads to better practice, which we seek to ensure, primarily when the research concept we are studying is used to tackle pressing problems like global climate change.

1.2 Problem statement

Conceptually TDR seeks to bridge the divide between science and society, particularly by involving actors and stakeholders from outside academia to stitch together problems, data, and solutions. The approach has been proved useful in prioritizing socially relevant issues and participation within environmental science-based projects (Hadorn et al., 2008). A large tenant of TDR is collaboration. There lies the difficulty in this when working with stakeholders across disciplines and societal circles who have their own individual knowledge sets, experiences, education, and assumptions about the research. Bringing more awareness from different stakeholders to a situation brings more perceptions and varied views and attempts to address complex interactions within the research process. In addition to increased stakeholder involvement, increased time requirements are needed to ensure equality and transparency among all those involved (Lyall, 2019). Collaboration and coordination efforts are not limited to facilitating

processes between academics and non-academics. Often, academic and funding institutions' operational values also create systematic barriers to TDR (Bromham et al., 2016; Cundill et al., 2018). Response to these two challenges alone can fall on the researchers' shoulders, acting as agents of communication and mediation. With these and other challenges in mind, why would academics engage in research-proven to be more time consuming, increase responsibilities, and demand specialized efforts?

The concept of transdisciplinarity differentiates from traditional research concepts, but are those academics actively engaging in this work also differentiated in their ideologies? As Lyall's (2019) study of Ph.D. candidates showed, there are several motivational reasons a project could be transdisciplinary that span beyond the researcher's academic interest. There are possibilities that tendencies toward transdisciplinary methodologies reflect a more personal stance rather than an academic preference. An improved understanding of the potential connections between perspectives could influence predictions of outcomes of transdisciplinary projects. An individual's perspectives are essential indicators of actions. Why would they be compelled to utilize transdisciplinary methods over others? Do they share common beliefs on what this methodology even means, and how do they see it as a structural part of their future?

The theoretical understanding of how TD researchers develop and what influences their identity is not complete. An analysis of this formation would lead to understanding which tendencies are more conducive to transdisciplinary research, offering insights into future education and framing research endeavors. Our research project intends to contribute to the existing literature on transdisciplinary researcher's attributes and tendencies. Having a more in-depth understanding of the academic researcher's perspectives and influences also help structure the current plurality of transdisciplinary definitions (Pohl, 2010). This can amount to more successful research projects that translate as an increase in tangible outcomes to help solve the world's complex problems.

1.3 Aim of research

The purpose of this study is to explore the relationship between researchers' rationales and early career experience through the context of transdisciplinarity. This study aims to

investigate the experiences through the use of qualitative methods to allow for more open development of themes. This qualitative study intends to collect, analyze, and discuss data on the formative influences and perspectives of transdisciplinary academics in the early stages of their careers. For the purposes of this thesis, the complexities of the TDR ideology will be viewed as a conceptual research approach. We also evaluate both its practical process and its theoretical standing as relevant points to understanding individuals' views. The aims of this study are to answer the following research questions:

- How do early career academics define transdisciplinary research?
- What influences their perspectives on transdisciplinary research?
- Why do they engage in transdisciplinary research?
- Is there a collective thought-style among transdisciplinary researchers?

Data has been collected in a three-fold approach, starting with a complete literature review of current research on the theory of transdisciplinarity, the role of the researcher, motivations, and perceptions. Secondly, an online survey collected a generalized viewpoint from a larger group of early career academics. Lastly, detailed data was collected that built upon responses from this survey from in-depth, semi-structured interviews with participants of a transdisciplinary research Summer course with the Integrative Research Institute on Transformations of Human-Environment Systems (IRI THESys) at Humboldt Universität zu Berlin.

The importance of this work is that those doing transdisciplinary work in the field, writing the proposals, and attending conferences are the researchers themselves. The dynamics of power and choice within this role exist and are an integral function in the implementation of TDR. It is important to look at who is making a choice to engage and why they are making these choices to understand how to increase successful research. How this role views a research method has the ability to shape and dictate the importance of the future of this type of work. These objectives act as a broad framing of our results that provide an open and flexible platform to begin discussing emergent themes and queries.

1.4 Format of thesis

This first chapter aimed to provide a background foundation, and the specific objectives for the problems sought to be explored through this study. The questions initiating our study were presented to introduce ideas that will be further explored in the coming chapters.

Chapter two reviews the literature corresponding to this research topic. This chapter will discuss the current use of transdisciplinarity as well as its historical development. It will analyze the role in which formative influences and perspectives play in a researcher's engagement with transdisciplinarity while clarifying key terminologies used. Lastly, it will introduce the theoretical framework developed by Barry and Born (2013), examining cases of transdisciplinarity, the roles of the researcher, and how they can be described by three logics. In addition, it will examine the potential impact that could stem from this research.

Chapter three will outline the methodological approach undertaken for this research study. It will define the aim and formation of the research, specifics of the case sample, the date collections used, and which approaches were used to analyze the data. It will end with a discussion of the ethical considerations of the study and any limitations found within these methods.

Findings garnered from the data collection, and subsequent analysis will be presented in chapter four. The results will be presented in narrative form based upon the outlined conceptual framework. The three logics of Barry and Born and any emergent themes will be supported through direct quotes from the interview data.

Chapter five will discuss interpretations of the logics and emergent themes. Attention will be paid to newly discovered logics and further questions raised from the data. The implications of these findings and recommendations for further research will also be discussed.

Chapter six will provide a brief summation of the study and its key findings. A brief overview of potentials for future research will be given.

2. Literature review

2.1 Transdisciplinary research

Miller (1982) writes on science being fueled by *"Change [that] is continuous, teleological, and ineluctable."*. We can see this change he speaks of in the processes of knowledge creation, specifically those processes having evolved in tandem with the concept of transdisciplinarity. Beginning with definitions of transdisciplinarity as a concept, instead of a particular research process, opens up its application and allows for the increased flexibility of practical strategies, personal rationales, and theoretical development. The benefits of transdisciplinarity as a fluid concept is stated by Klein (1990) as being *"a holistic vision; a particular method, concept or theory; a general attitude of openness and a capacity for collaboration; as well as an essential strategy for solving complex problems."*. Pohl (2010) has defined TDR by characteristics of intent, labeled as features, in combination with practical methodologies (Table 1). This overlap of theory and practical processes among definitions of transdisciplinarity overshadows the differences in schools of thought formatted from specific disciplinary limitations. To further transcend these differences, suggestions have been raised in the research community to regard transdisciplinarity as an approach to the research process rather than a specific set of methodology or outcomes (Klein, 2008).

Table 1: Characteristics of transdisciplinarity within three concepts

Transdisciplinarity according to concept **Features of transdisciplinarity**	A	B	C
Relating to socially relevant issues	▨	▨	▨
Transcending and integrating disciplinary paradigms	▨	▨	▨
Participatory research		▨	
Searching for a unity of knowledge			▨

Source: Pohl (2011)

Four commonalities are highlighted above in Table 1 to demonstrate the overlapping definitions taken by three differing conceptual framings of transdisciplinarity. Pohl (2011) created this table through a comparative review across academic literature defining transdisciplinarity. We focus on the four main features by viewing them from a theoretical standpoint and further taking these characteristic features as the foundation of our transdisciplinarity definition. Building upon the theoretical characteristics such as holistic natures and general openness is the more practical components of the transdisciplinary concept (Klein, 2008). These aspects are further defined for our study as research practices that approach the complexity of issues; integrate knowledge from various scientific and societal bodies of knowledge; coordinate knowledge production between multiple stakeholders; and aim to create knowledge that is solution-oriented and socially robust (Frodeman, 2014; Gibbons, 2000; Lang et al., 2012; Nicolescu, 2002; Pohl, 2011).

At its core, transdisciplinarity fosters innovative approaches to knowledge creation, and one could argue knowledge itself is the foundation of civilization and communication across all societal levels (Brier, 2009). Therefore, transdisciplinarity can be viewed as a tool to unite not only disciplines but societies. With this in mind, transdisciplinarity is considered to have the possibility of bringing the academic world and the needs of different social bodies together to address real-world issues and problems (Hadorn et al., 2008). Through this framing, it is easier to see how the concept of transdisciplinarity is understood as a method of developing questions that can be answered by new, innovative forms of thought and research practices (Barry and Born, 2013).

These integrative approaches conduct scientific research from a more democratic standpoint. They reflect an emphasis on knowledge production beyond disciplinary needs, but rather as a representation of the needs of a broader community (Frodeman, 2014). In this regard, it is vital to consider the different possible societal functions that transdisciplinarity can facilitate, including capacity building, legitimization, and agency (Lux et al., 2019). While working on problems beyond the academic community, the transdisciplinary concept's increasing presence does not mean a complete transformation or integration of science and society. As defining transdisciplinarity elements evolve and adapt, so does the evolution of how culture and science are entwined (Jahn et al., 2012; Nowotny et al., 2001).

Transdisciplinarity takes on a progressive role in knowledge production that encourages innovative action and fosters equity and responsible science. This allows for an increase of viewpoints and knowledge sets to be heard and utilized, so a more complete, ontological picture of the world is presented. While TDR's presence has become more commonplace among guidelines for institutions and framing of global issues, it is not yet fully recognized with esteem in academia. As the study of Lyall (2019) shows, there is still uncertainty about the self-identification of early career researchers as transdisciplinary, proving this concept is still considered risky in a sense. Questions arising from this progression of identity fuels our research questions and will be explored in our study.

2.1.1 A history of transdisciplinary research

In the reviewed literature, there is a wide range of definitions, conceptual framings, and practical examples of transdisciplinarity. There is also extensive work focused on covering the differences between the processes and methodologies (Frodeman et al., 2017; du Plessis et al., 2014). Yet, among this work, there is not a concrete world wide accepted definition. In fact, when discussing this term, attention must be paid to the interchangeability of nomenclature in regards to the use of the prefixes trans-, inter-, cross-, and multi-disciplinary within and outside of academia. While all these terms share some level of involvement with, between, or outside of disciplines, transdisciplinarity transcends disciplinary norms. Most frequently conflated is inter- and transdisciplinary, though for our purposes, the latter term holds more significance due to its tendency to be associated with more radical ideologies (Barry and Born, 2013). To better understand the terminology used for this study, it is necessary to look at selective historical foundations of transdisciplinarity. Due to its fluid nature, historical linkages to transdisciplinarity can expand into the philosophy of research, political science, cybernetics, and even the foundations of society itself (Brier, 2009; Elkana, 1979; Mittelstrass, 2011). A detailed account of its documentation throughout the past few decades would fill a book and has been done extensively, but not limited to, by the work of (Barry and Born, 2013; Frodeman et al., 2017; Hadorn et al., 2008; Klein, 1990; du Plessis et al., 2014). For the purposes of this study, an abbreviated timeline of the evolution of transdisciplinarity is presented in order to provide a foundational background for the conceptual framework found later in this chapter.

A commonly accepted historical perspective began in the early 1970s when the term transdisciplinary surfaced in published papers, discussions, and conferences. It's first typological appearance was at the 1970 Organization of Economic Cooperation and Development (OECD), an international conference on interdisciplinary research and teaching (Klein, 2014). The OECD conference defined transdisciplinarity through a sort of "*common system of axioms for a set of disciplines*" that would allow for a more fluid, barrierless, and collaborative creation of knowledge (Klein, 1990). Philosopher Apostel and others documented the conference within *Interdisciplinarity: Problems of Teaching and Research in Universities* (1972), which proposed more flexible adaptive approaches that moved beyond traditional methods of research. From participants of this conference, three main approaches were developed with, as is true to the flexibility of transdisciplinary research, varying degrees of definite conceptual boundaries around their particular notions. All regarded transdisciplinarity as a concept that had the capability to create and increase the use of interlanguages. It was a view that was treated with reverence due to the possibility of this leading to a more complete picture of the world (Hadorn et al., 2008). These interlanguages were developed based on newly formed approaches to improving communications between disciplines. Utilizing interlanguages across disciplines to discuss theories, mathematics professor Lichnerowicz (1972) outlined that the structural analysis of transdisciplinarity was mathematical in nature. Simultaneously, the developmental psychologist Piaget (1972) and the systems theorist Jantsch (1972) elaborated on transdisciplinarity as an alternative conceptual response to critiques of academic systems and the evolution of knowledge production, partially by means of transcending the boundaries of disciplines.

In addition to the well-known work produced at this conference was a piece written by a graduate student in America the same year as the OECD. Jack Mahan's Ph.D. *Toward Transdisciplinary Inquiry in the Humane Sciences* (1970) was produced independently from the OECD conference and from a social science standpoint, illuminating examples across disciplines of the presence of transdisciplinary undertones already existing within scholarly works. Mahan also found negative aspects within rigid disciplinary boundaries and advocates an element of ethical consideration in the quest for knowledge production (Mahan, 1970). Near the end of this decade philosopher Joseph Kockelmans (1979) brings his definition of transdisciplinarity that encompassed both the work of the OECD

and Mahan. His view combined avoiding problems brought on by hyper-focused disciplines and creating more social relevant knowledge production. Key ideas shared among these publications narrate definitions of transdisciplinarity with recognition of a shift in the interactions of society and science, advocating stepping away from traditional methods of scientific inquiry, and improvement of collaborative actions.

In the early eighties, transdisciplinarity was closely linked with interdisciplinary research by the work of social scientist Raymond Miller. According to Miller (1982), transdisciplinarity is a category of interdisciplinary approaches, further defining it as

> " ...articulated conceptual frameworks which claim to transcend the narrow scope of disciplinary world views and metaphorically encompass the several parts of the material field which are handled separately by the individual specialized disciplines.".

He further explains that paradigms utilizing TD approaches are free of the constraints of disciplines, labeling them as "non-discipline bound" (Miller, 1982). Marxism was used as an example of social theory with a transdisciplinary approach, further crediting the paradigm as providing platforms to view the world through new ways (Klein, 2013). Connections can be made from Miller's work to the social justice movements of the 1960s and 70s that exposed and circulated transgressive world views. Feminist, critical race, and queer theories were based on a commitment to social justice by way of exposing and eradicating inequalities while elevating subjugated perspectives (Leavy, 2011).

The methods in which these transdisciplinary approaches are feasible is through the synthesis of different disciplines handling materials with the use of the interlanguages introduced by Piaget (1972) and Jantsch (1972). A fusion of thought styles across the disciplines was evident, but in a manner that disregards disciplinary limitations (Hadorn et al., 2008). At the end of this decade, students and philosophers like Feyerabend (1987) began to assert rebellious claims against academia and the gatekeeping of knowledge. His "anything goes" methodology aims to take away the superiority of disciplinary control of knowledge production (Nowotny et al., 2001). Universities responded to the unrest of radical students, but also professors sympathizing with these

idealisms. Counterculture movements brought about a sort of utopian speculation about the future of universities and knowledge production (Leavy, 2011). This portion of transdisciplinary history is represented by the questioning of privilege and recognition of oppressive barriers to science, and the very notion of being bound to a traditional categorization of knowledge or discipline deemed antiquated. Transdisciplinary attitudes shifted towards accountability in science and increased arguments for knowledge production to take on ontological approaches.

In the late 1980s and 1990s, European use of the concept of transdisciplinarity shifted the focus onto problem oriented research, looking for an accurate portrayal of a problem instead of looking for a specific answer to a problem. This is seen in the founding of several prominent institutes that center around the use of transdisciplinarity in environmental and sustainability research. In 1987 the Institute for Interdisciplinary Research (IIR) advocated the importance of the interrelatedness of areas of knowledge while utilizing metaphysical knowledge (Klein, 1990). This sentiment is shared by the Centre International de Recherches et Études Transdisciplinaire (CIRET), founded in 1987 by theoretical physicist Basarab Nicolescu with the notion that mindset and thought processes are enhanced by the understanding of the complexities of science, utilizing spirituality and other non-traditional knowledge sets (Nicolescu, 2002). Newly founded organizations responded to the previous decade's counterculture movements' demands for the use of "non-traditional" knowledge sets as tools to produce a more socially relevant representation of the world through the use of transdisciplinary framings (Kessel and Rosenfield, 2008). In 1994 the First Congress on Transdisciplinarity was led by Nicolescu, artist Lima de Freitas, and the academic Edgar Morin. The resulting charter developed transdisciplinarity theoretically and practically while outlining new ways of thinking and inquiring (de Freitas et al., 1994). This new way of thinking was partially formed to ease working across disciplines, and the uses of their particular knowledge sets but also the inclusion of more spiritual subjects and philosophies in the scientific process. Nicolescu (2002) asserts this by saying, "*transdisciplinarity identifies with a new knowledge about what is between, across, and beyond disciplines.*"

Another defining project, *The New Production of Knowledge* (1994), gave a new approach to knowledge production that advocated the use of transdisciplinarity as a tool.

The book presented "Mode 2" knowledge production, which aimed to re-engineer the formation of knowledge around themes of complexity, non-linearity, heterogeneity, and transdisciplinarity (Gibbons et al., 1994). This knowledge production concept was designed to include the involvement of various stakeholders in the research process, reconfigure research project processes, and increase the distribution of knowledge to a greater societal audience (Gibbons, 2000). Its focus was inclusive of traditional types of scientific knowledge but fostered lay, non-academic perspectives as necessary to produce the most socially robust knowledge (Gibbons et al., 1994; Nowotny et al., 2001). Parallel to Mode 2's movement away from disciplinary based knowledge production is the theory of post-normal science. Postmodernism broke away from traditional assumptions of how systems operate and instead focused on complex cause-effect relationships through divergences of factual knowledge (Funtowicz and Ravetz, 1993). At this point, concepts that have begun to shape the evolving theory of transdisciplinarity not only include non-traditional knowledge sets but regard them with equal credibility as "traditional" academic knowledge. The inclusion of stakeholders at all levels of involvement is also considered essential in order to give agency to people commonly marginalized by past methods of knowledge production. We also see a continuation of the theme of improving methodologies and research practices to accurately get a picture of a real problem. Being able to produce a complete picture of a problem is stressed as the most productive method for socially robust knowledge.

At this point in its evolution, transdisciplinarity is being used as an approach utilizing conceptual frameworks intended to answer complex-systems questions, though still being utilized mainly in practice within the social sciences. Stakeholder participation initiatives prioritizing collaborative problem-oriented research for the common good as something that can be used by a larger audience became increasingly prominent in various global institutes (Lux et al., 2019). A drive for "real-world" solutions associated with sustainability studies led to a focus on researching the transdisciplinary process in the 2000s. Aligned with this problem-solving mentality was the Swiss-based Network for Transdisciplinary Research, known as td-net, originating from new approaches outlined in the Congress on transdisciplinarity in 2000 (Klein, 2014). To solve these real-world problems, new disciplines formed out of necessity that were imbued with a transdisciplinary methodology. Frameworks began to sprout up that answered the questions of how exactly to do transdisciplinary research. In 2008 td-net published *The*

Handbook of Transdisciplinary Research with the intent "*to enable learning from exemplary experiences in research and to provide a more systematic account of some cross-cutting issues*" (Hadorn et al., 2008). The 2011 founding of the International Network for Inter and Transdisciplinarity (INIT) provided a think tank where studies of the science of transdisciplinarity are approached without disciplinary constraints in order to explore questioning of how transdisciplinary research is conceptualized, organized, and achieved (Frodeman, 2014).

Within this abbreviated documentation, one can see that the concept of transdisciplinarity has expanded and evolved in its relatively short history. Its existence is documented through annual prizes, global institutes, increasing publications, inclusion into European wide strategic planning, and disciplinary-specific comprehensive frameworks. Though, with all the advancements of theory and practice, there is still more work to be done to identify, sustain, and strengthen practical framework processes in the transdisciplinary community. Recognizing differing thought-styles can affect how a research project is framed and contributes to improved clarity among actors and practices. This not only leads to transparency but also to more fluidity from a project's inception to its outcomes.

2.1.2 The role of the researcher

According to the Charter of Transdisciplinarity, " *Rigor, openness, and tolerance are the fundamental characteristics of the transdisciplinary attitude and vision.* "(de Freitas et al., 1994). This study takes into account the applicability of these and more broad characteristics towards the exploration of early career academics' perspectives and motivations. As seen in the work of Guimarães et al. (2019) and Lyall (2019) characteristic and motivations of researchers working within transdisciplinary projects plays a role in shaping projects, showing that more is required of researchers than just a knowledge of methodologies and practices.

As with all academic work and societal relations as well, how we act can be argued to come from sets of values. Every researcher has epistemological and ontological preferences that are reflected in their ethical and moral values, which then provide a contextual background for their interactions with the world. Victor Vroom's Expectancy Theory says that the tendency to act in a certain way depends on the strength of an

expectation that the act will be followed by a given outcome and on the attractiveness of that outcome to the individual (Parijat and Bagga, 2014). Tendencies are linked to either intrinsic motivation, where something is done because it is personally rewarding and pleasing, or extrinsic motivation, where an action is done because there is an external outcome, such as collecting research in order to publish an article (Ryan and Deci, 2000). Studies on transdisciplinary research ethics have shown both intrinsic and extrinsic motivational factors where the researcher can act simultaneously for both their own personal interest and benefits beyond their own gain (Guimarães et al., 2019; Robinson, 2008; Thompson et al., 2017). These somewhat contradicting motivations of a transdisciplinary researcher can be seen within characteristics such as openness to new perspectives, participating in self-reflecting incompetencies of one's own point of view, fostering feelings of inclusion, involvement in societal change, and recognition of equality or importance of the position and motives of others (Frodeman, 2014; Thompson et al., 2017).

What influences these motivations is not limited to only academic training and education. Underlying and explicit assumptions of knowledge sets, personal experiences, and disciplines themselves shape the perspectives and attitudes of researchers (Nicolescu, 2002; Pohl, 2011). Much like motivations, perspectives can have an impact on decisions, processes, engagement, and outcomes of transdisciplinary projects (Pohl et al., 2010; Rosendahl et al., 2015). According to feminist standpoint theory, the perception of the researcher dictates the context of knowledge and research (Harding, 1993). If we imagine transdisciplinary research as a coal-powered train, motivation is the engine which moves the train, and perception, mindset, and attitudes act here as the coal, broken down as the complex, component mechanics that enable the engine to operate. The power of a researcher's perspectives (Table 2) can profoundly affect projects' natures. Perceptions are classified as key attributes of transdisciplinary researchers (Mitchell et al., 2015). The aspects show how perception can influence work during the planning, implementation, and summation phases of a research project. This project will further explore these ideas, focusing on the questions of how these characteristics are formed and if there are linkages to more characteristics that affect early career researchers.

Table 2: Attributes of transdisciplinary researchers

Aspect	Significance
Intention	What is the intent of the research project? (i.e. purposive, normative, descriptive?). e.g. the research might be outcomes-focused with a (moral) commitment to improving the situation, or the intention may be to better understand the situation.
Worldview	What is the worldview or orientation of the research team? This can influence the theoretical lens, in addition to where boundaries are drawn around the project and the problem situation, and, which stakeholders participate and who are excluded.
Experience and qualifications	What are the existing qualifications, formal training, skills? Life experiences? Sense of role and responsibility in the project? This will also likely influence the theoretical framework and methods selected by the team, in addition to the quality of research.
Past engagement with the situation	What past experience, engagement or relationships in the situation under investigation does the research team have? This could positively or negatively influence trust in the researchers by other stakeholders, such as perceived reputation (e.g. 'street cred' or perceived as 'invested' in a particular situation as changing or staying status-quo).
Funding arrangements	Who is funding the research? This has implications both in terms of the outcomes of the research (e.g. whether it is likely to be implemented by the funding body – e.g. a government department or water utility); and, in terms of trust (e.g. if funded by a particular industry/governmental group the research may be perceived by others as biased if care is not taken to ensure independence)
Degree of engagement across disciplines	What is the degree of engagement across theoretical and epistemological perspectives? e.g. across social sciences, engineering, political economics, ecology, systems thinking? Or within the same theoretical/epistemological framework? (e.g. biology, geology, engineering, etc). This has implications in terms of the degree of transdisciplinarity, and hence opportunities for emergence and insight through engagement across disparate philosophical perspectives.
Degree of engagement with the situation	What is the degree of engagement across sectors and stakeholder groups? e.g. across governmental, industry, NGO, community and other organisations? Or is it limited to one stakeholder group (such as industry)? This has implications in terms of breadth of perspectives included in the analysis, and hence the outcomes. It may also influence the saliency, credibility and legitimacy of the research if it has engaged widely among stakeholders.

Source: Mitchel et al. (2015)

Researchers are knowledge producers that can feel the moral and ethical obligation to use any processes available to solve complex societal problems, such as outside education (Leavy, 2011). While these "extra" educational processes can be personally and professionally enriching, it has been addressed that lessons gained from career experience are rarely passed on to others for capacity building (Pohl, 2011). During transdisciplinary research, cooperation and co-production of knowledge among participants with varying backgrounds are often limited to a project-by-project basis. This makes the continuation of communication or collaboration restricted and not long-lasting past the project (Hadorn et al., 2008). This personal education sought by our early career participants could develop into the act of passing information from experiences onto other researchers or "paying it forward". This positions researchers as learners in the research process and not all-knowing experts who can design "perfect" research studies without problem-based context-specific data, as is commonly the case in traditional disciplinary driven research. One could argue that this particular educational process, while relatively fresh in the minds of the participants, is free from the limitations of being considered project or career-focused.

2.1.3 Thought-Styles

Building upon motivations and attributes is the way in which researchers think and process information. Methods of processing information depend on which conception of knowledge one possesses. This can be known as thought-styles or thought-collectives, according to Elkana (1979). Disciplinarity focused thought-styles have a tunnel formation in terms of knowledge accumulation, where the endpoint arrives at a smaller specific niche. This is quite the opposite for conceptual transdisciplinarity, where gaining a wide variety of experiences and knowledge sets is seen as integral for a successful transdisciplinary researcher (Frodeman, 2014). According to Pohl (2011), the collaboration of thought-styles fuel *"...[the] transdisciplinary research process as a collective production of knowledge"*. Transdisciplinarity research translates as less of a cohesive deep dive into the specific and more of a field of differences. Not being limited by one specific discipline is regarded as having a wider potential breadth of understanding (Frodeman, 2014).

The idea that researchers should become more transdisciplinary has become commonplace, as seen in the multiplicity of proposals stemming from INIT and CIRET. According to influential commentators, the unprecedented complexity of problems such as climate change or the social implications of biomedicine demand efforts that integrate social, natural sciences, and society (Barry and Born, 2013). Pohl (2010) recommends the benefits of this integration as a way to ensure the fusion of perspectives and research experience-based knowledge of academic researchers alongside non-academic stakeholders. The argument is that with an increase in accepting complexities of a problem, a deeper understanding of issues will result. Academia has responded through the reorganization of theoretical knowledge production, integration of new disciplines, and encouraging exploration of thought processes. While we do not seek to make direct relations to these changes in academia, our intent here is to recognize how current participation within higher education influences our participants' perceptions.

This increased call for transdisciplinary representation can be seen as a call for an increase in the integration of thought-styles of the researcher and of involved stakeholders. The need for this particular thought-style is not without contradictory issues. Literature shows transdisciplinary work can give substantial personal rewards of inclusion, self-reliance, and involvement in change, yet challenges of meeting this

increased demand for integrated transdisciplinary thought-styles are seen within the disjointed academic pathways laid for academics (Augsburg, 2014). While the thought-style of the transdisciplinary researcher is in demand, the career-oriented pathway of the transdisciplinary researcher is not as clearly defined or supported by institutions (Jaeger-Erben et al., 2018).

2.2 Conceptual framework

By the definitions presented, it comes as no surprise that the frameworks in which to evaluate transdisciplinary projects are also varied, disciplinarily bound, and plentiful. Working from the developed theoretical framing of our study established in the above section, we must further outline and discuss key concepts employed. In order to create clear and concise answers to the study's research questions, we will formulate a conceptual framework that reflects the reviewed literature and recent relevant studies. This will connect the core concepts the study bases its grounding theory upon and the framing of the data. To efficiently direct our results, it is necessary to rationalize and outline a conceptual framework that will serve as a guide to answer our research questions.

To provide the foundation of understanding rationalizations for participation and intent for the future of this research, Barry and Born (2013) have evaluated and categorized accounts into three logics of interdisciplinarity. Their logics are referred to as accountability, innovation, and ontology. The use of the interdisciplinary is not limited to a fixed definition of the term, but rather as a jumping point from a certain mindset or loosely collected idealism. In their definitions of interdisciplinary research, the authors make allowances for an application of these logics and topics discussed in their work to be applied to transdisciplinary research. They frame the term interdisciplinary in a generic fashion while recognizing that differences do exist between these two terms. Within their reasoning disciplines themselves do not inherently mean an agreed-upon theory, methods, or even a shared language. This is why understanding perceptions is essential for categorizing motivation and intent (Barry and Born, 2013). The three logics are not presented as an analytical framework that is applicable to the historical account of transdisciplinarity, nor are they exhaustive. Instead, Barry and Born insist that they represent the starting point for a multiplicity of rationals. The following three rationals

are a result of their analysis of cases spanning disciplines, media, governance, and immaterial forms of data.

To emphasize the rationals that influence transdisciplinarity, we must present them separately, but their use and application can, and often do, overlap. While they do not build upon each other in a linear fashion, one logic can be explained through the exploration of another logic's conceptual rationalization. The logic of accountability is supported by material and immaterial forms, for example, public discussions or policies, and is closely tied with the logic of innovation. Accountability here is a representation of rationals that make science more accessible, specifically through methodological practices of research and responsibility for outcomes of projects being used outside of academia. There is an element of science operating outside the traditional role of cognitive authority. This comes from the breaking of the barriers between not only disciplines but also science and society. The equalization of knowledge production and equity within this rationale can also be seen in the ideas of postmodernism and Mode 2 knowledge production (Gibbons et al., 1994). According to Huutoniemi and Tapio (2014), the use of the rationale of accountability represents an increased democratic and socially relevant future for equitable knowledge production. The process behind the breaking down of academic barriers is further strengthened by giving a voice to non-academic stakeholders in order to accurately address societal needs (Nowotny et al., 2001).

Following the breaking of barriers and inclusion of non-academic societal stakeholders comes the logic of innovation. This logic builds off of Fiorino's (1990) instrumental cases defending the use of participatory methods in regards to institutional decisions as a way to improve the quality of decisions. Alongside the concepts of accountability is the breaking down of disciplinary borders with the sense that they are barriers hindering the free movement of new and potentially non-traditional ideas. This access to more knowledge sources results in more robust outcomes than other conceptual methodologies. Innovation represents a more significant practical element of research processes and collaboration with stakeholders outside of academia. The logic of innovation is the practical response to the needs expressed by Klein (2013) to diminish the separation between the academic and societal knowledge sets for creative problem-solving.

The rationales behind the grounding of Fiornio's arguments are rooted in the belief that the democratic process is the more ontological approach towards solving complex problems. Barry and Born further this notion with their third logic, ontology. Ontology is the loosest of the defined motivations, as it represents a starting point for discussions and sound science paved pathways to problem-solving. What is meant here by ontology is the desire to answer larger questions. The logic of ontology is driven by the intent to form a representation of what the world really is, and that requires engaging with multiple types of knowledge sets, recognizing positions of power, and critical self-reflection. Though initially intrinsic in nature, the logic of ontology encompasses the extrinsic natures of innovation and accountability. In practical research design, this logic can overlap with the logics of accountability when looking at the aftereffects of a research project where research is completed not only just to satisfy an academic goal of a publication. Work done by Pohl (2011) and Klein (2018) advocate for a similar rationale that combines innovation and ontology, labeled as integration, as a reflection of the need to comprehensively utilize separate knowledge sets in order to accurately capture the complexities of reality.

Barry and Born recognize that this outline of the three logics behind interdisciplinary research is not entirely conclusive, that more logics exist, and that the overlapping of these logics is evident in many cases. Our goal of evaluating influences and perspectives can be used toward our purpose here pertaining to accountability, innovation, and ontology (Klein, 2008).

2.3 Research gaps

A lack of cohesion among definitions can present problems within a single discipline, and even more so for transdisciplinary projects with their complexities of borderless disciplines and varied background stakeholders. The concept of transdisciplinary research has evolved to provide practical solutions to intricate societal issues through equilateral collaboration between, but not limited to, public, civil, and academic stakeholders (Jahn et al., 2012). Research has been conducted to formulate frameworks (Holzer et al., 2018), value the practical processes (Mitchell et al., 2015), and equalize participation for transdisciplinary projects (Lux et al., 2019). Only a limited amount of work has been found that investigates the formative influences and perspectives of

academic stakeholders engaging in this type of research. Among these works, the intent of the research varies from investigating potential difficulties in career paths with relation to transdisciplinary intent (Guimarães et al., 2019; Lyall, 2019) to ex-ante evaluations of stakeholders and academics engaging in a particular project as the first stage of longitudinal research (Thompson et al., 2017). The potential of this project to be carried out again as a follow up with the same participants in five years' time is presented as a possibility to compare how time and experience within this field can adjust/alter perceived influences.

3. Methodology

This chapter aims to outline the rationale for and procedures of methodological approaches utilized to answer the study's research questions. The aim of the research will be presented first, followed by research methods employed, ethical considerations, and, finally, limitations to these methods. It will present a clear understanding of practical methodology in order to be followed by another study if possible.

3.1 Research approaches

The selection of research methods and approaches can serve to illuminate functions of intent within a project (Flick, 2019). In this study, a qualitative approach was applied in order to best seek answers to the above-outlined research questions. The qualitative method allows for data to influence and dictate themes, or rather, speak for itself. However, control parameters do exist in qualitative research by utilization of data that relates to a specific context in order to then be further analyzed to construct themes and theories (Creswell and Creswell, 2017). To properly explore the topics of motivation, perception, and personal experience, a wide allowance of flexibility is needed, which is the reason a qualitative approach was regarded as most relevant for this case study. A thematic analysis partially influenced by grounded theory was used as the qualitative approach for analyzing data gathered from surveys and the semi-structured interviews. Abiding by this analysis process, data was collected, coded, and categorized before being analyzed based on the emanating themes (Schmidt, 2004). The sampling of grounded theory looks at the data without strict preconceived notions to avoid adapting said data only to fit pre-existing theories. Grounded theory and thematic analysis advocates for a constant comparison of the consistency of data throughout the analysis

phase in order to cross-check the data for inaccuracies or developments of new themes (Corbin and Strauss, 2007). This analysis does not attempt to manage the chaos of the data, but, rather, it embraces the complexity to gain a more cohesive understanding (Creswell and Creswell, 2017). The conceptual framework for this analysis, as described in the above section, was developed based upon the theoretical positions of Barry and Born that explore rationales of researchers' engagement with interdisciplinary research projects. In this study, a conceptual framework is used as a primary approach to the final analysis.

3.2 Data collection

A theoretical sampling process was employed to foster deeper insights to be used towards answering the questions sought by this study (O'Leary, 2004). Theoretical sampling selects groups based upon the assumption that this particular group has information, or a particular insight, that corresponds or adds to an established theory (Flick, 2019). Therefore, the sample here was drawn from two groups of early career academics who attended two separate Summer School sessions facilitated by IRI THESys. Within both these sessions, similar material on the topic of transdisciplinarity was presented and discussed. The knowledge sets of the participants varied as they all have different disciplinary backgrounds and experiences, yet there was a personal motivation to pursue further education on the topic of transdisciplinarity. In our study, early career researchers are potentially still in a prominently learning mindset, having barely left or being in their final stages of academic certification. The focus on early career researchers stems from the proximity of the researchers and their academic careers.

A spectrum of theoretical approaches of transdisciplinary research was presented that encouraged the early career academics to delve into discussions about personal rationales and experiences. Further criteria limiting participation were presented directly to the individuals during the initial data-collection phase in regard to their personal identification. This ensured the categorization of participants at the beginning stages of their careers within this course of the research, with all being most recently either postdoc or Ph.D. students.

3.2.1 Survey

A survey was emailed to forty-two attendees of both the 2016 and the 2019 IRI THESys summer school. The survey consisted of five open-ended questions developed from the theoretical standpoint of Barry and Born (2013) and the practical standpoint of Braun and Clarke (2013). Each question was worded broadly with the intent to inspire respondents to provide answers more specific to their individual interpretations. A thematic coding of the survey responses was employed for analysis and, in part, to practice the technique. Data collected from this survey was used to further develop questions and themes for the interviews. Of the seventeen respondents, nine indicated they were interested in participating further with in-depth interviews.

3.2.2 Interviews

Working off responses from the survey, an interview guide was created to further explore the participants' perspectives. Qualitative interviews allow respondents the platform to express reasonings and insights on a particular phenomenon in unique ways (Creswell and Creswell, 2017). An in-depth interview format was utilized for the expression of more profound ideas and personal experiences by permitting the participants to delve beyond what initial ideas and themes the researchers might have had (Appendix 7.1). These interviews were conducted in a semi-structured fashion to gain access to subjective views from the participants while still attempting to manage time and quality of data. A total of ten questions were prepared for each interview, yet as the questioning was conducted in a semi-formalized, open structure, many of the discussed topics prompted further exploratory questions from the researcher and the respondents themselves. The end result of the interviews reads more like an open conversation that was lightly steered by the researcher. In accordance with the requirements of the global pandemic Covid-19, each interview was conducted over the video platforms Zoom or Skype and ranged from forty-five minutes to one hour. The interviews were recorded through the respective programs' own recording services for transcription.

3.3 Data analysis

After the interviews were completed, their corresponding video recordings were processed and transcribed using a Python code written by the researcher (Appendix 7.2). Recorded interviews were transcribed through the use of code utilizing open-source

Google Text-to-Speech services modified to fulfill the requirements of the data-specific input and output formatting. The recorded files were sent into the program formatted as mp4, then the audio was isolated and converted into FLAC files before being sent to the text-to-speech analytics. After the processing, a text file of the transcription was sent to the designated local directory. As this software is not without flaws, and the majority of the interviewees were non-native English speakers, the initially received transcripts were read through while listening to the isolated audio file and subsequently corrected. This step was done to check the authenticity of the transcription and to better understand the text.

The verification of the transcripts was an essential process to correct the data but also provided more time to read through the data, therefore, becoming more familiar with emerging themes and codes. After the data was transcribed and verified, it was coded, analyzed, discussed, and cross-referenced. With the aid of RQDA, a computer-assisted data analysis program designed by Huang (2016), an inductive coding scheme was deployed in order to analyze the open-ended questions on perspectives and formative influences that format the participants' views on transdisciplinary research. The analysis of the transcripts used recommendations of Auerbach and Silverstein (2003) outlining how the inductive approach to this data analysis starts systematically with continual rereading to become familiar with the transcripts, categorizing frequent topics, applying these topics as code, grouping codes by common themes, reviewing themes, further defining themes, and, finally, writing an analytical narrative to contextualize results with regard to a literature review. For the purposes of this study, an inductive approach was used based on the following objectives: summation of raw data from a survey and interviews into a condensed format; to relate these summarized findings to the research questions; and to create a narrative that highlights and shows connections between themes in the data in order to connect them with previous theoretical works (Braun and Clarke, 2013; Creswell and Creswell, 2017; Schmidt, 2004).

This approach is an inductive thematic analysis that has been influenced in part by the sampling of grounded theory, meaning the researcher utilized aspects such as extensive memo taking during the coding process without the intention of a fully developed theory, the primary expected outcome of grounded theory (Braun and Clarke, 2013; Corbin and Strauss, 2007). Although the stages used in the analysis of the data seem

sequential, they are iterative and built up in a theoretical, inductive bottom-up approach. Braun and Clarke (2013) describe analysis as *"... typically a recursive process, with movement back and forth between different phases."* In this study, the analytic process was fluid, and some of the stages overlapped or occurred out of a theoretical order. According to Basit (2003), the main purpose of this inductive approach is to remove limitations imposed from rigidly structured methodologies and to enable themes to emerge organically from research findings. An argument is made by Braun and Clarke (2013) and Bazeley (2013) that the use of specific questions as a foundation for topics is problematic due to their deductive nature and lack of flexibility in recognizing topics and themes that may be garnered from the data itself. The identifying of repeated categories and themes were found within the data itself, without the expectation of fulfilling predetermined theoretical expectations.

Thematic analysis began with reading the data multiple times to increase familiarity and to approach the emerging topics in a semantic way (Bazeley, 2013). Categorization and organization of topics and subtopics occurred within the coding process after the initial analysis of the transcripts. By using the RQDA software, the attention paid to remain consistent in the use and definition of topics, themes, and codes was simplified due to organizational benefits. Specific themes were formulated according to the recurring codes. Themes were defined as something that touches upon the main ideas of the research questions that could potentially represent a pattern or other meaning within the data (Braun and Clark, 2013). The analysis process included iterative and extensive memo writing. The analyzed data was then interpreted by the identification of frequency, sequence, similarities, and differences in the codes to provide sufficient analytical discourse (Auerbach and Silverstein, 2003). The last stage of the analysis was data verification, which ensured validation of identified themes, codes, and topics through a cross-checking of uncoded transcripts and memos. This gave the opportunity to the researcher to verify linkages between raw data and findings. After the themes had been identified, analyzed, and verified, they were compared against the logics of interdisciplinarity as outlined by Barry and Born (2013). To provide legitimacy to results, the researcher follows the three-step formula: "Describe, compare, and relate" provided by Bazeley (2013). With the use of this formula, themes can be made more significant when linked to another explanatory model.

3.4 Ethical considerations

The researcher addressed anonymity and privacy with all participants at different stages of the data-collection process, based on the ethical considerations outlined by Flick (2019). The following steps were conducted in order to ensure the informed consent of each of the participants. Included in the initial data-collection survey was a privacy statement that covered the intended use of data, reasons behind the research project, and anonymization of personal details. While scheduling interviews, a written request for recording was included in emails. Participants were also informed well before the interviews of the subject matter to ensure comfort with the topic and how the data collected would be processed. They also were given specific information on how identifying, and personal information would be kept separate during data analysis. At the beginning of each interview, verbal consent was requested to begin recording, after which the information given in the email was repeated. The researcher then communicated the intended length of the interview and verbalized that the participant was under no obligation to answer questions they did not feel comfortable answering. Adequate time was allowed at the end of the interview for questions relating to the topic from the interviewees. After each interview, a follow-up thank you email was sent to the participants encouraging them to contact the researcher with any concerns or questions.

3.5 Limitations

During the data-collection phase of the study, the researcher encountered limitations. The largest being the limited number of participants for the interview process. The size of the sample initially approached was under fifty, which already limited the percentage expected to reply. Even with this expected return of responses, caution must be applied when discussing findings based upon a proportionally small group of participants (Auerbach and Silverstein, 2003). To be more comprehensive in the development of theories, research processes engaging in larger sample sizes must be conducted.

Researcher bias is always present, though to a lesser extent, when data is collected through interviews (Creswell and Creswell, 2017). In order to be prepared for the interviews, the researcher in this study aimed to bring a common educational background, specifically a familiarity of materials presented during the Summer Sessions at IRI THESys. Vigilance was maintained through constant awareness of other

background biases, experiences, and mindsets of the researcher that could have skewed the collected data. It must be acknowledged that the bottom-up approach is interactive in a certain way due to the researcher's interest in answering questions that were formed from a theoretical framework.

4. Findings

This chapter will organize and elaborate on emergent themes from the survey and the interview process. These findings were analyzed through the use of a conceptual framework based on the works of Barry and Born's three logics that guide the nature of rationales of interdisciplinary research. In addition to these three logics, two potentially new, complementary logics are presented. The following section will provide a framing of these findings through the survey results, an introduction of the interview participants, categorized codes, and narratives presenting the data in the context of the conceptual framework.

4.1 Survey findings

Responses from the surveys were initially intended to attract potential interview participants and to aid in the development of further interview questions. Of the forty-five emailed, seventeen respondents completed the survey. The presence of the emergent themes (Table 3) that arose from the analysis of the open-ended questions are shown in their corresponding questions. Specific codes noted from the responses categorized under these themes will be presented alongside a narrative account that will also show the distribution of these responses among the survey respondents.

Table 3: Dispersal of themes within survey questions

Main Themes / Survey Questions	Theory	Practice	Rationale	Critique
Q1: In what ways is your research transdisciplinary?	■	■		
Q2: Which conscious efforts do you make to ensure your research is transdisciplinary?	■	■	■	■
Q3: What are your main motivations for doing transdisciplinary research?	■		■	
Q4: Which limitations do you face doing TDR in the way you want to?	■	■		■

Source: Author's own

4.1.1 Theory

The theme of theoretical transdisciplinary was found among all four survey questions. Instead of using definitions of transdisciplinarity as a theme, we have separated theory away from practice in order to highlight the differences between intent and reality. In Q1 and Q2, the publication Lang et al. (2012) was directly quoted by two respondents as a framework leading the researchers' work approaches. Responses grouped under this theme address the question of how one would do transdisciplinary research, rather than a straightforward definition of the ideal transdisciplinary process. A specific mindset of transdisciplinary approaches was mentioned, though not specifically labeled as such. Keywords found within half or more surveys of theoretical definitions were the codes multidisciplinary, flexibility, and co-production of knowledge. More than half of the responses grouped under this theme utilized passive verbs such as try and attempted when describing their work's use of theoretical approaches, which have the potential to connect with the other survey themes of practice and critique.

4.1.2 Practice

Less information was given on specific experiences of transdisciplinary processes than was given on theoretical intent. One defining element connected to practical foundations of defining transdisciplinarity was found in all the surveys. This was the collaboration with stakeholders. Differing levels of collaboration were outlined by specific research processes. The practices discussed were limited to in-field experiences of the researchers themselves, rather than relations to observed practices or educational experiences. Mentions of indigenous knowledge inclusion, participatory techniques, and the intersection of society and academia were noted as key elements linked to a transdisciplinary project's success. Two respondents focused on how their work could be defined as transdisciplinary because of the element of social interactions with non-academic stakeholders. One respondent simply stated that their work was transdisciplinary because the wording of their funding proposal reflected this term.

4.1.3 Rationale

The theme of rationales was made of a collection of codes that answered the question of why a choice was made to operate within transdisciplinarity. The rationales expressed by the participants were only found in the Q2 and Q3 of the survey. The answering of why to engage in this research was tied in with feelings of excitement in being a part of a research methodology that had potential. This potential is quoted as having an ability to satisfy the desires of the researchers. These desires range from collaboration, "fitting in" within academia, decolonization, recognition of complex systems, and sound science. Aftereffects and benefits of TDR were referred to in conjunction with practical experiences.

Sustainability of the results was used as a motivation in terms of TDR ensuring stakeholders' accessibility to knowledge created during the research process. An ethical duty is expressed by three of the participants, who identified themselves as having an obligation to promote and engage in sound science practices. Rationales here can also be seen as intent and motivation as opposed to justification. The survey responses did not read as if they needed to validate their choices.

4.1.4 Critique

The last theme was mentioned by participants in response to Q2 and Q4. Critiques of TDR were formatted as both personal, in regards to limitations of time and current research work, and institutional, meaning funding and disciplinary boundaries. The difficulties in time required to ensure proper transdisciplinary practices were cited as the research's biggest hurdle. This was linked to less understanding of the research approach by academic institutions where this extra needed time hinders the acceptance of research proposals.

4.2 Interview participants

Participant 1 is finishing a Ph.D. focused on gender dynamics in agriculture, building upon past work in social aspects of agriculture and environmental policy and management. They have engaged in fieldwork during and outside their academic career that has centered around power relations and food.

Participant 2 is working on a self-described transdisciplinary geothermal energy Ph.D. project, which developed from work with environmental conflict surrounding water management and a self-described, non-traditional economic background. Alongside their academic work, they participate in university collectives promoting non-traditional methods of research and collaboration.

Participant 3 is a university lecturer of environmental studies and human-environment relations. They hold a Ph.D. in climate change adaptation, which followed academic work in the fields of geography, resource development, and development studies.

Participant 4 is working on a Master's in GIS while already holding degrees in African studies, history, and geographical development. Their focus is on the biophysical aspects of human activities and various angles to understand these interactions.

Participant 5 is a trained architect currently working on a Ph.D. in water management with a focus on agriculture. Their work background varied and led them from architecture towards environmental management before returning to academia to pursue a Master's in environmental management.

Participant 6 comes from a diverse background of arts, social sciences, and 'hard' sciences. Their current Ph.D. work on participatory mapping projects is part of an interdisciplinary university department focused on environmental sustainability.

Participant 7 is in the beginning stages of a Ph.D. that focuses on conservation land benefits. Their background in biology and conservation provided the foundation for their work and is further expanded by studies in social fields.

4.3 Interview findings

Interview data from seven participants will be presented initially through an organization of thematic codes found during the analysis stage (Table 4). Then, a narrative led presentation of direct quotes and results will be discussed. Rationalizations will be made of the codes in relation to each theme in the context of the corresponding logics. The weight of each theme within its corresponding logic is shown in Table 4.

Table 4: Coding scheme of interview data

Logics	Themes	Codes	% of Logic
Accountability	After Effects	Knowledge Distribution, Policy Recommendations, Intentions, Funding	**56%**
	Legitimacy	Credibility, Public Acceptance	15%
	Filling the Gap	Knowledge Sets, Anti-Disciplinary	29%
Innovation	Flexibility	Benefits of TDR, TD by Another Name, Out of the Box	19%
	Teamwork	Beyond Single Discipline, Collaboration, Stakeholders	**35%**
	Practical Processes	In-Field Research, Participatory Approach, Workshops, Co-Production of Knowledge	24%
	Growth	Redesign Academic Structuring, Critique, Necessity, Adaptation	22%
Ontology	Mindset	Divergence from Tradition, TD Thought-Style, Sound Science	28%
	Benefit	Possibilities of TDR, Cultural Sensitivity	30%
	Complete Picture	Bridging Knowledge Gap, Freedom	**42%**
Sense of Self	Background	Experience, Education, Homelife, Cultural Beliefs	**47%**
	Identity	Personal Uncertainty, Career, Personal Views	34%
	Self-Reflection	Anti-Ego, Privilege	19%
Greater Ethical Morality	Equality	Stakeholders as Peers, Shared Responsibility, Agency	**39%**
	Decolonization	Anti-Oppression, Abolishment of Academic Structure, Power Dynamics, Break Barriers	35%

Definition of TD	Mindset, Better World Possibilities, Science Without Boundaries	26%

4.3.1 Accountability

The material and immaterial representations of the logic of accountability were found through the data and categorized into three themes of aftereffects, legitimacy, and filling the gap. All participants expressed a positive correlation with the awareness of the aftereffects that many TDR projects encompass. As seen in Table 4 aftereffects represents both tangible and intangible elements. Aftereffects were also expressed as ripple waves by Participant 6, end-line causal relations by Participant 7, and as responsible research by Participant 1. These were all noted as positive aspects of TDR compared to other traditional research methods. This is due in part to the shared intent of the researchers and the concept in seeking to answer complex questions for beneficial use beyond the research project itself. For all the participants, the intention of having tangible outcomes, such as community driven maps to be immediately utilized by non-academic stakeholders, was an attraction to engagement with transdisciplinary projects. Intangible outcomes were categorized as policy recommendations intended for immediate use on varying levels of governance.

Funding for future TDR projects ties into both the theme of aftereffects and the theme of legitimacy. The continuation of projects by means of institutional calls for proposals was stated as an outcome of legitimization. As the vernacular of TDR was specifically acknowledged by funding organizations, it has also been more widely used within the participants' academic circles. Another side of legitimization is public acceptance and interest in this research. Participation of non-academic stakeholders was stated as an integral aspect of successful projects, and methods to increase this were expressed as inclusion, engagement, and communication. Participants stated that another main attraction of TDR was the use of a type of shared language between all stakeholders, which only helps validate the credibility of this type of research. Participant 7 spoke of their desire to continue working with the TD approach because one of their perceived aftereffects was increased credibility through an increasing presence in academia.

The aim of legitimization found in this theme can be contrary to a traditional research methodology, specifically when our participants mentioned this. How the public viewed TDR was important to the participants as was how institutions recognized the work. Acceptance manifested through funding institutions was seen as another important aftereffect for the future of TDR. Found as a defining element of TDR explained by the researchers was the filling the gap theme. A code of anti-disciplinary was noted among this theme because of it's refusal to acknowledge constraints imposed by disciplinary thought-styles. The use of knowledge sets outside particular disciplines was highlighted by participants as key to presenting a more accurate version of a problem than disciplinary bound projects. Participant 1 expressed this use of knowledge sets in conjunction with personal rationalization of labelling themselves as a transdisciplinary researcher.

> *"(TDR) has helped me embrace the discomfort of feeling outside of a discipline by seeing sides of an issue or problem that those disciplines might not have seen." - Participant 4*

4.3.2 Innovation

Though closely tied with accountability, the logic of innovation was expressed by our participants as more process-based and from a substantive argument. Innovation logic was found within the data and shown clustered in Table 4 as themes of teamwork, flexibility, practical approaches, and growth. Teamwork took on a definition that was not limited to academic teamwork, but one where any involved party, or stakeholder, collaborated and participated within the research. In discussing how actions outside of research processes could be considered transdisciplinary, three participants described having interactions between disciplines and non-academic stakeholders. They credited a transdisciplinary thought-style for their ability to use interlanguages employed to ensure proper communication. The levels of flexibility to create communication and collaborative efforts with stakeholders was described by participants as uniquely transdisciplinary, and provided incentive to further engage with the concept.

> *"... [my] approach becomes more holistic because I have so many blind spots and it's actually exciting to me to engage across disciplines and across sort of spatial and jurisdictional levels of knowledge and decision-making*

because…you learn so much, you learned so many different things from different people and I can't I can't think of a better way to be effective in research."
-Participant 1

The flexibility of TDR projects was stated as not only a necessity but also one of its most encouraging and beneficial aspects. This openness to new ideas, knowledge sets, and ways of problem-solving was agreed upon by all participants as a defining element of the approach. Escaping the limiting, almost suffocating, restriction of academia was expressed by Participant 7 as "*...the idea of thawing the rigid structure of academia is a definite draw for me.*" Participants 2, 4, 6, and 7 each described the flexibility encouraged by TDR. They praised the encouragement within these projects to think freely while in the field and not being negatively limited throughout the research process by disciplinary boundaries.

Practice here is defined by research approaches that were considered responsible in nature. The researchers experienced this responsibility to respond to societal needs in part by legitimizing in-field practical research methods. Working alongside the legitimization theme from accountability, this innovation logic account represents more of a transparency of research practices. Expanding upon these transparent methods is the co-production of knowledge, which is also used as a main defining element of TDR. Transdisciplinary methods, such as the participatory approach and workshops, were spoken of positively due to their likelihood to have an outcome beyond a publication. Academic publications were stated as being something intangible for a large part of society and not a proper method of knowledge distribution. The responsible, transparent practices of transdisciplinary were said to amount in to the beneficial aftereffects outlined in the above section.

These four themes within the logic of innovation were dominated by the theme of growth. Transdisciplinarity was praised for its ability to use the scientific process to continually encourage the evolution of knowledge and research itself. This growth stemmed from the need to redesign processes at all levels of a project and most dynamically from the use of critiques at each step of the project. Through use of this work, the structuring of academia itself is being redesigned. This restructuring was not spoken of in a radical manner as some of our further results will show, but rather as a

necessity. For the participants, it was necessary for research itself to change as well, which was something they experienced with transdisciplinarity in order to reflect the changes in our understanding of the world. Participant 2 clarified this rationalization by describing:

> *"...our knowledge of the very nature of science and the world is constantly evolving and right now the scientific community on a whole can or refuses to barely capture that. [There's] this human factor whatever that is needs to be accounted for it and it's not only one thing you do on the table but it's the thing on the table even sometimes the elephant in the room that's being ignored forever and now it should be included ". - Participant 2*

4.3.3 Ontology

The ontology logic was found within the data through the themes of mindset, benefit, and complete picture. A morality mindset is described as a connection that the participants have shared with their peers and stakeholders. Not only was this concept of a transdisciplinary mindset expressed by all participants, it was also used with seemingly more revere than specific wording within the funding processes or in research proposals. One participant expressed the challenge of staying within the transdisciplinary boundaries during in-field research if all stakeholders did not maintain a similar mindset approach. This theme of thinking in a certain way differentiates from the previous code of intentions or teamwork by its active refusal to accept only traditional research methods and it's lack of inclusion in frameworks. Intent and practical processes are fueled by this mindset, but it also went beyond definitions of what TDR is. We defined this coding as sound science, where participants felt an intrinsic motivation to share cognitive authority with stakeholders.

> *" [scientific research] is socially constructed and it should be done democratically with people who are going to be affected by but also I feel that people on the margins of a society or in a situation it is not only valuable to bring them into the knowledge production process for democratic reasons or for justice reasons but also for ontological reasons because those people probably actually have understanding then anybody who would like a researcher and really they deserve to be heard." - Participant 6*

Justification of this morality mindset is further found in the theme benefits. The possibilities, defined and undefined, of this research concept are expressed by participants as encouragement to increase their engagement with TDR. The future potential was said to only be limited by the researcher's imagination, since flexibility and adaptation were part of their definitions of transdisciplinarity. Part of the benefit not only includes an ontological projection of the world but also an increased level of cultural sensitivity. This cultural sensitivity allows for a deeper engagement with a community that is seen as bringing a more whole presentation of a problem and of potential outcomes.

Ontology itself is a representation of what the whole is, thematically labeled here as the complete picture. This final theme in the logic of ontology is a culmination of thought-styles, active processes, and intent found in the other logics. Fitting into this theme is the code of freedom to see between the lines and create a picture that is more whole and complete, one that does not try to fit only within what the research is looking for. Seeing-between-the-lines works in conjunction with bridging the knowledge gap, which is not something simply accomplished by combining disciplines, as stated by Participant 7 *"...(TD) research achieves a more wholeness full picture of an issue that academic minds alone are unable to find."* This complete view of the world is held to be a main tenant of TD that is mentioned by all participants in this study.

4.3.4 Sense of self

A new, potential logic found in the data can be described as a sense of the self for the researcher. The participants' particular place in the world was discussed throughout all the interviews and was grouped into the themes of background, identity, and self-reflection. All the participants were asked to talk about their academic backgrounds, but their answers often included deeper cultural beliefs, images of home life, and life experiences. The richness of their experiences were painted with mentions of interactions with nature, childhood career aspirations, and locations they called home. The effect of these descriptions was not intended to regale nostalgic yearning. Their educational backgrounds were rationalized or directly connected through these non-academic aspects. The historical perspective gained by their backgrounds led to a current identity and was seen as influential towards their personal beliefs. Their

identities not only placed them within certain disciplines but also expressed personal preferences, views of issues, and explanations of their development as researchers.

The participants mentioned morals and intentions not fully realized through past research projects as lost opportunities to fully express elements of their identity. Five of the seven participants expressed a personal uncertainty of their place in not only academia, but their careers. Uncertainty was based upon not fully operating within specific disciplines in the academic world but also having one foot in academia and one foot in the "real-world." Participant 1 and 5 described this necessary fluidity as having to wear different hats that can be taken off when needed. An ease of operating while transitioning between these alternating "hats" was something the participants found to be easier within TDR projects. Their identities were communicated in a flexible way, not being limited to a particular career, academic title, or personal view.

All participants credited their ability to critically self-reflect to their desire to grow as researchers and active members of the transdisciplinary community. Much like the growth of the previous logic, evolution of the self was stated as necessity. Recognizing their and others' privilege was stated as integral to readjusting their preconceived notions of the world and their place in it. This recognition was a step towards the anti-ego aspect of the identity the participants shared, something seen as not only a part of their personal identity but also the identity of TDR itself.

> *"...if we don't get more comfortable with critiquing ourselves and more comfortable with our own privilege as you know, western foreigners going into low and middle-income countries, if we don't learn how to critique that properly then I think that's how we end up getting into more worry some situations than the problems we initially intended to you know, solve." -Participant 7*

4.3.5 Greater ethical morality

A fifth, distinct logic was uncovered within the interview data (Table 4). Building upon the ontological logic of what the world really is, is the greater ethical morality (GEM) logic of how the world should be. This greater ethical morality logic is defined by, but not limited by, the themes of definitions of TD, equality, and decolonization. Transdisciplinarity as a methodology and concept can be difficult to pin down in

concrete terms, especially when many projects that could be labeled as TD are only alluded to as such. Some of these tangible benefits of TDR were rationalized by previously described logics of ontology and innovation. Yet, the projection of possibilities of a better world represented a more ambitious intention from the participants. Linking to the actively breaking down academic barriers of accountability and innovation is the greater removal of cognitive authority in general. This removal was coded within this study as science without boundaries. Holding onto notions of the global north and global south were spoken of as deterrents to a boundaryless scientific community. During the interviews, participants viewed this as part of the broad mindset of a TD researcher. This especially so considering intentions are not always specifically documented in writing during the research process. The hidden labeling of this researcher mindset, or TD by another name, was said to be almost a necessity, especially considering the lack of a consensus on a definition of TDR. To the participants, the research was transdisciplinary in nature as long as it was carried out by those with intrinsic and extrinsic mindsets.

> *"I have never thought of doing anything transdisciplinary at all especially after struggling within finding different academic fields that fit my passions, and not being able to breach different disciplines. I just wanted to be making use of my knowledge between disciplines to address a complex problem, and I realized I could with the scope of transdisciplinary."- Participant 2*

Equality within this logic is not just the inclusion of stakeholders and participants but active participation and equal footing. The coding of stakeholders as peers differentiates from the teamwork codes framed within the logic of innovation by the removal of cognitive authority. A commitment to ensuring shared responsibility of practices was not classified as something to be limited to just the researchers and academics. Along with the stakeholders as peers was knowledge sets traditionally classified separately from academic knowledge. Indigenous knowledge wasn't viewed by the participants as something to be used due to its ability to fill in missing gaps in knowledge, but as a source of knowledge held with equal importance and credibility as academic or metaphysical knowledge. This shared responsibility of knowledge and research was said to provide agency to the non-academic stakeholders and create ownership of knowledge produced as an outcome of a project.

The moral tone of this logic further extended into conversations of decolonization. In crediting equality as an incentive to utilize transdisciplinary methodology, the participants also expressed more active stances of anti-oppression through means of recognizing power structures and abolishing academic structuring. This rationale found among the participants did not stem from motives to see how to improve the palatability of academia to the outside world, but rather to tear down the structural oppression that traditional academic endeavors have imposed upon the globe. A radical mindset that extends beyond academic involvement was seen when Participant 5 discussed anger over debates on terminology and a lack of action taken to enable agency among non-academic actors. Participants recognized the disproportionate power dynamics within not only their research teams, but communities engaging with research projects themselves as something a TD researcher needed to take into account. Understanding the privilege that comes with the position of an academic researcher in all aspects of the research process was stated as just the beginning of their moral duty to make the world a better place.

> *"...it's figuring out and understanding our various points of privilege and marginalization... it's about understanding how to effectively push against that and better represent people who are excluded from that structure and then doing so in a way that you know isn't speaking for them, but is you advocating for their voice..." -Participant 1*

5. Discussion

The purpose of this section is to discuss how our data answers the topics of perspectives of early career transdisciplinary academics and how their formative influences affected these perspectives. Some of the key findings confirmed what previous literature has provided about the attributes of researchers, motivational theory, and historical presentations of TDR. Other findings unveiled deeper personal motivations beyond common definitions of TDR and relations of the self to academic work. This chapter aims to further expand upon the above key findings section by discussing the implications that have arisen from our analysis. The initial section will expand the discussion on how the reviewed literature combined with data confirms the logics of our framework, with a particular focus on the two new logics. Then, further hypotheses formed from the data's analysis will be explored including any final limitations of the research. Lastly, proposed recommendations for future research in this area will be presented.

5.1 The three logics of Barry and Born

Though overlapping was proposed by Barry and Born in exploring their framework, no visual representation was presented by the authors. To allow for interpretation of their intent combined with our findings several figures will be presented in this chapter. When approaching the findings through the conceptual framework outlined in Chapter 2 an overlapping of accountability and innovation themes supports the foundation of the logic of ontology (Figure 1). While the three logics each have their own defining factors, it would be challenging to accurately describe their rationales without referencing their relation to each other. Accountability and innovation are closely linked and overlap, yet ontology could not fully be conceptualized without support from the two.

Figure 1: The three logics of Barry and Born
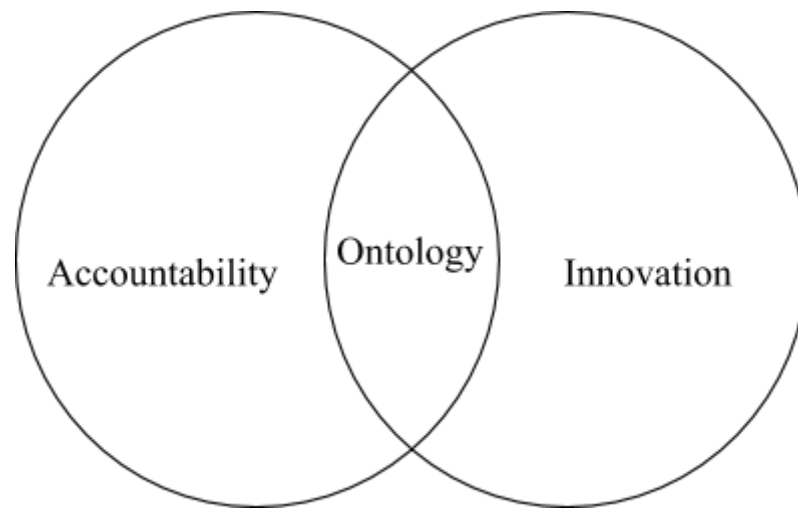
Source: Author's own

5.1.1 Accountability

Throughout the accountability results a driving factor of responsibility was woven into rationalizations of experiences the participants relayed in relation to the conceptualization of TDR. This came from a place of personal responsibility, but also responsibility felt on the different levels of the research process in general. This responsibility differed from the sense of self identification fueled cultural duty because of it's placement alongside knowledge production. The responsible, sound science element of aftereffects and legitimization are linked to the concept of accountability because of their material and immaterial forms. This sound science focused research is strengthened by specific practices preferred by the participants like co-production of knowledge and Mode-2, reflecting as well the works of Gibbons et al. (1994) and Nowotny et al. (2001). The needs of society at large are to be answered by creating knowledge on the basis of being directly utilized, with this altruistic focus shared among researchers with a personal connection to the projects they engaged in. Transdisciplinarity was seen as a way to bridge the gap between academia and society, following frameworks advocated by Lang et al. (2012). Instead of bringing science to the people it's more focused on bringing society and science together on an equal footing. We begin to see a theme of equality among all involved parties that will be further discussed under the new logic, greater ethical morality.

5.1.2 Innovation

We find the logic of innovation well supported through the results with references in codes not only linking directly to Barry and Born (2013), but to more modern academic works on transdisciplinarity. The results supporting the logic of innovation focus on varying levels of flexibility that recognize the dynamic nature of transdisciplinary problems. This dynamism is found within the descriptions of in-field work, the researchers abilities to connect with stakeholders, and funding institutions. These practical processes of research are directly mentioned as a main tenant of the innovation logic by Barry and Born (2013). Found within the results from both the survey and interviews was the participants excitement, or general interest of being part of something new, the potential for innovation was a great reasoning for participation. The combination of intrinsic and extrinsic motivations are present within this sentiment and with the flexibility of research operations. Benefits of flexibility included a personal element where thought-styles weren't confined to disciplinary boundaries, a motivation supported by the Klein's (1990) ideas of the general openness of transdisciplinarity and Frodeman's (2004) call for sustainable knowledge production to know no disciplinary limitations. In line with some theoretical constructions it seems that the participants share the idea that a future directed research method like transdisciplinarity has more potential than more traditional research methods due in part to it's flexible nature that encourages creativity (Pohl et al., 2010).

A difference between a theoretical viewing and a practical viewing of participation initially emerged within survey results, and continued within the interview data. These separate categories were applied within the context of both innovation and accountability in order to address the research question of why the participants would engage in TDR. Alongside the claims of Faguet (2015), four of the participants expressed a theoretical view of transdisciplinarity as a mindset that actively decentralized research. Specifics in how this decentralization was accomplished was limited to personal in-field experiences, while those participants lacking this particular experience did not mention this ascension of research methodology. Further strengthening a connection between this somewhat radical projection of theory and practice we have examples of tangible and intangible aftereffects. Examples of practical perceptions are shown in Table 4 under aftereffects and practical processes. These practical and theoretical methodologies create an open source of knowledge as an output

of the research that represents both perceptions. Based on observation, the prominence of either aftereffect within the individual interviews was weighed by importance based on the participants' personal experiences with transdisciplinary projects. Though the positive sides of both were plentiful, negative ideas were also expressed more so within tangible, beneficial aftereffects. The potential of improved results of future TDR projects was deemed hopeful, but somewhat of a double edged sword because of the lack of recorded results. Having the intention to produce beneficial solutions is considered less beneficial than actively ensuring the beneficial solutions come to fruition.

Risks of being involved within this type of research work were also expressed as the possibility of more time requirements, problems arising during in-field projects, or a lack of funding. These risks were seen as compelling a researcher to not maintain a transdisciplinary attitude, and therefore causing the transdisciplinary integrity of the project to fail. The main concerns and critiques of this method fell under the theme of growth. The reasoning behind this is how these criticisms of the practical sides of TDR were usually followed in conversation by how this negativity can be avoided or used to change future projects. The amount of time that is required to allow for equal participation was a concern that could also lead to a loss of depth to a particular research project. This was followed up by the exploration of engaging with future projects, and linking studies that may not have disciplinary overlap. To properly address that the researchers engaged themselves in extra work beyond paid career projects, which one could argue is a further dissolution of academic and society boundaries as expressed by Klein (2014).

5.1.3 Ontology

As seen in Figure 1 ontology is expressed as being built from the intersection of innovation and accountability. Yet, separate to these two logics, there is a unique outlook that an ontological perspective encompasses. There's an active approach driving the mindset of a transdisciplinary researcher, which builds upon the previous discussions of being a part of something by means of taking action. Ensuring the continuation of project results was stated by participants as something not included in the majority of project proposals. These researchers we interviewed wanted their work to go beyond the ivy walls of academia by helping answering larger questions that

would amount to real-life uses. This normative argument of the use of participatory techniques is outlined by the works of Fiorino (1990) as democratic. It was expressed by the participants as sound science, which has an added complexity of questioning which specific morality standards define sound science. This brings in the difficulties of personal definitions of TD that were recognized as being established elements of other research methodologies, but go by another research name. That was a common element among the interviews was localizing components of transdisciplinarity as more beneficial in an individual's approach. We see here again, this difference in theoretical and practical viewings of research. The theoretical benefits of TDR were applauded for their approach, intent, and possibilities, but if the individual researchers in a project themselves did not have a practical transdisciplinary intent throughout the project these benefits would likely remain theoretical.

The dynamic, unpredictable nature of transdisciplinary research projects benefits from a freedom of access to skills and distribution of budgets. Our participants lamented the hindrance of academic institutions' slow responses to transdisciplinary demands to enable successful fluidity among their projects. Literature suggests that transdisciplinary academics must be supported with a higher regard by institutional and funding agencies to properly actualize their research intent and the intent of transdisciplinarity itself (Nabudere, 2006). Here in ontology we see a response to the marriage of the rationalisation of legitimacy found in accountability, and the practical processes and growth discussed under the innovation umbrella. This motivation of answering larger questions of what the world is was stated as being found through acceptance of TDR as a legitimate conceptual framework. This acceptance was needed in addition to research practices being encouraged to constantly improve and create new manners of thought-styles. Our participants said the largest manner in which this can be supported is by tangible funding and institutional opportunities. Participants stated that an acknowledgement from institutions on the successes of transdisciplinarity would allow for its continuation, thus ending the problematic catch-22 paradox that currently shrouds the actualization of transdisciplinarity.

5.2 New Logics

Figure 2: The sense of self logic's relation with Barry and Born's logics

Source: Author's own

5.2.1 Sense of self

We have found a separate but overlapping category that easily fits alongside and supports the logics proposed by Barry and Born, the sense of the self. As seen in Figure 2 the sense of self is interlinked with innovation and accountability, while all three support the overarching ontological logic. Mindset and intent are similar notions that follow this new logic category and are supported under the logic of ontology. Yet, there is a distinct difference between these more generalized characteristics and this newer, individualist sense of self. Participants expressed reluctance to initially classify themselves as transdisciplinary researchers without first devling into what that concept meant to them. Through these clarifications of transdisciplinarity they began to express how their own personal identities are integrally tied to their research. It wasn't even the labelling of themselves as researchers they justified, but more of labeling themselves as transdisciplinary citizens of the world. There was a recognition that much of who they were culturally, historically, and mentally inherently shaped how they viewed the world

and as well how they approached scientific endeavors. This sense of the self expands past Miller's (1982) identification of transdisciplinarity actors as *"non-discipline bound"*. Instead of ignoring structuring themselves based on a singular discipline, these participants were able to pick and choose elements from disciplines, cultural beliefs, and experiences that suited their identification as researchers. Their acceptance and admittance that you cannot remove the effects of your past from your daily choices was self-reflective, which we can associate with the attribute briefly seen mentioned in Table 2 as experiences and qualifications.

Building off of the experiences by recognising one's own position in the world has the potential to enable empathy. Empathy to see and feel the position of others as they see and feel their position in the world. We have coded this here as anti-ego, which the six out of the seven participants expressed as one key aspect they saw in other transdisciplinary researchers. This anti-ego allowed for a recognition of privilege, which to the participants only clarified their representation of what the world really was. This recognition allowed the participants to see beyond the lens through which they had previously viewed their world. Instead of ignoring the cognitive authority that has existed within academia, they saw within themselves how they might be perpetuating this negative dominant hold on knowledge and instead, as individuals, felt it was their duty to dismantle their own egoistic motivations. The anti-ego we observed is similar to the *"critical attitude"* cited by Klein (2018) as a necessity for successful transdisciplinary projects.

Recognizing the cognitive authority that has been exercised in the history of science is an important factor when taking into account the roles of researchers. The ownership and privilege of research design has power. Who defines science also dictates the definitions of the world, which is something that is an integral part of the scientific method. Participants reflected on this methodological assumption of a metaphysical commitment which reflects beliefs about the nature of living and nonliving things in our world and about their relations to each other and to us. The researcher therefore is not a passive participant, but rather one who brings conventional understandings of disciplines, methodologies, and personal morals. In exploring the personal identities of these researchers encompassed by the sense of self we begin to see how they are influenced to make decisions. The more we understand about how transdisciplinary

researchers make decisions the better we can streamline the transdisciplinary process and further influence the democratisation of knowledge.

5.2.2 Greater ethical morality

Figure 3: Relation of GEM to the four other logics
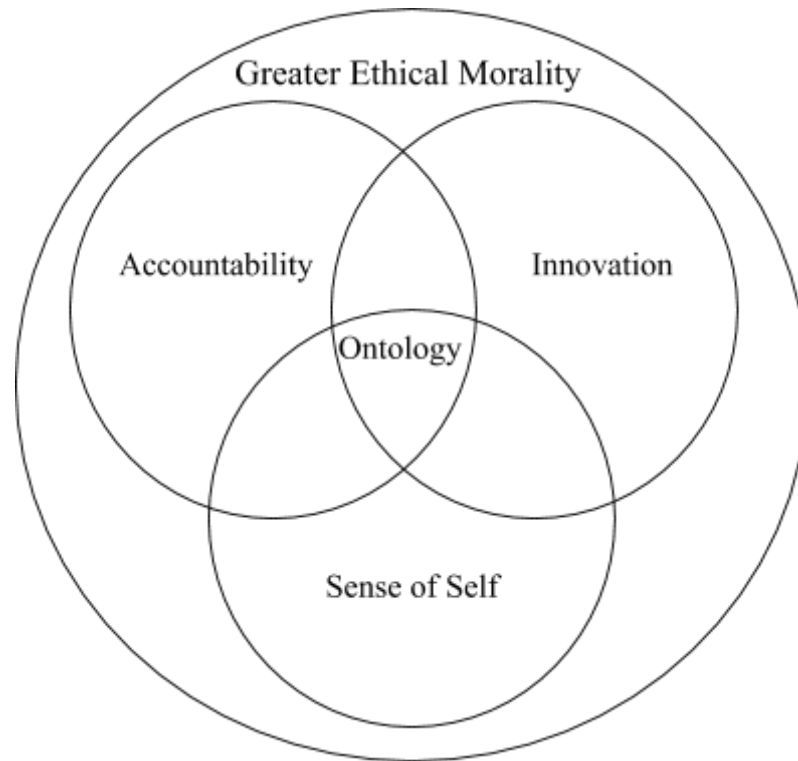
Source: Author's own

This final theme builds upon the above mentioned logics of Barry and Born, but does not quite fit within the boundaries of even their largest logic of ontology. The GEM expands upon the ontological logic in a sense that reflects the more radical works of Feyerabend (1987), Harding (1993), and Nabudere (2006). We see the GEM in Figure 3 as existing outside the four entwined logics, as an extra, encompassing layer. Amidst the powerful themes of decolonization that were expressed by the participants was a sense of utopia that seemed to be behind answers within this logic. These perspectives that cluster within this mode are ones of a liberation, anti-colonialism, and a somewhat rebellious nature.

Just as our discussions on the ontological justification of responses revolved around a more active role, the GEM logic expressed by the participants takes this one step further. When discussing information that isn't as commonly accredited to the scientific community terms like non-traditional and indigenous are often employed in reference to knowledge sets. To three of the participants of our study the use of this particular type of labelling was criticized as oppressive terminology that only further imposed superiority of global north-centric knowledge production. Participant 7 likened use of these terms to past phrases such as "third world countries", and that these knowledge sets required the same respect and equal footing as the "traditional" eurocentric knowledge sets.

A shift in uses of terminology can be constructed as a form of resilience to the former historical colonization of knowledge. Colonization in the way of an outsider coming into a situation and formulating a view on a problem, creating their version of a solution, and then carrying out experiments to collect data to prove their stance. This all being done without inclusion of indigenous methodologies or knowledge. With this type of oppressive approach the full picture of a situation cannot be recorded. A particular lense of the self is still present, possibly obscuring important elements. There was an agreement from our participants with the works of Nabudere's (2006) discussions about decolonization of knowledge. They argued his stance that the inclusion of traditional, hereditary, and indigenous knowledge sets as fundamental pillars in understanding the ontological perspective of the world (Nabudere, 2006).

This recognition of elements beyond traditional scientific knowledge sets led us to an additional form of empathy observed in the interviews. Cognitive empathy, rationally identifying with someone's experience, was present and can be linked earlier in our framework to the collaborative nature of innovation and accountability. Our new logic GEM is represented by an affective empathy where the researchers identify with the emotional essence of an experience. It is here that the nature of the ethical moral code is identified. The participants' role as researchers was self-described with a sense of ethical duty, with Participant 7 stating they felt like "*shepherds of knowledge*". We see again the active role a researcher is playing in knowledge creation, yet more along the lines of a facilitator rather than dictator. It was inferred from the participants that this ethical duty reflects the practical side of rationalization of research and is influenced by

agreed upon moral standards. Just who sets these moral standards, and how they evolve is a question for further research.

The moral element of this logic is found to be shaped by the participants' surroundings and emotional experiences. A shift away from the cognitive authority of other research methodologies and towards an affective empathic approach was noted among five of the participants. The mindset and sense of self discussed within the previous logics provides a foundation for the affective empathy of the GEM. The participants found the transdisciplinary approach conducive to their views of breaking metaphysical assumptions of the world. Metaphysical assumptions are commonly used as points of logic for Western thought-styles where the assumption is that the one reality we experience means that there can only be one truth. Further linkages to this notion of decolonization of knowledge are the works of Thomas Kuhn. Kuhn (2012) recognized the need for cognitive authority to be abolished for the growth of science into a true democratic institution. This affective empathy can also stem from knowledge of the works akin to Harding (1993) that criticize unequal distribution of social power and authority. With a touch of rebelliousness, our participants have defined transdisciplinarity as a research approach akin to scientific breakthroughs of the past. Breakthroughs that did not just simply create new theories, but changed how questions were asked, what the specific problems were, and what outcomes were acceptable.

Arising from the foundations laid by the ontological logic of Barry and Born is our study's greater ethical morality. From the participants we have collected information that shows their fusion of ethics from education and experience with their moral standards reflecting how the world should be. This sense of utopia is idealistic in ways, revolutionary in others, and by no means agreed upon by all our participants. We are not outlining that this is necessarily a drive felt among all transdisciplinary researchers. Only that from the participants who expressed this greater sense of duty, the rendering of their personal moral code was inextricable from their ethical code. They expressed how to use their positioning as researchers to make changes that are utilitarian in nature, or that do more benefit than harm. Their identification as transdisciplinary researchers was not the main focus of their work, nor was notoriety in academia, but to make knowledge more accessible in order to create a better, more democratic world.

5.3 Potential for future research

Specific limitations on this study's methodology has already been covered in Chapter 3, whereas here we employ a transdisciplinary methodology learned from our participants. Instead of only seeking to answer our own questions we allowed the data to present further lines of questioning. Several additional questions arose while reviewing our discussions of the data. While another study could be conducted to answer these specific questions we address those pertinent to our two new logics. We find answers to these in the context of our literature review alongside the researcher's personal opinions.

5.3.1 Is the sense of self correlated to the age?

Speculation can be made about connections to precarious personal identities in relation to age. Does more years experience operating within academia bring a stronger sense of identity and a sense of place? Does age have a role in perceptions? Within our study participants ranged in age from twenty seven to forty five with a mean deviation in age of six years, meaning that the variety of ages here is diverse. The number of years working in an academic setting was not explicitly asked during the interviews, but only one participant mentioned a gap larger than one year between academic programs. We can surmise that within our study the sampling is by no means representative of the entire academic community, but rather can reflect the opinions from individuals from at least two, if not three generations. Having this broad range of ages lets us explore the data with a critical eye on how different age groups respond while linking grounded theory that we have outlined in the methodology chapter.

One could argue that linkages between the tendency to engage with TDR are difficult to associate with the age of researcher due to the ever evolving nature and flexibility seen in this concept. Past projects could be transdisciplinary in part, though not labeled as such. Our participants expressed that sometimes a partial use of transdisciplinary methods was called for within project boundaries, or rather a flexibility allowance that is expected more of researchers in the current academic climate. While funding institutions may not be asking for transdisciplinarity to be explicitly mentioned in proposals, they are expecting the individual researchers themselves to harbor transdisciplinary mentalities. Just as TDR itself is inclusive of all knowledge sets, so is the sense of identity of a researcher in a position of prominence. How do we track partial use of these methods in current projects, let alone past projects?

We do know that social experience has a significant effect on one's scientific understanding of the world, therefore a sense of understanding of the self is a method to achieving more success as a researcher. This brings into question an assumption, do more years of life bring more experience? Within our sample group expressions of uncertainty of career positions within academia were present in the upper and lower ages. More experiences then do not necessarily mean more certainty of one's self identity. Our assumptions discussed in the previous sections on the sense of self then must be restated for clarification. Our logic of sense of self does not mean that the academic researcher who engages in transdisciplinarity has a clearly defined personal identity. It rather outlines that the participants in our study have shown that their past experiences, inside and outside academia, have constructed an identity that they utilize as a part of their work. We must volunteer another question to support our new logic, is this sense of self awareness present in a larger sampling of transdisciplinary researchers?

5.3.2 Does background affect the decolonization mindset?

In seeking to clarify where the aversion to authoritative structures rooting in colonialism stem from we naturally begin with a look at the backgrounds of our participants. It is possible that they each have a significant linkage to oppressive political regimes, personal loss due to colonization, or simply an interest in radical, socialist systems. These connections would need a follow up interview with the participants to clarify, but we can note that several of our participants did come from countries with historical political oppression and/or a colonial past. The other participants came from countries that could be described as colonizers with a history of subjugation and enslavement of native people. Our main evidence against the personal experiences with colonization influencing current perspectives of transdisciplinarity is that these two groupings of participants had no noticeable differences in their regards toward the theme of decolonization. We can assert that within our sample group, the historical political influence of one's country does not necessarily affect the GEM. This questioning of just how influential backgrounds and experiences affect motivations would need a deeper study with a broader sample of participants.

Another possible explanation to this proclivity is the participants own experiences in academia as early career researchers. This role is generally regarded at a lower place of prestige than that of other more experienced researchers. Their lower positions can be seen more clearly when they experience difficulties in publishing their own work that seemingly comes not from the caliber of their work, but the caliber of the experience of the researcher. This probable connection would need more data examining the specifics of likelihoods of getting published with varying factors of authors, editors, and subject of publication. Yet, we can connect this experience of academic career oppression to the potential affective empathy our participants feel towards those communities and cultures whose knowledge sets and inclusion in scientific research are regarded as lacking in credibility.

5.4 Further recommendations

The implications and recommendations that were garnered from this study are plentiful and have the potential to affect the future of transdisciplinary research and to an extent knowledge equity. As some recommendations for further questioning have been discussed in the previous section, many remain unmentioned. While implications made here are based upon a relatively small case study, their importance is not insignificant in it's contribution to literature. As found through the data, further research needs to be done in order to fulfil the needs of transdisciplinary researchers.

We recommend further research into the roles of transdisciplinary researchers who are more advanced in their careers in order to gain an understanding of how their perceptions could change with time and experience. Our last recommendation is for a future continuation of this study. Specifically, this could be accomplished with follow-up interviews with participants from this study in five years time. A comparative analysis of the results from this study and the five-year follow up study has the potential to show further development of thought-styles and perceptions. In addition to this future research providing bases for answering questions about experience it could provide answers to our other questions on background. A more catered interview guide would be able to seek deeper connections between research methodology tendencies and the social context of the researcher.

6. Summary

The increasingly interwoven complex problems of the world require more innovative and adaptive solutions. To better inform these solutions research approaches are needed to clarify and highlight specific real-world problems. As these problems are not always coordinated by a single discipline, the responding conceptual research methods must span knowledge sets and thought-styles. One way to attempt to answer these questions and their increasing complexities is to turn to a method of research that seeks to renegotiate approaches to knowledge production. The demand for better knowledge production resulting in more sustainable aftereffects is not new, nor is conceptual research intending in part to answer this demand. Transdisciplinarity as a concept seeks an ontological perspective of the world that encourages and ensures democratic knowledge production with stakeholders from all aspects of society. It is a flexible research concept that transcends disciplinary approaches and thought processes.

As this research concept is not fully clarified in definition we must look at pieces of its processes to improve its use. Concepts must be carried out by people, and in the case of transdisciplinarity it is carried out by academics and non-academics alike. This requires specific skills and intentions that are not inherently taught within academic curricula. The aim of this study is analyzing early career academics who are transdisciplinary in nature. These academic participants were questioned through semi-structured interviews to gain deeper insights into their perceptions. In order to allow for themes and topics to emerge from our study we employed qualitative methodologies.

We have examined rationalizations of participating in transdisciplinary endeavors, and the relation of the academic participants' thought-styles to each other. Alongside the conceptual framework we used to organize our data we have found two new potential logics that influence these transdisciplinary academics. From these two new logics we see that the formative influences that affect transdisciplinary academics play a large role in their identification as researchers. How they perceive themselves is reflected in the work they engage in. Though our participants differed in their educational, career, and cultural background, similarities were expressed among their definitions of transdisciplinarity. While we do not fully define the drive that would motivate early career academics we can discuss how these similarities could lead to understanding behaviors, attitudes, and perspectives. We have found that instead of adjusting to

funders requests and the constraints placed upon them from universities, institutions, and historical research practices some early career researchers are looking to "break the wheel" of research in order to reinvent it.

A somewhat radical morality was found to be shared among the majority of the participants, and requires deeper continued research to fully understand. Our participants felt their duty as researchers was to uplift marginalized voices and generally make the world a more democratic place. The common belief expressed by the participants that one of the main challenges for TDR are systemic barriers was supported through literature. Though not radical in nature, our participants shared a camaraderie in their intent towards more collaborative research efforts, even in the face of lower financial support from institutions. This study shows that there is much left to be researched in regards to answering the questions of why do these academics embrace transdisciplinarity. Though, we have found overlapping ideals, notions, and definitions of the concept that do shine an informative light on early career academics' perceptions of transdisciplinarity.

It is clear that ever growing complex problems are continuing to globally rise in frequency and severity. How we effectively address these problems depends in part to how we approach producing sustainable knowledge. The effectiveness of the transdisciplinary concept is affected by those who participate in it's theoretical and practical development. Studying the influences of why academics would engage in this research will help understand how to involve more academics in the future and continue the success stories of its use.

7. Appendix

7.1 Semi-Structured Interview Guide

-What's your academic background and current work focus?
-Tell me about your future goals within academia.
-What are your future goals outside of academia?

-What does TD mean to you?
-Why did you become interested in TD?
-How did you start TD work?
-What educational experience do you have with TD?
-How do your peers view TDR?

-Would you elaborate on how TD is a part of your work? (Practically)
-Why do you think TDR is a beneficial research method?
-What are the differences, if any, that you've seen between
 theoretical and practical implementation of TDR?

-What components of TDR have been successful from your point of view?
-What critiques do you have about TDR, from a theoretical standpoint,
 and also from a practical standpoint?

-What are your future plans in regards to TDR?

7.2 Speech-to-Text Code

This code was written using the Sublime Text editing app designed for the coding language Python. It was developed from open-source software.

```
from google.cloud import speech_v1
from google.cloud.speech_v1 import enums
import io
import argparse
from google.cloud import storage
import os
from shlex import quote
import audio_metadata

bucket_name = "spahle_thesis"

def inCloud(filename):
    """Lists all the blobs in the bucket."""
    # bucket_name = "your-bucket-name"

    storage_client = storage.Client()

    blobs = storage_client.list_blobs(bucket_name, prefix=filename)

    for blob in blobs:
        print(blob.name)
        return True
    return False

def upload(filename):
    storage_client = storage.Client()
    bucket = storage_client.bucket(bucket_name)
    blob = bucket.blob(filename)
    blob._chunk_size = 1024 * 1024

    blob.upload_from_filename(filename)

    print(
        "File {} uploaded to {}.".format(filename, filename))

def transcribe(uri, outfile, sample_rate):
    print('transcribing remote filename ', uri)
    client = speech_v1.SpeechClient()

    language_code = "us-EN"
```

```python
    encoding = enums.RecognitionConfig.AudioEncoding.FLAC
    config = {
        "language_code": language_code,
        "sample_rate_hertz": sample_rate,
        "encoding": encoding,
    }

    storage_uri = 'gs://{0}/{1}'.format(bucket_name, uri)
    audio = {"uri" : storage_uri}

    operation = client.long_running_recognize(config, audio)

    print(u"Waiting for operation to complete...")
    response = operation.result()

    outf = open(outfile, "w")
    for result in response.results:
        # First alternative is the most probable result
        print(result)
        alternative = result.alternatives[0]
        print(u"Transcript: {}".format(alternative.transcript))

        outf.write(alternative.transcript + "\n")
    outf.close()

def extractAudioFromVideo(filename):
    extension = os.path.splitext(filename)[1]
    outfile = filename.replace(extension, ".flac")
    if not os.path.exists(outfile):
        os.system("ffmpeg -i {0} -vn -sample_fmt s16 {1}".format(quote(filename),
quote(outfile)))
    else:
        print("file {0} already exists".format(quote(outfile)))

    meta = audio_metadata.load(outfile)
    sample_rate = meta.streaminfo.sample_rate

    return [(outfile, sample_rate)]

def fnameToTransFname(filename):
    extension = os.path.splitext(filename)[1]
    return filename.replace(extension, ".txt")

parser = argparse.ArgumentParser()
```

```
parser.add_argument('filename', type=str, help='the video file to transcribe')
args = parser.parse_args()
fnames = extractAudioFromVideo(args.filename)

for fn, sample_rate in fnames:
    if not inCloud(fn):
        upload(fn)
    else:
        print("Skipping upload of file {}, because it exists already.".format(quote(fn)))

for fn, sample_rate in fnames:
    transFilename = fnameToTransFname(fn)
    if not os.path.exists(transFilename):
        transcribe(fn, transFilename, sample_rate)
```

References

Apostel, L., Berger, G., Briggs, A., and Michaud, G. (eds) (1972). Interdisciplinarity: problems of teaching and research in universities. Paris: Organization for Economic Cooperation and Development.

Auerbach, C. F. & Silverstein, L. B. (2003). Qualitative Data: An Introduction to Coding and Analysis, New York, New York University Press.

Augsburg, T. (2014). Becoming Transdisciplinary: The Emergence of the Transdisciplinary Individual, World Futures, 70:3-4, 233-247.

Barry, A. & Born, G. (2013). Interdisciplinarity Reconfigurations of the Social and Natural Sciences. Abingdon, Oxon: Routledge.

Basit, T. N. (2003). Manual or electronic? The role of coding in qualitative data analysis. Educational Research, 45, 2, pp. 143-154.

Bazeley, P. (2013) Qualitative Data Analysis. Practical Strategies. Sage, London

Braun, V. & Clarke, V. (2013). Successful Qualitative Research: A Practical Guide for Beginners. London: Sage Publishers.

Brier, S. (2009). Cybersemiotics: Why information is not enough! Toronto, Canada: University of Toronto Press.

Bromham, L., Dinnage, R., & Hua, X. (2016). Interdisciplinary research has consistently lower funding success. Nature 534(7609), 684–687.

Corbin, J. & Strauss, A. (2007). Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. Sage Publications, Inc; 3rd edition.

Creswell, J. W. & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications.

Cundill, G., Harvey, B., Tebboth, M., Cochrane, L., Currie-Alder, B., Vincent, K., Lawn, J., Nicholls, R., Scodanibbio, L., Prakash, A., New, M., Wester, P., Leone, M., Morchain, D., Ludi, E., DeMaria-Kinney, J., Khan, A., Landry, M.-E. (2018). Large-Scale Transdisciplinary Collaboration for Adaptation Research: Challenges and Insights. Global Challenges.

Elkana, Y. (1979). Science as a cultural system: an anthropological approach. Scientific culture in the contemporary world, Special Volume published in Collaboration with UNESCO. Milano: SCIENTIA–International Review of Scientific Synthesis, 269-90.

Feyerabend, P. (1987). Farewell to Reason. London New York: Verso.

Flick, U. (2019) An Introduction to Qualitative Research, 6th edn. Thousand Oaks, CA: Sage.

de Freitas, L., Morin, E., & Nicolescu, B. (1994). The charter of transdisciplinarity. Retrieved from International Encyclopedia of Religion & Science, http://inters.org/Freitas-Morin-Nicolescu-Transdisciplinarity.

Frodeman, R., Klein, J. T., & Pacheco, R. C. D. S. (Eds.). (2017). The Oxford handbook of interdisciplinarity. Oxford University Press.

Frodeman, R. (2014). Sustainable Knowledge: A Theory of Interdisciplinarity. Basingstoke: Palgrave Macmillan.

Funtowicz, S. O. & Ravetz, J. R. (1993). Science for the post-normal age. Futures, 25(7), 739–755.

Gibbons, M. (2000). Mode 2 society and the emergence of context-sensitive science. Science and Public Policy, 27(3), 159–163.

Gibbons, M., Trow, M., Scott, P., Schwartzman, S., Nowotny, H., & Limoges, C. (1995). The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies.

Guimarães, M. H., Pohl, C., Bina, O., & Varanda, M. (2019). Who is doing inter- and transdisciplinary research, and why? An empirical study of motivations, attitudes, skills, and behaviours. Futures, 102441.

Hadorn, G., Hoffmann-Riem, H., Biber-Klemm, S., Grossenbacher-Mansuy, W., Joye, D., Pohl, C., Wiesmann, U., Zemp, E. (Eds.) (2008). Handbook of transdisciplinary research. Springer.

Harding, S.G. (1993). The "Racial" economy of science: toward a democratic future.Bloomington: Indiana University Press.

Holzer, J. M., Carmon, N., & Orenstein, D. E. (2018). A methodology for evaluating transdisciplinary research on coupled socio-ecological systems. Ecological Indicators, 85, 808–819.

Huang, R. (2016). RQDA: R-based Qualitative Data Analysis. R package version 0.2-8. http://rqda.r-forge.r-project.org/

Huutoniemi, K. & Tapio, P. (Eds.). (2014). Transdisciplinary Sustainability Studies. London: Routledge.

Jaeger-Erben, M., Kramm, J., Sonnberger, M., Völker, C., Albert, C., Graf, A., Hermans, K., Lange, S., Santarius, T., Schröter, B., Sievers-Glotzbach, S., & Winzer, J. (2018). Building Capacities for Transdisciplinary Research: Challenges and Recommendations for Early-Career Researchers. GAIA - Ecological Perspectives for Science and Society, 27(4), 379–386.

Jahn, T., Bergmann, M., & Keil, F. (2012). Transdisciplinarity: Between mainstreaming and marginalization. Ecological Economics, 79, 1–10.

Jantsch, E. (1972). Towards interdisciplinarity and transdisciplinarity in education and innovation. In: L. Apostel, G. Berger, A. Briggs, and G. Michaud (eds) Interdisciplinarity: problems of teaching and research in universities, pp. 97–121. Paris: Organization for Economic Cooperation and Development.

Kessel, F. & Rosenfield, P. L. (2008). Toward transdisciplinary research: Historical and contemporary perspectives. American Journal of Preventive Medicine, 35(2S), S225-S234.

Klein, J. T. (2018). Learning in Transdisciplinary Collaborations: A Conceptual Vocabulary. Transdisciplinary Theory, Practice and Education, 11–23.

Klein, J. T. (2014). Discourses of transdisciplinarity: Looking Back to the Future. Futures, 63, 68–74.

Klein, J. T. (2013). The Transdisciplinary Moment(um). Integral Review. 9. 189-199.

Klein, J. T. (2008). Evaluation of Interdisciplinary and Transdisciplinary Research. American Journal of Preventive Medicine, 35(2), S116–S123.

Klein, J. T. (1990). Interdisciplinarity: History, Theory, and Practice. Detroit: Wayne State University Press.
Kockelmans, J.J. (1979). Science and discipline: some historical and critical reflections, and Why interdisciplinarity? In: J.J. Kockelmans (ed.) Interdisciplinarity and higher education, pp. 11–48, 123–60. University Park, PA: Pennsylvania University Press.

Kuhn, T. S. (2012). The structure of scientific revolutions, 50th Anniversary Edition. University of Chicago press.

Lang, D.J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., Thomas, C.J. (2012). Transdisciplinary research in sustainability science: Practice, principles, and challenges. Sustainability Science. Sustainability Science. 7.

Leavy, P. (2011). Essentials of Transdisciplinary Research: Using Problem-Centered Methodologies. 1st ed. Walnut Creek, CA: Left Coast Press.

Lichnerowicz, A. (1972). Mathematic and transdisciplinarity. In: L. Apostel, G. Berger, A. Briggs, and G. Michaud (eds) Interdisciplinarity: problems of teaching and research in universities, pp. 121–7. Paris: Organization for Economic Cooperation and Development.

Lux, A.,Schäfer, M., Bergmann, M., Jahn, T., Marga, O., Nagy, E., Ransiek, A. C., Theiler, L. (2019). Societal effects of transdisciplinary sustainability research—How can they be strengthened during the research process?Environmental Science & Policy Volume 101, November 2019, Pages 183-191.

Lyall, C. (2019) Being an interdisciplinary academic: how institutions shape university careers. Palgrave MacMillan, Cham.

Miller, R. (1982). Varieties of interdisciplinary approaches in the social sciences. Issues in Integrative Studies, 1, 1–137.

Mitchell, C., Cordell, D., & Fam, D. (2015). Beginning at the end: The outcome spaces framework to guide purposive transdisciplinary research.Institute for Sustainable Futures, University of Technology, Sydney. Volume 65, Pages 86-96.

Nabudere, D. W. (2006) Towards an Afrokology of knowledge production and African regeneration, International Journal of African Renaissance Studies - Multi-, Inter- and Transdisciplinarity, 1:1, 7-32.

Nicolescu, B. (2002). Manifesto of transdisciplinarity. Albany, NY: State University of New York Press.

Nowotny, H., Scott, P., & Gibbons, M. (2001). Re-Thinking science:Knowledge and the Public in an Age of Uncertainty. Cambridge, UK: Polity Press.
O'Leary, Z. (2004). The Essential Guide To Doing Research, London, SAGE Publications Ltd.

Parijat, P. & Bagga, S. (2014). Victor Vroom's Expectancy Theory of Motivation – An Evaluation. International Research Journal of Business and Management, Vol. VII, Issue 9, p1-8.

Piaget, J. (1972). The epistemology of interdisciplinary relationships. In: L. Apostel, G. Berger, A. Briggs, and G. Michaud (eds) Interdisciplinarity: problems of teaching and research in universities, pp. 127–39. Paris: Organization for Economic Cooperation and Development.

du Plessis, H., Sehume, J. & Martin, L. (2014). Concept and application of transdisciplinarity in intellectual discourse and research. Real African Publishers.

Pohl, C. (2011). What is progress in transdisciplinary research? Futures, 43, 618–626.

Pohl, C. (2010). From Transdisciplinarity to Transdisciplinary Research. Transdisciplinary Journal of Engineering & Science, 1.

Pohl, C., Rist, S., Zimmerman, A., Fry, P., Gurung, G.S., Schneider, F., Speranza, C.I., Kiteme, B., Boillat, S., Serrano, E., Hirsch Hadorn, G., & Wiesman, U. (2010). Researchers' roles in knowledge co-production: experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal. Sci. Public Policy 37 (4), 267–281.

Robinson, J. (2008). Being undisciplined: Transgressions and intersections in academia and beyond. Futures 40 (1):70–86.

Rosendahl, J., Zanella, M.A., Rist, S., & Weigelt, J. (2015). Scientists' situated knowledge: strong objectivity in transdisciplinarity. Futures 65, 17–27.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. Contemporary Educational Psychology Vol. 25, p54–67.

Schmidt, C. (2004). The analysis of semi-structured interviews. In: Flick, U., von Kardorff, E. and Steinke (eds.) A companion to qualitative research. London: SAGE Publications Ltd, pp. 253-258.

Thompson, M.A., Owen, S., Lindsay J.M., Leonard G.S., & Cronin S.J. (2017). Scientist and stakeholder perspectives of transdisciplinary research: Early attitudes, expectations, and tensions. Environmental Science and Policy, 74 , pp. 30-39.

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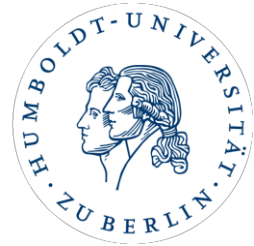
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