



# Changes in perceptions of transdisciplinary science over time



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## ABSTRACT

Transdisciplinary research teams offer an appropriate alternative to traditional research methods to address today's complex research problems. However, a lack of common technical language and differing attitudes on collaborative research can create challenges. This paper reports results of an evaluative survey on changes of collaborative capacity within a large transdisciplinary project. Our survey data, collected through pre-assessment (2011) and mid-assessment (2013) evaluation surveys of project participants, measured participants' attitudes, behaviors, and beliefs regarding transdisciplinary research. Paired samples *t*-tests were employed to compare measures from the same individuals at two points in time. The key variables were transdisciplinary attitudes, transdisciplinary behaviors, satisfaction with collaboration, perceived impacts of collaboration, and trust and respect. Changes over time were evaluated for the overall project team and by project role subgrouping that included principal investigators, professional and technical staff, graduate students, advisory board members, and extension educators. The analysis examined the following research questions: (1) Do participants' attitudes and behaviors toward the transdisciplinary process change over the course of the project? (2) Do these changes vary by participant role? Results indicate that while transdisciplinary behaviors did not significantly change for most of the role subgroups, advisory board members showed a decrease in transdisciplinary behaviors from the pre-assessment to the mid-assessment evaluation. Analysis of the other measures consistently showed a positive increase in mean scores from the pre- to the mid-assessment with one exception. Graduate student scores on the transdisciplinary attitude scale decreased over time. Understanding how participant perceptions may change over the course of a project and how project roles may influence these changes is important to managing effective long-term transdisciplinary projects.

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## 1. Introduction

### 1.1. Overview of transdisciplinary science

The traditional role of scientific research has resulted in big names and breakthroughs (Wuchty, Jones, & Uzzi, 2007). Names such as Newton and Einstein are singular individuals representing disciplinary roles that have propelled scientific discoveries to new levels. It is widely accepted that traditional, discipline-based research has contributed to immeasurable scientific advancements (Stock & Burton, 2011) and provided scientists with a common language and frame of reference

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(Petts, Owens, & Bulkeley, 2008). However, the last few decades have seen the development of new models of research that cross disciplinary boundaries in conceptualization and implementation (Kessel and Rosenfield, 2008; Stock & Burton, 2011; Stokols, Harvey, Gress, Fuqua, & Phillips, 2005; Wuchty et al., 2007). Collaborative methods for scientific research are increasing in importance as scientists are tasked with researching the world's most complex problems. The complexity of these issues requires scientists to transcend their own disciplinary boundaries and create teams to assess the interconnected network of systems associated with the problem.

This synergistic approach, known as team science, is defined as a collaborative effort to address a scientific challenge that leverages the strengths and expertise of professionals trained in different fields. It is based on the assumption that organizing scientists across multiple fields of study to analyze and research complex problems will produce better scientific outcomes. Within the field of team science there are varying levels of collaboration. Integrative research can be multidisciplinary, interdisciplinary or transdisciplinary. Multidisciplinary refers to two or more separate disciplines working together, yet maintaining their own disciplinary perspectives and methods (Russell, Wickson, & Carew, 2008). Interdisciplinary refers to the integration of multiple disciplines towards setting common goals and developing integrated knowledge and theory (Tress, Tress, & Fry, 2005). Transdisciplinary research (TDR) differs from multidisciplinary and interdisciplinary in that it integrates researchers from different, unrelated disciplines and non-academic partners, to research a common goal and create new theory and knowledge (Tress, Tress, & Fry, 2002). It is generally an issue-driven collaboration, focusing on an identified issue or threat (Harris & Lyon, 2013; Robinson, 2008). It is guided by a "logic of accountability" whereby a wide range of participants, including stakeholders, have the opportunity to provide input that will ostensibly improve scientific relevance and accountability (Barry, Born, & Weszkalnys, 2008; Donaldson, Ward, & Bradley, 2010; Nowotny, Scott, & Gibbons). In theory, this approach to research creates more feedback loops to guide research questions and outcomes.

Transdisciplinary research is conceptualized as the highest level of collaboration among scientists. Transdisciplinary research requires a collaboration of multiple disciplines and a melding of distinctive frameworks and methods (Brandt et al., 2013; Stock & Burton, 2011; Morton, Eigenbrode, & Martin, in process). It requires participants to merge knowledge, theories, ideas, and methods to create new ways to research and potentially solve complex problems (Brandt et al., 2013; Stock & Burton, 2011; Tress et al., 2002). This type of scientific integration can produce benefits, but there are challenges as well.

The remainder of this section examines the barriers and benefits of transdisciplinary research and why these integrated projects are important. The next section summarizes key literature, which provides some background information on key variables in this study. The statistical analysis used for this study is outlined in the Methods section, followed by a discussion of the results. Finally, a summary of the study and next steps are considered.

### 1.2. *The potential benefits of transdisciplinary science*

Transdisciplinary science is the collaborative target for many small and large research projects due to increasing optimism that the pooling of scientific knowledge can lead to a more comprehensive understanding of today's complex problems and their solutions. The participatory approach at the center of transdisciplinary science, which often combines experimental and applied research, has great potential to generate societal benefits. A growing number of funding agencies recognize the importance of this approach and are requiring research grants to include transdisciplinary teams to produce research outcomes. In addition, the National Institute of Health (NIH) has created multi-center initiatives intended to promote collaborative research and training (Hall et al., 2008).

These and other funding agencies, whether private or governmental, are under increasing pressure to produce research that will provide insights into some of our most pressing issues. Competition for diminishing research funds to address these complex issues provides an impetus for demonstrating the contributions of transdisciplinary research to society (Roux, Stirzaker, Breen, Lefroy, & Cresswell, 2010). To stay competitive, especially with large federally funded projects, scientists will be expected to participate in transdisciplinary efforts.

In addition, technological advances have facilitated an increase in transdisciplinary efforts. These innovations present opportunities to collaborate through the Internet via e-mail, web meetings, and data sharing. According to d'Andrea, Wyatt, Aarden, Lejten, and Seklocas (2009), "Research is asked to be more effective, fast, accountable, trans-disciplinary, result-oriented, policy-driven and able to generate benefits for people and firms in the short and middle run".

Transdisciplinary research offers the potential for a variety of scientific rewards. In addition to the prospect of better research outcomes, transdisciplinary efforts offer the following: potential societal benefits from increased outcomes (Pohl, 2011), positive impact on participants disciplines and students (Harris & Lyon, 2013), increased publication rates (Porter, Garner, & Crowl, 2012), greater visibility in the scientific community (Goring et al., 2014), and the creation of professional relationships through networking (Goring et al., 2014; Katz & Martin, 1997).

### 1.3. *The potential challenges of transdisciplinary research*

While TDR approaches have great promise, tensions have been identified between the benefits of working across disciplinary boundaries to understand complex problems and the potential costs of such collaborations (Cummings & Kiesler, 2005). Once a transdisciplinary project has been developed, there are numerous potential challenges that should be considered. Communication and language barriers are often cited as challenges to effective transdisciplinary work (Stock &

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