CLOSING THE LOOP:
EXPANDING OUR APPROACHES TO CONSERVATION THROUGH EVALUATION AND BEHAVIORAL SCIENCE

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by

Allen Townsend

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ALLEN TOWNSEND

COMMITTEE: LEIDY KLOTZ, ARSALAN HEYDARIAN, MAJID SHAFIEE-JOOD, BRIAN RICHTER, & JOHN PICKERING

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CONTENTS

"Problems that are hard are usually hard because of the set perspective and tools that have been used to try and solve them."
- Nathan Myhrvold[1]

"Floods are acts of god, but flood losses are largely acts of man."
- Gilbert White 'father of floodplain management'[2]

Objectives. I aimed to deconstruct the opportunities and challenges for increased adoption of state-of-the-art applied behavioral science among environmental program designers.

Methods. Focusing across decision makers involved in designing, implementing, and evaluating environmental behavior change programs, I engaged participants from 5 actor groups: environmental and conservation professionals, behavior change professionals, environmental policy and regulatory professionals, evaluation professionals, and environmental finance and funding professionals.

Results. Participants' organizations are inconsistently gathering behavioral data. Although participants do not regularly observe these data in the environmental community, they do view behavioral data as useful to assessing or developing programs. Moreover, among those surveyed, environmental and conservation professionals had the least confidence in their capacity to use behavioral data in their work.

Conclusions. Integration of applied behavioral science into environmental programs is a collective decision and process. Cross functional approaches could help accelerate adoption. Examples include establishing communication channels across groups, identifying and promoting change agents, and expanding the disciplinary perspectives involved in programmatic decisions nearer to the start of the process.

Keywords: design behavior, environmental programs, behavior change, evaluation, conservation

As we drive deeper into the 'Anthropocene', society's impact on ecological systems implicates human behavior. Nevertheless, our solutions to mounting and complex environmental challenges (e.g., climate change, biodiversity loss, community resilience) routinely underappreciate the human dimensions to change. Undervaluing the cognitive factors and psychological processes that influence human behavior (e.g., decision making, interpersonal dynamics, stereotypes, influence, and group processes) can lead to incomplete solutions or failure to deliver satisfactory outcomes at scale and that are durable[3]. **Put another way, while environmental challenges are biophysical or technological in nature, our capacity to appreciate the psychological, social, and behavioral processes that accelerate the adoption of alternative behavior(s) is likely to lead to more effective and efficient solutions.** Thus, integrating a behavioral lens into environmental analysis and interventions becomes the challenge.

Although there is a rising recognition of the advantages of integrating behavioral science into environmental solutions, adoption remains insufficient[4–7]. The modern environmental movement started in the 1970s, and early applications included motivating individual habits such as recycling and energy conservation[8]. Since then, however, behavioral science has been mostly missing from the environmental research agenda and impeded a shift to applications in climate change[9,10]. One of the primary impediments to integration has been disciplinary capture by physical scientists and epistemological differences with social scientists[8,11]. In practice, differences in what is considered 'evidence' often discount understanding from social science. Quantitative methodologies dominate climate research, and approaches to mitigating and adapting to climate change are more often led by physical scientists. In addition to institutional constraints, a 'usability gap' may exist between behavioral science knowledge produced in academia and translation to real world applications[12].

If recognized in environmental contexts, the human dimensions to change are often deprioritized compared to the biophysical issues or technological solutions. For instance, between 1990 and 2018, just 0.12% of total spending was devoted to social science, according to a review of global climate research funding[3]. In addition, the natural and technological sciences received 770% higher support. As another example, the U.S. Environmental Protection Agency tracks over fifty climate indicators to assess climate change[13]. However, leading behavior change metrics are not included outside of highly composite measures (i.e., greenhouse gas emissions and residential energy use)[8]. In a final example, the Green Climate Fund (GCF), a financing mechanism of the United Nations Framework Convention on Climate Change, conducted a behavioral systems analysis of its $5.6 billion project portfolio in 2020. They discovered that 82% of their investments did not sufficiently address the psychological hurdles that impeded pro-climate behaviors[14]. If conceptualized according to the transtheoretical model (TTM) of behavior change[15] (Figure 1), their analysis revealed "last mile gaps" in their approach to achieving project outcomes. Through their analysis, GCF recognized the potential advantages of applying behavioral science to bridge the intention-action gap[16]. For instance, the difference between an individual or group committing to reducing water consumption (TTM stages 1-3) and actually doing it (TTM stages 3-5). Accordingly, GCF's findings suggest that their programs' theories of change and strategies often get stuck at building intentions. In sum, these examples demonstrate that integrating behavioral science into environmental programs can enhance the effectiveness of interventions. Consequently, a deeper understanding of **the opportunities and challenges for accelerated adoption of applied behavioral science among environmental decision makers**, can help achieve desired outcomes.

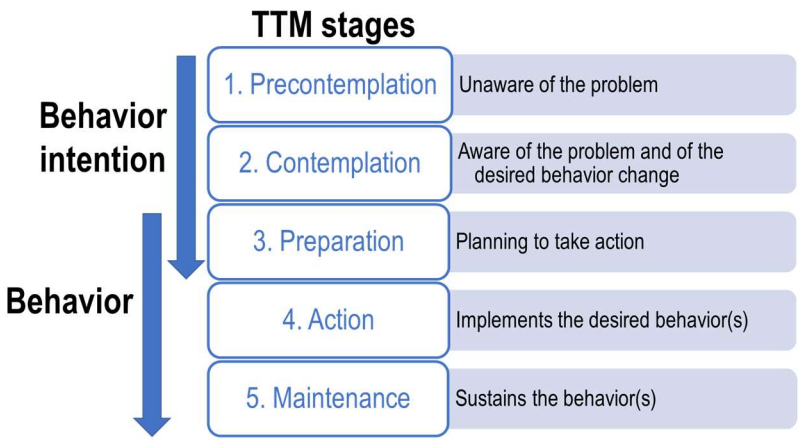

Figure 1. Transtheoretical Model (TTM) of behavior change[15]

One promising path forward is incorporating behavioral systems analysis into environmental program development, implementation, and evaluation practices to assist designers in complex decision-making environments. Engagement with these designers is attractive due to their ability to systematically effect change, hence achieving outcomes at scale. To do so requires overcoming barriers to behavior change data collection, translating sound behavioral science theories, merging with environmental analysis[17], and knowledge exchange among decision makers[18]. Ensuring that data and insights are accessible to individuals on the front lines of change enhances the likelihood that knowledge will be carried forward to new and ongoing interventions and that the approach will continue to propagate. For example, we suggest that carrying forward this knowledge can "close the learning loop" for program professionals as illustrated in Figure 2. In other words, Figure 2 shows an idealized environmental behavior change program journey, where the insights from the evaluation of programs are looped into the design of new and existing environmental behavior change programs. In addition, it ensures that key behavioral considerations are integrated into program objectives. Therefore, **the integrated assessment of environmental behavior change programs, could help translate behaviorally-informed interventions to quantifiable outcomes familiar to typical program designers needed for decision-making and justification[8].** In addition, an integrated evaluation approach would aid in closing the proverbial 'learning loop' and advancing the field's knowledge base.

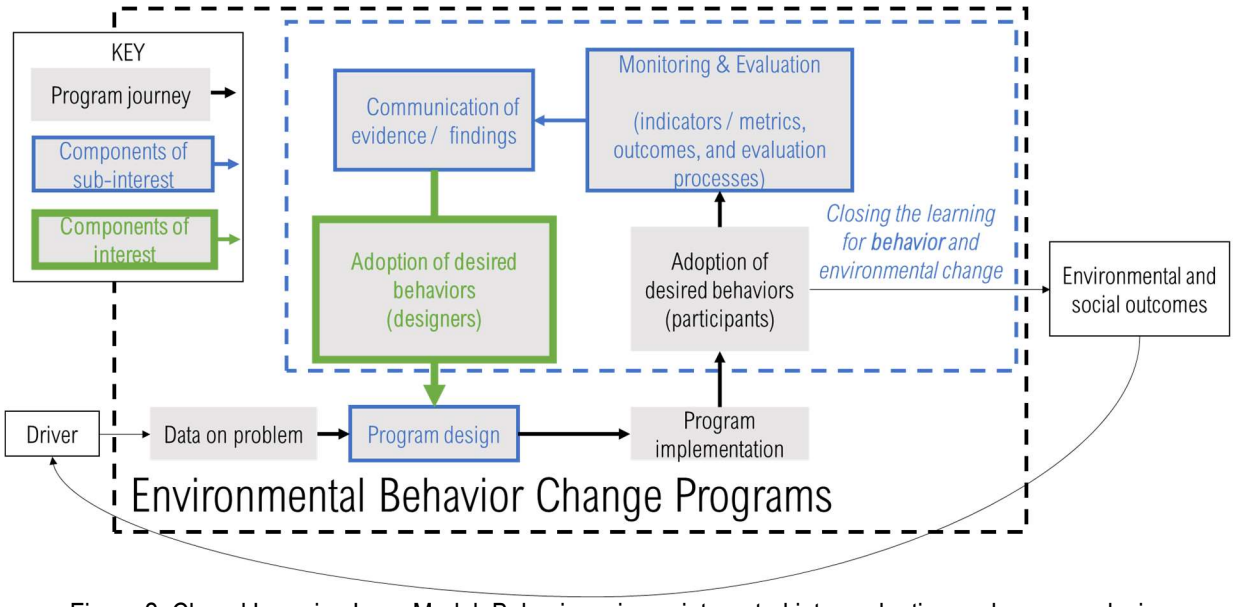

Figure 2. Closed Learning Loop Model. Behavior science integrated into evaluation and program design

The Need for Group Wisdom

Integrating behavioral analysis into environmental programming is still in its infancy despite its advantages. In order to address the 'last mile gap' at the scales needed to address environmental challenges, I hypothesize that greater attention is needed at the program designer level to collectively bridge the intention-action gap. For instance, decisions about environment programs (e.g., problem definition, content, theory of change, tactics) are often collaboratively made among program sponsors and partners. To help span that gap across decision makers, this work aimed to build the groundwork for practical theories of change across levels of influence (i.e., institutional, organization, programmatic) by directly engaging and incorporating firsthand perspectives across the programming cycle. Using a mixed-methods approach and drawing on systems thinking, I examine the perceptions of key functional roles involved in the programmatic decisions for environmental behavior change programs. Group Concept Mapping (GCM) is core to conducting this approach.

GCM is a "data-based method of extracting the knowledge that resides among a collective of individuals" that enables users to "arrive at a commonly authored conceptual framework that is supported by data."[19] Based on the pioneering work of Kurt Lewin on community-based participatory research[20], the technique translates qualitative data from those closest to environmental programming to a shared concept using multivariate analysis and "well-accepted" statistical operations[19]. GCM is appropriate for this inquiry because it facilitates a multistakeholder examination of the key functional roles in environmental behavior change programs and develops a shared concept among them.

What are the opportunities and challenges to integrating behavioral science into environmental program design, implementation, and evaluation? To find out, **I surveyed professionals across key programming roles.** Guiding questions were: *1) how do program professionals **interact with behavioral data**, and 2) which **behavior change metrics** matter to program professionals.* The answers to these questions across decision makers provide insight into the (mis)alignment of perspectives and potential pathways for the wider integration of behavioral science into environmental programs.

2. Methods

I collected survey responses from practitioners engaged in designing, implementing, or evaluating environmental programs to better understand their perspectives on integrating behavioral analysis in their (and their organization's) work. Group Concept Mapping's (GCM) multi-step process guided data collection and analysis. From a participant perspective, GCM entails 1) brainstorming ideas collectively, 2) rating them, and 3) sorting them into groups. Facilitation

of this process included 1) planning, 2) preparing content, 3) analysis, 4) and interpreting. I also used GCM to assess participant responses related to their current practices and what metrics 'matter' to work.

Stage 1: Planning

Identify participants

I outlined five key groups responsible for designing, implementing, and evaluating environmental behavior change programs in order gather and compare perspectives influential in the programming cycle. These were delineated based on my professional experience and my informal conversations with professionals in this line of work. Members from these groups interact in their functions and roles to make programmatic decisions and deliver the programs. Therefore, program actors and stakeholders were purposefully sampled for data collection. Commonly used in qualitative research, purposeful sampling involves selecting research participants based on the needs of the study[21] and the potential richness of information they may provide[22]. Participant selection criteria for the following groups included professionals actively working on environmental programs.

1) Environmental and conservation professionals

This group of professionals is responsible for designing, implementing, and sometimes evaluating environmental programs. Typically, this group is trained in the natural sciences and engineering. Examples of actors in this group include representatives from soil and water conservation districts and environmental nonprofits. Example titles and organizations in this group include Water Quality Specialist at The Nature Conservancy and Environmental Protection Specialist at U.S. Environmental Protection Agency, among others.

2) Behavioral change professionals

This group is responsible for designing, implementing, and, sometimes, evaluating programs. Typically, this group is trained in the behavioral sciences. Example titles and organizations in this group include Outreach Specialist at Wisconsin Sea Grant and Behavioral Scientist at Rare, among others.

3) Environmental policy and regulatory professionals

This group generally works in or supports the public sector at various levels of government. In some cases, environmental behavior change programs are a function of public policy. In other cases, programs may be derived outside of government. For the latter case, professionals in this group may use program evidence to support developing or revising broader policies. Examples of actors include representatives from government, consultants, and non-governmental organizations. Example titles and organizations in this group include Policy and Programs Director at USAID and Sustainability Advisor at U.S. House of Representatives, among others.

4) Evaluation professionals

This group typically focuses on designing and implementing the program's monitoring, evaluation, and learning plans. At the beginning of a program's development, professionals in the group construct the program's logic model to establish how a program is expected work[23]. Professionals in this group may be responsible for several types of evaluation (e.g., needs assessment, process, outcome, impact) and for various purposes (results, management, accountability, program improvement, decision making). Example titles and organizations in this group include Senior Evaluation Officer at Global Environment Facility and Evaluation Specialist at University of Wisconsin-Madison, among others.

5) Environmental finance and funding professionals

This group typically determines funding priorities, financially supports programs, and may identify program evaluation criteria and stipulations. Professionals in this group typically include representatives from public agencies, private organizations (e.g., business and foundations) or individuals. Example titles and organizations in this group include Program Officer at Gordon and Betty Moore Foundation and Grants Specialist at Virginia Department of Environmental Quality, among others.

Focus prompt

The focus prompt was developed after "pilot testing" with a preliminary set of participants and experts in applied behavioral science and sustainability. Typically, a prompt consists of a sentence or two that primes participants to consider the topic of interest and generate ideas or 'brainstorm'[19]. However, after testing several prompts, it became evident that, given the aims of the research, it was too difficult to ask participants to generate a rich list of metrics meaningful to assessing environmental behavior change programs. Writing a prompt that briefly introduced the topic and was easy to understand were the main challenges, particularly for participants who may or may not be familiar with the subject matter. In accordance with group concept mapping literature[24], I decided to instead present participants with a list of metrics to consider. The following prompt was used for this study:

> *"We want to learn the factors you think are relevant to developing, running, and/or evaluating environmental behavior change programs."* (readability grade level[25] = 15)

Idea generation: *behavior change metrics and behavioral science theories*

I developed and pilot-tested a list of metrics to provide participants for the rating and sorting activities. The final list of metrics presented to participants (Table 1) was not meant to be exhaustive but rather to offer participants a sense of the breadth of possibilities for assessing programs drawing from the literature. Using the frameworks developed by McKenzie-Mohr[26] and Steg and Vlek[27] as a basis, the list of metrics was purposefully dispersed across three components of behavior change program evaluation: (1) changes in determinates of the target population's behavior, (2) changes in target population's behavior and associated outcomes, and (3) resources used for the program[26,27]. In addition to program-level change metrics, the list of metrics was across behavioral systems levels for a target population[28]. For each metric, participants were also provided plain English definitions (Appendix C).

Table 1. Behavior Change Program Metrics Provided to Study Participants

I. Metric	II. System Level[28]	III. Category	IV. Behavioral Science Theories and Frameworks
Environmental attitude and values	Target population	Determinate of behavior	Evidn's Monitoring & Evaluation (M&E) framework[28]; The Theory of Planned Behavior[16]; Norm Activation Theory[29]; Transtheoretical Model[30,31]; COM-B Model[32]; Diffusion of Innovations[33]
Participant age	Target population	Determinate of behavior	Social Cognitive Theory[34]; COM-B Model[32]
Social capital	Target population's network	Determinate of behavior	Evidn's M&E framework[28]
Social norms	Target population	Determinate of behavior	Evidn's M&E framework[28]; The Theory of Planned Behavior[16]; Social Cognitive Theory[34]; COM-B Model[32]
Inter-organization collaboration	Organizational	Determinate of behavior	Evidn's M&E framework[28]
(Perceived) Self-efficacy	Target population	Determinate of behavior	Evidn's M&E framework[28]; The Theory of Planned Behavior[16]; Norm Activation Theory[29]; Social Cognitive Theory[34]
Programmatic costs to facilitate adoption of new practices		Resources used for the program	Evaluating the effectiveness of and efficiency of behavior change program[26,27]
Implementation rate of new practices		Behavior and associated outcomes	Transtheoretical Model[30,31]; Diffusion of Innovations[33]

I. Metric	II. System Level[28]	III. Category	IV. Behavioral Science Theories and Frameworks
Continuation rate of new practices		Behavior and associated outcomes	Transtheoretical Model[30,31]; Diffusion of Innovations[33]

Rating prompts: *which behavior change metrics matter*

Three rating prompts were developed to better understand 'which behavior change metrics matter' to environmental behavior change professionals. Prompts were assessed for readability, and literature was consulted in developing the unipolar, 5-point scales based on standard practice[35]. The rating prompts below were presented to study participants following the focus prompt.

Frequency Observed (readability grade level[25] = 7):

*"On a scale of 1 to 5, please rate **how often you see each factor used** in the environmental community:*

1=Never, 2=Sometimes, 3=About half the time, 4=Most of the time, and 5=Always."

Usefulness (readability grade level[25] = 14):

*"On a scale of 1 to 5, please rate the **usefulness** of the following factors when **evaluating** or **developing environmental behavior change programs**:*

1=Not at all useful, 2=Slightly useful, 3=Moderately useful, 4=Very useful, and 5=Extremely useful."

Comfort Interpreting (readability grade level[25] = 11):

*"On a scale of 1 to 5, please rate each factor based on **your comfort interpreting and making programmatic decisions with it**:*

1=Not at all comfortable, 2=Slightly comfortable, 3=Moderately comfortable, 4=Comfortable, and 5=Extremely comfortable."

Stage 2: Preparing Content

Participant Questions

In addition to the GCM section of the survey focused on '*which metrics matter*' (rating and sorting activities), a series of questions were developed on participants' demographics, '*current practices*' in program evaluation and behavioral analysis, and their perspectives on the '*opportunities and challenges*' for further integration into their work. Each section is described in further detail in Appendix D.

Data collection

Participant identification (purposeful sampling)

I identified potential participants based on the five groups previously outlined as key for environmental behavior change programs. The initial list was drawn from practitioners from my personal and professional networks. Following the development of the initial list of participants and assessment of their distribution among the key groups, additional participants were identified through my 2nd and 3rd degree LinkedIn connections and industry associations. Industry organizations included North Central Region Water Network, American Evaluation Association, Great Lakes Aquatic Nuisance Species panel, Mississippi River Basin Aquatic Nuisance Species panel, and Tools of Change. Connections were considered based on their title, organization, and responsibilities.

Communication channels

Over 120 participants were engaged by email or LinkedIn (messages or connection requests), depending on if I had their email address and their recent LinkedIn activity. If potential participants were not active on LinkedIn, I emailed or did not contact them. In my correspondence, I introduced myself (if we did not already know each other), the research

project, and its relevance to their work, and invited them to participate. Invitations included links to the study webpage and/or Qualtrics survey.

The study webpage was hosted on my research group's website (https://convergentbsi.org/closing-the-loop-survey/). Contents of the website included additional information about the study, IRB details, and two short videos on environmental behavior change[36,37] to help describe what an environmental program that centers on human behavior and behavioral science can look like (see Appendix E for screenshot). Lastly, the webpage provided a link to the Qualtrics survey.

Software: Qualtrics to GroupWisdom

GroupWisdom is a web-based tool specialized for Group Concept Mapping (GCM). The program progresses users iteratively through each GCM stage, processes and analyzes the data, and then visualizes the results. Due to the customizability limitations of GroupWisdom, I decided to collect data through a Qualtrics survey and then import the data into GroupWisdom. This data processing approach enabled me to exploit the capabilities of both software platforms. Qualtrics, for example, permitted virtually unlimited survey questions, but GroupWisdom allowed just five.

3. Results and Discussion

Participant overview

89 respondents began the survey across professional groups (Figure 3). On average, respondents were an experienced group. 35% had over 20 years of experience, 26% had 10-20 years of experience, 24% had 5-10 years of experience, 9% had 3-5 years of experience, and 7% had 0-3 years of experience. 56% of respondents were female, and 87% were white. 36% of respondents worked on water issues, 31% on issues specific to human interactions and impacts, 25% on ecosystem conservation, and 9% on climate, land and water issues. In terms of the scale of their work, 26% of respondents worked at the state level, 21% at the regional level, 16% at the national level, 13% at the local/community level, 12% at the basin/watershed level, and 10% at the international level. 92% of respondents were based in the United States. A tabular presentation of respondent demographics is in Appendix F.

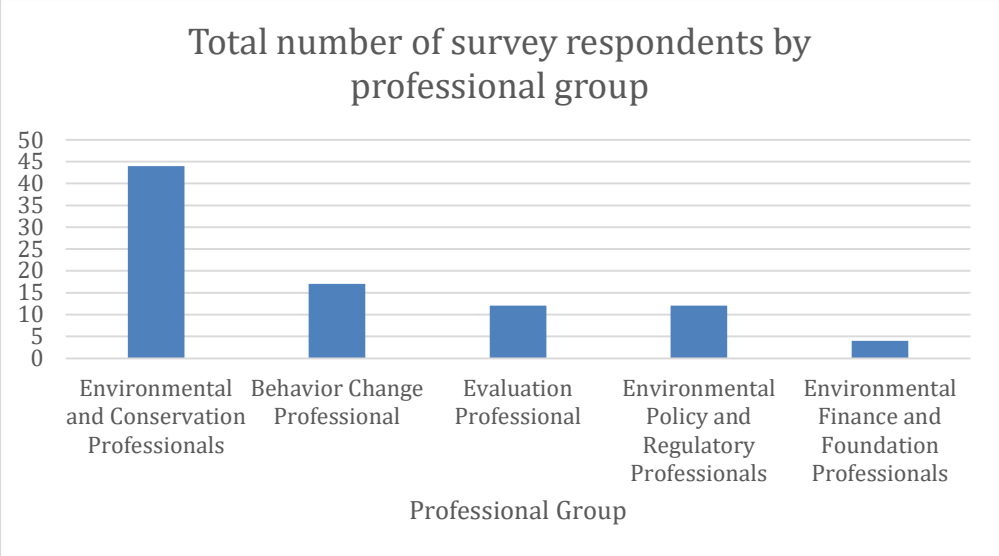

Figure 3. Total number of survey respondents by professional group

Data collection practices are a 'mixed bag'

In response to 'how often [does] your organization collect data for its programs?', the frequency of data collected showed slight variation among baseline, monitoring, and evaluation data. However, within each of these data collection phases, the response distribution was somewhat 'U-shaped' with "Most of the time" selected the most and "Never" selected the least across each phase (Figure 4).

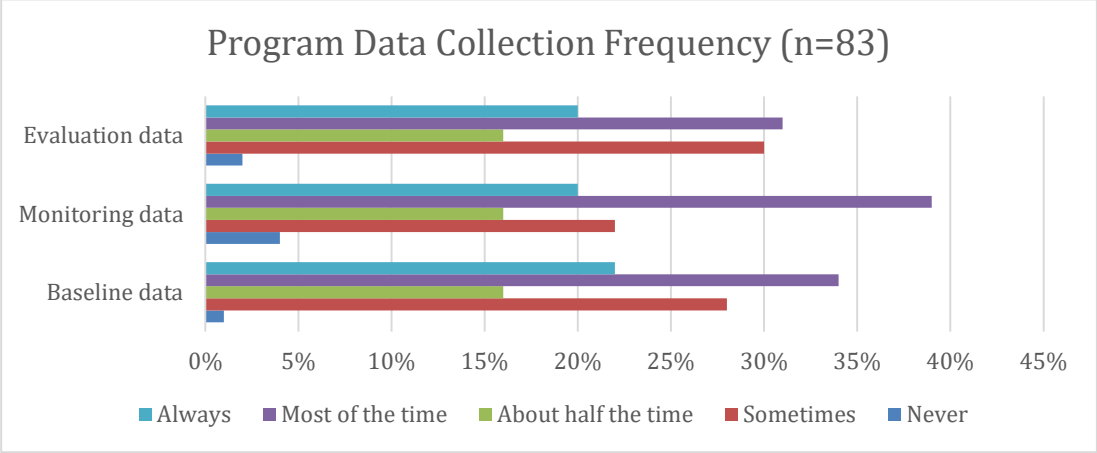

Figure 4. Program Data Collection Frequency

The data show that specific to behavior change metrics, 'environmental attitudes and values' and 'implementation rates of new practices' were the data most often collected (Figure 5). Social capital was by far the least collected metric by respondents' organizations.

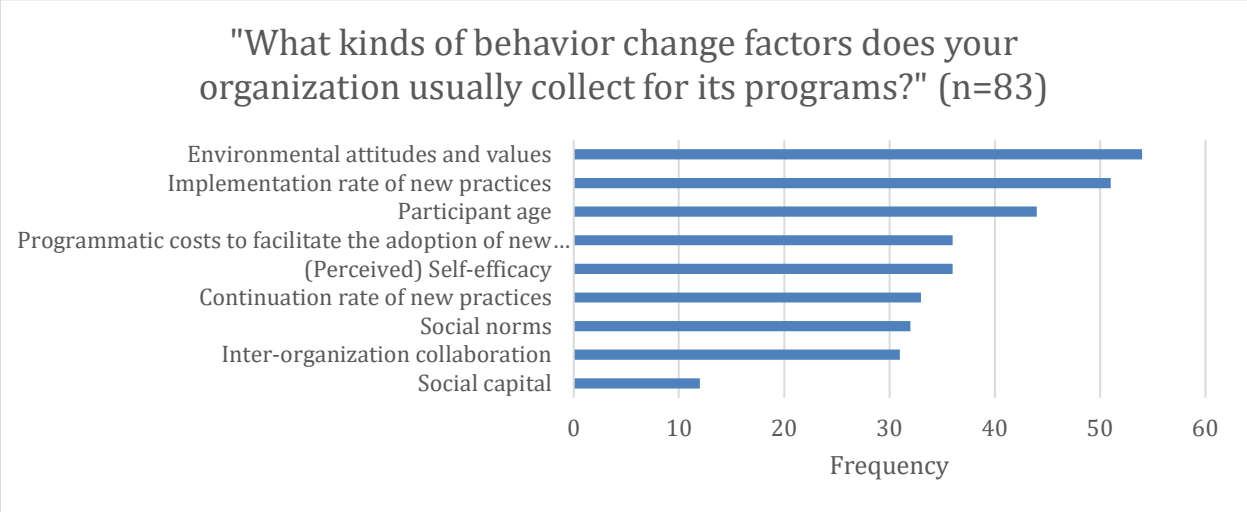

Figure 5. Behavioral data typically collected for programs

Surveys were by far the most common program data collection method. At the same time, several respondents also noted that their organization also used interviews and focus groups (Figure 6).

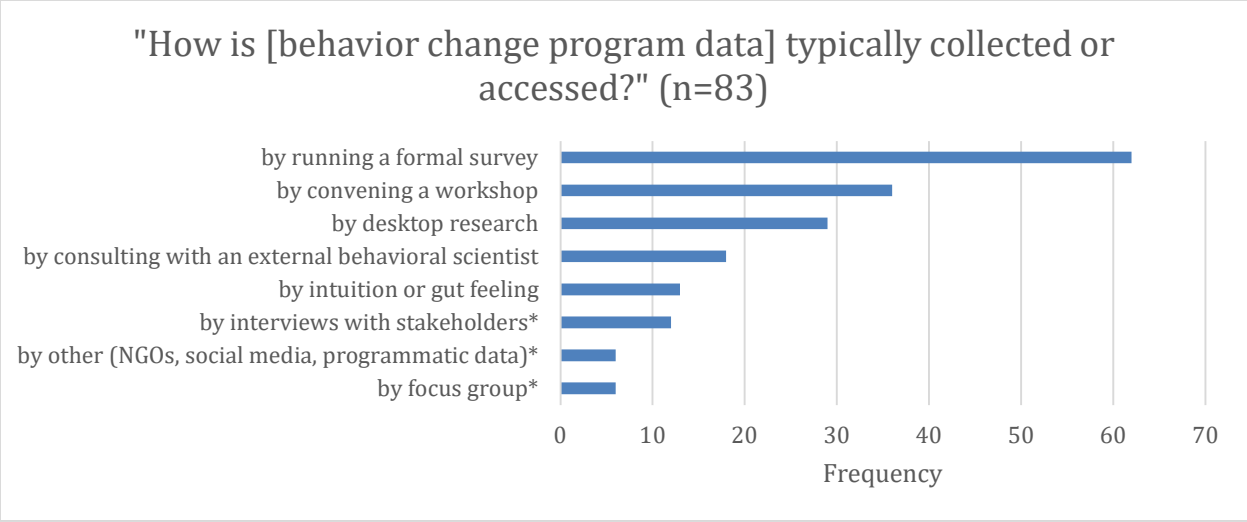

Figure 6. Behavioral data collection methods. *Write in by respondents

While the findings of the current practices section of the study demonstrate that industry data collection practices vary, they also indicate that some kinds of data are favored over others. In addition, the findings demonstrate that when behavioral data are gathered, surveys constitute the de facto mode of collection among the survey participants.

Behavior change metrics are missing in action but are seen as useful

Consistent with results on current practices across professional groups, environmental and conservation professionals are moderately familiar with behavior change metrics (Figure 7). In the rating section of the group concept mapping exercise, environmental and conservation professionals tied with behavior change professionals on how often they see behavior change metrics based on average (2.8 on a scale of 1 to 5). Only evaluation professionals had a higher average overall rating (3.2). In contrast, environmental finance and funding professionals rated the lowest average (2.3). Behavior change metrics with the most considerable discrepancy (on average) among professional groups were *participant age* (2.4) and *social norms* (2.2). In contrast, *inter-organizational collaboration* had the least average difference among professional groups (0.7). *Environmental attitudes and values* (3.1) and *continuation rates of new practices* (3.1) were metrics most frequently seen on average across professional groups, while *(perceived) self-efficacy* was seen the least (2.5).

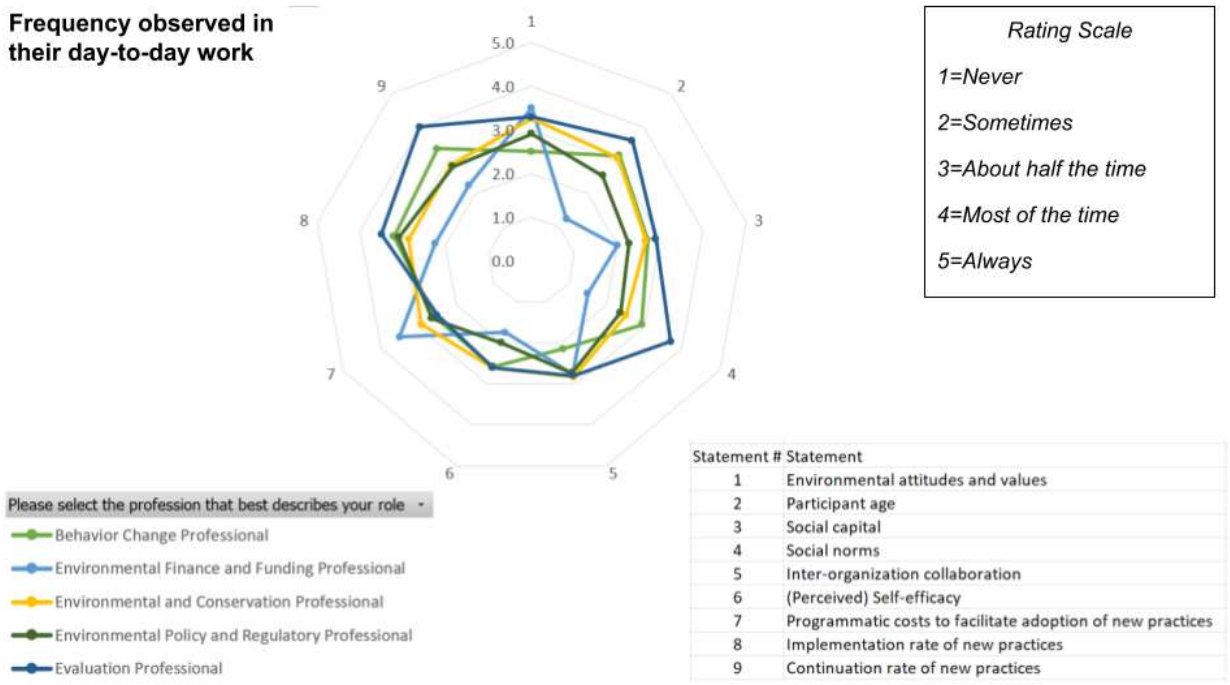

Figure 7. Average Frequency Rating of Behavior Change Metrics Observed by Professional Group

While those surveyed reported seeing the provided behavior change metrics in their work semi-often (2.8 on a scale of 1 to 5), there is marked recognition of their usefulness. On a scale of 1 to 5, with 1=not at all useful and 5=extremely useful, the average usefulness of behavior change metrics was rated 3.8 across professional groups (Figure 8). The perspectives of behavior change professionals are particularly instructive for this rating, given that the metrics were within their area of expertise. The response of behavior change professionals substantiates the metrics, as they saw them as 'very useful' across metrics (4.0). Notably, evaluation professionals had the lowest overall rating of the provided behavior change metrics (3.5) and consistently had the highest disagreement with behavior change professionals across metrics. Respondents rated *environmental attitudes and values* as most valuable (4.1), and *participant age* as least helpful (3.5). Among professional groups, *inter-organizational collaboration* and *implementation rates of new practices* received the most considerable difference in usefulness (1. 4 and 1.3, respectively). A tabular presentation of the ratings is in Appendix G.

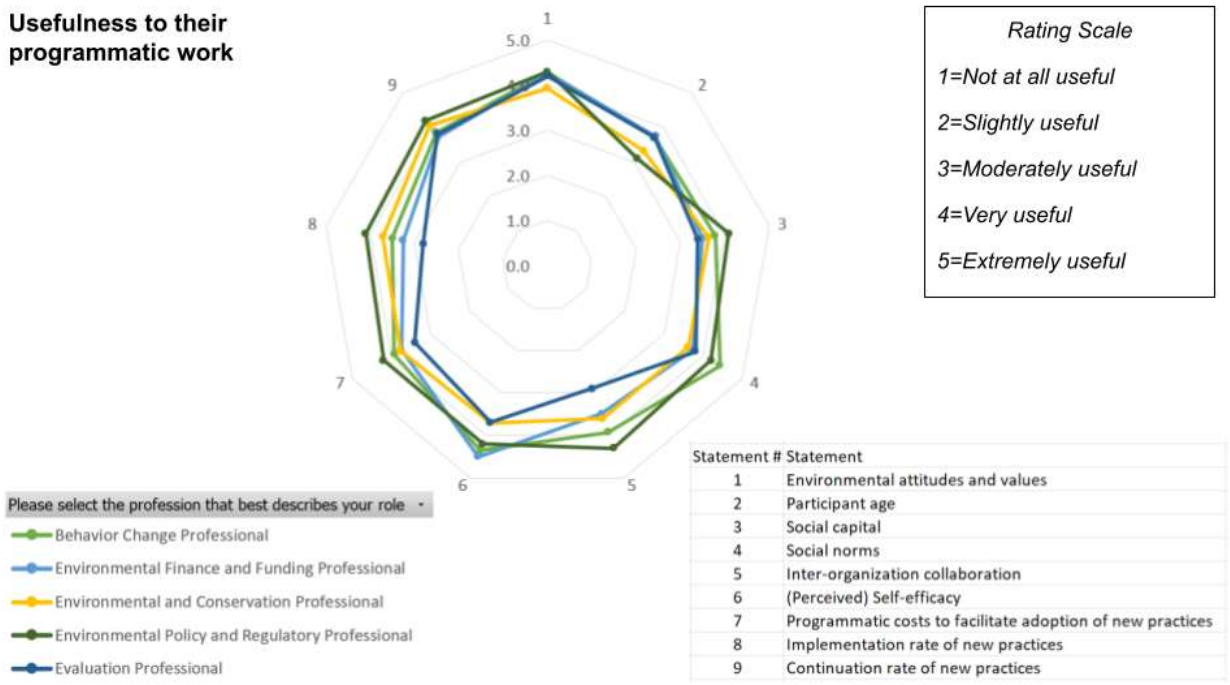

Figure 8. Average Usefulness Rating of Behavior Change Metrics by Professional Group

Environmental and Conservation Professionals are least confident in their ability to use behavioral data in their work

In the final rating activity, I asked study participants about their comfort interpreting and making programmatic decisions with these metrics on a scale of 1 to 5, with 1=not at all comfortable and 5=extremely comfortable. Compared to the average usefulness rating (3.8), the average comfort rating remained moderately high across professional groups (3.4). However, environmental and conservation professionals reported a remarkably lower rating (3.0) than their peers (Figure 9). A tabular presentation of the ratings is in Appendix G.

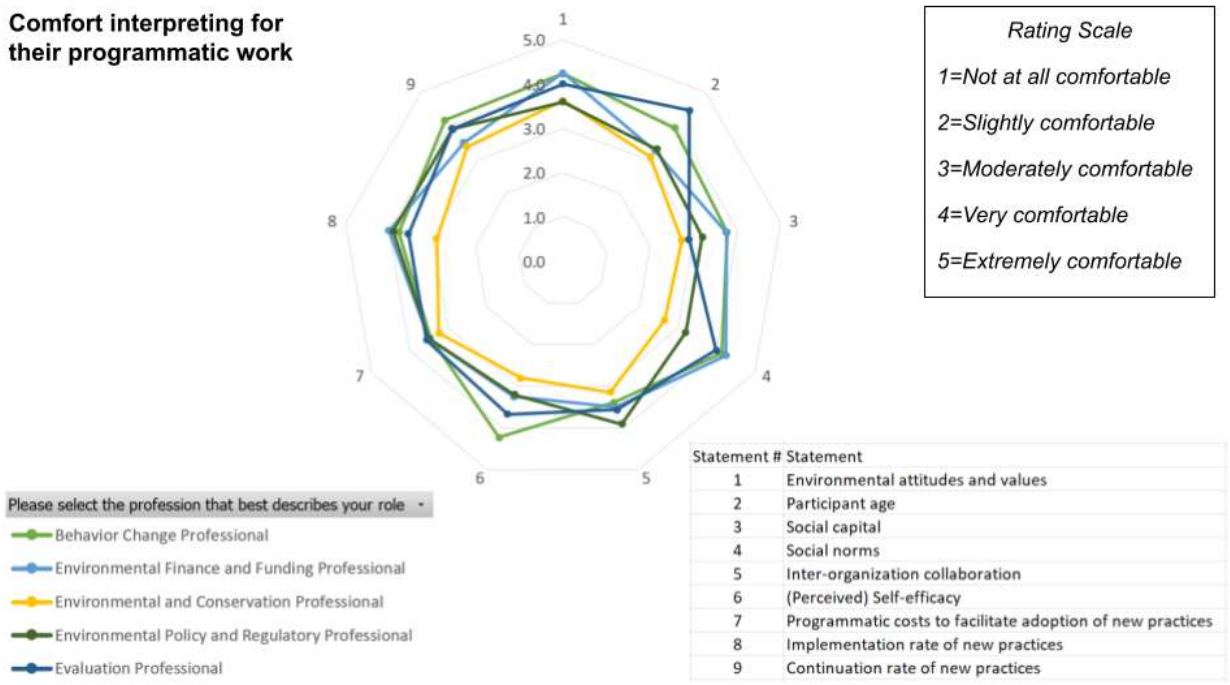

Figure 9. Average Comfort Interpreting Rating of Behavior Change Metrics by Professional Group

Sorting individual metrics into 'clusters' is the final step of group concept mapping. This exercise outputs a pattern match figure using a ladder graph representation. The pattern match compares the clustered ratings across professional groups using the same 5-point scale as the rating exercise. The GroupWisdom software calculates cluster averages using the subset of metric averages within the cluster across respondents for each rating. For example, the 'Alliance' cluster comprises the *social capital* and *inter-organizational collaboration* metrics. Four clusters emerged based on the responses, and the cluster names reflect the themes of the names respondents gave to each cluster. Put simply, the cluster maps are an aggregated representation of the rating figures. A tabular presentation of the ratings is in Appendix G.

One of the purposes for using the group concept mapping methodology was to explore how practitioners view and construct metrics relative to theory and established behavioral science frameworks (Table 1). The cluster results (left side of Figure 10) reveal how respondents across professional groups conceptualize individual metrics. As stated previously, the list of behavior change metrics provided to participants was not comprehensive. However, they were intentionally selected to provide participants with a representative cross-section of metrics based on academic literature. The sorting responses align, in part, with metric groupings from prior literature and theory (columns of II and III in Table 1). For example, there some agreement between "individualistic factors" and "determinates of behavior" (i.e., social norms and participant age)[26,27]. This finding is interesting because it demonstrates professionals presumably unfamiliar with behavioral science constructs developed categories, similar to the literature, based on their intuition and experience. It suggests that training program professionals on integrating behavioral science might be able to build from their existing views and will not require a complete unlearning of their intuition around behavior change metrics.

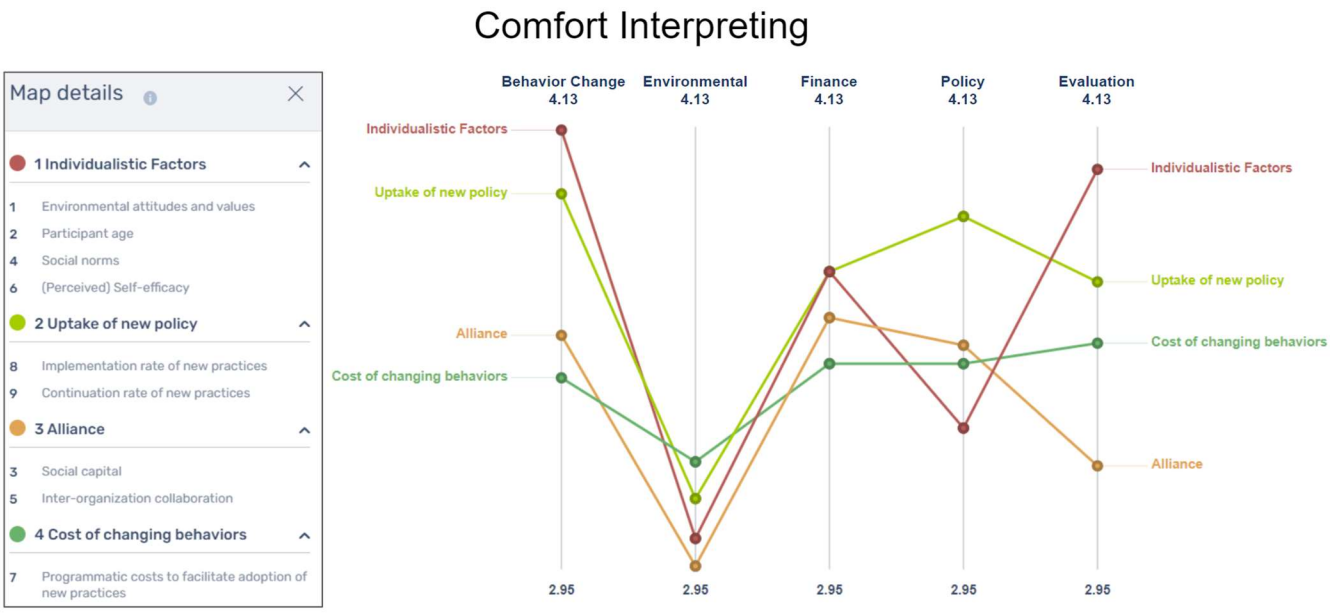

Figure 10. Average Comfort Interpreting Rating of Behavior Change Metrics by Professional Group

4. Future Work

This research aimed to deconstruct the opportunities and challenges for increased adoption of state-of-the-art behavioral science among environmental program designers. It illuminated the perspectives of a select group of program decision makers, and it was not intended to be generalizable or comprehensive. Nonetheless, it highlights the state of current practices and perspectives to integrating behavioral science into environmental programs. This research also adds to the literature on program design considerations and decision making for environmental outcomes. Specifically, this project advances the state of knowledge regarding: 1) shared and competing interests among individual and organizational environmental behavior change program designers; 2) understanding of disciplinary perspectives (i.e., behavioral, physical, evaluation) on interdisciplinary environmental behavior change models; 3) limitations and barriers to communication and engaging program designers; and 4) designer capacities to interpret and translate interdisciplinary findings to environmental behavior change program designs. Future research may corroborate the article's findings and further investigate opportunities and challenges.

Validation

A member check should be undertaken using a combination of previously surveyed participants and a new, more balanced cross-section of participants to increase the trustworthiness of the analysis and compare data among participants. These may be accomplished via workshops and or focus groups. The viewpoints of programs' target population(s) might also be solicited.

Group concept mapping

A more conventional group concept mapping exercise might be conducted in future work. Instead of gathering participants' responses unsynchronized to a limited set of metrics, researchers may use GroupWisdom software to allow participants to contribute metrics during the brainstorming phase and then present those metrics to all participants during the rating and sorting phases. This modification would provide a more comprehensive investigation of behavior change metrics and constructs. The viewpoints of programs' target population(s) might also be solicited.

Further inquiry

Future work may benefit from alternative approaches to data collection, such as interviews and observations, to understand designer perspective more confidently. Additional analysis could interrogate the interactions among

behavioral, environmental, and governance metrics[38]. Guiding questions could also explore professionals' perspectives on the challenges to integrating behavioral analysis into their work and the steps they believe could accelerate adoption.

5. Conclusion

My results have global and local implications. Firstly, I find that baseline, monitoring, and evaluation data collection practices vary for environmental programs. Program designers indicated similar data collection frequencies across program phases. However, respondents either collected data irregularly or seldom for baselining, monitoring, and evaluation purposes. I found that the collection frequency varies across behavior change metrics and differs in methodology. In general, program designers encounter behavior change metrics about semi-regularly in their work. This study demonstrates that analyzing a program specifically through a behavioral system lens is often a missing ingredient for environmental programs whose success relies on people changing their behavior. To do so requires having access to contextual behavioral data and the ability to translate sound behavioral science theory into a program's theory of change or interventions more broadly.

The collected or accessed data must be usable across design groups. The findings here demonstrate that behavioral data are missing in action for environmental programs but are seen as useful. However, consistent with others' findings, environmental and conservation professionals are least confident in using behavioral data in their work[39]. The decision to integrate behavioral science into environmental programs is collective and the first step in a sequential program development and implementation process, which makes this finding problematic for wider adoption of behavioral science. It suggests that enhancing how program decision makers and organizations collaborate is perhaps the highest priority to achieving sustainable outcomes at scale. Cross-functional approaches could help close the distances between program designers on the path to collectively integrating behavioral science into behavior change programs and so that lessons learned are carried forward. Facilitating more robust feed-forward loops among program designers can help span siloed knowledge by taking better advantage of learning gained through others' experiences and prior programs. To this end, example approaches include establishing communication channels across groups, identifying and promoting change agents, and expanding the disciplinary perspectives involved in programmatic decisions nearer to the start of the process.

Globally, ever-increasing resources are devoted to environmental solutions. Nevertheless, progress continues to fall behind the pace of environmental degradation, and accelerating results at scale are still needed[40]. Increasing interdependence between human and earth systems makes the decision-making environment more complex for policymakers, engineers, and decision makers on the ground. Within planetary systems, situations are increasingly difficult to comprehend with cascading trends in interlinked systems[41]. Add the dynamics of human factors such as population growth, declining public trust (particularly in government and science[42]), rising reports of loneliness[43] and depression[44], and decline in empathy[45], and the situation is further challenging to grasp[46]. With that said, applied behavioral science can enhances decision makers' ability to navigate the complexities of people, the planet and the interconnections between them. Accordingly, this project's findings provide empirical contributions at the nexus of human and environmental systems for evaluation of environmental behavior change programs. It establishes a basis for program design, implementation, and evaluation that sufficiently and convincingly considers the suite of behavioral outcomes integral to adaptive communities and a healthy environment. In sum, this research points toward a future in which the theory of change for environmental solutions is more closely aligned with the human dimensions of change.

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APPENDICES FOR

CLOSING THE LOOP: ALIGNING EVALUATION FOR GENERATIVE BEHAVIORAL AND ENVIRONMENTAL SOLUTIONS

Allen Townsend, Leidy Klotz (Advisor)

TABLE OF CONTENTS

Appendix A: Glossary of Terms

Term	Definition
behavioral sciences	The study of how humans behave and make decisions in the real world. Draws from psychology, neuroscience, behavioral economics, sociology, and related disciplines.
program designer	Consists of individuals involved with the design and implementation of environmental and conservation programs.
program evaluation	"The planned, periodic and systematic determination of the quality and value of a program, with summative judgement as to the achievement of a program's goal and objectives" - Scriven, M. (1991). Evaluation thesaurus. Sage.

Appendix B: Pre-study Interviewees

Name	Title / Organization	Actor Community
Tim Campbell	Aquatic Invasive Species Outreach Specialist at Wisconsin Sea Grant	Environmental and conservation professional
Dr. Amber Saylor Mase	Evaluation Specialist at University of Wisconsin – Extension Natural Resources Institute	Evaluation professional
Robert Sweet	Nonpoint Source Grants Coordinator at Michigan Department of Environment, Great Lakes, and Energy	Environmental finance and funding professionals
Dr. Ken Genskow	Chair, Professor, and Extension Specialist at University of Wisconsin-Madison	Environmental and conservation professional
Katri Haanterä	Senior Behavioral Scientist at Evidn	Behavioral change professional
Toneya McIntosh	Senior Behavioral Scientist at Evidn	Behavioral change professional

Appendix C: Behavior Change Program Metric Definitions Provided to Study Participants

Metric	Definition
Environmental attitude and values	What people in a community think about conservation and how they feel about the program (readability grade level[25]d = 5)
Participant age	The age of a person within the intervened community
Social capital	The number of key relationships that exist between individuals and community stakeholders (readability grade level[25] = 6)
Social norms	The common and generally accepted ways of acting in a community (readability grade level[25] = 7)
Inter-organization collaboration	The ways in which different groups in a community make decisions together (readability grade level[25] = 9)
(Perceived) Self-efficacy	How well people think they can put new practices into place and keep them up (readability grade level[25] = 6)
Programmatic costs to facilitate adoption of new practices	The resources used to get people to accept new ways of doing things (readability grade level[25] = 5)
Implementation rate of new practices	The percent of people in the community that continues to use new practices (readability grade level[25] = 8)
Continuation rate of new practices	The share of the intervened community that continues to put new practices into use (readability grade level[25] = 9)

Appendix D: Survey Questions

Demographics

Study participants were asked a series of demographic questions. The questions listed below were developed specifically for GCM analysis and comparison.

"Please select the profession that *best* describes your role

- Behavior Change Professional
- Environmental or Conservation Professional
- Environmental Finance or Funding Professional
- Environmental Policy or Regulatory Professional
- Evaluation Professional"

"What issues do you work on? Please select all that apply.

- Air
- Animals
- Energy
- Land
- Plants
- Soil
- Water
- If other, please click to add below"

"What geographic context do you *typically* work in?

- Local/Community
- Regional
- State
- Basin/Watershed
- National
- International"

"How many years have you been working in your profession?

- 0-3 years
- 3-5 years
- 5-10 years
- 10-20 years
- +20 years"

Current Practices

'*current practices*' in program evaluation and behavioral analysis…

"Please rate **how often your organization collects data** for its programs?

- Baseline data | Monitoring data | Evaluation data

"What kinds of behavior change factors does your organization usually collect for its programs? Please select all that apply."

- Metrics..

"How is this information typically collected or accessed? Please select all that apply."

- List

- Allowed write in

"Please add any other factors useful for developing, running, or evaluating environmental behavior change programs."

"How often do you personally talk to the people in the community your program(s) are trying to influence?"

- Never
- Sometimes
- About half the time
- Most of time
- Always

Opportunities and Challenges

"Please comment on the internal or external challenges to developing, running, and/or evaluating environmental behavior change programs."

"Please comment on the steps needed for your organization to collect and use behavior change metrics more regularly."

Appendix E: Study Webpage

https://convergentbsi.org/closing-the-loop-survey/

APPROACH PEOPLE RESEARCH ABOUT CONTACT

ENVIRONMENTAL CONSERVATION AND BEHAVIOR SURVEY FOR PRACTITIONERS

Thank you for your interest in helping with my research on behavioral science and environmental programs! Below, you will find details about my study and a 15 minute survey.

UVA IRB-SBS #: 4644
Principal Investigator & Contact: Allen Townsend
Contact Email: **at5ef@virginia.edu**
Contact Phone: 803.446.4833
Official Study Title: Closing the Loop: Expanding Our Approaches to Conservation Through Evaluation and Behavioral Science
Study Description
We are seeking professionals ages 18 and older in the following fields:

- Behavior change
- Conservation
- Conservation financing or funding
- Environmental policy or regulation
- Evaluation

We invite you to take part in a study that surveys the state of behavioral science in environmental policy and programs.

This study seeks to better understand practitioners' views on the use of behavioral science in program development and evaluation.* We ask volunteers to complete a survey lasting

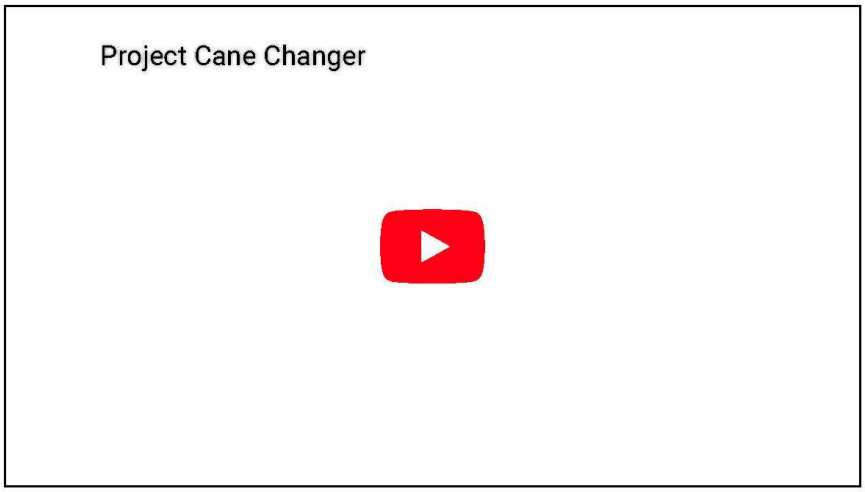
approximately 15 minutes.

Please call 803-446-4833 or email **at5ef@virginia.edu** for more information

Compensation: You will not receive any payment. However, your responses may help challenge the dominant approaches to environmental policy and program design.

Please take this survey on a computer for a smoother experience and click HERE to begin.

*If the types of programs I'm referring to are unclear, below are examples of what behaviorally-centered environmental solutions can look like.



Project Cane Changer – **Evidn**

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Appendix F: Survey respondent demographics

How many years have you been working in your profession?	
+20 years	34%
10-20 years	26%
5-10 years	24%
3-5 years	9%
0-3 years	7%
Total	100%

What geographic context do you typically work in?	
State	26%
Regional	21%
National	16%
Local/Community	15%
Basin/Watershed	12%
International	10%
Total	100%

What issues do you work on?	
Water	36%
Human Interactions & Impacts	31%
Ecosystem Conservation	24%
Climate, Land & Water	9%
Total	100%

How would you descrive yourself? Please all that apply.	
White	86%
Asian	5%
Black	4%
Other	4%
Total	100%

What is your gender?	
Female	57%
Male	43%
Total	100%

Appendix G: Ratings of behavior change metrics

Table F1 – Mean Frequency Observed Ratings, Overall and by Professional Group

Statement	Behavior Change Professional rating, mean	Environmental Finance and Funding Professional rating, mean	Environmental and Conservation Professional rating, mean	Environmental Policy and Regulatory Professional rating, mean	Evaluation Professional rating, mean	Overall rating, mean	Range
Environmental attitudes and values	2.5	3.5	3.3	2.9	3.3	3.1	1.0
Participant age	3.1	1.3	3.1	2.5	3.6	3.0	2.4
Social capital	2.7	2.0	2.7	2.3	2.9	2.6	0.9
Social norms	2.9	1.5	2.5	2.4	3.7	2.7	2.2
Inter-organization collaboration	2.1	2.8	2.8	2.7	2.8	2.7	0.7
(Perceived) Self-efficacy	2.6	1.8	2.6	2.0	2.6	2.5	0.9
Programmatic costs to facilitate adoption of new practices	2.6	3.5	2.9	2.6	2.5	2.8	1.0
Implementation rate of new practices	3.2	2.3	2.9	3.1	3.5	3.0	1.3
Continuation rate of new practices	3.4	2.3	2.9	2.8	4.0	3.1	1.8
Overall rating, mean	**2.8**	**2.3**	**2.8**	**2.6**	**3.2**	**2.8**	**0.9**

Rating Scale. 1=Never; 2=Sometimes; 3=About half the time; 4=Most of the time; 5=Always

Table F2 – Mean Usefulness Ratings, Overall and by Professional Group

Statement	Behavior Change Professional rating, mean	Environmental Finance and Funding Professional rating, mean	Environmental and Conservation Professional rating, mean	Environmental Policy and Regulatory Professional rating, mean	Evaluation Professional rating, mean	Overall rating, mean	Range
Environmental attitudes and values	4.3	4.3	3.9	4.3	4.2	4.1	0.4
Participant age	3.7	3.8	3.3	3.1	3.7	3.4	0.7
Social capital	3.8	3.5	3.6	4.1	3.4	3.7	0.7
Social norms	4.4	3.8	3.6	4.2	3.8	3.9	0.8
Inter-organization collaboration	3.9	3.5	3.6	4.3	2.9	3.7	1.4
(Perceived) Self-efficacy	4.4	4.5	3.7	4.2	3.7	4.0	0.8
Programmatic costs to facilitate adoption of new practices	3.9	3.8	3.8	4.2	3.4	3.8	0.8
Implementation rate of new practices	3.5	3.3	3.7	4.1	2.8	3.6	1.3
Continuation rate of new practices	3.9	3.8	4.1	4.2	3.8	4.0	0.5
Overall rating, mean	**4.0**	**3.8**	**3.7**	**4.1**	**3.5**	**3.8**	**0.6**

Rating Scale. 1=Not at all useful; 2=Slightly useful; 3=Moderately useful; 4=Very useful; 5=Extremely useful

Table F3 – Mean Comfort Interpreting Ratings, Overall and by Professional Group

Statement	Behavior Change Professional rating, mean	Environmental Finance and Funding Professional rating, mean	Environmental and Conservation Professional rating, mean	Environmental Policy and Regulatory Professional rating, mean	Evaluation Professional rating, mean	Overall rating, mean	Range
Environmental attitudes and values	4.2	4.3	3.6	3.6	4.0	3.8	0.7
Participant age	3.9	3.3	3.1	3.3	4.4	3.5	1.4
Social capital	3.8	3.8	2.7	3.2	2.9	3.1	1.0
Social norms	4.2	4.3	2.7	3.2	4.0	3.3	1.6
Inter-organization collaboration	3.4	3.5	3.1	3.9	3.6	3.4	0.8
(Perceived) Self-efficacy	4.2	3.3	2.8	3.2	3.7	3.3	1.4
Programmatic costs to facilitate adoption of new practices	3.5	3.5	3.2	3.5	3.6	3.4	0.3
Implementation rate of new practices	3.8	4.0	2.9	3.9	3.6	3.4	1.1
Continuation rate of new practices	4.2	3.5	3.4	3.9	3.9	3.7	0.8
Overall rating, mean	**3.9**	**3.7**	**3.1**	**3.5**	**3.7**	**3.4**	**0.8**

Rating Scale. 1=Not at all comfortable; 2=Slightly comfortable; 3=Moderately comfortable; 4=Very comfortable; 5=Extremely comfortable