

**Environmental Scientists' Support for Public Engagement Strategy Development
Is Predicted by a Range of Factors, But Mostly Perceived Benefits**

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Abstract

Communication strategies define audience-specific behavior goals, identify priority cognitive and affective communication objectives necessary to achieve those goals, and describe the specific communication tactics meant to increase the likelihood of achieving those objectives. Unfortunately, it appears that few scientific organizations have concrete, evidence-based strategies. This study therefore uses survey data to explore environmental scientists' willingness to prioritize the behavioral goal of creating a shared public engagement strategy. It finds that the best predictor of prioritizing strategy development is the perceived benefits of having a strategy, although the perceived feasibility of developing a strategy given available resources, and trust in their engagement staff were also reasonable predictors of strategy prioritization. Early career respondents and those who said they had previously thought about developing an engagement strategy were also more likely to say they think developing an engagement strategy should be prioritized. The study builds on the strategic communication as planned behavior approach to try to better understand scientists' communication choices in a way that could support efforts to improve these choices.

Keywords: scientists; strategic communication; goals

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Introduction

Most past research on scientists' views about public engagement has focused on overall willingness to communicate (e.g., Bao et al., 2023; Poliakoff & Webb, 2007; Rose et al., 2020; Styliński et al., 2018). Some recent studies have also begun to explore scientists' willingness to prioritize (1) specific tactics (e.g., communicative behaviors, messages, styles, sources, channels; Author Blinded, 2021), (2) cognitive or affective objectives (e.g., desired evaluative beliefs/perceptions, feelings/emotions, or frames; Dudo & Besley, 2016), and (3) overall behavioral goals (e.g., consider science when making policy, foster behavioral trust; Author Blinded, 2020). The current study uses a similar theoretical approach—grounded in well-established integrated theories of behavior change (e.g., Montano & Kasprzyk, 2015)—but focuses on what factors make it more likely that scientists say they will choose to prioritize putting resources into developing a public engagement strategy. It specifically focuses on factors that communication could potentially change and environmental scientists who work at a network of Long-Term Ecological Research (LTER) projects. Most of these projects are based at research sites in the United States or its territories.

The rationale for focusing on environmental scientists' willingness to prioritize the development of an engagement strategy reflects the expectation that science communication professionals may be able to help scientists make better choices about engagement tactics, objectives, goals by getting them to develop written strategies that provide a context and structure for these choices. The survey underlying this project was done as part of a larger project that will begin to explore the impact of providing LTER sites with support in developing and implementing engagement strategies.

The current study understands an engagement strategy as a plan describing the use of communication activities (i.e., tactics) to intentionally affect specific cognitive and affective outcomes in specific people (i.e., objectives) in order to affect desired behavioral outcomes in those people (i.e., goals). This approach builds on the delineation that Hon (1998) makes between behavioral goals and cognitive and affective objectives for communication and the broader literature on strategic communication (Hallahan, 2015). An evidence-based strategy is one that is based on research and, ideally, theory (Jensen & Gerber, 2020). For example, trust/credibility research (McCroskey & Teven, 1999; Schoorman et al., 2007) suggests that scientists whose goal was to foster behavioral trust might draw on evidence from trust research. Specifically, they might find that the evidence suggests that fostering behavioral trust might result from pursuing cognitive and affective “trustworthiness” objectives related to ensuring the community members see the scientists as competent (i.e., high ability), caring (i.e., high benevolence), and honest (i.e., high integrity; Hendriks et al., 2015). In turn, this means they may need to create communication opportunities that allow the community group to meaningfully assess the degree to which the relevant scientists have these characteristics. Recognizing the value of two-way communication, the research group could also have a goal of partnering with the community group and thus also design communication activities that let them engage in ways that let the scientists learn about group members’ abilities, motives, and integrity.

The current study also understands science engagement broadly (and pragmatically) to include a wide range of science communication activities while recognizing that higher quality communication typically involves efforts to cognitively and affectively engage all participants in the communication (Besley & Dudo, 2022b). This could occur through activities that may involve dialogue, storytelling, and personalization such that these participants—including

participating scientists—have the motivation and ability to attend to the experience in ways that increase the likelihood of forming the stable, evaluative beliefs (Petty & Cacioppo, 1986). It is these beliefs, in turn, which underlie long-term behavior change (Fishbein, 2009) and behavioral trust (Schoorman et al., 2007). This understanding of engagement does not equate dialogue with engagement, although it recognizes that dialogue-focused activities can be a powerful tool for engagement. The literature review below provides additional theoretical and practical context for the work.

The LTER context

The current study is focused on a population of scientists who work at a network of 27 American Long Term Ecological Research (LTER) site-based projects. These “LTER sites” are National Science Foundation-funded research projects that primarily occur at a range of sites the United States and its territories (LTER Network, 2023). The research is an initial part of a multi-year study built around helping these research teams try to think more strategically about their engagement efforts. LTER sites are useful locations for such research because they involve multiple scientists (typically less than 75) from a range of universities and other organizations who come together to conduct collaborative ecological research projects that often lend themselves to engagement efforts. What is key is that, while there is a wide range of research across LTERs, individual LTERs often have a few specific focal areas and thus have the potential for shared engagement goals. All sites are required to have some limited youth-oriented education programs but most also have *ad hoc* or planned communication activities with policymakers from various levels of government (including tribal governments), people from the private-sector/industry (e.g., landowners or commercial fishers), and/or other members of local communities (including tribal communities). The logic of the underlying project is that the range

of potential engagement choices means that a strategic approach might help sites identify specific priorities for focused, shared attention. Such a focus would enable higher quality engagement and a more efficient use of limited resources. The NSF is not the only funder at most sites, but the project provides a network through which these sites interact. The sites are also place-based, can have a long-term focus, and often employ (or partner with) a small number of professional communicators/educators who could help facilitate strategy development and implementation (Peterman et al., 2021).

Literature Review

A recent international study of research institutes and centers found that one of the best predictors of whether a scientific organization's leaders felt that they were having success at engagement was whether they had an engagement strategy (Besley & Dudo, 2022a). That research was partly based on an idea borrowed from public relations research that organizations are more likely to succeed in their communication efforts when they have the capacity to think at the level of communication strategy, and not just tactics (Grunig & Grunig, 2008). This would mean, for example, that an organization that is "excellent" at communication uses its organizational goals to identify relevant, audience-specific communication behavioral goals and then builds their communication efforts around finding realistic pathways to achieving those goals.

The situation is likely changing (Hendricks & Fond, 2023), but much of the science communication training in the United States, at least, appears to focus on improving tactical skills (Dudo et al., 2021). This might include the ability to speak clearly, tell interesting stories, and adapt to context. In contrast, Dudo et al. (2021) found that most training programs do not emphasize building capacity for evidence-based, collaborative strategy development and

implementation. Tactical skills are important (e.g., Aurbach et al., 2018; Rodgers et al. 2018), but technically skilled communicators may still focus on less-than-ideal topics and/or audiences if they do not think strategically. For example, strategic thinking would suggest that a scientific organization whose goal is to get policymakers to consider scientific evidence might decide to prioritize putting engagement resources into building relationships with policymakers. In turn, this would provide a justification for putting less time and money into programs for non-priority audiences and associated goals. Being a good storyteller does not help one make such choices. The expectation is that the sharpened focus on a few priority goals would enable higher quality engagement and thus greater likelihood of goal achievement. Indeed, it is impossible to talk meaningfully about effectiveness (or efficiency) without desired outcomes because the idea of effectiveness requires a planned outcome. Strategic thinking further seeks to ensure that the desired outcome is meaningful to an organization or individual. A specific tactic might be ‘effective’ at fostering desired beliefs, feelings, framings, or behaviors but a good engagement strategy is one where the outcomes contribute to some higher purpose (i.e., an organizational goal such as seeing policy considered, or increasing the likelihood that youth from a specific group consider a science career).

As noted, a key premise underlying the current study is that one way to help scientists become more effective communicators is to identify opportunities to get scientists to take part in the development of evidence-based public engagement strategies through organizations where they belong. In the language of strategy: Our vision is that scientists will be strategic in their communication activities and our nearer-term behavioral goal is to get them to put resources into developing and implementing strategic engagement plans. As such, we seek to identify the evaluative beliefs (i.e., perceptions) that might make it more likely that a scientist would put time

and other resources into the behavior of strategic planning. Evaluative beliefs are prioritized because these can be affected through communication. Background factors such as demographics may shape beliefs but cannot be readily changed through communication. Similarly, past experiences cannot be affected through future communication. However, including these types of variables can signal that future research may be needed if they remain meaningful predictors of behavioral willingness after controlling for more proximate variables (i.e., behavioral beliefs, in this case)

Strategic Science Communication as Planned Behavior

The current study builds largely on Poliakoff and Webb's (2007) recognition that we can treat scientists' "intention to engage" as a behavioral intention and thus study communication choices similar to other behaviors. They specifically adapted the well-established Theory of Planned Behavior (Fishbein & Ajzen, 2010) to assess evaluative beliefs associated with scientists' intentional engagement activity and found that scientists who were more willing to communicate tended to have stronger beliefs that communicating was beneficial (i.e., positive attitudes), common among their fellow scientists (i.e., descriptive norms), and within their control (i.e., positive self-efficacy). A number of others have built on this work (e.g., Dudo, 2013; Ho et al., 2022) and Besley and Dudo (2022b) proposed a 'strategic science communication as planned behavior' approach that proposes using behavior change theory to study the full range of scientists' intentional communication choices. This approach involves using an extension/derivation of the Theory of Planned Behavior (TPB) called the Integrated Behavioral Model (IBM; Fishbein, 2009; Montano & Kasprzyk, 2015) that integrates other behavior change models, as well as the Integrative Model of Organizational Trust (Schoorman et al., 2007), to look at scientists' choices about their willingness to consider specific

communication tactics (Author Blinded, 2021) cognitive and affective objectives (Author Blinded, 2018), and behavioral goals (Author Blinded, 2022). In general, this work has found that benefit beliefs (i.e., pro-behavior attitudes) are the best statistical predictor of communication choices, although behavioral control beliefs (i.e., self-efficacy, or agency) are also sometimes important. Normative beliefs, according to this research, seem to have little relationship to scientists' choices (for a review, see: Bennett et al., 2019; see also Bao et. al, 2023). To date, there has been little attention to the role that trust in public engagement practitioners plays in communication choices, but the Integrative Model of Organizational Trust suggests that people are more likely to behaviorally trust someone (i.e., make themselves vulnerable) as a function of their beliefs about the trustworthiness of that person (Hendriks et al, 2015; Schoorman et al., 2007). Some studies have also recently called for increased attention to the specific role of 'boundary spanners' in facilitating higher-quality engagement (e.g., Bednarek, 2018; Besley et al., 2021).

One type of communication choice that this line of research has not addressed is communication-*related* choices that might increase the likelihood that scientists make evidence-based communication choices but that are not choices about goals, objectives, or tactics. Scientists' choice to create an engagement strategy is such a choice and is the focus of the current study.

Research by Entradas and her colleagues, in this regard, has specifically pointed to "meso-level" factors such as access to public engagement support staff that make it more likely that scientists will engage (Entradas, 2021; Entradas & Bauer, 2016; Entradas et al., 2020). This is related to the aforementioned finding that having an engagement strategy is associated with perceptions of engagement success (Besley & Dudo, 2022a) and the increasing attention that

some communication scholars are putting on the importance of organizational factors in facilitating scientists' communication activity (e.g., France et al., 2017; Koivumäki & Wilkinson, 2020; Schäfer & Fährlich, 2020). Although not studied here, other types of meso-level communication-related behavioral choices that might deserve attention include choices about when to hire an expert communicator to help plan, organize, and how much to choose to invest in communication activities. The current study specifically uses the Integrative Behavioral Model (Montano & Kasprzyk, 2015) to identify potential evaluative beliefs that could make the choice to prioritize the development of an engagement plan more likely.

Intentional behaviors, in this regard, are different from habitual or automatic behaviors inasmuch as they are often done on purpose as a partial function of a persons' evolving evaluative beliefs, not simply as a result of heuristic cues from the environment (i.e., nudges). Of course, behaviors that are initially intentional can become habitual over time and appropriate cues can make existing beliefs more accessible and thus make behavioral intentions more likely (Fishbein & Ajzen, 2010), but the key is that those seeking intentional behavior change need to understand when they need to communicate to either update beliefs or make existing beliefs more cognitively accessible. Also, evaluative beliefs are understood as the building blocks of attitudes (i.e., attitudes can be operationalized as the sum of salient risk/benefit beliefs), social norms (i.e., the sum of salient normative beliefs), and agency (i.e., the sum of salient agency beliefs). They are 'evaluative' to the degree to which believing something is beneficial/risky, normative, or agency-relevant includes an affective element (i.e., risk is typically negative, feeling self-efficacious is positive, etc.; Fishbein & Ajzen, 2010). And it is ultimately these evaluative beliefs that have information analogues that proponents of a behavior can choose to include in their communication efforts. For example, a communication trainer who has a goal of

getting a group of scientists to spend more time listening to a community group might want to provide the scientists with engaging information about the benefits of listening, colleagues' norms around listening, as well as the feasibility of listening in order to shape (or make accessible) scientists beliefs about listening, norms, and feasibility.

As noted, the behavior of interest for the current study is whether scientists choose to prioritize developing a strategy for their public engagement efforts. Any strategic communication textbook will emphasize the importance of doing formative research to establish the communication situation and then building a plan to address that situation (e.g., Smith, 2021) but only 28% of U.S. respondents in one survey of university research centers or institutes said their organization had an engagement policy or policy (Besley & Dudo, 2022b). Related behaviors—not studied here—might include choices such as how much time gets devoted to engagement or what type of engagement support (e.g., a technical expert such as a writer or video producer, a strategist) one hires when building a communication team. These are not direct choices about goals, objectives, or tactics but they will likely affect those choices, for good or ill.

Hypotheses and Research Questions

The use of the Integrative Behavioral Model makes identifying potential predictors of our criterion variable straightforward. The novelty of the current study comes from applying this framework to scientists' meso-level choices. Also, behavioral models point to potential predictors of behavior but do not say which evaluative beliefs will be most highly associated with the focal behavior (Armitage & Conner, 2021). Formative research such as this is thus needed to assess what potential predictors are most highly correlated with a desired behavior, controlling for other factors.

In the current case, it could be expected that scientists who see a benefit to having an engagement strategy (i.e., positive attitude) would be more likely to say that developing such a strategy should be prioritized. Past research has generally found that various measures of benefit beliefs have typically been the best predictor of scientists' communication willingness (Bennett et al., 2019) and this is consistent with the broader TPB literature (Armitage & Conner, 2001). The IBM, however, specifically delineates two different types of benefit/risk beliefs to be consistent with literature that differentiates between expectations (1) about how a goal behavior will make a person feel when doing the behavior (affective or experiential beliefs about a behavior), and (2) the degree to which the person believes the target behavior is useful (instrumental beliefs about the behavior; Lawton et al., 2007). Additional research further suggests that it also makes sense to differentiate affective beliefs related to hedonic expectations (i.e., belief the behavior will be enjoyable) and eudemonic beliefs (i.e., belief the behavior will be satisfying; Oliver & Raney, 2011). For the current study, per table 1, it would have been ideal to have multi-item measures for each sub-construct, but space limitations precluded doing so. We also took a direct measurement approach rather than an expectancy value (EV) approach for similar reasons (i.e., we did not ask respondents to rate the likelihood that their expectations would come true). Direct measures appear to perform similarly to EV measures (Fishbein & Ajzen, 2010). As described below, the current analyses include two items to tap instrumental beliefs (i.e., engagement plans would be an effective and efficient way to achieve LTER projects' goals) and a single item to capture eudaemonic beliefs (i.e., developing an engagement plan would be satisfying). A hedonic measure (i.e., developing an engagement plan would be enjoyable) was not included because this seemed less applicable to the current context. The three

benefit measures also correlated highly enough that it seemed prudent to combine them and propose a single hypothesis.

H1: The degree to which LTER scientists believe that having an engagement strategy would be beneficial will be associated with the degree to which they prioritize the development of an engagement strategy.

Second, norms have generally been weak predictors of behavioral intentions in both the broader literature on planned behaviors (Armitage & Conner, 2001) and the specific research on scientists' communication choices (e.g., Bao et al., 2023; Tiffany et al., 2022). Nevertheless, concerns remain that scientists might avoid putting too much effort into communication because they worry other scientists will think negatively about them. This is sometimes called the Carl 'Sagan' Effect (e.g., Martinez-Conde, 2016). Expecting peer sanction could be considered a specific type of societal risk and is reflected in social norm theory's argument that one reason normative beliefs matter is that people want to avoid doing behaviors that lead to disapproval within a group they care about and do behaviors that their group will support. The idea of injunctive norms captures this idea in its focus on beliefs about what key groups expect (Rimal & Lapinski, 2015). Similarly, however, peoples' beliefs about what is common (i.e., normal) also likely matter because such perceptions serve as indicators for beneficial or harmful behaviors (i.e., if Starbucks is so popular then it is probably a competent coffee maker). For the current context, we therefore make two hypotheses, one about injunctive norm beliefs and the other about descriptive norm beliefs. Initially, a combined measure was considered (e.g., Author Blinded, 2021) but the items were only correlated at $r = .36$ ($p < .01$) so they were entered in the model separately.

H2: The degree to which LTER scientists believe that an engagement strategy is normatively expected will be associated with the degree to which they prioritize the development of an engagement strategy.

H3: The degree to which LTER scientists believe that an engagement strategy is normatively common will be associated with the degree to which they prioritize the development of an engagement strategy.

Third, the IBM distinguishes between two sub-types of agency beliefs, including beliefs about whether someone believes they have the skill to do a behavior (i.e., self-efficacy; Bandura, 1997; Robertson et al., 2018), and whether they believe they have control over the behavior (Ajzen, 2002). For example, someone might feel they have the expertise needed to create an engagement strategy but not the time or resources. In the current case, we also distinguished between the individual scientists' sense that they had the individual skills needed to contribute to an engagement strategy versus whether they believed their LTER project had the collective expertise (Thaker et al., 2019). The site-level collective expertise could also be considered a trustworthiness measure inasmuch as expertise (i.e., ability) is a standard sub-dimension of trustworthiness (Hendriks et al., 2015); this is discussed further below.

Beyond theory, the hypotheses are based on the logic that scientists will be more likely to be willing to prioritize developing a strategic engagement plan if they feel they (1) have the ability to help, (2) they believe their organization has the collective ability to support the work, and (3) they believe their organization has the time and financial resources to make it all happen. The first of these beliefs (personal skill beliefs) seems the least important, but it is included nevertheless because of a practical desire to see how the participating scientists believe about their abilities and how those self-efficacy beliefs might play into their willingness to contribute.

H4: The degree to which LTER scientists believe that they have the skill needed to help develop an engagement strategy will be associated with the degree to which they prioritize the development of an engagement strategy.

H5: The degree to which LTER scientists believe that their organization has the skill needed to develop an engagement strategy will be associated with the degree to which they prioritize the development of an engagement strategy.

H6: The degree to which LTER scientists believe that their organization has the resources needed to develop an engagement strategy will be associated with the degree to which they prioritize the development of an engagement strategy.

Trust is the fourth and final type of non-demographic variable included in the current effort to understand the factors associated with scientists' willingness to prioritize an engagement strategy. Ideally, we would have measures for scientists' specific beliefs in the trustworthiness of the engagement/communication staff that might be available to help them develop and implement an engagement strategy. Trustworthiness, in this regard, is typically understood to include perceptions of ability (i.e., expertise, or competence), integrity (i.e., honesty), and benevolence (i.e., goodwill, caring, warmth; Fiske & Dupree, 2014; Hendriks et al., 2015; McCroskey & Teven, 1999). In contrast, behavioral trust is typically understood as the behavior of making oneself vulnerable to a trustee (Schoorman et al., 2007). In scientific contexts, this might mean heeding a scientists' advice in situations of risk and uncertainty, or perhaps giving scientists scarce resources (e.g., time, money). For the current study, however, a full set of trustworthiness measures is not available but the afore-mentioned collective efficacy measure could be understood to equally tap LTER project-level expertise and there is a small set of behavioral trust measures that can be used. In this regard, the expectation is that scientists will be

more willing to say they want to prioritize developing an engagement strategy in situations where they are relatively more willing to lean on the people who are available to help them engage.

H7: The degree to which LTER scientists are willing to trust their public engagement staff will be associated with the degree to which they prioritize the development of an engagement strategy.

Demographics

In addition to variables for our primary hypotheses, we also include five control variables. Three of these are demographic measures and include self-reported gender, whether the respondent identifies as non-White, and career stage as a stand-in for age. We have no expectations for any of these—demographics have played a minor role in previous modeling of scientists' choices (Bennett et al, 2019)—though it may still be important to know if these broad categorizations have any relationship to views about developing an engagement strategy. The other two variables in the analyses are variables for past engagement experience (e.g., Dudo et al., 2018, Authors, 2018, Authors, 2019) and previous consideration (e.g., Authors, 2017, 2019) of engagement strategy. It might be hoped that scientists who have spent more time engaging and thinking about engagement would see additional value in having a strategy but, it might be that people with such experience believe they can succeed without a strategy. In both cases, however, these are not our current theoretical interest and are included for context and to help identify paths for future research.

Methods

Sample Characteristics

The survey used in this study was conducted using the Qualtrics online survey platform in March and February of 2023 using a list of all known LTER scientists provided by the LTER Network office. Scientists on the list were sent an email initial request followed by three reminders. The initial list of LTER scientists included 2,775 emails but a screening question at the start of the survey suggested that about 9.6% of respondents were non-scientist staff (i.e., educators, communicators) and thus the adjusted population of scientists is likely about 2,509 working scientists. Of these, 371 completed the bulk of the survey (adjusted response rate = 15%), although not all these respondents answered every question asked so the question-specific *n* is provided below. Also, LTER Network staff indicated that they expect that the list likely includes people who are no longer active with an LTER project so the real response rate might be somewhat higher. The survey took about 15 minutes to complete for the average respondent and the first page of the survey included informed consent as approved by the host university of the lead author.

Table 2 provides demographic information of those who responded to the criterion variable used in the analyses. About half of respondents identified as men (51%), and 15% did not identify as White. In both cases, a range of other options were included but we do not report these to avoid identifying respondents, given the small size of the study population. For career stage, a mean is reported but, of these, 28% were students, 16% were junior scientists (e.g., post-docs, assistant professor or equivalent), 21% were mid-career (e.g., associate professor or equivalent), 31% were senior, and 4% were retired/emeritus. In terms of field, although not used in the analyses, 78% identified as ecologists, 42% identified as biologists, 33% identified as biogeochemists, 19% identified as hydrologists, 8% identified as atmospheric scientists, and 8%

identified as social scientists/humanities scholars. Respondents could identify with multiple fields.

Also included in demographics (table 2) and the model below (table 3) are past engagement activity and previous consideration about the topic of strategic engagement plans. As noted, both are meant to represent contextual variables that might shape views about such plans. The data suggests that the scientists who responded have generally only done a small amount of public engagement activity and have not generally thought a lot about strategic engagement planning.

Measurement

In addition to the demographic variables in Table 2, Table 1 provides descriptive statistics and item wording for the criterion and predictor variables that are the focus of the current study. This includes measures of affective and instrumental beliefs, normative beliefs, and agency beliefs. These were all also adapted from past work focused on scientists' communication choices (e.g., Besley & Schweizer, 2022) as derived from the TPB/IBM (Montano & Kasprzyk, 2015).

INSERT TABLE 1 AND 2 ABOUT HERE (SEE BELOW FOR REVIEW)

The belief questions were asked on a single page of the survey instrument in a matrix table format. Space on the survey was limited so only some constructs were measured using multiple-item scales. This included the criterion variable, the benefit (attitude) measure, and one of the agency questions. Individual items were available for descriptive and injunctive norms, and two distinct aspects of agency. Supplementary Table 3 provides a correlation matrix for all the variables in the analyses.

Analyses

The primary analyses presented here were done using SPSS's mixed model procedure (Type III) for multivariate, multi-level analyses (for a primer, see: Hayes, 2006). The multi-level models were only used to appropriately address the fact that respondents were sometimes at the same project and thus not fully independent (Slater et al., 2006) but no attempt was made to propose hypotheses for project-level variables or test project-level hypotheses. These are not the current focus. The mixed model procedure is based on the General Linear Model and thus coefficients can be read in a way that is similar to Ordinary Least Squares regression with unstandardized coefficients.

Also, we report null-hypothesis statistical test results for the study's hypotheses as though we were using a traditional probability sample but, the fact that the survey represents an attempted census (i.e., all members of the population were contacted), means that all of the relationships discussed are technically 'significant.' The relevant error comes from non-response and measurement, rather than sampling.

Additional limitations of the current approach are addressed in the discussion.

Results

The mixed models reported in Table 3 indicate that believing that a strategic public engagement plan will help the scientists' LTER site (i.e., positive attitude) is the best predictor of a willingness to prioritize developing an engagement strategy but that other beliefs might also matter. For benefits, consistent with H1, the results suggest that all things being equal, a 1-point change in perceived benefits (on a 5-point scale) will result in about a 2/5-of-a-point change in support for putting resources into an engagement strategy (in all cases, see tables for specific estimates). In addition, scientists who said they believe people at their project site have the ability (i.e., collective self-efficacy) to do engagement planning (H6) and who trusted their

engagement staff (H7) were also somewhat more likely to support putting resources into engagement strategizing. In both cases, a 1-point change in the predictor variable was only associated with about a 1/6-of-a-point change in strategy willingness.

INSERT TABLE 3 ABOUT HERE (SEE BELOW FOR REVIEW)

In contrast, neither injunctive (H2) nor descriptive norms (H3), nor personal expertise (i.e., self-efficacy; H4), appeared to be meaningful statistical predictors of a willingness to prioritize strategic engagement planning. More unexpectedly, and contrary to H5, believing that your site has the expertise to contribute to an engagement strategy is negatively associated with a desire to develop an engagement strategy after controlling for other variables. The correlation table in Supplementary Table 3 shows that this collective-efficacy variable is essentially uncorrelated with the criterion variable on its own. Potential reasons for this pattern are discussed below.

Overall, even with the single-item measures, the marginal and conditional pseudo- R^2 suggest that the individual-level criterion variables coupled with the demographic variables account for a substantial portion of the overall variance in the criterion variable. This includes a substantial amount of the between-site variance (i.e., the marginal and conditional pseudo- R^2 are similar in Model 4 and the ICC is .03).

Although not the primary focus here, it is also noteworthy that career stage is somewhat negatively associated with a willingness to prioritize the development of a public engagement strategy, but previous consideration of engagement strategy is positively associated. Both relationships are discussed below in the context of future research. In contrast, past engagement activity is only weakly associated with public engagement strategy prioritization. Identifying as a man or non-White are not associated with the criterion variable. This is consistent with past

surveys of scientists where demographics are rarely substantial predictors (e.g., Bennett et al., 2019) and underlies the rationale for putting limited focus on these variables here.

Discussion

The current results suggest that believing that an engagement plan would be beneficial was associated with LTER scientists' stated willingness to prioritize developing such a plan (H1). This pattern of results is generally consistent with behavior change research and theory (e.g., Montano & Kasprzyk, 2015; Armitage & Conner, 2001) and specific work focused on scientists (e.g., Authors 2018; Ho et al., 2023; for a review, see: Bennett et al., 2019). The minimal relationship between norms and behavioral intention (H3 and H4), for example, continues to show that normative beliefs seem to have little relationship to how scientists think about engagement (Tiffany & Besley, 2023). Similarly, although the context is quite different, the meaningful role of beliefs about site-level resources (H6) is consistent with some past work showing that perceived resources (e.g., time) matter to scientists' individual engagement choices (Besley et al., 2018). The fact that site expertise beliefs are negatively correlated with willingness to strategize (H5) after controlling for other variables is hard to understand but the relationship is small and not present in the basic correlations. Future research is thus needed to confirm and explore this potential pattern in the data. It could be, for example, that all things being equal, scientists who believe they have strong site-level engagement expertise are comfortable allowing experts to manage the process without a site-wide engagement strategy. The trust measure (H7), however, points to the idea scientists who want engagement staff to lead engagement efforts are also more willing to prioritize the development of an engagement strategy. Whatever the case, the main finding remains the strength of the benefit perceptions variable in predicting views about the criterion variable, especially when compared to the

weakness of the other potential predictors. Past work (e.g., Besley et al, 2018; Poliakoff & Webb, 2007) has generally not found that any single variable has this type of outsize role. The practical value of this clear pattern is that it suggests that anyone who wants to encourage scientists to develop an engagement plan might want to communicate that doing so will be beneficial.

It is possible to make the ‘communicate the benefits of strategic plans’ argument with just logic and associated concepts but identifying specific examples of scientific organizations that have developed and implemented strategies that resulted in goal achievement might help. Such examples appear to be rare in the science communication space but are central to broader discussions about organizational strategy (e.g., Malone & Fiske, 2013; Rumelt, 2011). The closest science-communication-specific example is perhaps Davies & Horst (2016), but their focus is more conceptual and historical than case studies. There are also copious examples of research aimed at evaluating specific engagement activities (e.g., Hall et al, 2013) but this also seems different from target research seeking to understand scientists’ experiences with organizational-level, multi-goal, multi-activity strategies. This suggests it may be necessary for science communication scholars who want to advance strategic thinking in public engagement to try to identify scientific organizations who have successfully used strategic plans to achieve their goals. If such organizations are as rare as they seem, it may be necessary to work with scientific organizations to develop, implement, and evaluate strategic engagement efforts. Some of this work is ongoing as part of the broader project underlying the current study but additional studies by other scholars would be helpful.

It is also noteworthy that a potential challenge to communicating about the benefits of engagement strategies is that the descriptive statistics reported here suggest that many scientists

already see having an engagement strategy as an effective, efficient, and satisfying path forward (table 1). There is therefore only limited room to move scientists' perceptions. Nevertheless, the correlations in Supplementary Table 3 suggest that scientists who are later in their careers might benefit from communication aimed at communicating the potential benefits of engagement strategy.

The trust factor (H7) has a similar problem to the benefit factor (H1) in that there is limited room to increase the score (i.e., scientists already seem to trust their engagement professionals), but this is not the case when it comes to the variable for behavioral control related to resources (H6). Indeed, the descriptive statistics suggest that there is a lot of opportunity to (re)shape perceptions about whether sites have the resources—time and money—to develop and implement engagement strategies. Of course, the solution is not simply to disingenuously communicate that resources are available if they are not. A reasonable path forward likely involves an iterative process of identifying potential resources and then communicating their availability. Again, however, there is likely the need for the identification and/or development of exemplars that show how engagement resources can be found and deployed appropriately.

Additional areas for future work

Although not a primary focus of the current work (and underlying theory), the results for career stage and previous consideration of engagement strategy both point to potential opportunities for researchers and practitioners. As background variables, the hope was that these factors would become statistically insignificant once the more proximate belief variables were considered. The fact that they remained at least somewhat significant predictors suggests that both may be associated with additional beliefs not captured in the current study.

For career stage, while the relationship is small, it seems plausible that relatively older scholars might be more satisfied with the status quo (or pessimistic about potential changes) while younger scholars believe that an engagement strategy might be useful. The correlations reported in supplementary Table 3, specifically suggest that older scholars see having a strategy as less beneficial, less normal, and less within their sites' abilities. Follow-up research specifically aimed at assessing the nature of any such differences, including their potential origins, seems warranted despite past findings suggesting that age is generally a small predictor of engagement views (for a review, see Bennett et al, 2019).

For previous consideration of engagement strategy, the results suggest there may be both practical and research benefits to getting scientists to think more about strategy. The additional positive correlations shown in Supplementary Table 3 further suggest that such consideration has meaningful relationships with a range of pro-strategy beliefs. Interestingly, career stage was not associated with previous thinking about engagement strategy but there was a fairly strong correlation between previous engagement experience and previous thinking about strategy. The finding that older scholars were somewhat more likely to have engaged but not more likely to have spent time thinking about engagement strategy further points to the importance about designing research specifically aimed at understanding the specific effects of having scientists think through engagement strategy.

The project underlying the current study is moving forward with finding ways to work with groups of scientists such as associated with LTERs to better understand how to develop evidence-based engagement strategies that are effective and feasible given available resources. The hope is to co-create and implement strategies that have the support of site scientists and build on increased discussion with relevant actors (i.e., local community groups). The current

study focused only on the idea of getting scientists to prioritize the development of engagement strategies but, in practice, it will also be important to ensure that strategies are consistent with current public engagement thinking related to ethics (i.e., the importance of reciprocity, and justice, see: Priest et al., 2018), as well as impact (e.g., Besley & Dudo, 2022; Hendricks & Fond, 2023).

Other areas where the current research line could advance and address its limitations include building out the measurement of key constructs—especially the trust in engagement practitioners measures (e.g., Hendriks et al., 2015)—and potentially increasing the specificity of the focus. For example, the current study focuses on overall views about putting resources into an engagement strategy, but it might also be useful to focus on views about the development of an engagement strategy designed to meet a specific set of agreed-upon goals. It might be expected that, in such a case, the individual scientists' agreement with the priority goals would shape their views about the value of a strategy. An interesting element of the current study is that it also focuses on a specific type of scientist—environmental scientists working with LTER projects—because of the possibility of working with such sites in the future to help them develop engagement strategies. An alternative approach would be to focus on broader samples of scientists to get a more general sense of scientists' willingness to develop engagement strategy. It might be that norms and efficacy factors become more relevant as the issue becomes more concrete. A potential challenge to use a broader is ample is that it is not clear if all scientists have groups within which it makes sense to develop shared engagement strategies. As noted above, a reason for focusing on LTER scientists in the current study is that it seems likely that being part of an organization where there is a potential for shared goals and collaboration will increase the likelihood of long-term engagement success. Similarly, recognizing that most scientists have

little experience with strategy development, it may be interesting to identify scientist samples who have more experience with strategy to see if the patterns reported here change. Ultimately, of course, it would be ideal to see if communication and experience shape engagement strategy views in predictable ways.

Ethics Statement

This research was done with the approval of the [BLINDED; NAME OF REVIEW PANEL UNIVERSITY TO BE INSERTED PRIOR TO PUBLICATION]. All respondents completed an informed consent prior to completing the survey and could withdraw at any time.

Table 1.

Descriptive statistics for belief measures

	Mean	SD	N
Strategic engagement plan prioritization scale ($\alpha = .87$)	3.51	0.76	329
Each LTER <i>site should</i> have an overall engagement <i>strategy</i> to help scientists help achieve priority goals.	4.12	0.94	323
How much time, if any, do you think your LTER site should put into developing a public engagement strategy ¹	3.12	0.86	329
And how much of the LTER's financial resources do you think your LTER site should put into developing such a strategy? ²	2.73	0.87	328
Benefit beliefs scale (Attitudes; $\alpha = .87$)	4.28	0.74	323
Having an engagement strategy would be an <i>effective</i> way for my LTER site to help achieve priority goals.	4.38	0.76	323
Having an engagement strategy would help my LTER site achieve priority goals more <i>efficiently</i>	4.29	0.85	323
It would be <i>satisfying</i> for my LTER site to have an engagement strategy to help achieve priority goals	4.15	0.89	322
Normative beliefs			
<i>Injunctive norm:</i> My colleagues would approve of having an engagement strategy at our LTER site to help achieve priority goals	3.95	0.88	322
<i>Descriptive norm:</i> It is normal for places like LTER sites to have engagement strategies to help achieve priority goals.	3.53	1.01	323
Agency Beliefs			
I have the <i>personal ability</i> to contribute to an engagement strategy to help achieve priority site goals at my LTER site	3.42	1.24	323
People at my LTER <i>site</i> have the <i>expertise</i> to contribute to an engagement strategy to help achieve priority goals	3.77	1.05	323
Site resource belief scale ($r = .59$)	2.84	0.99	323
My LTER site has the financial resources to contribute to an engagement strategy to help achieve priority goals	2.91	1.11	323
People at my LTER site have the time to contribute to an engagement strategy to help achieve priority goals	2.76	1.12	323
Trust in public engagement staff ($r = .81$)¹	4.34	0.86	322
Desired role of engagement/outreach staff in developing engagement strategy	4.33	0.90	320
Desired role of engagement/outreach staff in implementing engagement strategy	4.35	0.90	316

Notes: Italics denote text used in Table 3. Unless noted, the response options were: 1 = Strongly disagree, 2, = Disagree, 3 = Neither agree, nor disagree, 4 = Somewhat agree, 5 = Strongly Agree. The allocation questions had response options of 1 = None/A very small amount of time/financial resources, 2 = A small amount of time/financial resources, 3 = A moderate amount of time/financial resources, 4 = A fairly substantial amount of time/financial resources, 5 = A very substantial amount of financial resources. Supplementary Table 1 provides additional related questions that provide further context into the role that scientists wanted various actors to play in the development and implementation of strategic engagement plans.

Table 2

Descriptive statistics for demographic measures

Demographic item	Est.	SD	n
<i>Identifies as a man</i>	51%		317
<i>Does not identify as White</i>	15%		329
<i>Career stage</i> ²	2.69	1.36	317
<i>Past engagement scale</i> (alpha = .82) ³	2.26	1.05	312
Individual adult society members in the broader public (e.g., museum visitors, news readers/viewers, social media users, consumers, voters)	3.00	1.73	310
People in specific professional groups (e.g., environmental managers, healthcare workers, lawyers, trade-workers, social-workers, educators)	2.50	1.63	311
People from specific racial/cultural identity groups	2.27	1.68	307
Journalists and other media professionals (e.g., producers, filmmakers)	2.19	1.22	312
Policymakers and others involved in public policy (e.g., politicians, government employees, lobbying/advocacy organizations)	2.18	1.52	309
People from specific values-focused identity groups (e.g., liberals, conservatives, evangelicals, environmentalists)	1.90	1.44	308
For-profit businesses/people in the private sector (e.g., people who work for companies to develop, implement, and/or assess new products and services)- For-profit Actors	1.78	1.26	311
<i>Previous consideration</i> : I have previously thought a lot about the value an LTER engagement strategy to help achieve priority goals	3.25	1.27	324

Notes: Italics denote text used in Table3. Responses were filtered to only include respondents for which there is strategy prioritization data. ¹Asked with belief questions reported in Table 2; response options were: 1 = Strongly disagree, 2 = Disagree, 3 = Neither agree, nor disagree, 4 = Somewhat agree, 5 = Strongly Agree. ²For career stage, 1 = Student, 2 = Junior (e.g., post-doc; assistant professor, entry-level researcher/analyst/technician), 3 = Mid-career (e.g., associate professor, mid-level administrator or researcher/analyst/technician), 4 = Senior (e.g., full professor, senior administrator or researcher/analyst/technician), 5 = Retired/Emeritus. ³Past engagement questions were preceded by "First, how often have you engaged with public audiences about science in the last year? We're interested in both engagement related to the LTERs as well as other engagement in which you may have participated. For each type of public engagement audience, please select the choice that best describes your amount of engagement in the last year through any channel (i.e., face-to-face, online, in writing, through audio/video, etc.)." Response options were: 1 = Never, 2 = Once, 3 = 2-5 times, 4 = 6-11 times, 5 = About once a month, 6 = Multiple times per month, 7 = Once a week, or more. A separate youth/student category was not included in the scale.

Table 3. Mixed model results for environmental scientists' views about prioritizing the development of a strategic engagement plan (Unstandardized estimates with 95% confidence intervals)

Model 1: Intercept Only				
	Est.	95LL CI	95UL CI	p
Intercept	3.48	3.33	3.62	.00
<i>Random Effects</i>				
Residual	0.50	0.42	0.58	.00
LTER Site	0.09	0.04	0.19	.02
<i>n</i> , -2LL, ICC, Marg./Cond. Pseudo R ²	329	754.39	0.15	.00/.15
Model 2: Demographics⁺⁺ (Full Model Results in Supplementary Table 2)				
<i>n</i> , -2LL, ICC, Marg./Cond. Pseudo R ²	301	593.18	0.07	.28/.33
Model 3: Behavioral Predictors (Full Model Results in Supplementary Table 2)				
<i>n</i> , -2LL, ICC, Marg./Cond. Pseudo R ²	311	501.37	0.07	.48/.52
Model 4: Complete Model				
<i>Fixed Effects</i>				
Intercept	3.56	3.46	3.65	<.01
Identifies as man	-0.05	-0.17	0.07	.41
Does not identify as white	-0.08	-0.27	0.12	.44
Career stage	-0.08	-0.12	-0.03	<.01
Past engagement	0.06	0.00	0.13	.07
Previous consideration	0.13	0.07	0.18	<.01
Benefit Beliefs (Attitude; H1)	0.39	0.30	0.49	<.01
Injunctive Norm Belief (H2)	-0.01	-0.08	0.07	.86
Descriptive Norm Belief (H3)	0.06	0.00	0.12	.07
Personal Expertise Belief (H4)	0.06	0.00	0.12	.06
Site Expertise Belief (H5)	-0.09	-0.15	-0.02	.01
Site Resources Beliefs (H6)	0.14	0.07	0.21	<.01
Trust in Public Engagement Staff (H7) ¹	0.14	0.07	0.21	<.01
<i>Random Effects</i>				
Residual	0.25	0.21	0.29	0<.01
LTER Site	0.01	0.00	0.09	.45
<i>n</i> , -2LL, ICC, Marg./Cond. Pseudo R ²	288	448.46	0.03	.56/.57

Notes: ¹This is not a typo; they really were the same. 95LL CI = 95 % Lower-level confidence interval; 95 UL CI 95% Upper-level confidence interval. ICC = Intraclass coefficient efficient (proportion of total variance accounted for by LTER site clusters). Marginal pseudo-R² represents fixed effects while conditional R² represents variance explained by fixed and random effects.

Supplementary Tables

Supplementary Table 1.

Descriptive statistics for environmental scientists' views about who should be involved in strategic engagement plan development and implementation.

	Mean	SD	N
Looking forward, how much of a role would you want each of the following types of people to play in developing an engagement strategy at your LTER site? By "developing," we mean identifying and prioritizing shared goals and then choosing what near term objectives and specific activities LTER-affiliated individuals would prioritize to achieve those goals.			
• Site Leadership Team	3.95	0.93	322
• Research Scientists	3.44	1.00	322
• Post-doctoral Researchers	2.95	1.01	322
• Graduate Students	2.94	1.05	322
• Undergraduate Students	2.45	1.06	318
• Education Staff	3.49	1.11	321
• Public Engagement/Communication Staff*	4.33	0.90	320
How much of a role would you want the following types of people to play in implementing an engagement strategy at your LTER to achieve priority goals? By "implementing," we mean carrying out the activities (e.g., leading or participating in outreach events, speaking with relevant groups; writing for relevant groups, etc.).			
• Site Leadership Team	3.56	1.05	318
• Research Scientists	3.44	1.02	317
• Post-doctoral Researchers	3.09	1.05	318
• Graduate Students	3.11	1.08	317
• Undergraduate Students	2.66	1.10	316
• K-12 Education Staff	3.56	1.17	316
• Public Engagement/Communication Staff*	4.35	0.90	316

Notes: 1 = No role/very small role, 2 = Somewhat small role, 3 = Moderate role, 4 = Somewhat large role, 5 = Very large role.

*This is the only data used in the modeling described in the main body of the study.

Supplementary Table 2.

Additional Mixed Model results for environmental scientists' views about prioritizing the development of a strategic engagement plan (see also main text of Table 2)

Model 2: Demographics⁺⁺	Est.	95LL CI	95UL CI	p
<i>Fixed effects</i>				
Intercept	3.56	3.43	3.68	<.01
Identifies as man	-0.09	-0.24	0.06	.22
Does not identify as white	-0.06	-0.30	0.18	.61
Career stage	-0.14	-0.20	-0.09	<.01
Past engagement	0.08	0.00	0.16	.05
Previous consideration	0.25	0.19	0.32	<.01
<i>Random Effects</i>				
Residual	0.38	0.33	0.45	<.01
LTER Site	0.03	0.01	0.11	.16
n, -2LL, ICC, Cond./Marg. Pseudo r ²	301	593.18	0.07	.28/.33
Model 3: Behavioral Predictors				
<i>Fixed Effects</i>				
Intercept	3.51	3.42	3.59	<.01
Benefit Beliefs (Attitude; H1)	0.45	0.36	0.55	<.01
Injunctive Norm Belief (H2)	0.01	-0.07	0.09	.90
Descriptive Norm Belief (H3)	0.08	0.02	0.14	.01
Personal Expertise Belief (H4)	0.10	0.05	0.16	<.01
Site Expertise Belief (H5)	-0.10	-0.16	-0.03	<.01
Site Resources Beliefs (H6)	0.14	0.07	0.21	<.01
Trust in Public Engagement Staff (H7) ¹	0.14	0.07	0.21	<.01
	311	501.37	0.07	.52
<i>Random Effects</i>				
Residual	0.27	0.23	0.32	<.01
LTER Site	0.02	0.01	0.07	.12
n, -2LL, ICC, Cond./Marg. Pseudo r ²	310	631.15	0.06	.48/.53

Notes: See main study body for Model 1 and 4. 95LL CI = 95 % Lower-level confidence interval; 95 UL CI 95% Upper-level confidence interval. ICC = Intraclass coefficient efficient (proportion of total variance accounted for by LTER site clusters). Marginal pseudo-R² represents fixed effects while conditional R² represents variance explained by fixed and random effects.

Supplementary Table 3.

Correlation matrix of all variables

	D1	D2	D3	D4	D4a	D4b	D4c	D4d	D4e	D4f	D4g	D5	B1	B1a	B1b	B1c	N1	N2	A1	A2	A3	A3a	A3b	T1	T1a	T1b	S1	S1a	S1b	S1c
<i>Identifies as a man (D1)</i>																														
Does not identify as White (D2)	-.12																													
Career stage (D3)	.24	.09 ^{ns}																												
Past Engagement (D4)	.07 ^{ns}	.14	.08 ^{ns}																											
Policymakers (D4a)	.07 ^{ns}	.14	.08 ^{ns}	.07 ^{ns}																										
For-profit Actors (D4b) [*]	.02 ^{ns}	.14	.08 ^{ns}	.07 ^{ns}	.02 ^{ns}																									
Professions (D4c)	.01 ^{ns}	.14	.08 ^{ns}	.07 ^{ns}	.02 ^{ns}	.01 ^{ns}																								
Race/Cultural Group (D4d)	-.04 ^{ns}	.14	.08 ^{ns}	.07 ^{ns}	.02 ^{ns}	.01 ^{ns}	-.04 ^{ns}																							
Values-based Group (D4e)	.16	.07 ^{ns}	.09 ^{ns}	.08 ^{ns}	.03	.01	.07	.05 ^{ns}	.10 ^{ns}	.16	.15	.13	.13	.10	-.03 ^{ns}	-.06 ^{ns}	.00 ^{ns}	.17	.15	.16	.12									
General Adults (D4f)	.32	.15	.10 ^{ns}	.14	.15	.03 ^{ns}	-.09 ^{ns}	.29	.02 ^{ns}	.13	.13	.10	-.03 ^{ns}	-.06 ^{ns}	.00 ^{ns}	.17	.15	.16	.12											
Journalists (D4g)	.40	.14	.13	.09 ^{ns}	.15	.07 ^{ns}	-.04 ^{ns}	.35	.13	.13	.15	.08 ^{ns}	.06 ^{ns}	.03 ^{ns}	.08 ^{ns}	.23	.21	.20	.18											
Previous consideration (D5)	.32	.15	.10 ^{ns}	.14	.15	.03 ^{ns}	-.09 ^{ns}	.29	.02 ^{ns}	.13	.13	.10	-.03 ^{ns}	-.06 ^{ns}	.00 ^{ns}	.17	.15	.16	.12											
Benefit beliefs (B1)	.19	.09 ^{ns}	.13	.08 ^{ns}	.05 ^{ns}	.02 ^{ns}	.06 ^{ns}	.19	.12	.20	.21	.15	-.02 ^{ns}	-.07 ^{ns}	.02 ^{ns}	.08 ^{ns}	.09 ^{ns}	.05 ^{ns}	.07 ^{ns}											
Effective (B1a)	.33	.14	.14	.10 ^{ns}	.13	.07 ^{ns}	-.09 ^{ns}	.33	.12	.07 ^{ns}	.09	.03	.08	.05	.10	.21	.22	.15	.12											
Efficient (B1b)	.33	.05 ^{ns}	.02 ^{ns}	-.01 ^{ns}	.13	.11	.02 ^{ns}	.22	.11	.08 ^{ns}	.06 ^{ns}	.09 ^{ns}	.03 ^{ns}	.03 ^{ns}	.02 ^{ns}	.25	.18	.25	.26											
Satisfying (B1c)	.26	.05 ^{ns}	.05 ^{ns}	.04 ^{ns}	.05 ^{ns}	.07 ^{ns}	.04 ^{ns}	.20	.09	.16	.17	.11	.02 ^{ns}	.01 ^{ns}	.01 ^{ns}	.17	.16	.14	.12											
Injunctive Norm (N1)	.23	.10 ^{ns}	.11	.02 ^{ns}	.13	.05 ^{ns}	.01 ^{ns}	.24	.07 ^{ns}	-.03 ^{ns}	.04 ^{ns}	-.09 ^{ns}	.14	.11	.15	.16	.16	.13	.09 ^{ns}											
Descriptive Norm (N2)	.25	.11 ^{ns}	.08 ^{ns}	.09 ^{ns}	.11	.03 ^{ns}	-.11	.21	.10 ^{ns}	.05 ^{ns}	.05 ^{ns}	.03 ^{ns}	.06 ^{ns}	.02 ^{ns}	.09 ^{ns}	.03 ^{ns}	.03 ^{ns}	.04 ^{ns}	.03 ^{ns}											
Personal ability (A1)	.28	.17	.21	.36	.22	.19	.53	.17	.30	.23	.31	.13	.12	.13	.45	.39	.39	.38												
Site expertise (A2)	.90	.90	.88	.41	.20	.41	.17	.27	.23	.24	.27	.26	.24	.62	.60	.51	.38													
Resource Beliefs (A3)	.77	.67	.34	.22	.36	.15	.32	.13	.22	.18	.22	.22	.19	.51	.49	.42	.31													
Financial (A3a)	.65	.35	.15	.32	.13	.22	.18	.22	.22	.22	.22	.22	.19	.51	.49	.42	.31													
Time (A3b)	.40	.18	.42	.18	.25	.21	.23	.24	.24	.24	.24	.24	.21	.62	.58	.51	.41													
Trust in PE Staff (T1)	.36	.27	.34	.23	.20	.22	.14	.14	.13	.31	.33	.23	.16																	
Developing plan (T1a)	.16	.20	.23	.22	.19	.10 ^{ns}	.12	.07 ^{ns}	.27	.28	.18	.19																		
Implementing plan (T1b)	.25	.33	.30	.28	.13	.12	.12	.44	.40	.38	.32																			
Plan prioritization (S1)	.47	.38	.45	.11 ^{ns}	.10 ^{ns}	.09 ^{ns}	.13	.15	.08 ^{ns}	.07 ^{ns}																				
Site should have strategy (S1b)	.89	.89	.08 ^{ns}	.06 ^{ns}	.09 ^{ns}	.37	.32	.34	.27																					
Time (S1b)	.59	.11	.09 ^{ns}	.13	.35	.31	.30	.27																						
Financial resources (S1c)	.03 ^{ns}	.02 ^{ns}	.03 ^{ns}	.31	.26	.30	.21																							
	.95	.95	.32	.30	.29	.20																								
	.81	.31	.28	.31	.19																									
	.30	.29	.25	.19																										
	.89	.82	.77																											
	.53	.44																												
	.76																													

Notes: NS subscript designates $p < .05$. Boxed text indicates variables in a scale.

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