

RESEARCH ARTICLE

Which aspects of restoration project organization relate to volunteer engagement in community-based initiatives?

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Abstract

Introduction: Project organization is an under-studied but important aspect of volunteer engagement in ecological restoration and conservation. Previous studies on volunteer commitment have found that people are more engaged in well-organized projects, but what constitutes good project organization from a volunteer perspective has not been empirically examined.

Objectives: This study investigates how the components of project organization (i.e. social capital, transformational leadership, and organizational capacity) relate to volunteer engagement in ecological restoration and conservation projects.

Methods: We conducted an online survey of volunteers in ecological restoration and conservation projects in Ontario, Canada (182 respondents accessed the survey; 143 provided analyzable responses) to examine the relationship between these three factors and volunteer engagement.

Results: A path analysis showed that transformational leadership ($\beta = 0.472$, $p < 0.001$) and organizational capacity ($\beta = 0.263$, $p = 0.002$) were positively associated with social capital, which in turn was positively associated with volunteer engagement ($\beta = 0.407$, $p < 0.001$). The model accounted for 37.7% of the variance in social capital and 16.6% in volunteer engagement. Neither transformational leadership nor organizational capacity showed a direct association with volunteer engagement once social capital was accounted for.

Conclusion: Volunteer engagement was most strongly associated with social capital—the trust, shared vision, and interpersonal connections among volunteers—and the associations of leadership and organizational capacity with engagement appear to operate through it rather than independently. Because the design is cross-sectional and single-source, these are associations rather than causal effects. Practitioners seeking to increase engagement nonetheless have grounds to attend to the relational dimension of their programs alongside leadership and resourcing.

Implications for Practice: Volunteer managers should focus on building social capital (e.g. trust, friendship, and shared vision) among volunteers to increase engagement. While good leadership and organizational capacity are important, their association with volunteer engagement appears to operate through social capital rather than directly. Therefore, restoration and conservation volunteer programs that foster community among participants through shared activities, group identity, and interpersonal connections may see higher levels of volunteer engagement, which may in turn contribute to more effective restoration outcomes.

Key words: community-based initiatives, conservation volunteering, restoration ecology, voluntarism, volunteer engagement

Introduction

Volunteer participation in ecological restoration and conservation is both a means of accomplishing stewardship goals and a way of enhancing people's engagement with nature (Suding et al. 2015; Molsher & Townsend 2016). Increasing volunteer participation is essential to scaling up restoration efforts and achieving the goals of the United Nations Decade on Ecosystem Restoration (Fischer et al. 2020). Volunteer-supported restoration projects tend to be seen as more legitimate and exhibit reduced conflict with local communities (Baker 2017). Volunteer engagement is therefore a core goal of ecological restoration because it has the potential to reduce costs and increase the impact and reach of restoration work (Suding et al. 2015).

While research on volunteering has tended to focus on the motivations that draw people to participate (Molsher & Townsend 2016), other factors that may condition ongoing

engagement have received less attention. Notably, volunteers who are committed to projects cite project organization as a core

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reason for their continued involvement (Ryan et al. 2001). For example, interviews with divers who participate in invasive lionfish control found that a well-organized project contributed to their motivation to participate (Carballo-Cárdenas & Tobi 2016), and a survey of volunteers for the Texas Parks and Wildlife Department ranked project organization ahead of social and career motivations (Ding & Schuett 2020). Knowledge of how organizational functioning affects ecological restoration outcomes has been described as a key determinant of restoration's viability as a strategy to improve ecosystem services (Galatowitsch 2023). However, despite these indications that project organization matters to volunteers, what constitutes good project organization from a volunteer perspective has not been empirically examined.

Community-based initiatives, which are defined here as local groups of community members who self-organize to collectively address environmental problems (Chaskin 2001; Edelenbos et al. 2018), are the organizational form that much community-led ecological restoration takes. These initiatives are distinguished from traditional volunteer organizations (e.g. chapters of national conservation charities) by their grassroots origins and reliance on local self-governance, though many receive funding and support from governments and organizations. Research into the performance of community-based initiatives—defined as the degree to which the organization meets its stated goals—has identified social capital, transformational leadership, and organizational capacity as factors important for success (Igalla et al. 2020; see Table 1 for definitions). These are factors internal to an initiative, and they are not the only things that bear on whether people volunteer or keep volunteering. Other factors—such as environmental norms (García-Valiñas et al. 2012), political and economic conditions (Kwiatkowski et al. 2020), and population demographics (Lamb 2019) all matter, but here we examine the conditions a project itself can act on.

Research on what sustains long-term volunteer participation has moved beyond initial motivations to examine organizational

and relational factors that condition ongoing commitment. Studies of volunteer retention in natural resource management contexts have found that perceived organizational support, interpersonal relationships, and sense of purpose are key predictors of continued participation (Gooch & Warburton 2009). In nature-based volunteering more broadly, Ganzevoort and van den Born (2023) found that organizational quality bears asymmetrically on retention, mattering more to why volunteers leave than to why they stay. The role of leadership in shaping volunteer experience has received growing attention: Joseph and Carolissen (2022) identified leadership style as a silent but significant factor in student volunteer retention, while Tsai et al. (2024) found that leader behavior significantly predicted volunteer satisfaction in emergency volunteer organizations, mediated by psychological safety. The importance of perceived project quality and interpersonal connections as determinants of sustained engagement has also been formalized into a conceptual model tested by Gilbert et al. (2021), who found that volunteers' assessments of project organization were among the strongest predictors of their commitment. Taken together, this literature suggests that organizational factors like leadership and relational dynamics play an important role in sustaining volunteer engagement. However, this work has largely examined general volunteering or sector-specific contexts. Whether and how similar dynamics operate in ecological restoration, and which specific dimensions of project organization matter most, remain underexplored.

In the case of ecological restoration organizations, volunteer engagement itself is often an explicit goal of volunteer programs (Suding et al. 2015). We define volunteer engagement as the degree to which volunteers report feeling connected to the project's goals and energized by its activities (Vecina et al. 2012), measured using an adapted version of the Utrecht Work Engagement Scale (UWES) (Schaufeli et al. 2006). If the factors that affect the performance of community-based initiatives also influence volunteer engagement, then understanding these relationships has consequences beyond the design of individual volunteer programs. Restoration is not a single intervention but a sequence of commitments: sites planted in one season require weeding, watering, and invasive species control for years afterward, and monitoring is only effective if it is sustained long enough to detect trajectory (Suding et al. 2015). Volunteer turnover may impose a recurring cost on organizations already operating at the margins of their capacity. Knowing which aspects of project organization are related to sustained engagement therefore bears directly on which efforts will make a community-based initiative viable over the timescales that ecological restoration requires—a question of increasing consequence as restoration commitments under the UN Decade on Ecosystem Restoration outpace the professional workforce available to deliver on them (Fischer et al. 2020).

We conducted a survey of volunteers in community-based ecological restoration and conservation initiatives in Ontario, Canada, to answer the following research question: What is the relationship between the three factors of community-based initiative performance—social capital, transformational leadership, and organizational capacity—and volunteer engagement? We test the direct associations between each factor and

Table 1. Definitions of the components of community-based initiatives.

Feature	Definition
Social capital	Networks, norms, and trust between volunteers within the organization, with others outside the organization, and between the organization and formal institutions (Putnam 2001; Igalla et al. 2019).
Transformational leadership	A leadership style that focuses on making connections between individuals or groups, prioritizing organizational values, and directing and inspiring people (Wright et al. 2012; Igalla et al. 2019).
Organizational capacity	The ability for the organization to provide the knowledge and resources (e.g. tools, supplies, and equipment) volunteers need to accomplish their tasks (Igalla et al. 2020).

engagement, then test whether social capital accounts for part of the association between the two formal organizational factors and engagement.

This study makes three contributions. First, it opens the black box of “good project organization” in ecological restoration, identifying which of its components volunteers respond to. Second, it extends a model developed to explain the performance of community-based initiatives (Igalla et al. 2020) to the engagement of an individual volunteer, and in doing so tests whether organizational determinants of collective performance are the same as determinants of individual engagement. Third, by estimating the organizational factors jointly, it distinguishes factors associated with engagement directly from factors associated with it through other channels, which can indicate where a volunteer program should invest finite resources. For restoration practice, it helps inform the decision of whether programs should be designed around the delivery of training and equipment, or around the cultivation of relationships among volunteers.

Theory and Hypotheses

Community capacity has emerged as a framework for understanding the organizational and social resources that enable collective action (Chaskin 2001). Chaskin defines community capacity as “the interaction of human capital, organizational resources, and social capital existing within a given community that can be leveraged to solve collective problems and improve or maintain the well-being of a given community” (Chaskin 2001, p 295). This definition underpins subsequent work to develop survey instruments for community-based initiatives that explore the interactions between human capital, organizational resources, and social capital.

A systematic literature review of community-based initiatives identified four key components that explain their performance: leadership, social capital, organizational resources, and government support (Igalla et al. 2019). Community capacity is not a unidimensional construct but a combination of interacting factors (Chaskin 2001). In order for this research to be of practical use, we focused on the three components an organization can itself influence: transformational leadership, social capital, and organizational capacity. Engagement is also shaped by conditions outside a project’s control: the strength of a society’s volunteering tradition and its environmental social norms (García-Valiñas et al. 2012; McDougle et al. 2015), the visibility and perceived legitimacy of nature organizations and the political framing of their work (Pagès et al. 2019), and the economic and policy environment that determines both public funding for conservation and the discretionary time people have to give (Lamb 2019; Kwiatkowski et al. 2020). Confining the survey to a single province holds much of the governance and macro-economic context constant across respondents, but individual factors may still vary.

Transformational Leadership and Engagement (H1)

Transformational leadership is defined as leadership that motivates people by appealing to their ideals and values, and that

brings them together around a shared mission (Tucker & Russell 2004). Leadership style has been found to be related to the performance of community-based initiatives (Edelenbos et al. 2020). Transformational and boundary-spanning leadership, in particular, were found to be necessary conditions for success in a qualitative comparative analysis of 17 community-based initiatives (Edelenbos et al. 2020).

This leadership style has been associated with increased creativity and engagement in organizational settings (Bin Saeed et al. 2019) and is contrasted with transactional leadership, which focuses on bureaucratic standards and exchange relationships (Tucker & Russell 2004).

Two mechanisms could link it to volunteer engagement: meaning-making and reciprocity. By articulating a vision and connecting routine tasks to that vision, transformational leaders engage in meaning-making and can turn an afternoon of pulling garlic mustard into a contribution to a valued end. Engagement—feeling energized by and absorbed in the work (Schaufeli et al. 2006; Vecina et al. 2012)—depends on the work being experienced as significant. Volunteers receive no wage, so leaders who demonstrate follow-through on commitments and show consideration signal that a volunteer’s time is valued and encourage reciprocity. Both mechanisms operate on the individual volunteer experience, which is why we hypothesize a direct association.

H1: Transformational leadership is positively associated with volunteer engagement.

Transformational Leadership and Social Capital (H2)

Transformational leaders also shape the relationships among the people they lead, not only each volunteer’s relationship with the leader. By articulating a shared vision, they supply the common frame of reference that constitutes cognitive social capital; by modeling consistency and follow-through, they establish the behavioral norms from which generalized trust—relational social capital—is inferred; and by developing agreement in group decision-making, they create the occasions for information exchange that constitute structural social capital (Pastoriza & Ariño 2013). In a voluntary setting, where formal authority to compel cooperation is weak, this norm-setting function is a leader’s principal instrument.

H2: Transformational leadership is positively associated with social capital.

Social Capital and Engagement (H3)

Social capital is broadly defined as the networks, norms, and trust that facilitate collective action (Putnam 2001) and has been identified as a key component of community-based initiative performance (Igalla et al. 2019, 2020). The concept has a long history in the social sciences, with foundational typologies distinguishing between bonding (within-group), bridging (between-group), and linking (vertical) social capital (Putnam 2001). Edelenbos et al.

(2020) apply this typology to community-based initiatives, referring to these dimensions as aspects of “network structure.”

Because our study focuses on the internal dynamics of volunteer groups rather than their external relationships, we adopted a meso-level framework that distinguishes between structural, relational, and cognitive dimensions of social capital (Pastoriza & Ariño 2013). Structural social capital refers to information and resource sharing among volunteers; relational social capital measures generalized trust; and cognitive social capital captures collective goal orientation and shared vision (Pastoriza & Ariño 2013). This framework is appropriate for measuring within-organization social dynamics as experienced by individual volunteers.

Social capital may bear on engagement through belonging and obligation. Volunteers who trust each other and are known by each other derive a social identity (as well as an environmental one) from the activity. Trust between volunteers and staff, and among volunteers, lowers the friction of participation: a volunteer who can rely on others and communicates reliably encounters fewer frustrations. Finally, dense ties may generate a mutual expectation to participate.

H3: Social capital is positively associated with volunteer engagement.

Organizational Capacity and Engagement (H4)

Organizational capacity is a latent variable that, for the purposes of this survey, encompasses volunteers’ perceptions of the adequacy of their technical knowledge, access to tools, and financial support for the projects they are involved in. Adequate tools, training, and funding should support engagement by fostering competence and efficacy. Volunteers who possess the knowledge and equipment their tasks demand can complete them successfully. Experience of visible accomplishment is a principal source of satisfaction in restoration work (Ryan et al. 2001; Asah et al. 2014). Conversely, where capacity is limited, there may be the experience of wasted effort and frustration (Ganzevoort & van den Born 2023). We therefore expect a direct positive association, while noting that capacity may be a necessary condition whose absence frustrates more than its presence energizes.

H4: Organizational capacity is positively associated with volunteer engagement.

Organizational Capacity and Social Capital (H5)

Capacity may also condition the relationships among volunteers. Resources are the enabling condition that allows volunteers to help one another: an organization with enough tools for everyone allows volunteers to work alongside each other rather than in rotation, and the presence of someone to ask for help facilitates the sharing of knowledge through which social capital is built (Pastoriza & Ariño 2013). Funding stability extends the group’s time together, allowing for repeated interactions that are crucial to trust.

H5: Organizational capacity is positively associated with social capital.

The Indirect Path (H6)

Taken together, H2, H3, and H5 imply that organizational factors are associated with engagement partly through social capital. Two of the formal features of an initiative—leadership and funding – may be experienced by volunteers through the conduct of their colleagues. A well-resourced and well-led project has volunteers who communicate, share, and can be relied upon. Those experiences may register as engagement; therefore, we test an indirect path model (Fig. 1) in which social capital carries part of the association between the organizational factors of engagement.

H6: The associations of transformational leadership and organizational capacity with volunteer engagement are transmitted in part through social capital.

Methods

A survey was used to examine the relationships between components of community-based initiative performance and volunteer engagement. Surveys are an effective method for discovering associations between abstract concepts such as social capital, organizational capacity, and transformational leadership

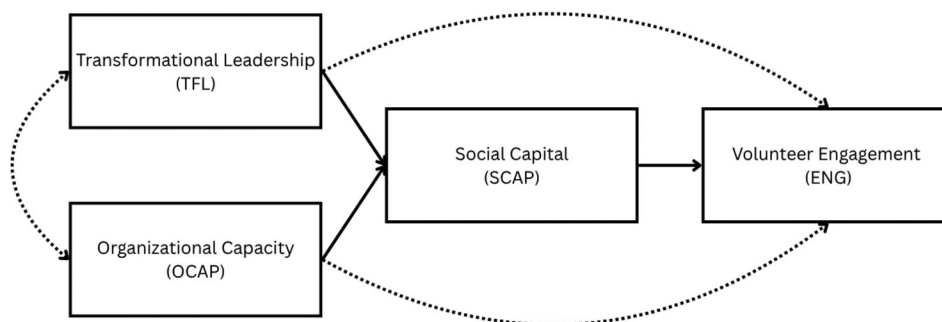


Figure 1. Hypothesized path model showing the expected positive relationships between transformational leadership, organizational capacity, social capital, and volunteer engagement. Arrows indicate hypothesized associations; this study does not claim directional causality.

through sampling a portion of a population (Fowler 2014). A web-based survey was chosen because the population being surveyed is dispersed across the province of Ontario, and web-based surveys allow for rapid deployment and effective response gathering (Rea & Parker 2014).

Recruitment

A non-exhaustive list of community-based environmental organizations was compiled through internet searching, by reviewing recipients of grants (e.g. Canada's EcoAction Community Funding Program, TD Friends of the Environment Foundation, Ontario Community Environment Fund), and through consultation with area experts. The survey was sent to environmental organizations across the Canadian province of Ontario, a geographic limitation chosen to standardize the governance context in which organizations operate, as government support has been shown to affect community-based initiative performance (Igalla et al. 2020). Organizations were included if they had a website and used the word "community" in their mission or vision statements. This criterion was used to identify organizations that are locally organized and community-driven, consistent with the definition of community-based initiatives in the literature (Chaskin 2001; Igalla et al. 2019). The organizations contacted were provided with a paragraph of text and an image to include in their volunteer newsletter or to email to their volunteers. Each organization was emailed once, then received a follow-up 2 weeks later. The survey was administered using the online survey platform Qualtrics. All participants provided informed consent before beginning the survey.

Sample

The median completion time among analyzed respondents was approximately 9.5 minutes. Of the 182 respondents who accessed the survey link, 98 (53.8%) consented and reached the end of the questionnaire. Thirty-nine respondents—including three who reached the end—provided no answer to any Likert-scale item and were excluded, leaving 143 respondents who provided full or partial responses to the constructs of interest. All 143 had provided consent.

Respondents reported the organization for which they mainly volunteer (Supplement S1, Q4). Because the question was free text, responses were harmonized to combine spelling variants, abbreviations, and chapter names; 129 of the 143 analyzed respondents could be assigned to an organization on this basis, and 14 gave an answer that was blank or could not be resolved. The 129 assignable respondents were drawn from 38 distinct organizations, with a median of 1 respondent per organization (range 1–45); 23 organizations contributed a single respondent, and the largest contributed 45, or 31.5% of the analytic sample.

Because volunteers from the same organization report on a shared leadership, a shared resource base, and one another, their responses cannot be assumed independent. We therefore estimated the intraclass correlation for each composite variable using a null multilevel model with organization as the grouping

factor. Clustering was substantial for transformational leadership (intraclass correlation coefficient (ICC) = 0.424) and absent for the other three constructs (social capital, organizational capacity, and volunteer engagement, all ICC = 0.000). The corresponding design effect for transformational leadership is 1.94 under the equal-cluster-size formula, but 9.20 under Kish's formula for unequal cluster sizes (Kish 1965), which is the appropriate figure given that one organization contributed 45 respondents.

We therefore re-estimated the path model with cluster-robust standard errors on the 129 respondents assignable to an organization, treating organization as the cluster variable. The standardized coefficients were unchanged to three decimal places and no path changed significance at $\alpha = 0.05$. This is what would be expected: the clustering is confined to a predictor rather than to the residuals of either outcome variable, and clustering in a predictor does not bias standard errors in the way that clustering in residuals does. Results of the cluster-robust refit are reported in Supplement S4.

Measures

Descriptive Questions. Participants were asked which organization they mainly volunteer for, how frequently they volunteer, and how long they have been volunteering. They were asked which activities they perform, whether they have prior environmental education, and whether they have work experience in restoration and conservation. Demographic questions included gender identity, ethnicity, and age, in order to characterize the sample composition. Household income and employment status were not collected, as excessive demographic questioning may have reduced response rates. See Supplement S1 for the full survey instrument.

Volunteer Engagement. A systematic review of volunteer management literature recommends the UWES as a common measurement tool for evaluating volunteer engagement (Einolf 2018). The UWES was adapted for this study to focus on participation in ecological restoration and conservation volunteering. The adapted scale consists of nine items measured on a 1–7 frequency scale (1 = never, 7 = always):

ENG1: During my volunteer work, I feel bursting with energy.

ENG2: During my volunteer work, I feel strong and vigorous.

ENG3: I am enthusiastic about my volunteer work.

ENG4: My volunteer work inspires me.

ENG5: When I get up in the morning, I feel like going to my volunteer work.

ENG6: I feel happy when I am volunteering intensely.

ENG7: I am proud of the volunteer work that I do.

ENG8: I am immersed in my volunteer work.

ENG9: I get carried away when I am volunteering.

Transformational Leadership. Leadership may refer to the board of directors of an initiative or to volunteers who perform leadership activities such as planning, fundraising, and

coordination. Participants were not asked whether they also served in a formal leadership role within their organization. All respondents were instructed to evaluate their project's leadership from the perspective of a general volunteer participant. Responses from individuals who hold leadership roles may therefore reflect some degree of self-assessment, which should be considered as a limitation in the interpretation of leadership scale results. Leadership was measured by asking volunteers about their perception of their project's leadership style, using items adapted from scales developed for community-based institutions (Lempa et al. 2008). While the Lempa et al. (2008) scales were originally developed in a health education context, they have been widely used to measure organizational dimensions of community capacity, and the leadership items align with established conceptualizations of transformational leadership.

Leadership was measured on a 1–7 agreement scale (1 = strongly disagree, 7 = strongly agree) using the following items:

TFL1: The project leadership is motivated by helping others.

TFL2: Volunteers involved with the project trust the leadership.

TFL3: The leadership shows compassion for people.

TFL4: The volunteers involved with the project support the principles or values of the leadership.

TFL5: Volunteers involved with the project agree with the leadership's vision.

TFL6: The leadership tries to develop agreement in group decision-making.

TFL7: The leadership's vision is clear to people involved with the project.

TFL8: The leadership spells out its principles or values clearly.

TFL9: The leadership follows through on their commitments.

Social Capital. Social capital was measured on a 1–7 agreement scale using the following items adapted from Pastoriza and Ariño (2013):

SCAP1: In our group, volunteers engage in open and honest communication with one another.

SCAP2: In our group, volunteers share and accept constructive criticism without making it personal.

SCAP3: In our organization, volunteers keep each other informed at all times.

SCAP4: I can rely on the volunteers I work with.

SCAP5: Volunteers in our group show a great deal of integrity.

SCAP6: Volunteers have confidence in one another in this group.

SCAP7: Volunteers share the same ambitions and vision for this group.

SCAP8: There is a commonality of purpose among volunteers in this group.

SCAP9: Volunteers view themselves as partners in charting this group's direction.

Organizational Capacity. This operationalization draws on the community capacity scales developed by Lempa et al. (2008), which focus on resources such as office space, equipment, and funding, as well as the organizational capacity indicators used by Igalla et al. (2020), which include the number of volunteers and revenue sources.

Organizational capacity was measured on a 1–7 agreement scale using the following items:

OCAP1: I have the technical knowledge needed to complete my volunteer tasks.

OCAP2: There is someone I can ask for help if there is something I do not know how to do.

OCAP3: I feel confident in my ability to complete volunteer tasks.

OCAP4: I always have the tools needed to do my volunteer tasks.

OCAP5: There are enough supplies for all the volunteers to complete their tasks.

OCAP6: We have an adequate number of tools for the projects we take on.

OCAP7: The group knows where it can go for funding.

OCAP8: I feel confident that our group will continue to receive funding.

OCAP9: Before the pandemic, I had many chances to work with government officials on projects.

The construct as measured spans two conceptually distinct levels: three items concern the individual volunteer's perceived capability (technical knowledge, availability of someone to ask, confidence in completing tasks) and the remainder concern group-level resources (tools, supplies, and funding). We treat them as indicators of a single reflective construct on three grounds. First, the construct is defined here as the volunteer's perception of task-relevant sufficiency rather than as an objective organizational property; from the volunteer's standpoint, not knowing how to do a task and not having the tool for it are the same experience of being unable to proceed, and it is that experience we intend to capture. Second, the items are not conceptually independent in this setting: a volunteer's technical knowledge is largely supplied by the organization through training and through more experienced volunteers, so perceived individual capability is in part an outcome of organizational provision rather than a competing construct. Third, the empirical structure supports a single factor: all retained items loaded on one factor above the 0.40 threshold with no cross-loadings, the scree criterion did not indicate a fifth factor, and internal consistency was acceptable ($\alpha = 0.786$; see Table 4).

We conducted a sensitivity analysis in which perceived individual capability (OCAP1–OCAP3) and organizational resources (OCAP4–OCAP8) were entered as separate composites. The two subscales correlated at $r = 0.560$, with Cronbach's alpha of 0.663 and 0.782, respectively; the lower value belongs to a three-item subscale, where alpha understates reliability. Perceived individual capability ($\beta = 0.176$, $p = 0.055$) and group-level resources ($\beta = 0.183$, $p = 0.020$) contributed near-equally to social capital. Splitting the construct reduced each component's coefficient to roughly two-thirds of the

combined value without redistributing it between them, which is the pattern expected of two indicators of one construct rather than of two distinct predictors, and the split model fit worse than the combined one ($\chi^2[3] = 8.54, p = 0.036$; RMSEA = 0.114, 90% CI 0.026–0.207, against 0.000 for the combined model). In a regression of engagement on all four composites, however, the two halves behaved differently: perceived individual capability was positively associated with engagement ($\beta = 0.348, p = 0.007$) while group-level resources were not ($\beta = -0.181, p = 0.090$). We report this because the composite alone conceals this divergence, and we do not want to overstate the case for combining. It does not alter the substantive conclusion—social capital remains the dominant predictor in that regression ($\beta = 0.465, p < 0.001$) and the ordering of the paths is unchanged—but it does suggest that the individual-capability items carry a relationship to engagement that the combined construct averages away. We therefore retain the combined construct for the primary analysis, on the grounds given above and because the split model fits worse, while noting that the two components warrant separate treatment in a study designed to distinguish them. Full results are reported in Supplements S2 and S4.

Analytical Approach

Sample Size and Reliability. There were 143 full or partial responses to the survey. Sample size calculations based on the total population were not appropriate because the sample frame was limited to a population of unknown and fluctuating size (Hill 1998). When the population size is unknown, guidance suggests allowing the analytical requirements to determine the minimum sample (Bartlett et al. 2001).

We performed exploratory factor analysis (EFA) and path analysis. Appropriate sample sizes for structural equation modeling range widely, from 30 to 460 observations depending on model complexity (Wolf et al. 2013). Two main approaches exist: basing sample size on the number of parameters (Kline 2023) or on the number of latent variables and their indicators (De Winter et al. 2009). Kline (2023) recommends a minimum of 10 cases per parameter, with 20 cases per parameter being ideal. Our hypothesized model contains 10 free parameters, and the reduced model estimated here contains 8, yielding a recommended range of 100–200 observations. Additionally, De Winter et al. (2009) found that a sample of 94 cases was sufficient for reliable factor extraction with a four-factor model having high loadings per factor. With four factors, between six and nine retained items per factor, and high average factor loadings over the retained items (TFL = 0.73; ENG = 0.72; SCAP = 0.61; OCAP = 0.62), our sample of 143 is sufficient for both factor analysis and path analysis.

Demographic variables were collected to characterize the sample rather than as predictors, and the primary models are unconditional on them. Two considerations informed this choice: our hypotheses concern organizational rather than individual determinants of engagement, and the sample offers limited demographic variation to exploit—93.0% of respondents

identified as White/European and 72.7% were 56 or older—so demographic terms would be estimated on sparse groups. We nonetheless verified that the omission does not drive our results by re-estimating the models with age (as an ordinal variable) and gender (female/male/other or not reported) included as covariates. Age was modestly associated with social capital ($\beta = 0.144, p = 0.038$) but not with volunteer engagement ($\beta = 0.025, p = 0.695$); gender was associated with neither (social capital $\beta = 0.099, p = 0.150$; engagement $\beta = -0.144, p = 0.089$). Every substantive path retained its significance with both covariates included, and no standardized coefficient changed by more than 0.022. Full results are reported in Supplement S4.

Data Cleaning and Preparation. Submissions in which no Likert-scale items were answered—consisting only of partial or absent demographic information and likely representing participants who accessed the survey link but did not engage with its content—were excluded ($n = 39$). The remaining dataset contained 120 missing item responses, 2.3% of the item-by-respondent cells. Missingness was concentrated in the later sections of the instrument. By construct, 0.5% of engagement items, 2.6% of leadership items, 2.3% of social capital items, and 3.9% of organizational capacity items were missing, and 6 respondents accounted for 92% of all missing values. Item-level missingness ranged from 0.0 to 4.9%. Missingness is lowest in the first item block administered and highest in the last, rising from 0.5% of engagement items to 3.9% of organizational capacity items, with the two intermediate blocks close to one another. This pattern is consistent with progressive drop-off through the instrument rather than with item-specific non-response, which makes the data plausibly missing at random conditional on progress through the instrument—the assumption under which full-information maximum likelihood is appropriate. The fully itemized breakdown is given in Supplement S3.

Missing values were replaced with the item mode. Mode substitution preserves the discrete response scale, which mean substitution does not, and performs comparably to other single-imputation methods for Likert data when missingness is below approximately 10% of each item's response distribution (Downey & King 1998). We acknowledge its limitations: single imputation may understate uncertainty by treating imputed values as observed, and mode substitution reduces item variance, which may compress variance further.

To test whether imputation affected our conclusions, we reran the EFA and path model on complete cases only ($n = 129$) and, separately, using full-information maximum likelihood, which uses all available data without imputing values. Factor structure was unchanged under both. The standardized path coefficients differed from the primary analysis by no more than 0.034 in the complete-case analysis and by no more than 0.017 under full-information maximum likelihood, and the significance of every path was unchanged. Full results are reported in Supplement S3.

Measurement Model. EFA was used to verify that the survey items loaded onto the hypothesized latent variables (Beaujean 2013, 2014). EFA was chosen because, although our scales and items were derived from the literature, the specific relationship between these items and the latent variables in our population had not been previously confirmed. Factor analysis on discrete (Likert-type) data was performed using the weighted least squares estimator (Barendse et al. 2015). EFA was used rather than Principal Components Analysis (PCA) because the items are reflective indicators of the latent constructs they represent (Alavi et al. 2020). An oblique rotation was applied because we expected correlations among factors, which is consistent with our theoretical model (Fabrigar et al. 1999; Osborne 2015). Items with factor loadings ≥ 0.40 were retained in the composite variables (Cutillo 2019).

Path Analysis. The path model was estimated in the R package *lavaan* (Rosseel 2012) using maximum likelihood. Coefficients are reported as fully standardized solutions (Std.all in *lavaan*), in which both predictor and outcome are standardized. Indirect effects were tested using bias-corrected bootstrap confidence intervals based on 5000 resamples, as recommended for mediation analysis in modest samples, where the sampling distribution of the product of coefficients is not normal and the delta-method standard error is correspondingly unreliable (Preacher & Hayes 2008). An indirect path is treated as statistically distinguishable from zero where the 95% bias-corrected interval excludes zero. Confidence intervals are reported on the unstandardized estimates, which are the quantities *lavaan* resamples.

Because neither transformational leadership nor organizational capacity showed a statistically significant direct association with volunteer engagement in the full model (Results section; Supplement S5), these direct paths were excluded from the path model, yielding the more parsimonious mediation model presented here. This reduced model was arrived at by removing paths that were not significant in the same data, so its fit indices cannot be treated as independent confirmation of the hypothesized structure. We therefore also estimate the full model, retaining the theoretically motivated direct paths from transformational leadership and organizational capacity to engagement, and report both. Model comparison is by likelihood-ratio test and by Akaike information criterion (AIC) and Bayesian information criterion (BIC).

Results

Descriptive Results

Table 2 summarizes the demographic and descriptive characteristics of the sample ($n = 143$). The sample consisted of 91 respondents who identified as female (63.6%), 49 who identified as male (34.3%), and 1 who identified as non-binary (0.7%); 2 respondents either left the question blank or preferred not to say (1.4%).

The sample skewed older: 72.7% of respondents ($n = 104$) were 56 or older and 39.9% ($n = 57$) were over 65, against roughly

31.4% of the Ontario adult population aged 55 or older (5,103,075; Government of Canada 2026). Respondents also skewed female (63.6%) and White/European (93.0%). More than half (54.5%, $n = 78$) reported having some environmental education prior to volunteering, but most (60.8%, $n = 87$) reported no prior environmental work experience. Respondents performed a variety of activities including administrative tasks such as fundraising ($n = 36$), outreach ($n = 64$), and project planning ($n = 62$); trail maintenance ($n = 58$) and ecological monitoring ($n = 46$); and ecological interventions including invasive species management ($n = 66$), planting seeds ($n = 41$), and planting nursery stock ($n = 53$). Most volunteers reported being involved for more than 1 year ($n = 121$, 84.6%) and volunteering weekly or more often ($n = 72$, 50.3%) or on a monthly basis ($n = 39$, 27.3%). Descriptive statistics for all community-based initiative survey items are presented in Table 3 (scale range: 1–7). Responses to the three organizational constructs were concentrated at the upper end of the scale. All nine transformational leadership items and all nine social capital items had a median of 6.0, as did seven of the nine organizational capacity items; the exceptions were OCAP2 (median 7.0) and OCAP9 (median 4.0), the latter being one of the items the factor analysis excluded. On composite means, social capital was highest ($M = 6.03$, $SD = 0.64$), followed by organizational capacity ($M = 5.95$, $SD = 0.69$) and transformational leadership ($M = 5.91$, $SD = 0.79$). Volunteer engagement items showed greater variability, with medians ranging from 4.0 to 7.0 and the lowest composite mean ($M = 5.48$, $SD = 0.90$).

Measurement Model

Bartlett's test of sphericity was significant ($p = 2.22 \times 10^{-16}$) and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.82, exceeding the threshold of 0.70, indicating that the data were suitable for factor analysis (Shrestha 2021). A scree plot (Fig. 2) indicated that four factors were appropriate, as additional factors had eigenvalues below 1.0, meaning each subsequent factor would explain less variance than a single original item.

Factor loadings from the oblique rotation are reported in Table 4, which lists every administered item, including those not retained. Every retained item loaded on its anticipated factor, and no item cross-loaded at or above 0.40 on more than one factor. Four items did not reach the 0.40 threshold on any factor and were excluded from their composites: SCAP3 ("In our organization, volunteers keep each other informed at all times"; highest loading 0.34), OCAP2 ("There is someone I can ask for help if there is something I do not know how to do"; 0.39), OCAP7 ("The group knows where it can go for funding"; 0.36), and OCAP9 ("Before the pandemic, I had many chances to work with government officials on projects"; 0.09).

The retained composites therefore comprise nine engagement items, nine transformational leadership items, eight social capital items, and six organizational capacity items. Internal consistency for the retained items was acceptable throughout: volunteer engagement ($\alpha = 0.905$), transformational leadership ($\alpha = 0.918$), social capital ($\alpha = 0.869$), and organizational capacity ($\alpha = 0.786$). Composite variables for the path analysis

Table 2. Descriptive question results. Ethnicity and activities are multi-select; column percentages may sum to more than 100%. Response options for Q6 were presented as administered; no option covered the interval between 1 and 2 years, so respondents in that interval will have selected either the first or the second category.

Question	N	Response	n	%
Volunteering frequency (Q5)	143	Daily	12	8.4%
		Four to six times a week	16	11.2%
		Two to three times a week	28	19.6%
		Once a week	16	11.2%
		Four to six times a month	10	7.0%
		Two to three times a month	19	13.3%
		Once a month	10	7.0%
		A few times a year	32	22.4%
Years volunteering (Q6)	143	Less than 1 year	22	15.4%
		2–5 years	54	37.8%
		6–10 years	28	19.6%
		11 or more years	39	27.3%
Age (Q7)	143	18–25 years old	3	2.1%
		26–35 years old	9	6.3%
		36–45 years old	17	11.9%
		46–55 years old	10	7.0%
		56–65 years old	47	32.9%
		Above 65 years old	57	39.9%
			91	63.6%
Gender identity (Q8)	143	Female	49	34.3%
		Male	1	0.7%
		Non-binary	2	1.4%
		Not reported	1	0.7%
Ethnic background (Q9, multi-select)	143	Indigenous (Inuit/First Nations/Métis)	1	0.7%
		White/European	133	93.0%
		Black/African/Caribbean	0	0%
		Southeast Asian	3	2.1%
		Arab	0	0%
		South Asian	1	0.7%
		Latin American	0	0%
		West Asian	1	0.7%
		Other (open response)	6	4.2%
			46	32.2%
Volunteer activities (Q10, multi-select)	143	Ecological monitoring	41	28.7%
		Planting (seeds)	53	37.1%
		Planting (nursery stock)	66	46.2%
		Invasive species management	58	40.6%
		Trail maintenance	64	44.8%
		Outreach	36	25.2%
		Fundraising	62	43.4%
		Project planning	51	35.7%
		Project management	35	24.5%
			43	30.1%
Environmental education prior to volunteering (Q11)	143	Yes, lots	65	45.5%
		Yes, some	18	12.6%
		None	38	26.6%
Work experience in restoration/conservation (Q12)	143	Yes, lots	87	60.8%
		Yes, some		
		None		

were created by averaging the response values of the retained items loading on each factor (Boone & Boone 2012).

Path Analysis

Path analysis was used to test all six hypotheses. We estimated a full model containing every hypothesized path, including the direct paths from transformational leadership and organizational capacity to engagement (H1 and H4) and a reduced model omitting those two paths, and we report both.

Model fit was good ($\chi^2(2) = 1.34, p = 0.513$; CFI = 1.000; Tucker-Lewis index = 1.019; RMSEA = 0.000 (90% CI 0.000–0.147); SRMR = 0.026) (Supplement S2). Transformational leadership ($\beta = 0.472, p < 0.001$) and organizational capacity ($\beta = 0.263, p = 0.002$) were positively associated with social capital, together accounting for 37.7% of its variance. Social capital was positively associated with volunteer engagement ($\beta = 0.407, p < 0.001$), accounting for 16.6% of its variance. Transformational leadership and organizational capacity were themselves correlated ($r = 0.339, p = 0.003$). Path

Table 3. Descriptive statistics for community-based initiative survey items (1–7 scale).

Concept	Statement	Median	Standard deviation
Volunteer engagement	During my volunteer work, I feel bursting with energy.	5	1.16
	During my volunteer work, I feel strong and vigorous.	5	1.06
	I am enthusiastic about my volunteer work.	6	0.93
	My volunteer work inspires me.	6	1.05
	When I get up in the morning, I feel like going to my volunteer work.	5	1.36
	I feel happy when I am volunteering intensely.	6	1.09
	I am proud of the volunteer work that I do.	7	0.96
	I am immersed in my volunteer work.	5	1.29
Transformational leadership	I get carried away when I am volunteering.	4	1.64
	The project leadership is motivated by helping others.	6	1.00
	Volunteers involved with the project trust the leadership.	6	1.02
	The leadership shows compassion for people.	6	1.03
	The volunteers involved with the project support the principles or values of the leadership.	6	0.86
	Volunteers involved with the project agree with the leadership's vision.	6	0.98
	The leadership tries to develop agreement in group decision-making.	6	1.17
	The leadership's vision is clear to people involved with the project.	6	1.13
Social capital	The leadership spells out its principles or values clearly.	6	1.01
	The leadership follows through on their commitments.	6	0.98
	In our group, volunteers engage in open and honest communication with one another.	6	0.91
	In our group, volunteers share and accept constructive criticism without making it personal.	6	1.00
	In our organization, volunteers keep each other informed at all times.	6	1.18
	I can rely on the volunteers I work with.	6	0.80
	Volunteers in our group show a great deal of integrity.	6	0.81
	Volunteers have confidence in one another in this group.	6	0.89
Organizational capacity	Volunteers share the same ambitions and vision for this group.	6	0.92
	There is a commonality of purpose among volunteers in this group.	6	0.62
	Volunteers view themselves as partners in charting this group's direction.	6	1.06
	I have the technical knowledge needed to complete my volunteer tasks.	6	0.96
	There is someone I can ask for help if there is something I do not know how to do.	7	0.86
	I feel confident in my ability to complete volunteer tasks.	6	0.73
	I always have the tools needed to do my volunteer tasks.	6	0.99
	There are enough supplies for all the volunteers to complete their tasks.	6	0.88
	We have an adequate number of tools for the projects we take on.	6	0.98
	The group knows where it can go for funding.	6	1.33
	I feel confident that our group will continue to receive funding.	6	1.30
	Before the pandemic, I had many chances to work with government officials on projects.	4	1.56

coefficients are presented in Figure 3 and hypothesis testing results in Table 5. With only two degrees of freedom, the fit statistics carry limited information, and the RMSEA confidence interval extends to 0.147 (Supplement S2).

The indirect association between transformational leadership and volunteer engagement through social capital was 0.217 (95% bias-corrected bootstrap confidence interval [0.091, 0.395], $p = 0.006$), and the indirect association between organizational capacity and engagement through social capital was 0.140 (95% CI [0.059, 0.262], $p = 0.005$). Both intervals exclude zero. The intervals are reported on the unstandardized estimates, which are the quantities lavaan resamples; the corresponding fully standardized effects are 0.192 and 0.107.

We also estimated the full model, retaining both direct paths for the reason given in the Methods. That model is saturated—it has zero degrees of freedom—so its comparative fit index (CFI) of 1.000 and root mean square error of approximation (RMSEA) of 0.000 are arithmetic necessities rather than

evidence of fit, and we do not report them. Neither direct path was significant (transformational leadership to engagement, $\beta = 0.067$, $p = 0.516$; organizational capacity to engagement, $\beta = 0.068$, $p = 0.460$). The reduced model did not fit significantly worse than the full model ($\Delta\chi^2(2) = 1.34$, $p = 0.513$) and was preferred on both information criteria (AIC 1191.2 vs. 1193.9; BIC 1214.9 vs. 1223.5). Coefficients for the paths retained in both models were substantively unchanged, with the exception of the path from social capital to engagement, which fell from 0.407 to 0.341 as the two direct paths absorbed variance. The full model is reported in Supplement S5.

Discussion

Our path analysis is consistent with an indirect-path account in which the association between organizational factors and volunteer engagement is transmitted through social capital rather than operating directly. Hypothesis testing is

Table 4. Factor loadings from exploratory factor analysis (weighted least squares estimator, and oblimin rotation). Loadings below $|0.40|$ are suppressed; the highest loading of each excluded item is shown in parentheses. Items excluded from composites are marked with a dagger. Alpha is reported for the retained items in each composite. ENG = volunteer engagement; TFL = transformational leadership; SCAP = social capital; OCAP = organizational capacity. *Highest loading on any factor; item did not reach 0.40 and was excluded from its composite. OCAP9's highest loading falls on the engagement factor, not on capacity.

Item	Concept	TFL.F1	ENG.F2	SCAP.F3	OCAP.F4
ENG1	ENG		0.81		
ENG2	ENG		0.80		
ENG3	ENG		0.82		
ENG4	ENG		0.86		
ENG5	ENG		0.78		
ENG6	ENG		0.80		
ENG7	ENG		0.54		
ENG8	ENG		0.58		
ENG9	ENG		0.45		
TFL1	TFL	0.60			
TFL2	TFL	0.80			
TFL3	TFL	0.72			
TFL4	TFL	0.78			
TFL5	TFL	0.79			
TFL6	TFL	0.70			
TFL7	TFL	0.80			
TFL8	TFL	0.69			
TFL9	TFL	0.70			
SCAP1	SCAP			0.52	
SCAP2	SCAP			0.59	
SCAP3	SCAP			(0.34)*	
SCAP4	SCAP			0.65	
SCAP5	SCAP			0.78	
SCAP6	SCAP			0.72	
SCAP7	SCAP			0.51	
SCAP8	SCAP			0.60	
SCAP9	SCAP			0.51	
OCAP1	OCAP				0.49
OCAP2	OCAP				(0.39)*
OCAP3	OCAP				0.56
OCAP4	OCAP				0.75
OCAP5	OCAP				0.68
OCAP6	OCAP				0.80
OCAP7	OCAP				(0.36)*
OCAP8	OCAP				0.42
OCAP9	OCAP				(0.09)*
Cronbach's α		0.918	0.905	0.869	0.786

summarized; here we consider what the pattern implies rather than restating it.

The Mechanism

The direct association between social capital and volunteer engagement is consistent with other research. For example, a survey of members of conservation groups in New Zealand found that members reported higher levels of social capital than non-members (Gerolemu et al. 2022), and social capital developed from co-working relationships has been found to affect volunteer satisfaction (Zappa & Zavarrone 2010). The indirect relationship between organizational capacity, transformational leadership, and volunteer engagement suggests that informal social interactions, combined with leadership and organizational factors, may create the conditions for increased engagement. It is also plausible that the relationship is reciprocal: engaged

volunteers may themselves generate social capital by investing more time and energy into building group relationships, creating a self-reinforcing dynamic in which engagement and social capital mutually strengthen one another over time.

This study extends the applicability of the community-based initiative performance model developed by Igalla et al. (2020), who originally connected social capital, transformational leadership, and organizational capacity to initiative performance. Our findings suggest that volunteer engagement—one dimension of performance—is associated with the same organizational factors, though primarily through their influence on social capital.

The centrality of social capital we observe in Ontario is consistent with findings from restoration and conservation volunteering in several other national contexts, which suggests the pattern is not an artifact of the Canadian setting. In New Zealand, members of volunteer conservation groups reported higher social capital than non-members, and group

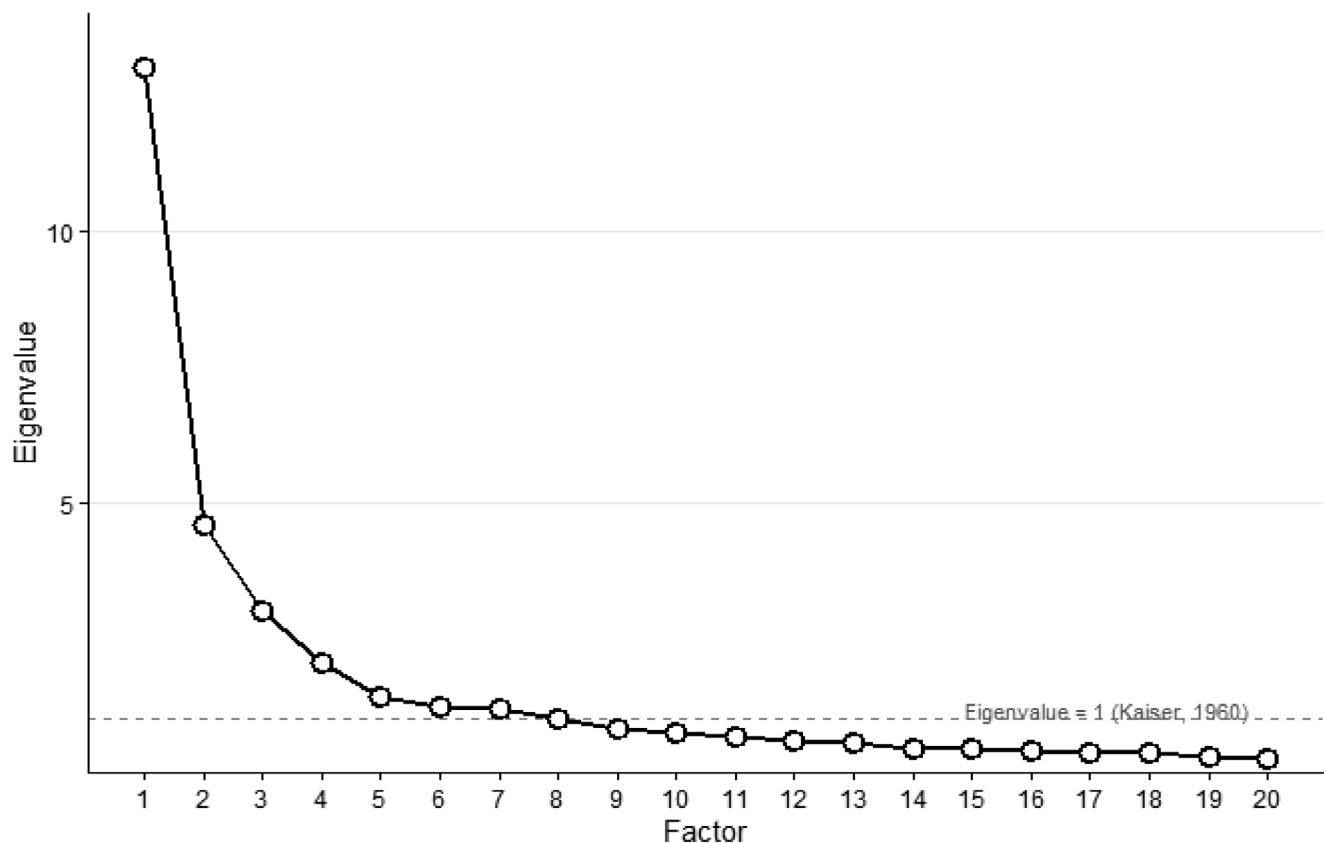


Figure 2. Scree plot showing the proportion of variance explained by each factor. The horizontal line indicates the eigenvalue = 1 threshold (Kaiser 1960).

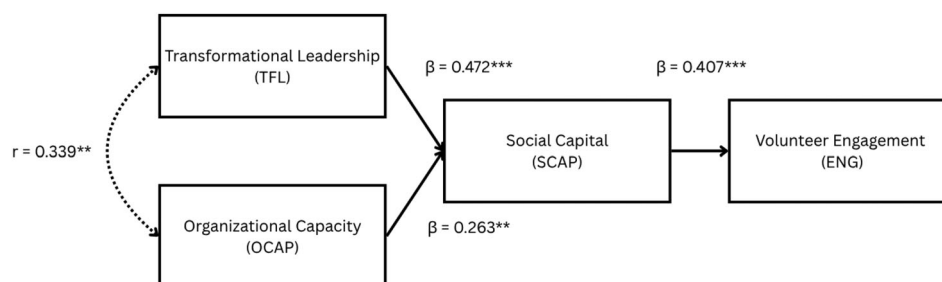


Figure 3. Path model with standardized path coefficients. ** p less than 0.01; *** p less than 0.001.

membership was itself among the strongest correlates of sustained involvement (Gerolemou et al. 2022). In the Netherlands, Ganzevoort and van den Born (2023) found that nature volunteers' reasons for continuing centered on social bonds while their reasons for quitting were organizational—an asymmetry our indirect-path result would predict. Outside the environmental sector, work with volunteer firefighters in Austria (Mayr 2017) and in sports clubs in Germany (Swierzy et al. 2018) points the same way: relational and identity-based factors mediate the association between organizational features and volunteer commitment. That the mediating role of relational factors recurs across settings differing in governance regime,

funding model, and volunteer task suggests it reflects something general about how volunteers experience organizational quality.

Our finding that neither transformational leadership (H1) nor organizational capacity (H4) was directly associated with volunteer engagement merits further consideration. The result for transformational leadership is similar to that of Mayr (2017), who found that the effect of transformational leadership on the engagement of volunteer firefighters was mediated by group identification and perceived social impact—two constructs closely related to social capital. Our results suggest that it is the relational correlates of transformational leadership (trust, shared vision, and interpersonal connection) rather than the

Table 5. Summary of hypothesis testing. TFL = transformational leadership; OCAP = organizational capacity; SCAP = social capital. β is the fully standardized solution (Std.all in lavaan). For H6, the bias-corrected bootstrap CIs are computed on the unstandardized estimates, which are the quantities lavaan resamples: TFL 0.217 [0.091, 0.395], $p = 0.006$; OCAP 0.140 [0.059, 0.262], $p = 0.005$.

Hypothesis	Test	β	Result
H1: Transformational leadership $\rightarrow$ engagement	Path model (full)	0.067 ($p = 0.516$)	Not supported
H2: Transformational leadership $\rightarrow$ social capital	Path model (reduced)	0.472 ($p < 0.001$)	Supported
H3: Social capital $\rightarrow$ engagement	Path model (reduced)	0.407 ($p < 0.001$)	Supported
H4: Organizational capacity $\rightarrow$ engagement	Path model (full)	0.068 ($p = 0.460$)	Not supported
H5: Organizational capacity $\rightarrow$ social capital	Path model (reduced)	0.263 ($p = 0.002$)	Supported
H6: TFL + OCAP $\rightarrow$ SCAP $\rightarrow$ engagement	Path model (reduced), bootstrap CIs	TFL 0.192; OCAP 0.107	Indirect associations via social capital; both bias-corrected bootstrap intervals exclude zero

leadership style itself that accounts for the association with volunteer engagement.

One implication of this finding is that volunteer activities with weaker social dynamics may be perceived as less engaging despite having transformational leadership. For instance, ecological monitoring activities that involve individual data collection in relative isolation (e.g. species counts conducted alone) may provide fewer opportunities for the social interactions that build capital. However, it is important not to conflate solitary field activity with an absence of community. Citizen science programs, for example, regularly cultivate strong group identities and social bonds even when individual volunteers conduct fieldwork alone, through shared data platforms, training workshops, and collective data interpretation events. Volunteers engaged in biodiversity monitoring may feel part of a community of practice despite rarely working side by side. What matters for social capital development may be less the physical setting of volunteer activity and more the quality of interpersonal interactions that a program actively fosters around those activities. This consideration is particularly relevant given ongoing cultural shifts in volunteering, including the ongoing impacts of the Covid-19 pandemic on communal in-person efforts.

Organizational capacity was significantly associated with social capital (H5) but not directly with volunteer engagement (H4). The items forming this latent variable focused on volunteers' perception of having adequate tools, knowledge, and resources. Given that fellow volunteers often provide these resources, it is plausible that perceptions of organizational capacity are intertwined with the social dynamics of the group. Research into organizational capacity using objective measures (e.g. budget, number of paid staff, and infrastructure) has shown significant effects on volunteer recruitment (Swierzy et al. 2018). Future research could examine whether objective measures of organizational capacity show different patterns of association with engagement than the subjective perceptions measured here.

Theoretical Implications

The result bears on how organizational quality should be theorized in voluntary settings. Models of community-based

initiative performance treat leadership, capacity, and social capital as three parallel inputs to a common outcome (Igalla et al. 2020). Our findings are more consistent with an ordering among them: the two formal features appear to operate on the individual volunteer through the relational one, which would make social capital not a third input but the proximate condition through which the others are experienced. If this ordering holds, it offers an account of the retention asymmetry noted above (Ganzevoort & van den Born 2023). Leadership and resources would then be enabling conditions whose absence disrupts the relational fabric on which engagement rests, rather than sources of engagement in their own right.

Implications for Practice

For volunteer programs, the implication is not that leadership and resources are unimportant but that their value to volunteer engagement depends on how they are deployed. The same equipment budget spent on enough tools for everyone to work simultaneously, rather than on better tools used in rotation, changes whether the work party is a shared activity. The same leadership effort spent on developing agreement in group decisions, rather than on issuing instructions, changes whether volunteers form a view of one another. Concretely, this points to scheduling that keeps the same people working together rather than maximizing throughput; deliberate unstructured time before and after work parties; and decision-making formats that require volunteers to talk to each other rather than to a coordinator.

The strong age skew in our sample warrants comment, since it bears both on the generalizability of our findings and, potentially, on what they describe. Two readings are possible. The first is sampling bias: our recruitment ran through organizational newsletters and email lists, channels that may reach longer-tenured volunteers preferentially, and older volunteers may have had more time to respond to an eight-minute survey. The second is that the distribution is substantially real, and that environmental stewardship volunteering in Ontario is in fact carried predominantly by people over 55. Comparable surveys of environmental volunteers report similar profiles (Ryan et al. 2001; Ganzevoort & van den Born 2023). We cannot distinguish the two readings without a denominator for the volunteer population, which does

not exist for this sector. If the second reading is correct, the skew is itself a finding: a restoration workforce concentrated in one cohort is a succession risk for the sector, quite apart from what it means for our estimates.

The age distribution also raises the question of whether the mechanism we describe operates uniformly. Our finding that engagement runs through social capital may be conditioned by life stage. For retired volunteers, stewardship groups often function as a primary site of social connection, and for this cohort the relational dimension may be a large part of what participation is for; the modest association we observe between age and social capital ($\beta = 0.144$, $p = 0.038$) is consistent with this. Younger volunteers, whose social needs are met elsewhere and whose available time is more constrained, may weight other considerations—skills development, professional networks, credentialed experience, or flexible scheduling—more heavily, in which case a single engagement strategy would not serve a mixed-age volunteer base equally well. A multi-group invariance test would settle this, but our sample contains only 39 respondents under 46, which is too few to support one; we propose it as future work rather than attempting it here.

Limitations

Several limitations of this study point to productive directions for future research. First, data were collected cross-sectionally using volunteer self-report; longitudinal designs and objective measures of organizational capacity (e.g. budget size and staff–volunteer ratios) would allow researchers to examine causal dynamics and change over time. Second, the directionality of the social capital–engagement relationship is not established here: future work could test whether social capital promotes engagement, engagement generates social capital, or both are mutually reinforcing. Third, the sample likely overrepresents highly engaged volunteers, as less engaged individuals may be less likely to respond; strategies to include lapsed or minimally engaged volunteers would help address self-selection bias.

Our sampling frame required that an organization maintain a website and use the word “community” in its mission or vision, which will have excluded the less formalized initiatives. A referral or snowball component, in which participating organizations nominate others they consider comparable, would help reach groups with little web presence and could be implemented for future studies using this design. Respondents are nested within organizations and the number of respondents per organization is uneven, so organizations contributing more respondents exert more influence on the estimates. The design does not permit organization-level predictors to be modeled separately from individual perceptions of them; a multilevel design with a larger number of organizations would allow the organizational and perceptual components of leadership and capacity to be distinguished.

Including volunteers who have left organizations would allow researchers to examine whether the framework also explains disengagement and dropout, which has direct practical relevance for volunteer retention. The demographic

homogeneity of the sample—predominantly older, female, and White/European—limits generalization to volunteer populations with different compositions and precludes the subgroup analyses that would test whether the associations we report hold across cohorts.

A further limitation is related to scope. Our model contains only factors internal to the project, and the variance it leaves unexplained—62% in social capital and 83% in engagement—will include external factors. By confining the sample to one province, we hold the governance and macro-economic context roughly constant across respondents, but it does nothing to hold constant the characteristics of the population an initiative recruits from. Age, education level, and income are among the most consistent predictors of who volunteers and how much (Pillemer et al. 2009; Lamb 2019), and environmental values and connection to nature shape who is drawn to conservation work in particular (Guiney & Oberhauser 2009). We tested age and gender as covariates but did not collect education level, household income, employment status, or measures of environmental world view, and so cannot estimate their contribution to the unexplained variance. The associations we report should be read as describing variation among Ontario environmental volunteers within a common external context, rather than as a complete account of what makes people engage.

Our analytic sample of 143 meets conventional adequacy criteria for a model of this complexity (De Winter et al. 2009; Kline 2023), but adequacy for estimation is not the same as power to detect small effects. With $N = 143$, power to detect a standardized path of 0.15 at $\alpha = 0.05$ is approximately 0.39—such an association would have been detected in about two samples in five. The non-significant direct associations we report for transformational leadership and organizational capacity are therefore consistent both with genuinely null associations and with small associations this study was not equipped to detect, and we describe them as not detected rather than as absent. Restricted variance compounds the problem: median responses were at or near 6 on a 7-point scale across all three organizational constructs, so few respondents report poorly led or poorly resourced projects and the range across which an association could express itself is narrow.

Because leadership, capacity, social capital, and engagement were all reported by the same respondent at one time point, the associations we observe may be inflated by common-method variance, and their direction cannot be established. A volunteer who is highly engaged may perceive their group more favorably across all four measures. The reciprocal possibility we raise—that engagement generates social capital as much as social capital sustains engagement—cannot be adjudicated with these data and would require longitudinal or multi-source measurement.

This study adapts a framework on community-based initiative performance to examine how project organization relates to volunteer engagement in ecological restoration. Project organization has been identified as an important factor in volunteer commitment (Ryan et al. 2001; Asah et al. 2014; Ding & Schuett 2020), yet its constituent elements have not been empirically examined. Our results indicate that social capital is the factor most closely associated with volunteer engagement, and

that the associations of transformational leadership and organizational capacity with volunteer engagement are largely indirect, transmitted through social capital. This highlights the central importance of interpersonal trust, shared vision, and community bonds in sustaining volunteer participation. For practitioners, this suggests that investments in building social capital among volunteers—through group activities, shared decision-making, and fostering interpersonal connections—may be more effective at sustaining engagement than organizational improvements alone. As the ecological restoration sector expands under the UN Decade on Ecosystem Restoration, the ability to retain and energize community volunteers is increasingly critical to achieving conservation goals at scale. These findings invite practitioners and researchers alike to consider volunteer programs not merely as mechanisms for mobilizing labor, but as communities of practice in which the quality of social relationships is itself a conservation outcome worth cultivating.

Acknowledgments

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Supporting Information

The following information may be found in the online version of this article:

Supplement S1. Full survey on community-based initiatives and volunteer engagement.

Supplement S2. Results of path analysis model.

Supplement S3. Missingness and imputation sensitivity.

Supplement S4. Robustness checks.

Supplement S5. Full model diagnostics.