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How Trust Manifests in a Natural Resource Partnership

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ABSTRACT

Trust is essential for successful environmental governance, but more research is needed to understand how trust ecology dynamics interact to influence partnership success. We applied the trust ecology framework to partnerships between federal agencies and non-governmental organizations focused on outdoor recreation management. Data were collected from U.S. agency personnel and nonprofit organizations engaged in partnerships to understand partnership success, overall trust, and the four trust pathways: expected behavior (rational trust), emotional connection/shared values (affinitive trust), systems providing a safety net (systems-based trust), and the trustor's predisposition to trust (dispositional trust). High levels of overall trust were strongly linked to partnership success. Affinitive trust was the most significant predictor of overall trust. These trust pathways were highly interdependent, each likely reinforcing the others in shaping trust dynamics. We advance shared governance theory by highlighting the importance of context-specific strategies for building and sustaining trust in natural resource management.

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Introduction

Trust has long been identified as a central component of successful environmental governance arrangements (Ansell and Gash 2008; Cerveny et al. 2022a; Emerson, Nabatchi, and Balogh 2012; Ostrom 2003). When parties trust each other in the face of uncertainty, unproductive conflict decreases, the speed and efficiency of interactions increase, and collaboration between parties can occur in diverse contexts (Mayer, Davis, and Schoorman 1995; Rousseau et al. 1998; Stern and Coleman 2015). Trust in another party can result from judgments about their expected behavior, a feeling of affinity or emotional connection to the other party, the presence of a system that provides a safety net, and the trustor's proclivity to trust others (Stern and Coleman 2015). Trust is considered robust and resilient when all four pathways to trust development are present, although each pathway may individually promote trust (Stern and Baird 2015).

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An outstanding question concerns the role these pathways, individually and jointly, play in developing trusting relationships across environmental governance issues.

We employ the trust ecology framework to examine how trust manifests in partnerships focused on natural resource management, where public agencies and private entities interact to supply a public good. We focus on relationships between the United States Forest Service or the United States National Park Service and non-governmental partners, where the focus of the partnerships is supporting outdoor recreation trails. Partnerships include on-the-ground actions (e.g., trail construction) but also include co-production of goals and priorities, resource sharing, and assisting with management coordination. These trail partnerships are a form of shared governance, central in supporting the agencies' foundational mandates to provide public access to outdoor recreation. While unique in purpose, trail partnerships are a useful case study because they are emblematic of how natural resource agencies meet their core needs that extend beyond their internal capacity.

Examining the pathways that foster and sustain trust in these partnerships helps inform the future development of and provides lessons for analogous partnerships. Theoretically, we examine the relative contributions of different trust pathways to overall levels of trust in trail partnerships, providing an analysis of existing theory in a new context. Specifically, we seek to understand how each trust ecology pathway contributes to perceptions of overall trust, a key driver of success in these trail partnerships (Freeman and Sorice 2026). Understanding where to focus trust-building efforts is critical given the myriad challenges facing collaborative efforts with government agencies, including a lack of incentives to engage in building collaborative relationships, a decline in agency staff, and general resource constraints (Beeton, Cheng, and Colavito 2022; Coleman et al. 2021; Santo et al. 2021).

Conceptual Framework

Trust ecology recognizes trust as an emergent property shaped by interconnected factors related to the trustor, the trustee, and relevant institutional dynamics. It provides a framework for exploring how trust is formed and maintained across contexts (Stern and Baird 2015). The multidimensional framework identifies four pathways fostering trust (Stern and Coleman 2015).

Dispositional trust involves an individual's predisposition to be generally trusting of others or not. This form of trust is embedded within an individual's personality, which has been developed over time through their experiences. It serves as the default trust one has in other people when additional information is missing to judge the trustworthiness of a person or entity (Yamagishi et al. 2015). While other pathways can be rapidly shaped by contemporaneous events (e.g., changing rules or actions demonstrating trustworthiness), dispositional trust is generally stable and not easily altered. However, it can change over an individual's life course.

Rational trust is based on an individual's evaluation of the likely outcomes of an interaction with a potential trustee. In this form of trust, the individual predicts how another party will behave or perform based on judgements of their past actions, reputation, competence, consistency, and follow-through. Thus, the trustor must decide if these qualities suggest an advantageous outcome.

Rather than involving an active prediction of behavior, *affinitive trust* involves comfort with or liking of another actor that fosters a sense of connection or shared bond. It can be grounded in a general bias people have to favor others who share similar values, interests, backgrounds, and experiences (McAllister 1995). This affinity can develop instantaneously through a first impression or develop over time. Repeated interactions and exchanges of goodwill can give rise to positive feelings of social connectedness that lead one party to believe they share similar values or have a shared identity with the other party. Determinants may include demonstrations of genuine caring or active listening, positive social experiences, or other interactions that leave a party "feeling good" about the interaction.

Systems-based trust is a form of trust supported by sets of rules and procedures in which an interaction occurs. When all parties agree to abide by procedures that are perceived to be fair, the need for other forms of trust may be relaxed. Developing trustworthy systems can facilitate the initial participation of distrusting individuals and support the development of rational and affinitive trust (Coleman and Stern 2018b).

The application of the trust ecology framework across diverse contexts provides insight into the forms of trust that most powerfully drive collective outcomes. It has been applied to multiple natural resource contexts, including trust in water utilities (Grupper et al. 2021), transboundary policy networks (Song et al. 2019); forest management (Coleman and Stern 2018a, 2018b; Davis et al. 2018; Nelson, Gosnell, and Warren 2017); sediment remediation (Nixon, Carlton, and Ma 2023); fishery management (Lima et al. 2019; Sohns, Hickey, and Temby 2022); protected areas establishment (Michel et al. 2022); rangelands management (Lien et al. 2021); aquaculture (Hartenstine 2022); healthcare (Rennie et al. 2023); biosecurity (Maclean, Farbotko, and Robinson 2019); participatory modeling (Bartels and Furman 2023); conservation easements (Rissman et al. 2023), and private land conservation (Lutter et al. 2018).

Trust ecology posits that the resilience of long-term collaborative arrangements requires adequate stores of rational, affinitive, and systems-based trust (Stern and Baird 2015). Multiple studies provide evidence of the importance of all three of these forms of trust to successful collaboration and management actions, sometimes for different purposes (Coleman and Stern 2018b; Eastwood et al. 2022; Grohmann et al. 2023; Rissman et al. 2023). For example, Coleman and Stern (2018a) found that affinitive trust was especially valuable for convening early members in a collaborative group, while rational and procedural trust were particularly important for recruiting and retaining additional members. Song et al. (2019) found that rational trust was important for aligning mutual goals, while affinitive trust was more significant for influencing decision-making. Other studies suggest that the relative importance of each pathway may vary from context to context. For example, systems-based trust may be most important in low salience situations, such as trust in a municipal water system, where people aren't regularly or directly engaging with potential trustees (Grupper et al. 2021). Affinitive and rational trust may be the most important forms for collaborating with local landowners to conduct research on their properties (Vandervort 2023). Overall, research on trust ecology has varied in methodology and the specific dimensions investigated; however, the importance of each pillar is generally supported.

Rather than relying on the axiom that trust is important in the success of natural resource partnerships, we first evaluate the relationship between overall trust and

perceptions of partnership success. We then assess the degree to which each trust pathway is related to ratings of overall trust.

Trail Partnerships

The need for trail partnerships with external, nonfederal institutions extends back to the origin of the National Trail System Act of 1968 (P.L. 90-543), which authorized national trails like the Appalachian and Pacific Crest Trails, and laid out a framework for collaboration among federal, state, and local agencies, private organizations, and individuals to create and manage these trails (Cerveny, Derrien, and Miller 2020). Sustained demand for outdoor recreation has led to diminished trail conditions, exacerbating extant budgetary and capacity challenges (Cerveny, Derrien, and Miller 2020, Cerveny et al. 2022b; Follman, Cseh, and Brudney 2016). Partnerships allow agencies to engage in shared governance, increase capacity to meet mission goals, and engage a willing public to contribute to public lands management (Cerveny, Derrien, and Miller 2020; Cerveny et al. 2022b; Koontz and Johnson 2004). The partner institutions and their members benefit through intrapersonal (e.g., increased concern for natural resources), interpersonal (e.g., career networking opportunities.), and institutional (e.g., resource pooling) development (Follman, Cseh, and Brudney 2016; McCreary et al. 2012).

These partnerships take a variety of forms, from very informal hand-shake agreements to official memorandums of understanding. Partners engage in the tenets of collaborative governance by going beyond procurement and the contractual work of trail maintenance and construction, for example, to participating in planning and execution of environmental analyses, co-planning annual work programs, helping to set priorities, fundraising, and assisting with coordination across management units (Follman, Cseh, and Brudney 2016; Freeman and Sorice 2026). The U.S. Forest Service and National Park Service have come to rely heavily on trail partnerships. For instance, the Forest Service manages a network of 162,984 miles of formal trails and roads. In 2022, partners contributed to 50% of the 57,412 miles maintained (Yankoviak 2023, Personal communication).

While agencies enter partnerships to support capacity, non-governmental partners engage with the federal government for many reasons (Follman, Cseh, and Brudney 2016; McCreary et al. 2012). Partnering may fit well into an organization's mission and values. It may help the organization (e.g., competitive advantage, reputation). Partnering can also support a variety of interpersonal goals (e.g., building relationships with others, developing skills across sectors, career advancement, publicity) and intrapersonal goals (e.g., concern for natural resources, having fun, and building sales esteem) in the organization.

Methods

Sampling and Data Collection

Because partnerships are created and maintained by each national forest or national park unit, we first created a sampling frame by distributing a short questionnaire through the agencies' networks of regional and local trail managers. We defined trail

partnerships for respondents as arrangements between the agency and one or more stakeholders, or partners, where resources like funding, labor, or information are shared. We noted they could consist of formal written agreements (e.g., MOUs, partnership agreements, group volunteer agreements) or informal agreements. We reminded them to consider only those partnerships that support trail work on US Forest Service and/or National Park Service lands. We also asked them to consider dyadic partnerships that include only two parties, the agency and the partner. We asked respondents to identify up to six partnerships in which they are involved (three successful and three less successful). They provided us with names and contact information for each partnership. Finally, we asked them to rate the overall success of the partnership on a scale from 1 = *Not at all successful* to 9 = *Extremely successful*.

From this survey we generated a sampling frame of 202 partnerships. A majority (61%) of the partnerships supported trails within a single National Forest or Forest Service region while 13% of partnerships supported trails within a single National Park unit. Approximately 14% of the partnerships supported National Scenic Trails (e.g., Appalachian Trail), which cross jurisdictions. National Historic Trails without a physical trail footprint (e.g., Selma to Montgomery National Historic Trail) comprised 12% of partnerships.

We randomly sampled 83 of these partnerships, slightly adjusting the sampling procedure to ensure national coverage as well as a diversity of partnership structures (e.g., volunteer agreements, participating agreements, challenge cost-share agreements), partnership attributes (e.g., partnership age, geographic location, number of people involved in the partnership), and variation in perceptions of success. Managers who administer more than one partnership were asked to report on a single partnership that we selected.

For this next phase of research, we followed Dillman, Smyth, and Christian (2014) methodology to recruit agency personnel and partners for an online survey conducted with QuestionPro. In March 2022, agency leaders at the USFS and NPS emailed staff, alerting them of the survey and requesting cooperation. The following week, we emailed the initial survey to agency contacts and the partner points of contact with an individualized link to the survey. We sent email reminders seven and fourteen days after the initial distribution. Questionnaires were customized so each stakeholder (agency or partner) read the name of their actual partner and partnership in the survey document. Additionally, the partner survey included the success question that had already been asked to agency personnel.

Measurement

To assess overall trust, we first asked respondents to indicate whether they *trust* or *distrust* their partner. Because a lack of trust differs substantively from distrust (Lewicki, McAllister, and Bies 1998), we provided respondents with a definition of distrust as "the expectation that the other party's actions are likely to cause harm." If *trust* or *distrust* was chosen, the respondent indicated whether they trusted or distrusted the partner slightly, moderately, or strongly. Based on this survey format, we constructed a single 7-point Likert-type scale scored as 1 = *Strongly distrust*, 4 = *Neither trust nor distrust*, and 7 = *Strongly trust*.

We measured the determinants of trust using guidelines provided by Stern and Coleman (2015). Because this was an online survey, partner names were customized for each respondent. Rational trust consisted of two items averaged together: "My past experiences working with [partner] were positive" and "[Partner] is capable of doing the work required to support our partnership" ($r_{Pearson}$ = 0.59). Affinitive trust also consisted of two items averaged together: "[My organization] cares about their relationship with [Partner]" and "[My organization] and [Partner] get along well with each other" ($r_{Pearson}$ = 0.73). Systems trust consisted of a single indicator: "The rules that govern the operation of our partnership are fair and predictable." Dispositional trust was measured with a single item: "I generally trust others." All responses were collected using a 5-point Likert-type scale from 1 = *Strongly disagree*, 3 = *Neither agree nor disagree*, and 5 = *Strongly agree*.

Data Analysis

We used ordinary least squares regression to examine the relationship between success and overall trust and between overall trust and the trust determinants (StataCorp 2021). We further investigated the relative contribution of trust determinants to overall trust using structure coefficients, commonality analysis, and relative importance analysis.

Structure coefficients are the bivariate correlations between the predicted values of overall trust and the independent variables that improve the interpretation of regression output when predictor variables are correlated (Courville and Thompson 2001). Because they are not subject to collinearity, they provide complementary information about the contribution of a predictor regardless of statistical significance in a regression model. For instance, a study on private landowner intentions to enroll in a conservation program to help an endangered species, focusing on regression coefficients, found that a private landowner's belief about excessive paperwork was statistically significant while concern about losing control of land-use decisions was not (Sorice 2012). However, the structure coefficients indicated that both were equally able to explain intention.

Commonality analysis decomposes the variance into contributions uniquely attributable to a predictor and contributions shared amongst predictors. In addition to identifying the overall contribution of a predictor variable in explaining variance, it helps to identify the magnitude and location of multicollinearity and suppression in a regression model (Ray-Mukherjee et al. 2014). For instance, a commonality analysis used in a study on hunters' support or opposition to a ban on lead shot in hunting found that a hunter's belief that preventing the spread of lead in the environment was not statistically significant, yet it contributed substantively to the model through the variance it shared with other predictors (Schroeder, Fulton, and DonCarlos 2016). We used the *commonality* function in R software to conduct the commonality analysis (Nimon et al. 2008).

Finally, we visually explored trust pathways to examine their potential to act as necessary conditions for a high level of trust to occur. Necessary conditions operate on the logic that a particular determinant of trust *must* be present for high trust. Said in another way, the absence of a pathway guarantees the absence of a high level of trust. We define high trust as respondents who indicated that they *moderately* or

strongly trust their partner. We generated plots of each determinant against overall trust and overlaid a step-function that creates a "ceiling line" (Dul 2020). This ceiling line permits visual inspection of each antecedent's threshold, resulting in high trust for at least one respondent.

Results

We began with 202 partnerships and sampled 83 of them. Because each partnership has two members, this yielded a total of 166 eligible individuals. We received 88 individual surveys. Those 88 responses came from 61 of the 83 partnerships. Of these 61 partnerships, 27 full partnerships were represented (both members responded), and 34 were from a single respondent of the partnership. No one from the remaining 22 partnerships responded. Because we focus on individual perceptions of trust and not agreement/disagreement within partnerships, our unit of analysis is the individual rather than the partnership.

The sample represented partnerships from all nine regions of the U.S. Forest Service and five of twelve regions of the National Park Service were represented in the sample. Most partnerships were from the Forest Service (89%) and less than ten years old (60%). Various agreement types were represented, with 38% reporting formal volunteer agreements, 32% reporting challenge cost-share agreements, 13% reporting cooperating agreements, 12% reporting a memorandum of understanding, and 10% reporting a participating agreement. Note that a single partnership can have >1 agreement type. Four respondents reported that their partnerships operated without a written agreement.

Role of Trust in Successful Partnerships

Partnerships were evaluated by respondents to be generally successful on average (*Mean* = 6.8, *SD* = 1.9, *Median* = 7), with 41% rating their partnership as *very* or *extremely* successful (i.e., ≥8) (Figure 1A). Less than 10% rated the partnership as *not at all* or *slightly* successful (i.e., ≤3 on the scale). Trust in the partner was also high, with 76% indicating *moderate* or *strong* trust and less than 10% indicating distrust (*Mean* = 5.9, *SD* = 1.6, *Median* = 7) (Figure 1B). A curvilinear relationship between trust and success provided the best fit to the model ($F_{(2,60)}$ = 40.06, $p < 0.01$). The single-item trust measure explained over half of the variance in the partnership success evaluation (R^2 = 0.53). The curvilinear relationship indicates that success ratings increase substantially once the trust level exceeds a rating of *neither trust nor distrust* (Figure 1C).

Determinants of Trust

Respondents generally *agreed* with statements related to rational, affinitive, systems, and dispositional trust (Dispositional mean = 4.46, median = 4; Affinitive mean = 4.43, median = 5; Rational mean = 4.08, median = 4.5; Systems mean = 4.03; median = 4). The model regressing overall trust on rational, affinitive, systems, and dispositional trust was statistically significant, explaining almost two-thirds of the variance in trust ($F_{(4,60)}$ = 22.37, $p < 0.01$; R^2 = 0.67, R^2_{adj} = 0.65) (Figure 2; Table S1). Only affinitive trust was statistically significant ($b = 1.17$, $t = 4.61$, $p < 0.01$). A one-level

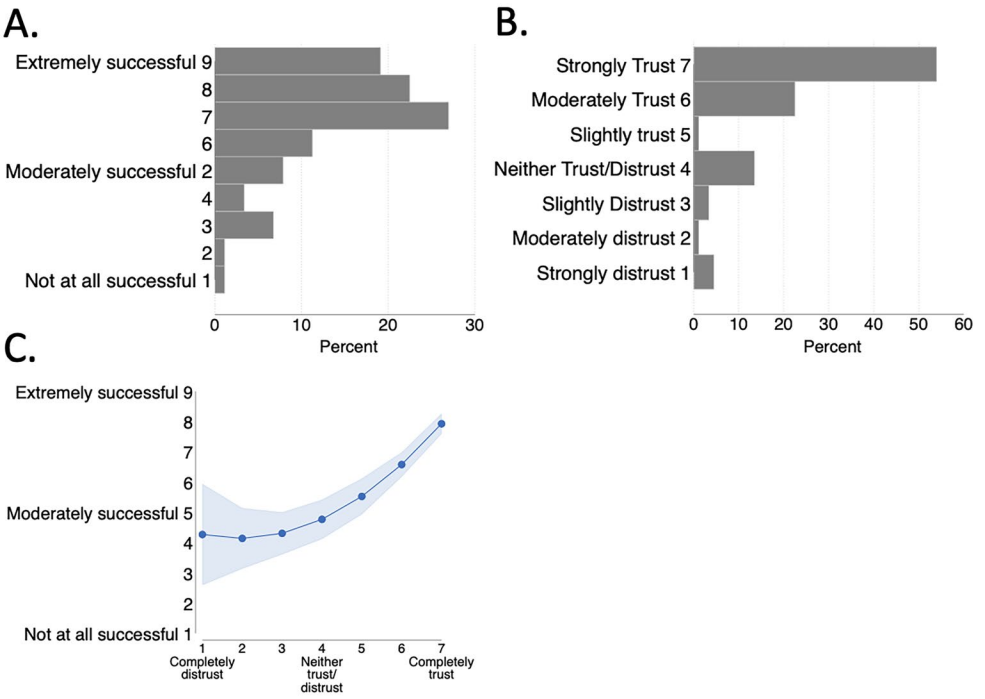
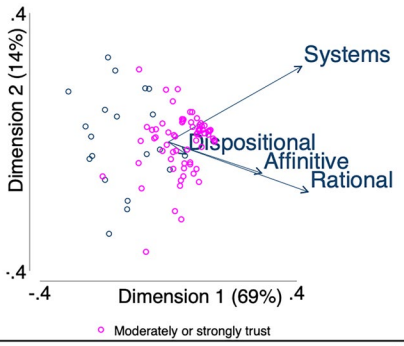


Figure 1. (A) Partnerships are generally considered to be moderately to highly successful and (B) largely demonstrate high trust. (C) Highly successful partnerships require at least some level of trust.

increase in affinitive trust is associated with a 1.17-level increase in overall trust on average. Rational trust was marginally significant and positively related to overall trust ($b = 0.36$, $t = 1.82$, $p = 0.07$). Neither systems trust nor dispositional trust were statistically significant (Systems: $b = 0.25$, $t = 1.24$, $p = 0.22$; Dispositional: $b = -0.30$, $t = -1.48$, $p = 0.14$).

The structure coefficients provide initial insight into the hidden value of statistically insignificant trust pathways. Structure coefficients for rational trust (r_s = 0.83) and systems trust (r_s = 0.73) were high despite a lack of statistical significance (Figure 2). Because the pathways were highly correlated (Table S2), we investigated potential issues with multicollinearity. We found the variance inflation factors for each determinant to be <2.3, indicating little concern about multicollinearity (Montgomery, Peck, and Vining 2021).

A principal components analysis biplot provides a visual inspection of the covariance structure of the trust determinants with the respondents' scores (Figure 2). The points represent respondents mapped on the first principal component (x-axis) and second principal component (y-axis). Individuals in pink have *moderate* or *strong* trust ratings. The arrows represent the loadings of the pathways. The longer the arrow, the greater the pathway's contribution to explaining variation. Component 1 on the x-axis explains a total of 69% of the variance in the pathways and primarily reflects contributions of rational and affinitive trust. Component 2 on the y-axis accounts for an additional 14% of the variance and highlights the role of systems trust in explaining trust. The angle between the arrows reflects the degree of correlation, with 90-degree angles indicating no correlation and small angles representing high correlation. Affinitive,



Variable	b	β	r_s	VIF	Commonality Unique	Commonality Common
Rational trust	0.3652	0.2267	0.8274	2.25	0.0229	0.4348
Affinitive trust	1.1714*	0.5512	0.9496	1.93	0.1572	0.4457
Systems trust	0.2523	0.1559	0.7258	1.76	0.0138	0.3384
Dispositional trust	-0.3018	-0.0956	0.0680	1.04	0.0088	-0.0057

*p<0.05

Figure 2. The biplot illustrates the covariance between trust determinants. Respondents with the pink color represent respondents with high overall trust. The summary table provides regression coefficients (b), standardized coefficients (ß), structure coefficients (r_s), variance inflation factor (VIF), and a summary of the commonality analysis. Together these results support the proposition that trust is an emergent property with multiple determinants.

dispositional, and rational trust are highly correlated and somewhat correlated with systems trust.

The further to the right a respondent is on the biplot, the higher their scores tend to be on all of the determinants. Respondents lower on the figure have stronger scores for rational, affinitive, and dispositional trust and lower systems trust scores. A substantial number of the high-trusting respondents and relatively few lower-trusting respondents cluster near or along arrows, indicating that trust may be better characterized by the determinants considered jointly rather than separately.

The commonality analysis shows that affinitive trust alone accounts for almost one-quarter of the variance in overall trust (24% of the R^2 value) (Table 1). Rational and systems trust uniquely account for 3% and 2% of the variance, respectively, and dispositional trust accounts for <1%. This means that ~70% of the variance in overall trust is shared between pathways. For instance, rational and affinitive trust combine to jointly account for 20% of the explained variance, while rational, affinitive, and systems trust jointly account for an additional 42%.

A summary of these findings suggests that each pathway may be a necessary condition for high levels of trust (Figure 2). Visual inspection of our data suggests that high trust does not occur in the absence of rational, affinitive, or systems trust and supports these concepts as necessary conditions for high trust (Figure 3). Interpretation of the graphs focus on the blocks of blank white space above the frontier line. High levels of trust can be found in respondents who *somewhat disagree* either that their partner is good at what they do (Figure 3A) or that procedures are fair (Figure 3C), but not when respondents *strongly disagree* with those statements. High trust does not occur with any level of ambivalence or disagreement regarding affinitive trust (Figure 3B).

Table 1. Commonality analysis decomposes the r-square into variance accounted for by each variable.

Determinants	Portion of R^2	Percent of R^2
Rational, affinitive, & systems	0.2783	42%
Affinitive only	0.1572	24%
Rational & affinitive	0.1354	20%
Affinitive & systems	0.0327	5%
Rational & systems	0.0251	4%
Rational only	0.0229	3%
Systems only	0.0138	2%
Dispositional only	0.0088	1%
Rational, affinitive, systems, & dispositional	0.0045	1%
Systems & dispositional	−0.0003	0%
Affinitive, systems, & dispositional	−0.0003	0%
Affinitive & dispositional	−0.001	0%
Rational, systems, & dispositional	−0.0016	0%
Rational & dispositional	−0.0031	0%
Rational, affinitive, & dispositional	−0.0039	0%
Total	0.6686	100%

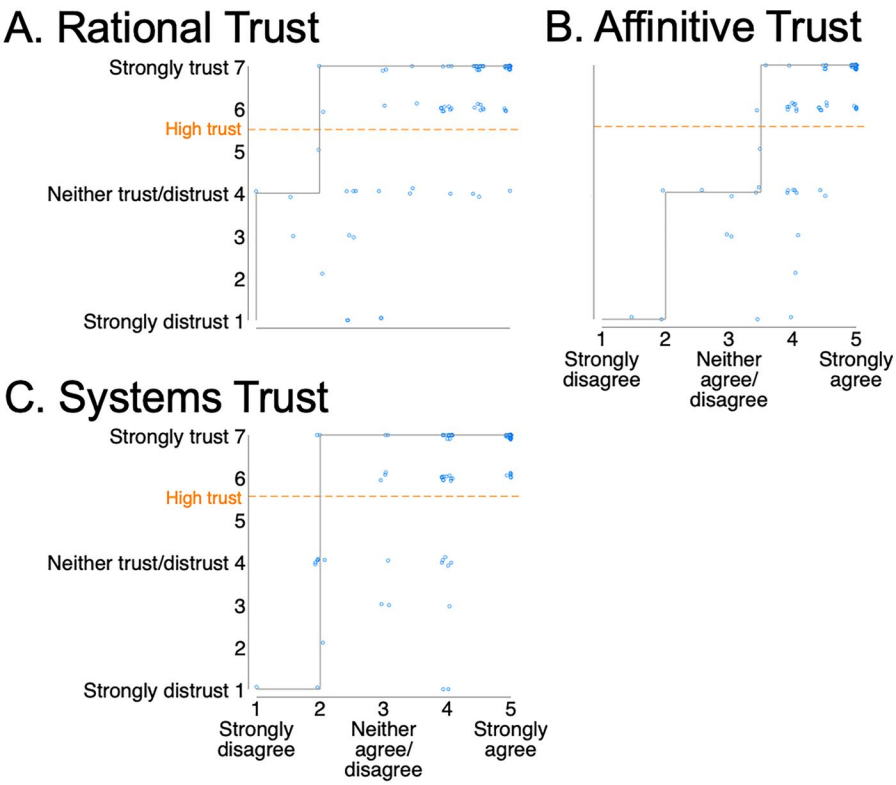


Figure 3. A stepwise function (free disposal hull frontier line) was used to explore the possibility of each determinant as a necessary condition for trust. High trust does not occur when respondents strongly disagree that rational trust (a), affinitive trust (B), or systems trust (C) exists.

Discussion

Fitting with the literature on shared governance, we find that trust plays a central role in understanding the perceived success of trail partnerships. Affinitive trust was the

strongest determinant of overall trust, although all three actionable types of trust pathways (affinitive, rational, and systems-based) contributed meaningful explanatory power. Dispositional trust did not contribute to understanding trust in this case. This study supports the trust ecology hypothesis that adequate stores of all three actionable forms of trust are important for successful collaboration (Stern and Baird 2015).

The context in which trust is established shapes how trust pathways converge and affect the overall trust dynamic (Lacey et al. 2018; Stern and Coleman 2015). With this in mind, we explore lessons from similar partnerships between federal land management agencies and non-governmental partners with largely aligned interests in achieving outcomes for a non-controversial scope of work.

In the context we examined, the participants may feel less vulnerable than other cases in the literature, as substantial changes to the landscape, livelihoods, and other major controversies are largely absent (Hamm, Möllering, and Darcy 2024; Stern and Coleman 2015). Often, external partners have voluntarily entered into agreements with the goals of trail maintenance and improvement of on-the-ground trail conditions. While federal agencies may have specific priorities for trail work, the sheer amount of worthwhile work to be done and limited capacity within the agencies commonly grant external partners sufficient autonomy to focus on the specific projects that most align with their organizational mission and skill. Negotiations are between parties about which work will be done, and many options are commonly acceptable to both. This contrasts with trust ecology research on larger collaborations, where agency-public interactions involve multiple parties with conflicting values, making them more prone to conflict and escalation (Coleman and Stern 2018b; Michel et al. 2022).

The emphasis on the role of affinitive trust in our results suggests an intuitive path forward: focusing directly on developing positive regard and shared values and visions between organizations. This may involve being kind, active listening, and expressing genuine appreciation for the time, effort, and accomplishments of the people involved. A focus on fostering empathy, the capacity to understand and share the feelings of another person, can also improve affinitive trust because it encourages people to be vulnerable, engage in open conversation around the successes and challenges of a partnership (Aramatas et al. 2021; Pavlovich and Krahnke 2012; Wald et al. 2017). Sharing the inner workings of the agencies and organizations involved can help each partner to better understand the challenges and accountabilities each other faces, how and why each is committed to the work, and how they can help each other succeed (Stern 2018). Informal (or formal) gatherings can help partners celebrate their accomplishments and get to know each other, contributing to affinitive and rational trust development (Coleman and Stern 2018a).

Focusing on interpersonal relationships and developing shared understanding is a good place to start, and perhaps adequate in many non-controversial settings with a simple partnership structure. However, when partnerships include the federal government or other large bureaucratic institutions, focusing primarily on interpersonal relationships at the expense of systems and rational trust may unintentionally introduce risk. Within the context of federal-government collaboration, frequent employee turnover and a general 'culture of transition' complicates continuity, trust, and relationship-building from the perspectives of both agency and non-agency partners (Beeton, Cheng, and Colavito 2022; Coleman et al. 2021; Santo et al. 2021). Often,

the viability and success of partnerships are contingent on the commitment of individual personnel within agencies (Beeton, Cheng, and Colavito 2022). Therefore, succession planning in partnerships is critical. Beeton, Cheng, and Colavito (2022) stressed the importance of raising awareness of collaborative projects with new employees during onboarding, and explicitly articulating procedures, visions, and expectations in 'boundary objects' (e.g., charters, MOUs, agreements).

Focusing on different trust pathways is not zero-sum; the high covariance across pathways in our study and other trust ecology research suggests that shoring up other pathways can create positive cascades that support affinitive trust (Bartels and Furman 2023; Coleman and Stern 2018b; Grupper et al. 2021). For instance, the joint development of fair and transparent processes and procedures (systems trust) can be critical for reducing the risks of entities engaging in high-stakes deliberations (Coleman and Stern 2018b). Such a system provides opportunities for demonstrating competence (rational trust) and can create an environment facilitating affinitive trust by developing a baseline set of shared rules that define the expectations for the partnership. In the case of trail partnerships, an initial focus on these types of systems may facilitate effective collaboration by enabling quicker agreements and decision-making. This can make interactions more pleasant and the work more satisfying, enhancing affinitive trust. Pursuing affinitive trust by developing systems trust and rational trust may be particularly beneficial in the federal government context, where building relationships through informal interactions (e.g., social gatherings, sharing common interests outside of work) can be challenging. For instance, there is a long history of concern that land management agency employees are susceptible to being 'captured' by local interests, and there is a more recent trend toward agency employees living outside of the communities where they work (Santo et al. 2021); these institutional norms and trends likely impede the building of affinitive trust through the common, often social and locally rooted, channels.

Across disciplines, trust is a core construct to explain why participants across settings do or do not cooperate, and the trust ecology framework provides testable hypotheses into key pathways that lead to cooperation. A recurring insight also supported by our research suggests that the rational, affinitive, and systems trust pathways intersect, making each a key ingredient for effective collective action. By clearly articulating the context in which trust is studied, including the degree of salience, interdependence, vulnerability, and risk, trust ecology can provide actionable insights and priorities for improving collaboration in environmental governance.

While we are confident in the internal coherence of our findings, several design features limit the generalizations that can be drawn. First, the selection bias that is inherent in all self-administered survey research may be somewhat increased in studies that examine effectiveness, resulting in lower response rates for less effective partnerships. It is also possible that unsuccessful partnerships, by their very definition, do not last over many years, ultimately reducing the available pool to sample at any point in time. While we did receive response diversity in trust, it was skewed toward high-trusting partnerships. In addition to selection bias at the partnership level, this skew may reflect an individual bias for managers who may be reluctant to report on unsuccessful partnerships, given that they are part of their work duties (i.e., self-selection bias).

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Authors' contributions

JWF, MGS, and MJS designed the research with input from CAA; JWF collected the data; MGS led the data analysis with support from MJS and JWF; MGS led manuscript development; MJS, CAA, and JWF provided critical contributions to the manuscript and have given final approval for publication.

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