



Testing the Influence of Tactics on an Intention to Participate in an Environmental Management Collaborative

Shannon Heaney¹ · Ryan Plummer¹ · Julia Baird¹ · Amy Bowen² · Gillian Dale¹

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Abstract

Complexity, uncertainty, and conflict characterize contemporary environmental challenges. Addressing these issues is beyond the purview of any one actor. A collaborative approach to environmental management is required; participation in collaboration is needed. However, participation in collaborative environmental management is a persistent challenge in practice. This research examines tactics used to engender participation in collaborations. Tactics constitute a strategy for communications with an intended goal and encompass the framing (i.e., wording, imagery) and platform of dissemination. This research examined the influence of tactics on an intention to participate in an environmental management collaboration. Eight tactics were empirically tested on 300 individuals aged 18–29. Descriptive and inferential statistical analysis was undertaken. Results uncovered the effectiveness of contextual and personal framings in engendering participation and deepened the understanding about past participation, tactics, and an individual's intention to participate. Opportunities to engender participation in collaborations using tactics are abundant. The research emphasizes the need for greater attention to tactics in environmental management and contributes to a greater understanding of tactics, identifying effective practices for engendering participation and broad dissemination.

Keywords Tactics · Communication · Environmental management collaboration · Participation

Introduction

Participation in environmental management collaborations is crucial for tackling complex environmental challenges. It is of paramount importance because no single actor has the capacity, knowledge, and/or responsibility to address these challenges alone (Armitage et al. 2012; IPBES 2019). Participation in environmental management collaborations is wide-reaching and takes many forms including stewardship by individuals, non-government organizations, and government agencies; collaboration by constellations of actors; people partaking in community science; and public engagement in committees, community-based groups, and/or volunteer opportunities.

Participation offers considerable social and conservation benefits, including creating positive relationships amongst

actors, increased trust amongst participants and leaders, enhancing diversity of actors in decision making, and fostering inclusivity (Wates 2006; Lei and Kelly 2015). It affords an opportunity to align values of individuals and communities with anticipated outcomes, impelling greater acceptance and just outcomes (Debnath et al. 2022; Huntington et al. 2017). In addition, many conservation and environmental outcomes emerge including improved protection or restoration of habitats and species, watershed protection, and ecosystem restoration (Wilkins et al. 2021).

Demographic analysis affords nuanced insights into the characteristics of participants in environmental management collaborations. Demographic details of participants have been found to vary within environmental sustainability literature (Han et al. 2011; Ganzervoort et al. 2017). However, a small number of relatively consistent characteristics have been identified; participants in environmental management frequently include high education and income (Carman 1998; Hnajnal and Clark 1998; Henion 1972; Roberts 1996; Conway et al. 2023; Wilson 2012), individuals who identify as white (Conway et al. 2023), and identify as female (Han et al. 2009; Han et al. 2011; Ganzervoort and van den Born 2020; Van den Berg et al. 2009; Abell 2013).

✉ Shannon Heaney
sh21jm@brocku.ca

¹ Environmental Sustainability Research Centre, Brock University, St. Catharines, ON, Canada

² Consumer Sensory & Market Insights, Vineland Research and Innovation Centre, Vineland, ON, Canada

Age is more disparate. Younger individuals have been identified as engaging in certain areas of environmental literature including green infrastructure and the purchase of green products (Evanschitzky and Wunderlich 2006; Conway et al. 2023). Conversely, middle-aged individuals are frequently identified as prominent participants in environmental sustainability collaborations (Ganzevoort et al. 2017; Ganzervoort and van den Born 2020; Conway and Bang 2014; Elton et al. 2022); with a relatively low number of younger participants identified (Asah and Blahna 2013; Ganzevoort et al. 2017; Conway and Bang 2014; Hahmann 2021). In addition, many younger participants, those aged 15–18, are mandated to participate due to required high school volunteer hours (Volunteer Canada 2006). Within urban forestry, the context of this research, participants are predominately characterized as middle-aged (Conway and Bang 2014; Elton et al. 2022; Asah et al. 2014; Still and Gerhold 1997). Duinker indicates the importance of diverse demographic representation of public participants in urban forestry Duinker (1998) and the variation of values relating to urban forestry that occurs amongst various demographic groups Duinker (2008).

Urban forestry was selected as the focus of this research as tree planting events are a common collaborative opportunity in environmental management and were expected to be known to participants. Despite the numerous benefits and some understanding of the characteristics of individuals who participate, participation is a noteworthy and ongoing challenge for environmental management (e.g., Chi et al. 2013; Laurian 2004; Haughton 1999). Participation in environmental management collaborations is lower relative to the overall number of participants as well as the total hours spent in other opportunities for participation (Hahmann 2021). Increasing this consistently low level of participation is identified as a persistent challenge (e.g., Chi et al. 2013; Laurian 2004; Haughton 1999; Hahmann 2021). Such challenges may include disinterest from potential participants or a lack of awareness of opportunities to participate (Hahmann 2021). Consequently, there is an urgent need for research on how to bring about greater participation in environmental management collaborations (IBPES 2019; Cappa et al. 2018; Shaw et al. n.d.).

Can social media help solve this ‘participation problem’? The rise of social media is prompting considerable attention, specifically in understanding how it may be leveraged to influence participation in environmental management (De Luca et al. 2022; Petkov et al. 2012; Ballew et al. 2015; Shaw et al. n.d.; Byrum 2019). Previous research has explored the use of social media as an educational tool for sharing information about environmental issues (e.g., Ardoin et al. 2013), as a platform for environmental activism (e.g., Ganglbauer et al. 2013), and for online participation (e.g., Cox et al. 2015; Newman et al. 2012); however, there is limited research that

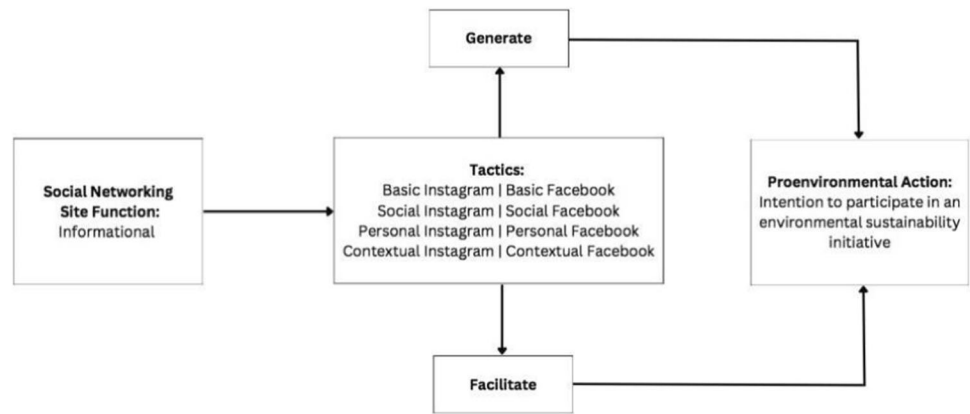
explores the use of social media for engendering participation in environmental management collaborations (Pearson et al. 2016). Further research is needed to explore the use of social media for engendering participation due to its enormous potential and wide-reaching audiences (Pearson et al. 2016; Mai and Gruzd 2022). This is especially pertinent to younger individuals, who have a high usership of social media (Mai and Gruzd 2022; Pew Research Centre, 2023; Statista 2023) and are underrepresented as participants in environmental management collaborations (e.g., Asah and Blahna 2013; Ganzevoort et al. 2017; Conway and Bang 2014; Hahmann 2021) following the completion of mandated volunteer hours as a high school requirement.

This research explores the use of social networking sites for engendering participation in environmental management collaboration. It tests the effectiveness of tactics on influencing the intention of 18–29-year-olds to participate in a collaborative tree planting event. Therein, the research specifically examines the:

1. effectiveness of tactics to produce the intention to participate in a collaborative tree planting event;
2. relationship between demographic characteristics and tactics; and,
3. relationships among previous participation in environmental collaborations, tactics, and the intention to participate.

The Technologies for Proenvironmental Action Model (TPAM; Ballew et al. 2015) is unique as a conceptual framework addressing the intricacies of leveraging social media in environmental communication to generate or facilitate proenvironmental action (Ballew et al. 2015). Social networking sites (SNSs), the focus of this research, falls under the umbrella of social media and provides users with an online space or web address to interact and connect with other people (Henderson et al. 2010). Three functions of SNSs are identified: (1) informational, (2) relational, and (3) experiential (Ballew et al. 2015). Informational functions focus on the dissemination of knowledge through various platforms, relational promotes social connections and relationship building, and experiential creates opportunities for interaction, social participation, and engagement (Ballew et al. 2015). These three overarching functions of SNSs are not exclusive; many online platforms host more than one function in varying degrees of functional capacity. These functions give rise to three framings (personal, social, contextual) that may generate (create new) or facilitate (activate existing) proenvironmental action. (Ballew et al. 2015). The TPAM framework has shaped subsequent thinking about the use of SNSs for influencing proenvironmental action (Allison et al. 2023; Gupta and Syed 2022; Pearson et al. 2016).

Fig. 1 Conceptual Framework (Ballew et al. 2015)



This research draws on the TPAM framework. Tactics within this framework constitute a strategy for communications with an intended goal. They encompass the framing (i.e., wording, imagery) and platform of dissemination. Tactics either generate or facilitate an intention for proenvironmental action. ‘Generate’ refers to the creation of novel intentions to participate in proenvironmental action in individuals who do not actively engage in proenvironmental action. ‘Facilitate’ refers to the driving or reigniting of an intention to participate in proenvironmental action in individuals who have engaged in proenvironmental action frequently in the past. This research focuses on SNSs and their informational function (Fig. 1); the informational function represents communication used to inform the intended audience of a specific topic (i.e., a tree planting event) (Ballew et al. 2015). The informational function was selected as this is a common approach by organizations to disseminate information across various platforms. The research likewise aligns with a fortress communication strategy which involves unidirectional communication (Kanter and Fine 2010) no continued interaction with the intended audience. between the source and receiver, it is often used due to constraints of financial and human resources.

Tactics are central to the conceptual framework (Fig. 1). Eight tactics were created for this research and are listed in Fig. 1 in the central box.

Methods

Study Design

Tactics developed for this research aim to engender participation in a collaborative tree planting event. Four framings (social, personal, contextual, basic) were formulated by drawing upon the TPAM framework (Ballew et al. 2015). Each framing was prepared for the two respective platforms, creating a 2×4 design, resulting in 8 tactics. The framing

remained constant across the platforms; however, how the message was presented, and the imagery used varied across the platforms. Variation in the message presentation and imagery was done in alignment with communication literature which stresses the importance of formatting to the platform’s vernacular and style; this variation is increasingly important when cross-posting (Reich and Pittman 2019; Gibbs et al. 2015).

Facebook and Instagram were selected as the two platforms (i.e., SNSs) for the research. They were selected due to their high use by individuals aged 18–24 and 25–34 (Mai and Gruzd 2022; Pew Research Centre 2023; Statista 2023), which captured the target audience of this research. Recent research by Mai and Gruzd (2022) revealed that Facebook was used by 86% of individuals aged 18–24 and 88% of those aged 25–34 in Canada. Similarly, 87% of individuals aged 18–24 use Instagram, and 79% of individuals aged 25–34 use Instagram (Mai and Gruzd 2022). Similar usage is found in the United States, with Facebook having the highest rate of usership (78%), with 70% of individuals aged 18–29 having an active Facebook account (Statista 2023; Pew Research Centre 2023).

The imagery used in the research was drawn from public stock photos and graphics. The imagery used on Facebook consisted of stock photos aligning with the corresponding framing. The imagery used on Instagram consisted of graphics aligning with the corresponding framing. Although differing as stock photos and graphics, the content of the imagery was similar across platforms with imagery aligning with the specific framing. All 8 tactics and the framing outlines can be found in Online Resources 1 and 2.

Survey Design

An online survey was created for data collection consisting of three sections. The full survey can be found in Online Resource 3. Section one asked participants for demographic information. Demographic questions were based on the Canadian Census to ensure clarity and cultural

appropriateness. Section two presented all eight tactics in random order. Tactics were presented in the survey as screenshots. Respondents were asked to rate their likelihood of intention to participate based on the tactic presented on a 7-point Likert scale (1 = Extremely unlikely; 7 = Extremely likely). Participants were then asked to rate the influence of the elements of each tactic (e.g., wording and imagery used) on their likelihood of intention to participate using a 7-point Likert scale (1 = Not influential at all; 7 = Extremely influential). The third section presented an adapted proenvironmental behavior (PEB) scale (Mateer et al. 2022). Participants were asked to rate their frequency of participation in a set of proenvironmental behaviors over the past 6 months. The adapted PEB scale was rated on a 7-point Likert scale (1 = Never; 7 = Every time) to capture individuals' frequency of behavior. The adapted PEB scale and corresponding means and standard deviations for each question can be found in Table 1.

Procedure

The survey was distributed on Prolific, an online survey recruitment service. Prolific was selected as the survey platform due to its reported high-quality data, diverse participation pool, and survey features (Peer et al. 2017). A total of 300 surveys were requested from the United States and Canada. A North American geographic boundary was selected to remove any additional, unknown variables that may have occurred with a broader geographic pool of participants. The survey was only available to Prolific workers between 18–29 years of age to capture the target audience identified in the research. If individuals met the qualifications (geographic location and age) for the survey and completed the survey to the appropriate standard, they were provided a monetary reward through their Prolific account.

Approval for this research was obtained from the Brock University Research Ethics Board, file 22–161. Prior to

participating in the survey, participants provided written, informed consent. A Captcha verification was included at the survey's start and an attention getter question requiring written text was randomly placed in the survey. Data was reviewed before being approved. Responses not meeting the validity checks were excluded.

Data Analysis

Data collected was reviewed for any errors, missing data, or incorrect data entry (Fink 2011). Numerical values were assigned to answers for each question in the data set in preparation for the analysis using SPSS software. When the assumption of normality was violated in the analysis, the Greenhouse Geisser correction was used to correct the violation for results.

Descriptive statistics were performed to determine the means and standard deviations for all survey measures. Means and standard deviations for tactic measures can be found in Online Resource 4. Demographic variables were recoded into new variables prior to the analysis to condense the demographic categories. New variables were created based on the frequency of participants within each original variable and the grouping of similar variables.

Table 2 shows the recoded variables. Responses of Prefer Not to Say were not included across all variables. The gender variable was not recoded; responses of Prefer Not to Say ($N = 2$), Non-Binary ($N = 9$), and Other ($N = 1$) within the gender variable were not included due to the small sample size. Family status, marital status, and cultural background were not included due to the wide variation in responses and the small sample size. A series of mixed model ANOVAs were performed to investigate demographic variables and likelihood of intention to participate.

Individual participants' likelihood of intention to participate scores were averaged to create a new variable

Table 1 proenvironmental behavior scale: means and standard deviations

Proenvironmental Behavior Scale Question	<i>M</i> (<i>SD</i>)
Bought environmentally friendly and/or energy efficient products	3.62 (1.177)
Walked or rode a bike when traveling short distances	3.96 (1.857)
Bought organic vegetables	3.53 (1.548)
Minimized use of heating or air conditioning to limit energy use	3.96 (1.599)
Talked to others in your community about environmental issues	2.57 (1.419)
Worked with others to address an environmental problem or issue	2.15 (1.286)
Participated as an active member in a local environmental group	1.78 (1.210)
Signed a petition about an environmental issue	2.16 (1.435)
Donated money to support local environmental protection	1.97 (1.283)
Reused or mended items rather than throwing them away	4.30 (1.301)
Avoided buying products with excessive packaging	3.48 (1.444)

Table 2 Recoded demographic variables

Recoded Variables	Original Variables Included	Original Frequency	Recoded Frequency
Education			
No University	Some High School	3	139
	High School	94	
	Trade School	7	
	Certificate or Diploma	35	
University	Bachelor’s Degree	124	158
	Master’s Degree	27	
	PhD or higher	7	
Living Situation			
Living with Parents	Living with Parents	123	123
Living on Own	Renting	133	172
	Homeowner	39	
Income			
\$0–\$49,999	Less than \$24,999	49	113
	\$25,000–\$49,999	64	
\$50,000–\$99,999	\$50,000–\$99,999	109	109
\$100,000+	\$100,000–\$199,999	55	66
	\$200,000+	11	

deemed *overall likelihood* ($M = 4.17$, $SD = 1.34$). The overall likelihood variable was categorized using tertiles creating three equally distributed groups (low = <3.749 , medium = $3.750–4.875$, high = >4.876) labeled as participants with low likelihood of intention to participate scores ($N = 91$), medium ($N = 105$), and high ($N = 106$). Chi square tests of independence were completed for each demographic variable to see if participants overall likelihood of intention to participate scores varied as a function of demographic variables.

Internal reliability of the 11-point adapted PEB scale was investigated using Cronbach’s alpha. The alpha of the total scale was 0.820. Examination of individual item statistics indicated that all items should remain in the scale to maintain a high reliability score. Due to an administrative error, 57 participants did not receive the full adapted PEB scale. These 57 participants were excluded from the analysis resulting in 243 responses. Descriptive statistics were used to create cut points for three equal groups based on the overall PEB scores of participants. Participants were subsequently categorized into three groups: (1) generate (<2.54), (2) middle group (between 2.54 and 3.36), and (3) facilitate (>3.36). The middle group was excluded from analysis to maintain the two groups: generate and facilitate. Subsequent analysis was carried out with the two remaining conditions, generate ($N = 91$) and facilitate ($N = 84$).

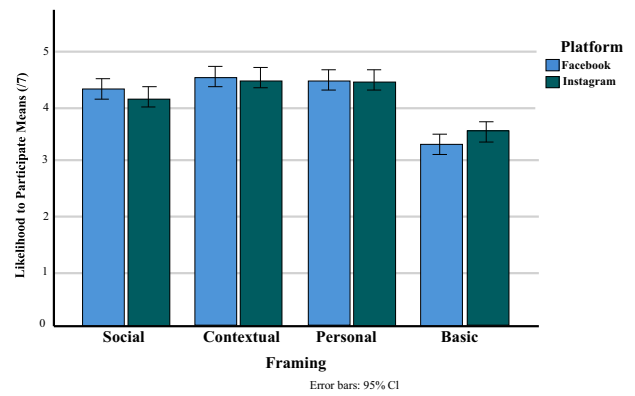


Fig. 2 Likelihood of Intention to Participate in Response to Overall Tactics

Results and Discussion

Effectiveness of Tactics

The first objective was to examine the effectiveness of the eight tactics for engendering an intention to participate in a tree planting event. Figure 2 illustrates the likelihood of intention to participate for all eight tactics. The mean score for the likelihood of intention to participate across the eight tactics was 4.20 (1.34) on a 7-point Likert scale. The contextual Facebook tactic was identified with the highest mean score as the most effective tactic for engendering a likelihood of intention to participate; the basic Facebook tactic was conversely identified as the least effective tactic, with the lowest mean score. Overall, the tactics were rated with a similar range on likelihood of intention to participate, except the basic Facebook tactic and the basic Instagram tactic which engendered a much lower likelihood of intention to participate.

Figure 2 also illustrates a breakdown of the eight tactics by framing and platform. A repeated-measures ANOVA was performed to examine their effects on likelihood of intention to participate. There was a significant main effect of framing, $F(2.458, 739.833) = 125.917$, $p < 0.001$, $\eta^2 = 0.295$, such that likelihood of intention to participate differed depending on the different framing viewed. There was no significant main effect of platform, $F(1, 301) = 0.069$, $p = 0.794$, $\eta^2 < 0.001$, suggesting that there was no significant difference in likelihood of intention to participate across platforms. There was a significant interaction between framing and platform, $F(2.840, 854.883) = 5.571$, $p = 0.001$, $\eta^2 = 0.018$, such that likelihood of intention to participate varied as a function of the interaction between framing and platform. Full results can be found in Online Resource 5.

A Bonferroni post-hoc analysis on framings showed that the contextual ($M = 0.281$, $SD = 0.049$) and personal ($M = 0.227$, $SD = 0.058$) framings led to a higher likelihood of intention to participate in comparison to the social

framing, with no statistically significant difference between the contextual and personal framings ($p = 0.265$). The basic framing rated lower than the other three framings.

A series of Bonferroni-adjusted paired-samples t-tests were performed to explore the interaction between framing and platform and the effect on likelihood of intention to participate. There were no significant differences between the four framings on Facebook compared to Instagram (social, $t(301) = 2.107$, $p = 0.036$, $d = 0.121$; contextual, $t(301) = 0.774$, $p = 0.439$, $d = 0.045$; personal, $t(301) = 0.572$, $p = 0.568$, $d = 0.033$; basic, $t(301) = -2.500$, $p = 0.013$, $d = -0.144$) suggesting that likelihood of intention to participate did not significantly differ due to the interaction of framings across platforms.

An additional repeated-measures ANOVA was performed with the variable platforms collapsed due to the absence of a main effect of the variable. With platforms collapsed, there was still a main effect of framing, $F(2.458, 533.727) = 125.917$, $p < 0.001$, $\eta^2 = 0.295$. An additional Bonferroni post-hoc analysis on tactics showed that the basic framing continued to rate with the lowest likelihood of intention to participate. Additionally, the social framing continued to rate lower than the personal and contextual framings, which had no statistically significant difference between them ($p = 0.265$).

The basic Facebook and Instagram tactics were rated with a lower likelihood of intention to participate than the remaining six. These results provide empirical evidence to support the overarching conjecture of the TPAM framework, that tactics created and informed by specific literature on social, contextual, and personal influence produce a greater likelihood of intention to engage in proenvironmental action compared to a basic tactic (Ballew et al. 2015). It also reinforces the assertion that communication that is well curated and which frames the event in a positive and beneficial manner is more effective than broad basic communication (LaBelle and Waldeck 2020).

These results also indicate that platform is not significantly influential on likelihood of intention to participate ratings. Likewise, there was no significant difference between the two platforms for the majority of the framings tested. These results are consistent with findings that indicate that the target age category uses Facebook and Instagram with a similar frequency and therefore may not hold a significant preference to one platform (Mai and Gruzd 2022; Statista 2023; Pew Research Centre, 2023). However, as participants were not required to login to a Facebook or Instagram account to see the tactics these results are limited as they did not mimic a typical interaction with the two platforms. In the absence of one platform being clearly advantageous the use of multiple platforms, a common strategy identified in communication literature (LaBelle and Waldeck 2020; McGuire 1984), is beneficial.

The preference for contextual and personal tactics may indicate that individuals aged 18–29 are more driven to participate to give back to and connect with their community (Ballew et al. 2015; Van Vugt et al. 2014; Marcus et al. 2011; Van Vugt 2002) and their own personal goals and connection to nature (Frantz and Mayer 2014; Nisbet et al. 2009; Ballew et al. 2015; Tam 2013; Mayer et al. 2008) rather than social influences such as injunctive and descriptive norms (Ballew et al. 2015).

Influence of Wording and Imagery

The subsequent analysis probed deeper into the influence of the four framings on participants' likelihood of intention to participate by exploring the influence of wording and imagery used in each framing, across both platforms. Participants were asked to provide an influence rating for both the wording used in each tactic and the imagery used in each tactic on their previous rating of likelihood of intention to participate, presented on a 7-point Likert scale (1 = not influential at all, 7 = extremely influential).

As such, a repeated-measures ANOVA was performed to examine the effect of framing and platform on influence ratings of wording. There was a main effect of framings, $F(2.541, 734.259) = 73.424$, $p < 0.001$, $\eta^2 = 0.203$, such that framings did have a statistically significant effect on ratings of influence for wording. There was no significant main effect of platform $F(1, 289) = 3.649$, $p = 0.057$, $\eta^2 = 0.012$, indicating that the ratings of wording influence did not significantly vary across Facebook and Instagram. Finally, there was a significant interaction between framing and platform, $F(2.472, 714.494) = 11.205$, $p < 0.001$, $\eta^2 = 0.037$, suggesting that ratings of influence for wording vary as a function of the interaction between framing and platform.

A Bonferroni adjusted post-hoc test was performed to examine the effect of framings on ratings of influence for wording. Results indicated that the wording used in the basic framing resulted in the lowest influence ratings in comparison to the additional three framing ($M = -0.677$, $SD = 0.087$; $M = -0.990$, $SD = 0.081$; $M = -1.058$, $SD = 0.098$). The wording used in the social framing was found to have a lesser influence rating than the wording used in both the personal (social $M = -0.381$, $SD = 0.077$) and contextual (social $M = -0.313$, $SD = 0.061$) framings. No statistically significant difference was found for the influence rating between the wording used in the contextual and personal framings ($p = 1$).

Four Bonferroni-adjusted paired-samples t-tests were performed to examine whether influence ratings of wording significantly differed for framings on Facebook (e.g., Facebook social, Facebook contextual, Facebook personal, and Facebook basic) compared to framings on Instagram (e.g., Instagram social, Instagram contextual, Instagram

personal, and Instagram basic). There were no significant differences found between wording of social, contextual, and personal framings on Facebook compared to social, contextual, and personal framings on Instagram (social: $t(297) = 1.082$, $p = 0.280$, $d = 0.066842$; contextual: $t(298) = -1.297$, $p = 0.196$, $d = 0.071787$; personal: $t(297)$, $p = 0.465$, $d = 0.066539$), suggesting that the ratings of wording influence used in the aforementioned three framings did not vary across platforms.

However, there was a significant difference between the basic framing on Facebook and the basic framing on Instagram, $t(297) = -5.794$, $p = <0.001$, $d = 0.339558$, suggesting that ratings of influence for the wording used in the basic framing did vary across platforms, with the wording used in the basic framing on Instagram being rated as more influential.

The greater influence of the wording used in the contextual and personal framings indicates that wording that reflects community connection and opportunity to give back to the community, as presented in the contextual framing, and messages that promote the opportunity to reach one's personal goals and strengthen their individual connection to nature, as presented in the personal framing are more influential. The lower influence ratings for the wording used in the social framing further suggests that the use of injunctive and descriptive norms is less influential than the aforementioned framings.

Continuing to probe the four framings, a repeated-measures ANOVA was performed to examine the effect of framing and platform on influence ratings of imagery. There was a significant main effect of framings, $F(2.588, 771.297) = 47.031$, $p = <0.001$, $\eta^2 = 0.136$, such that ratings of imagery influence did vary across framings. There was also a main effect of platform, $F(1, 298) = 21.191$, $p = <0.001$, $\eta^2 = 0.066$, indicating that ratings of imagery influence likewise vary across platforms. Finally, there was a significant interaction between framings and platform $F(2.731, 813.855) = 3.735$, $p = 0.014$, $\eta^2 = 0.012$, such that ratings of imagery influence varied as a function of the interaction between framings and platform.

A Bonferroni adjusted post-hoc test was performed to examine the effect of framings on ratings of influence for imagery. Results indicated that the imagery used in the basic framing resulted in the lowest influence ratings ($M = -0.652$, $SD = 0.078$; $M = -0.858$, $SD = 0.082$; $M = -0.415$, $SD = 0.090$) in comparison to the additional three framings. The imagery used in the contextual framing was rated with the highest influence rating (social $M = 0.206$, $SD = 0.054$; personal $M = 0.443$, $SD = 0.072$), followed by the imagery used in the social framing (personal $M = 0.237$, $SD = 0.075$). Imagery used in the personal framing followed the influence ratings of the imagery used in the social framing but rated with

higher influence than the imagery used in the basic framing.

A Bonferroni-adjusted paired-samples t-test was performed to examine whether ratings of imagery influence significantly differed for imagery used on Facebook compared to imagery used on Instagram, across the four framings. A significant difference was found for influence ratings of imagery used on Facebook compared to Instagram across the social, contextual, and personal framings (social, $t(300) = 2.578$, $p = 0.010$, $d = 0.151509$; contextual, $t(300) = 3.322$, $p = 0.001$, $d = 0.204668$; personal, $t(300) = 4.492$, $p = <0.001$, $d = 0.371054$) suggesting that the ratings of imagery influence did vary significantly across Facebook and Instagram for the aforementioned framings, with the imagery used on Facebook recording higher ratings of influence than the imagery used on Instagram. No significant difference was found between the imagery used in the basic framing across Facebook and Instagram basic, $t(301) = 1.664$, $p = 0.097$, $d = 0.107732$, suggesting that the influence of the imagery used in the basic framing did not vary across platforms.

Due to the different imagery used across platforms the varying results across platforms may be a function of the imagery selected rather than the platforms. As such, the findings indicating higher influence ratings for the imagery used on Facebook (stock photos) may indicate a greater influence from photos compared to graphics, as used on Instagram. This finding aligns with the City of Seattle's Urban Forestry Toolkit which recommends the use of photos of people and urban forests (Scheiderer Partners, n.d.). Likewise, the International Society of Arboriculture image database reflects similar characteristics with an abundance of photos for use in urban forestry promotion (ISA 2018).

The recorded higher ratings of influence for the imagery used in the contextual and social framings may signal a greater influence on the likelihood of intention to participate from imagery that is populated with people compared to imagery that features landscapes or solitary individuals interacting with the urban forest. These findings likewise align with the City of Seattle's Urban Forestry Toolkit which suggests that imagery used in urban forestry communications should feature social interactions between happy people, and people engaging with the urban forest (Scheiderer Partners, n.d.).

Relationship between Demographic Characteristics and Tactics

The second objective of this research was to probe the relationship between demographics and various tactics for engendering an intention to participate in urban forestry initiatives. A series of mixed model ANOVAs with platform and framings as within-subjects factors and

demographic categories as between subjects' factors were performed to investigate demographic variables and the likelihood of intention to participate. Two subsequent mixed model ANOVAs were performed to investigate the ratings of influence of wording and imagery of each tactic, respectively, across gender, living situation, education, and income.

The ANOVA tests revealed no differences as a function of demographics (all F 's < 1.999, all p 's > 0.067), with the exception of gender which differed across all variables (likelihood: $F(1, 288) = 0.4789$, $p = 0.029$, $\eta^2 = 0.016$; wording influence: $F(1, 276) = 5.798$, $p = 0.017$, $\eta^2 = 0.021$; imagery influence: $F(1, 285) = 6.034$, $p = 0.015$, $\eta^2 = 0.021$), such that females recorded a greater likelihood of intention to participate across all framings and platforms, and rated wording and imagery with a higher influence across all platforms and framings compared to male participants.

Such results align with scholarly literature in both urban forestry and the broader environmental literature, which often indicate that females are the more prominent participants (Shirk et al. 2012; Conway and Bang 2014; Han et al. 2009; Granzervoort and van den Born 2020; Van den Berg et al. 2009; Abell 2013). The results further reinforce that females have a higher likelihood of intention to participate and may respond more favorably to tactics used to engender participation.

The results pertaining to level of education as well as income differ from previous studies in urban forestry and environmental engagement more broadly, which have found higher education levels and higher annual incomes to be related to greater likelihood to participate in environmental initiatives (Elton et al. 2022; Conway and Bang 2014; Ganzevoort and van den Born 2020; Still and Gerhold 1997; Carman 1998; Hanjnal and Clark 1998; Henion 1972; Roberts 1996; Conway et al. 2023; Wilson 2012). The discrepancy may result from the age group (18–29) and correlation of other demographic characteristics. For example, education and income level are often correlated with participants in middle and older age groups (Still and Gerhold 1997; Conway and Bang 2014).

A series of chi square tests of independence with pairwise z-tests were completed to test if there was an overall effect of demographic variables on likelihood of intention to participate scores. The analysis showed that the three groups of low, medium, and high likelihood of intention to participate did not differ as a function of living situations, income, or education. Overall, there was no effect of gender, $\chi^2(2, N = 290) = 4.107$, $p = 0.128$. A post-hoc pairwise z-test found there were significantly fewer females ($N = 36$, 24.7%) than males ($N = 51$, 35.4%) in the low likelihood of intention to participate group, aligning with aforementioned findings in this research and past research

(Shirk et al. 2012; Conway and Bang 2014; Han et al. 2009; Granzervoort and van den Born 2020; Van den Berg et al. 2009; Abell 2013).

Previous Participation in Environmental Sustainability Initiatives, Tactics, and the Intention to Participate

Subsequent analysis occurred exploring the relationships with tactics and the likelihood of intention to participate. Figure 3 and Fig. 4 show the likelihood of intention to

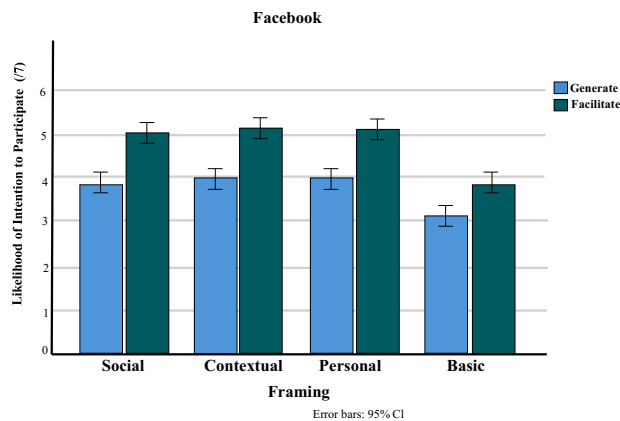


Fig. 3 Likelihood of Intention to Participate Among Conditions: Facebook. *Note.* Participants are grouped into two categories: generate (1) and facilitate (2). Generate refers to the creation of novel intention of participation in proenvironmental action in individuals who do not actively engage in proenvironmental action. Facilitate refers to the driving or reigniting of an intention to participate in proenvironmental action in individuals who have engaged in proenvironmental action frequently in the past

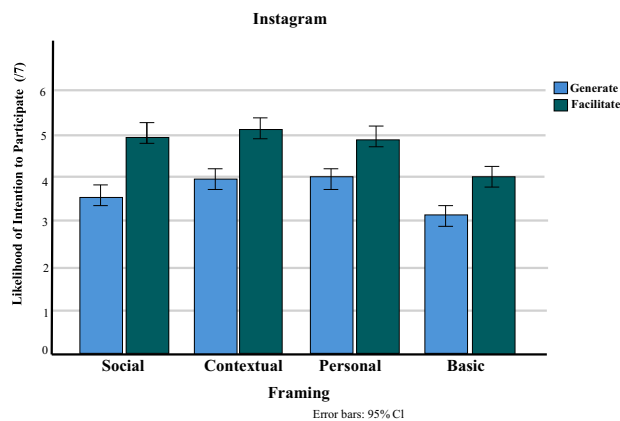


Fig. 4 Likelihood of Intention to Participate Among Conditions: Instagram. *Note.* Participants are grouped into two categories: generate (1) and facilitate (2). Generate refers to the creation of novel intention of participation in proenvironmental action in individuals who do not actively engage in proenvironmental action. Facilitate refers to the driving or reigniting of an intention to participate in proenvironmental action in individuals who have engaged in proenvironmental action frequently in the past

participate of individuals within the two conditions (e.g., generate and facilitate) in response to the eight tactics.

Subsequent analyses probed deeper into the effectiveness of tactics between the two conditions by looking at the various framings and platforms and their effect on likelihood of intention to participate between conditions. Specifically, a 2 (platform; Facebook, Instagram) \times 4 (framing; social, contextual, personal, basic) \times 2 (conditions; facilitate, generate) mixed model ANOVA with platform and framing as within-subjects factors and the conditions as the between-subject factor was performed to examine how the two conditions differed in likelihood of intention to participate. There was a significant interaction between framings and the two conditions, $F(2.449, 423.687) = 3.455$, $p = 0.024$, $\eta^2 = 0.020$, indicating that likelihood of intention to participate varies as a function of framing between conditions. There were no significant interactions between platform and conditions, $F(1.00, 173.000) = 0.011$, $p = 0.916$, $\eta^2 = 0.000$; likewise, there was no significant interaction between framing, platform and conditions, $F(2.747, 475.192) = 1.480$, $p = 0.222$, $\eta^2 = 0.008$. There was a significant overall main effect of conditions, $F(1, 173) = 31.759$, $p = <0.001$, $\eta^2 = 0.155$, indicating that there was variation on intention of likelihood to participate between the two conditions.

These results indicate that the likelihood of intention to participate between the two conditions did not vary significantly based on framings or platforms. This finding suggests that regardless of the condition in which individuals exist, the contextual and personal framings are more effective on likelihood of intention to participate. Aligning with the previous findings, this suggests that individuals in both conditions have a greater likelihood of intention to participate in response to framings which draw upon their connection to community, desire to give back to their community (e.g., Ballew et al. 2015; Van Vugt et al. 2014; Marcus et al. 2011; Van Vugt 2002; Scannell and Gifford 2010; Halpenny 2010), the potential achievement of their own personal goals (Ballew et al. 2015), and their individual connection to the environment (Frantz and Mayer 2014; Nisbet et al. 2009; Tam 2013; Mayer et al. 2008).

The results also indicate a significant difference in the likelihood of intention to participate between the two conditions, with those in the facilitate condition rating a higher overall likelihood of intention to participate. This finding aligns with Ballew et al.'s (2015) work which suggests that past participation indicates a greater likelihood for future participation as indicated by the facilitate condition. The greater likelihood of an intention to participate in the facilitate condition may be heightened by a pre-existing personal, social, or contextual influence on participation (Ballew et al. 2015); furthermore, participants in the facilitate condition may be influenced by their past participation

experiences. Albeit a lower rating, those in the generate condition still rated a likelihood of intention to participate which may indicate receptivity to potential participation further aligning with Ballew et al. (2015).

Following the exploration of the tactics and the two conditions, the subsequent analysis probed deeper into the influence of the four framings on the likelihood of intention to participate by exploring the influence of wording and imagery used in each framing, across both platforms.

To begin, a 2 (platform; Facebook, Instagram) \times 4 (framing; social, contextual, personal, basic) \times 2 (conditions; facilitate, generate) mixed model ANOVA with framing and platform as within-subjects factors and conditions as the between-subject factor was performed to examine how the two conditions differed on influence ratings of wording. There was no significant interaction between framing and the two conditions, $F(2.536, 420.915) = 1.685$, $p = 0.178$, $\eta^2 = 0.010$, nor was there a significant interaction between platform and the two conditions, $F(1.000, 166.000) = 0.403$, $p = 0.526$, $\eta^2 = 0.002$, or a significant three-way interaction (framing, platform, and condition), $F(2.571, 426.771) = 2.126$, $p = 0.106$, $\eta^2 = 0.013$. There was however a significant overall main effect of the two conditions, $F(1, 166) = 12.607$, $p = <0.001$, $\eta^2 = 0.071$.

Similar to the findings for likelihood of intention to participate, these findings indicate a consistent greater influence of the wording used in the contextual and personal framing between both conditions. This finding supports the aforementioned preference for the use of connection to community (e.g., Ballew et al. 2015; Van Vugt et al. 2014; Marcus et al. 2011; Van Vugt 2002; Scannell and Gifford 2010; Halpenny 2010) and personal goals (e.g., Frantz and Mayer 2014; Nisbet et al. 2009; Tam 2013; Mayer et al. 2008) in influencing the target audience.

Likewise, there was a significant difference between the two conditions, with the facilitate condition rating the influence of wording higher. Therefore, a greater likelihood of intention to participate, as recorded in the facilitate group, may influence greater receptivity to the wording used in tactics to engender participation. Likewise, those in the generate condition, that recorded a lower likelihood of intention to participate, may not be as receptive to the wording used in the tactic due to their lower likelihood of participation. This result supports the efficacy of Ballew et al.'s (2015) findings on the facilitate and generate conditions differing in intention to participate.

A 2 (platform; Facebook, Instagram) \times 4 (framings; social, contextual, personal, basic) \times 2 (conditions; facilitate, generate) mixed model ANOVA with framing and platform as within-subjects factors and the two conditions as the between-subject factor was performed to examine how the two conditions differed on ratings of influence of

imagery. There was no significant interaction between framing and the two conditions, $F(2.640, 448.785) = 1.864$, $p = 0.142$, $\eta^2 = 0.011$, such that imagery ratings did not vary significantly by framing between conditions. There was no significant interaction between platform and conditions, $F(1.000, 170.000) = 0.308$, $p = 0.580$, $\eta^2 = 0.002$, such that imagery ratings did not vary significantly across platforms between conditions. Finally, there was no significant three-way interaction (framings, platform, and conditions), $F(2.606, 443.079) = 1.604$, $p = 0.194$, $\eta^2 = 0.009$.

There was a significant overall main effect of the two conditions, $F(1, 170) = 18.244$, $p = <0.001$, $\eta^2 = 0.097$, indicating that there was significant variation on influence ratings of imagery between conditions, with individuals in the facilitate condition rating imagery significantly higher than the generate condition. Aligning with the aforementioned results, those in the facilitate condition may resonate with the imagery used in the tactics more strongly due to their previous participation and their greater likelihood of intention to participate. Conversely, those in the generate condition may not resonate with the imagery as strongly due to their lower likelihood of intention to participate. Due to the variation in imagery used across platforms, participants' responses may have been influenced by the different imagery rather than the platform and may have impacted results.

Overall, the results of this research indicate that contextual and personal framings evoke the strongest likelihood of intention to participate across demographic characteristics as well as facilitate and generate conditions. Furthermore, the in-depth probe into the wording used further reinforces these findings. Conversely, the findings from imagery indicate a greater preference for contextual and social framings and the use of stock photos as used on the Facebook platforms.

Limitations

Participants were not asked if they have an active Facebook or Instagram account, nor the frequency and type of use on both platforms. This is an acknowledged limitation of the research. However, these platforms are highly used by individuals aged 18–24 (86% Facebook, 87% Instagram) and 25–34 (88% Facebook, 79% Instagram) in Canada. (Mai and Gruzd 2022; Pew Research Centre, 2023; Statista 2023). Similar use of these platforms by individuals in these age groups has been found in the United States (Statista 2023; Pew Research Centre, 2023). However, future research should query participants about their current use of the platforms in questions to curate a more accurate representation of the user pool.

Additionally, due to the variation of message presentation and imagery use across platforms the results of this research relating to platform must be observed with the understanding that the variation of message presentation and imagery may influence how the platform is perceived and participants ratings of likelihood of intention to participate and message and imagery ratings of influence across platforms.

Conclusions

Despite the numerous benefits to the planet and people, participation in environmental management collaborations is low (e.g., Chi et al. 2013; Laurian 2004; Haughton 1999; Hahmann 2021). Ways to increase participation are urgently needed; especially among young adults, an often-underrepresented population of participants in environmental management collaborations (Asah and Blahna 2013; Ganzevoort et al. 2017; Conway and Bang 2014). In sum, the research advances understanding of how the informational function of SNSs, a way to disseminate information with targeted audiences, can be used to bring about an intention of participation of individuals 18–29 years of age in an urban forestry collaborative event. The use of a fortress strategy, in which there is limited interaction between the source and receiver (Kanter and Fine 2010), was found to influence the likelihood of participation. Tactics were specifically found to influence the likelihood of participation and thus empirical evidence is thus provided to support conceptual conjectures in the TPAM framework (Ballew et al. 2015). The likelihood of intention to participate of individuals in this research was most influenced by personal and contextual framings. This reinforces the need for environmental managers to position their tactics in alignment with knowledge regarding this age demographic in terms of their personal goals and connectedness to nature (Nisbet et al. 2009; Ballew et al. 2015; Frantz and Mayer 2014; Tam 2013; Mayer et al. 2008) as well as desire to give back to and/or connect with their community (Ballew et al. 2015; Van Vugt et al. 2014; Marcus et al. 2011; Van Vugt 2002). The insights provided from this research are particularly important as individuals 18–29 years of age are underrepresented participants in environmental sustainability initiatives generally and urban forestry initiatives specifically (Ganzevoort and van der Born 2020; Asah and Blahna 2013; Ganzevoort et al. 2017; Conway and Bang 2014; Elton et al. 2022; Asah et al. 2014).

The extensive probe into the elements used within each framing moves beyond previous work (i.e., Ballew et al. 2015) and provides a more in depth understanding of the influence of wording and imagery on the target audience. The identified greater influence of the wording used in the

personal and contextual framings provides evidence supporting the use of such framings to engender participation from individuals aged 18–29 by drawing upon their connection to community (Ballew et al. 2015; Van Vugt et al. 2014; Marcus et al. 2011; Van Vugt 2002), personal goals, and connection to nature (Nisbet et al. 2009; Ballew et al. 2015; Frantz and Mayer 2014; Tam 2013; Mayer et al. 2008). From the in-depth probe, variation emerged indicating a greater influence in response to the imagery used in social and contextual framings, in which photos were populated with people engaging together and with the urban forest. This contribution provides greater insights into the elements of tactics and provides evidence for environmental managers and their use of imagery in tactics.

The research also elucidated relationships between/ among other demographic characteristics, tactics, and the likelihood of intention to participate. Females were found to be more likely to participate based on their higher ratings of likelihood of intention to participate. Furthermore, females rated the elements of tactics including the wording and imagery used as significantly higher than their male counterparts. This finding is consistent with previous studies of participation in environmental sustainability initiatives (Ganzevoort and van der Born 2020; Van den Berg et al. 2009; Abell 2013). At the same time, level of education and income were not found to be significant in this research, which differs from previous studies (e.g., Carman 1988; Hanjnal and Clark 1998; Conway et al. 2023). The absence of variation in education and income may be related to the relatively small age category that was targeted in this research compared to past studies which found an influence of education and income on older populations (Still and Gerhold 1997; Conway and Bang 2014).

The research deepens understanding about previous participation in environmental sustainability initiatives, tactics, and the intention to participate. Individuals in facilitate and generate conditions were receptive to tactics and the intention to participate. Those in the facilitate condition had a consistently higher likelihood of intention to participate; however, there was no variation in tactic preference between the conditions. Empirical support is thus furnished for both these contentions, as set out by Ballew et al. (2015). The extensive probe into the elements of tactics provided further, in-depth evidence for the continuity of the broad age category, regardless of the condition in which they exist. Environmental managers who disseminate tactics exclusively to individuals who have participated previously (e.g., email databases, targeted mailing lists) may exclude many potential participants. Using multiple tactics (platforms and framings) is suggested to maximize participation from both conditions explored in this research.

The question of how social media can be effectively leveraged to influence participation in sustainability is an

open and dynamic area of study (Petkov et al. 2012; Ballew et al. 2015; De Luca et al. 2022; Shaw et al. n.d.; Byrum 2019). It is thus unsurprising that this research surfaces several avenues for future inquiry. First, the need to understand how other groups can be enhanced. Engendering greater participation from marginalized individuals is especially important with respect to inclusivity and representation of the community at large (Johnson et al. 2018; Rongerude and Sandoval 2016), ultimately resulting in more just outcomes (Debnath et al. 2022).

Figure 1 conceptually guided this research and served as a foundation upon which future studies can build. The focus on SNSs and the informational function can be elaborated upon to consider the diverse platforms used by environmental managers as well as other functions they afford. Additional aspects ripe for elaboration and experimentation include the: tactics developed and utilized; audiences targeted; and types of environmental sustainability initiatives. Finally, measuring the likelihood (intention) of individuals to participate after being presented with tactics is an important step in to moving from conceptual conjectures to an empirical-based understanding about what engenders participation. Future research must go further. The next step in this progression is studying the efficacy of tactics in relation to participation in sustainability initiatives.

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Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

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