

How Education Shapes Volunteer Motivation and Experience: Lessons from Master Gardeners and Watershed Stewards During COVID-19

S. Windon¹, H. You², A. Adhikari³

Abstract

This study investigates how educational attainment shaped the motivations and experiences of Extension Master Gardeners (MGs) and Master Watershed Stewards (MWSs) during the initial phase of the COVID-19 pandemic. The pandemic's disruptions provided a unique context for examining how volunteers with differing educational backgrounds engaged with Extension programming and adapted their roles. This research is part of a larger project that examined the relationships between volunteer leadership competencies and stewardship behaviors within Penn State Extension's MG and MWS programs. An online questionnaire was distributed to 3,000 volunteers, yielding 1,196 responses (39.9% response rate). Of these, 331 participants (27.7%) provided open-ended responses describing their motivations and experiences, which were analyzed in this study. A mixed-methods design integrated thematic analysis, Latent Dirichlet Allocation (LDA) topic modeling, natural language processing, and principal component analysis (PCA). Results indicated that volunteers with graduate degrees frequently assumed strategic and leadership-oriented roles emphasizing virtual engagement and innovation, while those without graduate degrees focused on hands-on service, community outreach, and applied learning. Despite these variations, both groups demonstrated resilience and a strong commitment to service. Findings underscore the importance of aligning volunteer roles with educational backgrounds to enhance engagement, satisfaction, and program effectiveness. Implications for Extension programming and future research are discussed.

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Introduction and Problem Statement

Volunteerism involves individuals contributing their time and expertise to advance community or nonprofit goals (Stukas et al., 2014). In the United States, Extension organizations play a key role in empowering communities by providing volunteer education and training opportunities, even amid global uncertainty and rapid change (Osafo, 2020). Volunteers are critical to delivering educational outreach that enhances community resilience and facilitates knowledge sharing within the Cooperative Extension system.

Among these efforts, the Master Gardener (MG) and Master Watershed Steward (MWS) programs are particularly significant, as they foster public awareness of horticulture and environmental conservation (Blair et al., 2021; Eiseman et al., 2020). Investing in volunteer learning and leadership within these programs produces social and economic returns. For example, the work of Master Gardener volunteers as community educators has been valued at approximately \$9 million in economic impact (Strong & Harder, 2011). Through hands-on training and leadership development, MG and MWS programs prepare participants to share their gardening and watershed management expertise while serving as leaders within their local communities (Dorn et al., 2019).

In 2020, the global COVID-19 pandemic disrupted these efforts in an unprecedented manner. Health restrictions halted most in-person volunteer activities, compelling organizations such as Cooperative Extension to swiftly transition to virtual platforms and implement new safety measures to sustain engagement (Israel et al., 2020).

Although past crises have demonstrated that volunteers often intensify their commitment during emergencies, seeking purpose and social connection through service (Miao et al., 2021), the pandemic introduced distinctive challenges. Social isolation, health-related anxieties, and the abrupt shift to digital modes of participation complicated the traditional dynamics of volunteer engagement (Principi et al., 2022).

Given the disruption caused by the pandemic, examining what motivates and sustains these volunteers is crucial for maintaining program continuity and community impact (Dorn et al., 2021). This study examines how MGs and MWSs remained engaged during the early stages of the pandemic and investigates whether their educational backgrounds influenced their motivations for serving.

Theoretical and Conceptual Framework

Motivation for Volunteering

In the functional approach to volunteer motivation, Clary and Snyder (1999) and colleagues developed the Volunteer Functions Inventory (VFI) to categorize six primary motivations: values, understanding, social, career, protective, and enhancement (Clary et al., 1998). The Values function refers to altruistic motives, such as volunteering to help others and contributing

to the greater good, which reflects deeply held personal values and civic responsibility (Agostinho & Paço, 2012; Clary et al., 1998). This altruistic drive often brings personal fulfillment and is frequently cited as a core reason people engage in community service (Bruyere & Rappe, 2007).

The Understanding function involves a desire for new knowledge and skills; volunteers are motivated by opportunities to learn and to apply their expertise in real-world settings (Clary et al., 1998). Especially in educational or environmental programs, volunteers seek to deepen their understanding of community issues and gain horticultural or scientific knowledge through service. The Career function pertains to utilitarian benefits, such as volunteering to gain experience, maintain skills, or explore new career paths (Clary et al., 1998). This motive is common among younger or early-career individuals who view volunteer service as a means of professional development or building their résumé.

The Social function of volunteering emphasizes relationships and a sense of belonging. Many volunteers are driven by the social aspects, such as being part of a group, making friends, or engaging in an activity that is viewed favorably by one's social network (Clary et al., 1998; Mohd Rashid et al., 2023). Social motivations can reinforce a sense of community and encourage sustained involvement through camaraderie and peer support. Finally, the Protective and Enhancement functions capture motivations tied to self-concept. The Protective function involves volunteering to reduce guilt or address personal issues, essentially to protect the ego from negative feelings (e.g., offsetting one's relative privilege by giving back) (Clary et al., 1998). The Enhancement function goes beyond protection, seeking to *enhance* one's self-esteem and personal growth through service (Clary et al., 1998). Volunteers motivated by enhancement report that volunteering lifts their mood, increases their self-worth, and provides satisfaction from doing something meaningful. Together, these functions demonstrate that volunteer motivation is multifaceted; many volunteers are drawn to service by a combination of altruistic and self-oriented incentives.

Cultural and personal norms can also influence volunteer motivation. Social and moral obligations often play a role. For example, some individuals feel a sense of duty or moral obligation to engage in their communities. Those driven by duty may volunteer because they feel it is the "right thing to do," or because of normative pressure from family, religion, or community expectations (Okun, 1994). Research has shown that fulfilling a moral obligation (e.g., to "give back" or serve one's community) is a significant predictor of frequent volunteering, especially among older adults. Similarly, among college students, perceived moral obligation to help others can strongly predict intentions to volunteer for community service (Hyde & Knowles, 2013). In such cases, the value motive is intertwined with personal identity and ethical self-concept. Volunteers may publicly emphasize altruistic reasons for volunteering, which are socially applauded, even as they also pursue personal benefits, such as learning or networking (Grimm & Needham, 2011; Kiptot et al., 2016). This dynamic interplay, sometimes described as "altruistic individualism," suggests that volunteers simultaneously seek to benefit others and themselves (Kiptot et al., 2016; Peachey et al., 2013). For Extension volunteer programs, recognizing the spectrum of volunteer motivations is crucial. Recruitment and

retention strategies should address this diversity, offering opportunities that fulfill volunteers' desires to do good, learn, socialize, advance their careers, and find personal fulfillment.

Impact of Volunteerism on Local Communities

Community volunteer programs foster social cohesion, civic engagement, and resilience (Jenkinson et al., 2013). In community health, volunteer-led initiatives have improved access to essential resources, including nutritious food and healthcare information, which in turn correlates with better health outcomes for community members (Baker et al., 2020). By improving local food security—through community gardens, food drives, nutrition workshops, and other initiatives—volunteers help address public health issues such as hunger and poor nutrition, promoting social interaction and mutual support (Baker et al., 2020). These efforts can reduce isolation and foster supportive relationships, which are particularly valuable in times of uncertainty or crisis.

Environmental volunteers support conservation efforts, promoting sustainability and ecosystem health (Demirović et al., 2018; Hsiao et al., 2019). Research indicates that volunteers in environmental programs contribute significantly to ecological outcomes, including increased recycling rates, improved urban green spaces, and the conservation of local watersheds (Hsiao et al., 2019).

Beyond the direct ecological benefits, involving community members in environmental projects raises environmental awareness and advocacy. People who volunteer for environmental causes often adopt more sustainable behaviors in their personal lives and influence others to do the same (Demirović et al., 2018). Moreover, volunteer labor provides significant economic value by offsetting personnel costs and contributing millions of dollars' worth of service to environmental and educational initiatives (Kirk-Ballard et al., 2024). For example, a coordinated community clean-up led by volunteers can save a municipality substantial funds while engendering community pride. Importantly, volunteers often become ambassadors for environmental issues, educating their peers and advocating for policy changes at the local level (Demirović et al., 2018).

MG and MWS Challenges During COVID-19 and Educational Background

The U.S. Cooperative Extension System effectively engages volunteers through specialized initiatives such as the Master Gardener (MG) and Master Watershed Steward (MWS) programs. These initiatives demonstrate how volunteer networks can expand the reach of educational institutions and enhance their community impact.

Master Gardeners are community volunteers who receive extensive horticultural training to help Extension professionals share research-based gardening knowledge with the public. Training typically involves 40–80 hours of instruction covering plant biology, soil management, pest control, and sustainable gardening practices. In exchange, volunteers contribute service hours, commonly 50 hours in their first year and additional hours in subsequent years, to retain their certification (Blair et al., 2021). MGs engage in various outreach efforts, including conducting educational workshops, providing guidance through garden hotlines, creating

community gardens, and supporting public events such as fairs and farmers' markets (Bennett et al., 2013; Kirk-Ballard et al., 2024). These activities promote environmentally responsible gardening and enhance community food production, urban green infrastructure, and public understanding of horticultural science (Strong & Harder, 2011; Winton et al., 2023).

Beyond education, MG-led projects contribute to food security and nutrition by increasing access to locally grown produce and encouraging biodiversity by cultivating native plant species. In cities and suburbs, initiatives such as pollinator gardens and tree plantings help sustain ecosystem connectivity and mitigate biodiversity loss (Goddard et al., 2010).

Similarly, Master Watershed Stewards complete in-depth training on water resource management and environmental stewardship. Their coursework emphasizes watershed dynamics, water quality assessment, stream restoration, and community-based pollution prevention strategies (Eiseman et al., 2020). MWS volunteers collaborate with Extension educators and conservation partners on stream cleanups, riparian buffer restoration, rain garden construction, and public education on stormwater management. Through these efforts, they help extend the capacity of local and regional agencies to monitor and protect water resources.

The pandemic disrupted MG and MWS programs by limiting in-person activities, especially impacting older adults and those without digital access (Giua et al., 2021; Principi et al., 2022). Coordinators responded with virtual tools, solo projects, and urgent community support, such as addressing food insecurity (Corley et al., 2021; Eiseman et al., 2020; Lopez et al., 2021). This revealed volunteer resilience and increased altruism (Mak & Fancourt, 2021). Educational attainment influences engagement: volunteers with graduate degrees often prefer leadership and civic roles (Ferreira et al., 2012; Posner, 2015), whereas those without advanced degrees tend to emphasize hands-on impact and community ties (Van Sickle et al., 2015). Although motivations overlap, engagement differs (Winton et al., 2023). This study examines how motivations vary by education, analyzing narratives to inform the development of inclusive volunteer strategies.

Purpose

This study is an extension of a larger research project examining the relationship between volunteer leadership competencies and stewardship action-taking experiences among Penn State Extension Master Gardener (MG) and Master Watershed (MW) volunteers. Building on that foundation, the present study investigates the factors that influenced MGs and MWSs during the early stages of the COVID-19 pandemic, with particular attention to how educational attainment, specifically, whether volunteers held a graduate degree, shaped their motivations and experiences. The pandemic provided a distinctive context for exploring volunteer engagement amid widespread disruption and uncertainty. Guided by the research question, *'How did educational attainment shape volunteer motivation and experience among Extension MGs and MWSs during COVID-19?'* this study seeks to advance the understanding of volunteer

behavior and resilience in times of crisis. The insights gained will help Extension program coordinators design engagement strategies that better align with volunteers' intrinsic motivations, supporting crisis response and ongoing program effectiveness.

Methods

Research Design and Context

This study analyzes open-ended responses from a broader cross-sectional online survey of Penn State Extension MGs and MWSs, focused on volunteer motivations during early COVID-19 restrictions. We followed Dillman et al.'s (2014) method and surveyed 3,000 MGs and MWSs, receiving 1,196 responses (39.9% response rate). Of these, 331 participants (27.7%) provided open-ended responses describing their motivations and experiences, which were analyzed in this study. A mixed-methods design integrated thematic analysis, Latent Dirichlet Allocation (LDA) topic modeling, natural language processing, and principal component analysis (PCA). We consulted Braun and Clarke's (2006) thematic analysis and Latent Dirichlet Allocation topic modeling (Blei et al., 2003) to identify and interpret patterns in the narratives. Three researchers independently coded responses, refining a codebook collaboratively through inductive and deductive processes guided by volunteer motivation theory (Clary et al., 1998). Peer debriefing ensured rigor and confirmed consistency between the manual and web analysis results. Our mixed-methods approach integrated NLP preprocessing, LDA topic modeling (Blei et al., 2003) with hyperparameter tuning, and PCA visualization, followed by collaborative qualitative interpretation within Clary et al.'s (1998) motivation theory framework, as discussed above.

Data Collection

For this study, we examined a subset of survey responses that included narrative comments submitted in response to an open-ended question about volunteer experiences and motivations during the COVID-19 pandemic. Specifically, participants were prompted to "describe your experiences as a Master Gardener/Watershed Steward during the COVID-19 pandemic, including what motivated you to continue (or not continue) your volunteer service." We collected demographic information through the initial online survey. Key variables included participants' highest level of education, years of volunteer experience, and current employment status. For this study, we created a dichotomous education variable: "Graduate Degree" (master's or doctoral degree) versus "Non-Graduate Degree" (associate's degree, bachelor's degree, or no college degree). After excluding incomplete or off-topic entries, we analyzed qualitative responses from 331 study participants in the final analytic sample. Of these, 150 (45.3%) held a graduate degree, while 181 (54.7%) did not. Most participants had multiple years of experience, ranging from 1 to 2 years for newer volunteers to over 20 years for long-term participants.

Table 1 displays the distribution of volunteer experience and employment status across educational levels. We conducted chi-square tests to determine whether significant differences exist between volunteers with and without graduate degrees on these variables. The

distribution of volunteer tenure did not significantly differ between those with graduate degrees and those without ($p = .212$). Both educational groups were similarly represented across all experience categories, from early-stage volunteers (1–3 years) to those with over a decade of service. This suggests that educational attainment did not correspond with longer or shorter engagement in Extension volunteer programs.

Table 1

Volunteer Characteristics by Educational Level: Years of Volunteer Experience and Employment Status

Items		Graduate Degree, %	Non-Graduate Degree, %	<i>n</i>	<i>p</i> -value
Total		150	181	331	
Years of volunteering experience	1-3 years	44 (46.6)	51 (53.4)	95	.212
	3-5 years	21 (40.4)	31 (59.6)	62	
	5-10 years	40 (46.5)	46 (53.5)	52	
	11-19 years	27 (43.5)	35 (56.5)	86	
	Unknown	18 (50)	18 (50)	36	
Employment Status	Full-time	26 (44.8)	32 (55.2)	58	≤.05
	Other	16 (25.8)	46 (74.2)	62	
	Part-time	9 (42.9)	12 (57.1)	21	
	Retired	82 (47.9)	88 (52.1)	170	
	Self-employed	9 (42.9)	12 (57.1)	21	

Employment status, however, showed a marginally significant difference between groups ($p = .05$). Volunteers without graduate degrees were more likely to report "Other" forms of employment (74.2%) compared to their graduate-educated counterparts (25.8%). Conversely, a greater proportion of graduate degree holders reported full-time employment (44.8% vs. 55.2%) and retirement (47.9% vs. 52.1%). These patterns may suggest subtle differences in time availability or employment flexibility, which could potentially shape how and why individuals engage with volunteer service. However, the overall comparability between the two groups supports the validity of subsequent thematic comparisons in volunteer motivations.

Participants

We divided participants based on their highest degree attained: 45.3% held a graduate degree, while 54.7% did not. The two groups did not differ significantly in volunteer tenure ($\chi^2 = 5.83$, $p = .21$) but showed a slight difference in employment status ($\chi^2 = 9.49$, $p = .05$), warranting further consideration.

Data Preparation

We exported 331 open-ended survey responses for qualitative analysis and applied multiple strategies to ensure credibility and analytical rigor. Three researchers independently coded the data and reviewed Latent Dirichlet Allocation (LDA) topics, resolving discrepancies collaboratively to minimize bias (Creswell, 1998). We incorporated participant quotes to ground interpretations and triangulated findings from LDA, Principal Component Analysis (PCA), and

manual coding to enhance contextual accuracy (Griffiths & Steyvers, 2004). LDA provided a foundation for deeper qualitative interpretation.

Quantitative data underwent verification, with chi-square tests ($p < .05$) and Fisher's exact tests applied as appropriate. To maintain consistency, we performed standard text preprocessing, including lowercasing, cleaning, and tokenizing the text, correcting typographical errors, and standardizing terminology (e.g., combining "MG" and "Master Gardener" under a single label). We removed common stop words (e.g., "the," "and," "to") and generated bigrams to retain meaningful fixed phrases such as "food pantry."

We eliminated personally identifying details, including names and geographic references, to protect respondent confidentiality. We also reviewed highly frequent context-specific terms like "COVID" and "pandemic," flagging them to prevent these dominant words from overshadowing subtler motivational themes.

After preprocessing, the dataset was ready for computational and thematic analysis. The final corpus contained several thousand words reflecting diverse volunteer perspectives on motivation, challenges, emotions, and actions during the pandemic. Three researchers each open-coded 20% of responses before developing and applying a shared codebook across the whole dataset, achieving intercoder agreement above 0.80. To further strengthen confirmability, we employed peer debriefing and negative-case analysis following Lincoln and Guba's trustworthiness framework as summarized by Creswell (1998).

Analytic Workflow

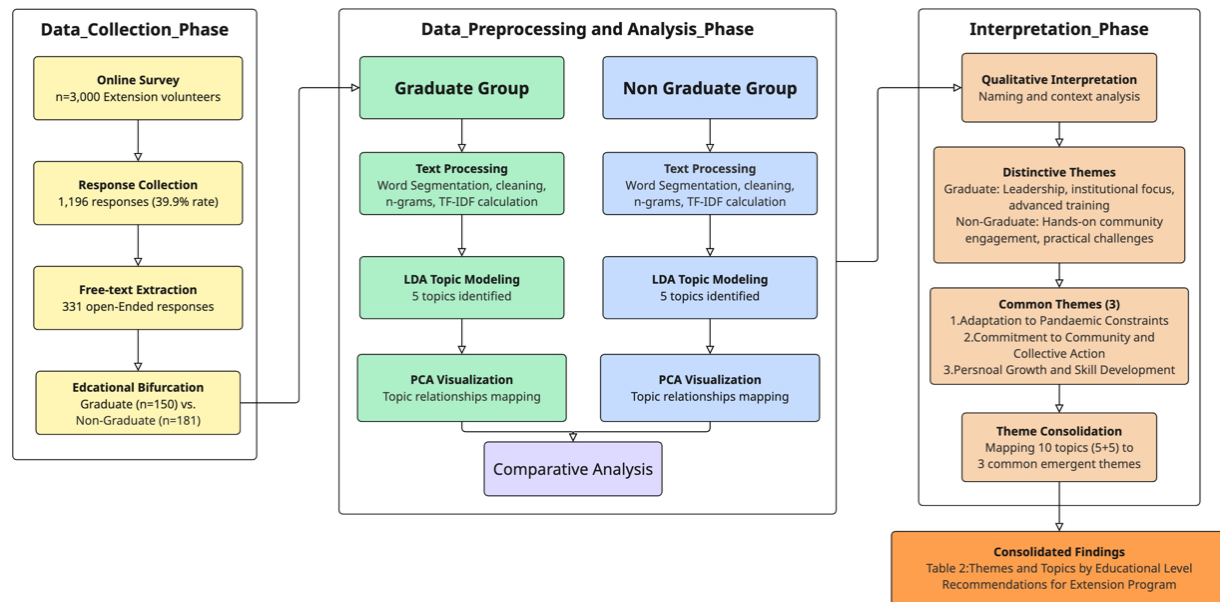
As shown in Figure 1, our process unfolded in three phases. We administered a web survey that yielded 1,196 responses (39.9% return rate) and 331 (27.7%) for MGs and MWSs volunteers, with ($n=150$) and without ($n=181$) graduate degrees. We used LDA, a topic modeling technique, to identify latent themes in volunteer responses, treating each response as a mixture of topics (Blei et al., 2003; Inoue et al., 2022). To visualize topic relationships and reduce dimensionality, we applied Principal Component Analysis (PCA) (Hotelling, 1933). Using Python's Gensim, we selected a five-topic model based on coherence scores (Röder et al., 2015). Separate LDA models were run to explore motivation differences for volunteers with ($n=150$) and without ($n=181$) graduate degrees. Topics were labeled collaboratively, combining inductive analysis with frameworks like the Volunteer Functions Inventory (Braun & Clarke, 2006; Clary et al., 1998). Two researchers independently reviewed data and resolved discrepancies to ensure rigor (Lincoln & Guba, 1985). Triangulating LDA, PCA, and manual coding grounded interpretations in participants' words (Griffiths & Steyvers, 2004). Quantitative results were verified using chi-square and Fisher's exact tests ($p < .05$). This mixed-methods approach strengthened the validity and depth of the findings.

Two analysts identified topics by drawing on the Volunteer Functions Inventory and thematic heuristics (Braun & Clarke, 2006; Clary & Snyder, 1999), achieving a κ value of greater than .80. We translated the model outputs into meaningful insights during interpretation, identifying community non-graduates and leadership graduates. Three overarching themes—pandemic

adaptation, community commitment, and personal development emerged from the ten LDA topics listed in Table 2. We confirmed these findings through peer debriefing and triangulation across LDA, PCA, and manual coding (Griffiths & Steyvers, 2004; Lincoln & Guba, 1985).

Figure 1

Thematic Analysis Process (Consolidated): From LDA Topic Modeling to Emergent Themes in MGs and MWSs



Analysis with Latent Dirichlet Allocation (LDA)

We applied Latent Dirichlet Allocation (LDA), a probabilistic topic modeling technique developed by Blei et al. (2003), to identify latent themes within the volunteer narratives. LDA is particularly effective for uncovering underlying thematic structures in large bodies of text. It operates under the assumption that each document, in this case, each volunteer comment, represents a mixture of topics, and that each topic consists of a set of words that tend to co-occur across the corpus.

We selected LDA for its ability to inductively generate topic clusters without predefined coding schemes, aligning well with the exploratory nature of our research. We followed three steps to conduct the LDA analysis.

Step 1. We implemented the model using the Gensim library in Python and experimented with various model parameters, including the number of topics. We evaluated model performance using coherence scores and qualitative interpretability. Based on these assessments, we identified five topics as the optimal number for each subgroup (volunteers with graduate degrees and those without). Preliminary models indicated that additional topics offered diminishing thematic distinction, whereas five-topic solutions struck a balance between parsimony and thematic richness.

Step 2. We conducted separate LDA analyses on two subsets of the data: one comprising responses from volunteers with graduate degrees and the other from those without. This approach enabled us to identify topic structures that may be distinct for each educational group. The LDA model generated a set of topics for each subgroup, each defined by a list of high-probability keywords. To interpret these topics, we reviewed the top 10–15 keywords associated with each and examined representative excerpts—individual responses that the model assigned a high probability of belonging to a given topic. This process allowed us to anchor abstract topic structures in the language and expressions used by the volunteers themselves.

Step 3. We collaboratively assigned descriptive labels to each topic (e.g., “Adaptation and Learning,” “Community Outreach Challenges”) through an iterative process involving discussion and cross-validation among the research team. While LDA facilitated the identification of thematic patterns in a large textual dataset, our interpretation was informed by inductive insights emerging from the data and deductive reasoning grounded in established frameworks of volunteer motivation. By integrating algorithmic modeling with human interpretive analysis, we aimed to maintain contextual sensitivity and enhance the trustworthiness and depth of our findings.

Principal Component Analysis and Topic Visualization

Following topic identification using the LDA, we examined the relationships among topics within and across the two volunteer subgroups. To achieve this, we used Principal Component Analysis (PCA), a dimensionality reduction method introduced by Hotelling (1933). PCA transforms high-dimensional data, in this case, the word probability distributions that define each LDA-derived topic, into a smaller set of orthogonal components that capture the greatest variance in the data. We used PCA to project the five topics from each subgroup into a two-dimensional space, allowing for visual comparison of topic similarity and divergence. This visualization facilitated the identification of thematic proximity and potential overlaps or distinctions between topics generated for graduate-degree and non-graduate-degree volunteers.

We generated two separate scatterplots to visualize the topic structures identified through LDA: one for the five topics derived from graduate-degree volunteers and one for those from non-graduate-degree volunteers. In each plot, individual points represent topics, positioned according to their coordinates on the first two principal components from the PCA. This visualization allowed us to assess which topics clustered closely, indicating thematic similarity, and which appeared as outliers, suggesting distinct or unique themes.

We aimed to identify the shared and distinct motivational patterns of the two groups. We expected some conceptual overlap, such as themes related to adapting to pandemic-related changes, while anticipating that other topics would reveal experiences or values unique to each group.

We compared the two PCA plots (Figure 2 for the graduate group and Figure 3 for the non-graduate group) to assess where themes converged or diverged qualitatively. When both plots displayed clusters related to education or learning, we interpreted this as evidence of an everyday motivational driver. In contrast, if the graduate-degree group exhibited a distinct and isolated cluster associated with “leadership,” we viewed this as an indication that leadership held greater relevance or was expressed differently among volunteers with higher educational attainment.

Trustworthiness and Rigor

We implemented several validation strategies to enhance the credibility and dependability of our findings. During data coding and interpretation, we employed investigator triangulation, where two researchers independently reviewed subsets of responses and LDA topics, resolving differences through discussion and refining topic labels collaboratively. This process minimized individual bias and supported analytic rigor (Lincoln & Guba, 1985, as cited in Creswell, 1998). We also incorporated long text descriptions by presenting illustrative quotes for each theme, grounding interpretations in participants’ words. Methodologically, we triangulated computational techniques (LDA and PCA) with manual qualitative review to ensure that algorithmically derived patterns were contextually meaningful (Griffiths & Steyvers, 2004). We treated LDA outputs as heuristic tools for deeper qualitative interpretation. For the quantitative analysis, we verified accuracy by double-checking the data and statistical procedures. Chi-square tests were conducted at a 0.05 significance level, with Fisher’s exact test used when assumptions were not met. Together, these strategies enhanced trustworthiness and interpretive clarity of our results.

Findings

LDA-Derived Topics Among MG and MWS with a Graduate Degree

Latent Dirichlet Allocation (LDA) generated five distinct topics from the open-ended responses provided by volunteers with graduate degrees. Each topic was defined by a set of terms with high probability weights, as determined by the LDA model’s word distributions, rather than by simple word frequency.

Topic 1: Personal Development and Pandemic Constraints. This topic captured volunteers’ reflections on the dual nature of their experience, highlighting both the opportunities and limitations associated with their involvement. Respondents frequently mentioned a desire to “gain experience” or improve their gardening skills, reflecting a motivation for personal enrichment amid the challenges of pandemic-related safety protocols and scheduling adjustments.

Topic 2: Training Demands and Emotional Ambivalence. Comments on this topic expressed mixed feelings about increased training or volunteering expectations. While some respondents appreciated the chance to learn and contribute, others described feeling overwhelmed or

burdened. This tension between perceived obligation and personal growth underscored a complex emotional response to expanded responsibilities during a disruptive period.

Topic 3: Collaboration and Adaptability. This theme emphasized group-based engagement, including online classes, virtual meetings, and collaborative community initiatives. Despite disruptions caused by COVID-19, many participants voiced a continued commitment to volunteering in whatever capacity was possible, signaling resilience and adaptability in the face of shifting circumstances.

Topic 4: Leadership and Outreach Challenges. This topic reflected participants' leadership orientation and focus on public engagement in horticultural and environmental domains. While there were many noted barriers to information sharing during in-person restrictions, they remained proactive in sustaining outreach efforts and engaging fellow volunteers.

Topic 5: Optimism and Goal Orientation. The final topic highlighted a forward-looking perspective on horticultural expertise and institutional milestones. Respondents frequently referenced "native plants," specific "requirements", and organizational guidelines, often framing their involvement as a source of optimism and purpose, even amid pandemic-related disruptions.

Visualization: MG and MWS with a Graduate Degree

Figure 2 presents a two-dimensional PCA plot of five topics derived from MG and MWS volunteers with graduate degrees, explaining 83.7% of the variance (PC1: 59.4%, PC2: 24.3%). Topics 1, 3, and 4 cluster together, reflecting overlapping themes of community involvement, leadership, and hands-on volunteering. Their low cosine distances suggest that they share similar motivations. Topic 5, focused on horticultural knowledge (e.g., "native plants"), stands apart on the horizontal axis, indicating a distinct motivational dimension. Topic 2, located higher on the vertical axis, centers on emotional experiences, with terms like "feel" and "enjoy," highlighting the personal and subjective aspects of volunteering.

LDA-Derived Topics Among MG and MWS without Graduate Degree

Latent Dirichlet Allocation (LDA) identified five distinct topics from the open-ended responses of MG and MWS volunteers without graduate degrees.

Topic 1: Resilience in the Face of Disruption. This topic captured volunteers' reflections on the disruptions caused by the pandemic, alongside their continued determination to "keep going." Many participants emphasized the importance of acquiring new knowledge and experiences, which suggested an adaptive mindset despite ongoing uncertainties and challenges.

Topic 2: Community Education and Outreach Motivation. Respondents in this topic emphasized their enthusiasm for community education and their personal motivation to expand outreach efforts. While acknowledging the constraints of COVID-19 on public events and face-to-face interactions, volunteers expressed a strong desire to bridge knowledge gaps and connect with others through alternative means.

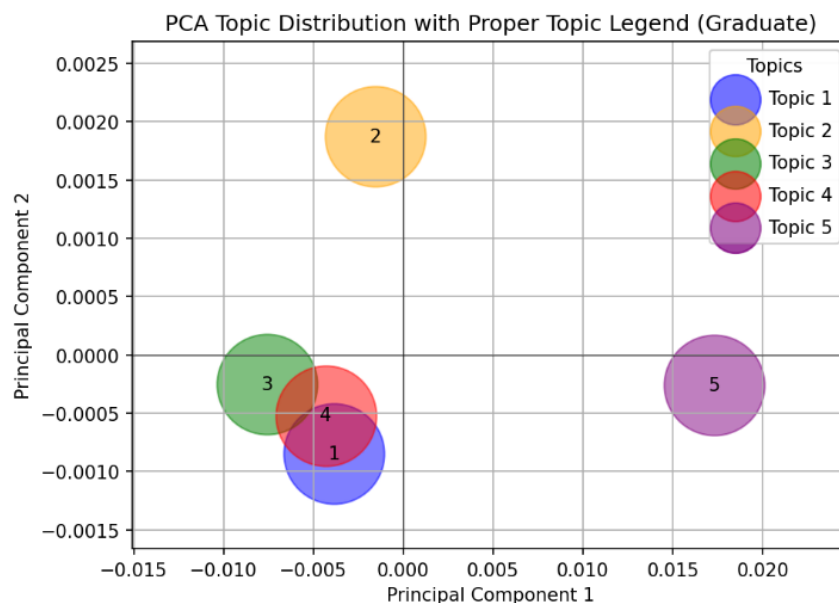
Topic 3: Volunteering and Personal Responsibilities. This topic highlighted the tension between volunteering and personal obligations, particularly family responsibilities such as caring for children. Volunteers emphasized their commitment to self-development, leadership skill-building, and improving their local communities, despite the added challenges posed by balancing these competing demands.

Topic 4: Hands-on Stewardship and Logistical Challenges. Participants in this topic emphasized the importance of hands-on, field-based stewardship, particularly in activities such as watershed conservation. While many volunteers noted logistical hurdles, such as limited funding or difficulties with coordination, they emphasized the importance of physical presence in these efforts, adapting to safety protocols as necessary.

Topic 5: Teaching and Active Engagement. This topic focused on the shift to online platforms and the volunteers' continued success in meeting institutional requirements for certification. Despite these shifts, many respondents continued to express their preference for direct, hands-on involvement in projects whenever feasible, reflecting a sustained desire for “active” engagement.

Figure 2

Principal Component Analysis (PCA) Plots of Emergent Themes among MG and MWS with Non-Graduate Degrees.



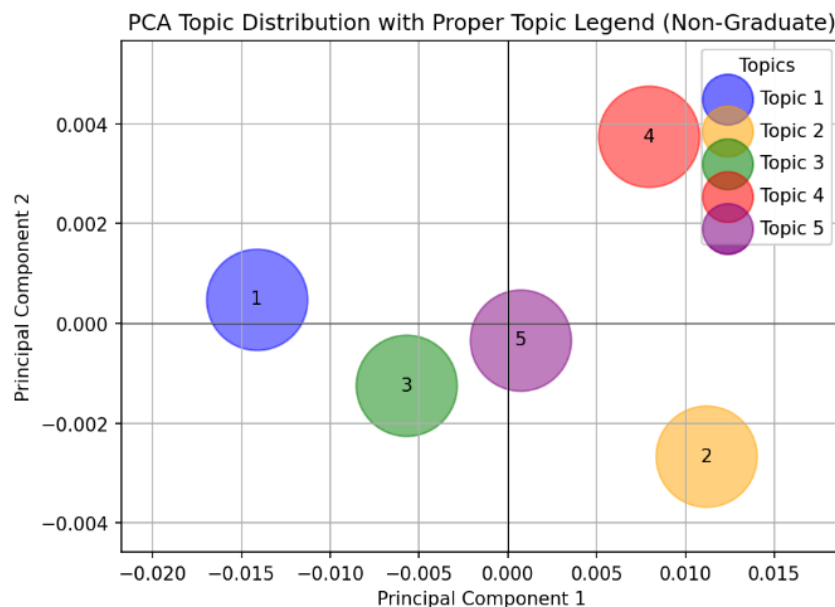
Visualization: MG and MWS without a Graduate Degree

Figure 3 illustrates five topics from MG and MWS volunteers without graduate degrees, with PCA components accounting for 77.9% of the variance (PC1: 52.6%, PC2: 25.3%). Topic 4,

focused on fieldwork (“watershed,” “field”), stands apart, suggesting a distinct motivation for hands-on conservation. Topics 1 and 3 cluster together, highlighting shared themes of pandemic impact, community, and family obligations. Topic 2, located lower on the vertical axis, emphasizes education and aspiration (“love,” “education,” “opportunities”) as separate motivational drivers. Topic 5 sits near the center and overlaps with Topic 3, suggesting personal growth and teaching are core, cross-cutting motivations for this group.

Figure 3

Principal Component Analysis (PCA) Plots of Emergent Themes among MG and MWS with Non-Graduate Degrees.



Comparative Analysis

Educational attainment influenced the motivations and experiences of Extension MGs and MWSs during the early COVID-19 pandemic. Both groups demonstrated strong commitment and resilience; however, graduate-degree volunteers focused on strategic leadership and program development, while non-graduate volunteers emphasized hands-on fieldwork and community-level adaptations. PCA visualizations confirmed these patterns, with graduate volunteers clustering around strategic themes and non-graduate volunteers around practical engagement. Graduate volunteers sought specialized knowledge and leadership roles; non-graduate volunteers prioritized skill-building and community participation. These differences suggest the need for tailored volunteer management, offering leadership opportunities for graduates and hands-on projects for others, while both groups share a strong service commitment that supports effective Extension programs.

Conclusions, Discussion, and Recommendations

As detailed in Figure 1, we conducted a three-phase analytic workflow, encompassing data collection, preprocessing with Latent Dirichlet Allocation (LDA), and thematic interpretation, to demonstrate how educational attainment influences the ways Extension Master Gardeners (MGs) and Master Watershed Stewards (MWSs) translate motivation into action. We began by dividing the 331 open-ended survey narratives into two groups: graduate ($n = 150$) and non-graduate ($n = 181$). We then cleaned, tokenized, and weighted the text. Guided by Röder et al.'s (2015) coherence metric and an elbow-curve inspection, we trained separate five-topic LDA models using Gensim. We used Principal Component Analysis to distill topic probabilities for visual comparison and applied chi-square and Fisher exact tests ($\alpha = .05$) to quantify differences between groups. Two analysts independently identified the topics, integrating inductive term patterns with the Volunteer Functions Inventory and reflexive thematic heuristics (Braun & Clarke, 2006; Clary & Snyder, 1999), achieving a κ value greater than .80. We secured analytic rigor by triangulating LDA output, PCA results, and manual codes, and by incorporating peer debriefing and negative-case analysis (Lincoln & Guba, 1985). Comparative LDA outcomes identified three primary themes by level of education. Adaptation to Pandemic Restrictions accounted for 37.2% of graduate accounts and 42.3% of non-graduate accounts, which correlated at .68 ($p < .01$). Resilience manifested within both groups, according to studies (Mak & Fancourt, 2021; Winton et al., 2023); graduates emphasized online innovation "I assisted in the launch of an off-campus consulting program where residents could submit photos of plant problems and get expert advice" and non-graduates mentioned hyper-local solutions such as front-yard demonstration plots on view from the sidewalk. A Commitment to Community and Collective Action was evidenced in 45.2% of graduate texts and 38.4% of non-graduate texts (cosine similarity = 0.54, $p < 0.01$), illustrating the association between altruism and stewardship (Hyde & Knowles, 2013; Kiptot et al., 2016). Graduates highlighted leadership and program design, such as "I convened a strategic planning committee to redesign service delivery," whereas non-graduates emphasized direct outreach, including dispensing grow-at-home kits through food pantries. Personal Development and Acquisition of Skills emerged in approximately one-third of narratives (29.1% graduates, 33.3% non-graduates), demonstrating that motivation to learn propels service (Agostinho & Paço, 2012; Bruyere & Rappe, 2007). Graduates acquired leadership certificates, "I completed advanced training modules for a program-wide role," while non-graduates acquired hard skills such as diagnostic photography for online pest identification.

Consolidated Findings

The LDA and PCA analyses confirmed that Extension MG and MWS volunteers remained engaged during the COVID-19 pandemic, demonstrating resilience, community commitment, and personal growth. Educational background shaped how these motivations manifested. Volunteers with a graduate degree adopted a strategic, leadership-oriented approach, focusing on virtual adaptation and program innovation. Meanwhile, volunteers without graduate degrees emphasized hands-on service, local outreach, and acquiring practical skills. Despite

these differences, both groups demonstrated strong resilience and dedication, with volunteering serving as a tool for community support and personal coping.

Implications for Research and Practice

The findings of this study confirm that educational background plays a crucial role in shaping volunteer motivations, providing valuable insights for future research and program development, both during and beyond the global pandemic. These insights should be viewed as lessons learned that can inform ongoing and post-pandemic volunteer engagement strategies.

Because this study employed a convenience sampling approach, the results cannot be generalized to all volunteer populations. However, we encourage other volunteer-based programs to explore aligning volunteer roles with participants' educational backgrounds, as this may enhance both volunteer satisfaction and program impact. For example, volunteers with graduate degrees may be well-suited for leadership, mentoring, or strategic planning roles, while those without advanced degrees may prefer more hands-on service and applied learning opportunities. Designing flexible, inclusive volunteer programs that recognize and leverage these differences can strengthen retention, increase engagement, and build resilience among volunteers who can adapt to changing circumstances.

Further research should investigate how education influences volunteer engagement across diverse contexts and organizational settings, not only during crisis periods, such as the COVID-19 pandemic, but also in more typical operational environments. Studies employing mixed methods that combine computational analysis with qualitative interpretation could yield deeper insights into the complex relationship between educational background, motivation, and engagement across various volunteer sectors.

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Artificial Intelligence: Grammarly and ChatGPT were utilized as AI tools to assist in refining language and correcting grammar during manuscript preparation.

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References

- Agostinho, D., & Paço, A. (2012). Analysis of the motivations, generativity and demographics of the food bank volunteer. *International Journal of Nonprofit and Voluntary Sector Marketing*, 17(3), 249–261. <https://doi.org/10.1002/nvsm.1427>
- Baker, C., Courtney, P., Kubinakova, K., Crone, D., & Billingham, D. (2020). Assessing the broader social outcomes of a community health programme through a social-ecological framework. *International Journal of Health Promotion and Education*, 58(3), 137–151. <https://doi.org/10.1080/14635240.2020.1719861>
- Bennett, P. J., Bauske, E., O'Connor, A. S., Reeder, J., Downer, J., & others. (2013). *Farmer's market, demonstration gardens, and research projects expand outreach of Extension Master Gardeners*. *HortTechnology*, 23(4), 411–415. <https://doi.org/10.21273/HORTTECH.23.4.411>
- Blair, C. K., Adsul, P., Guest, D. D., Sussman, A. L., Cook, L. S., Harding, E. M., Rodman, J., Duff, D., Burgess, E., Quezada, K., Brown-Glaberman, U., King, T. V., Baca, E., Dayao, Z., Pankratz, V. S., Davis, S., & Demark-Wahnefried, W. (2021). Southwest Harvest for Health: An Adapted Mentored Vegetable Gardening Intervention for Cancer Survivors. *Nutrients*, 13(7), 2319. <https://doi.org/10.3390/nu13072319>
- Blei, D. M., Ng, A. Y., & Jordan, M. I. (2003). Latent Dirichlet allocation. *Journal of Machine Learning Research*, 3, 993–1022. <http://www.jmlr.org/papers/volume3/blei03a/blei03a.pdf>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Bruyere, B., & Rappe, S. (2007). Identifying the motivations of environmental volunteers. *Journal of Environmental Planning and Management*, 50(4), 503–516. <https://doi.org/10.1080/09640560701402034>

- Clary, E. G., & Snyder, M. (1999). The Motivations to Volunteer: Theoretical and Practical Considerations. *Current Directions in Psychological Science*, 8(5), 156–159. <https://doi.org/10.1111/1467-8721.00037>
- Clary, E. G., Snyder, M., Ridge, R. D., Copeland, J., Stukas, A. A., Haugen, J., & Miene, P. (1998). Understanding and assessing the motivations of volunteers: A functional approach. *Journal of Personality and Social Psychology*, 74(6), 1516–1530. <https://doi.org/10.1037//0022-3514.74.6.1516>
- Corley, J., Okely, J. A., Taylor, A. M., Page, D., Welstead, M., Skarabela, B., Redmond, P., Cox, S. R., & Russ, T. C. (2021). Home garden use during COVID-19: Associations with physical and mental wellbeing in older adults. *Journal of Environmental Psychology*, 73, 101545. <https://doi.org/10.1016/j.jenvp.2020.101545>
- Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Sage.
- Demirović, D., Radovanović, M., Petrović, M. D., Cimbalević, M., Vuksanović, N., & Vuković, D. B. (2018). Environmental and Community Stability of a Mountain Destination: An Analysis of Residents' Perception. *Sustainability*, 10(1), 70. <https://doi.org/10.3390/su10010070>
- Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method* (4th ed.). John Wiley & Sons
- Dorn, S., Newberry, M. G., Bauske, E. M., & Pennisi, S. V. (2019). Are We on the Same Page? Exploring National, State, and Local Educational-response Themes for Extension Master Gardener Coordinators and Volunteers. *HortScience*, 54(3), 568–575. <https://doi.org/10.21273/HORTSCI13679-18>
- Dorn, S., Newberry, M. G., Bauske, E. M., & Pennisi, S. V. (2021). If You Build It, Will They Come? Examining Motivations of Extension Master Gardener Volunteers. *Society & Natural Resources*, 34(9), 1250–1267. <https://doi.org/10.1080/08941920.2021.1949511>
- Eiseman, D. L., Armstrong, A. K., & Chatrchyan, A. M. (2020). Designing an extension Climate Stewards volunteer program: incorporating sense of community, social practice, and self-efficacy theories. *Environmental Education Research*, 26(11), 1636–1655. <https://doi.org/10.1080/13504622.2020.1811841>
- Ferreira, M., Proença, T., & Proença, J. (2012). Motivation among hospital volunteers: an empirical analysis in Portugal. *International Review on Public and Nonprofit Marketing*, 9(2), 137-152. <https://doi.org/10.1007/s12208-012-0083-3>

- Giua, C., Paoletti, G., Minerba, L., Ferrara, P., Vacca, A., Soro, F., Saba, L., & Muresu, E. (2021). Community pharmacist's professional adaptation amid COVID-19 emergency: A national survey on Italian pharmacists. *International Journal of Clinical Pharmacy*, 43(3), 708–715. <https://doi.org/10.1007/s11096-020-01228-5>
- Goddard, M. A., Dougill, A. J., & Benton, T. G. (2010). Scaling up from gardens: Biodiversity conservation in urban environments. *Trends in Ecology & Evolution*, 25(2), 90–98. <https://doi.org/10.1016/j.tree.2009.07.016>
- Griffiths, T. L., & Steyvers, M. (2004). Finding scientific topics. *Proceedings of the National Academy of Sciences*, 101(Suppl. 1), 5228–5235. <https://doi.org/10.1073/pnas.0307752101>
- Grimm, K. E. and Needham, M. D. (2011). Moving beyond the “i” in motivation. *Journal of Travel Research*, 51(4), 488-501. <https://doi.org/10.1177/0047287511418367>
- Hotelling, H. (1933). Analysis of a complex of statistical variables into principal components. *Journal of Educational Psychology*, 24(6), 417–441. <https://doi.org/10.1037/h0071325>
- Hsiao, H., Hsu, C., Chen, L., Wu, J., Chang, P., Lin, C., Huang, C., & Lin, T. (2019). Environmental volunteerism for social good: A longitudinal study of older adults' health. *Research on Social Work Practice*, 30(2), 233–245. <https://doi.org/10.1177/1049731519892620>
- Hyde, M., & Knowles, S. (2013). What predicts Australian university students' intentions to volunteer their time for community service? *Australian Journal of Psychology*, 65(3), 135–145. <https://doi.org/10.1111/ajpy.12014>
- Inoue, M., Fukahori, H., Matsubara, M., Yoshinaga, N., & Tohira, H. (2022). Latent Dirichlet allocation topic modeling of free-text responses exploring the negative impact of the early COVID-19 pandemic on research in nursing. *Japan Journal of Nursing Science*, 19(4), e12520. <https://doi.org/10.1111/jjns.12520>
- Israel, G. D., Diehl, D. C., Galindo, S., Ward, C., Ramos, A. K., Harrington, M., & Kasner, E. J. (2020). Extension Professionals' Information Use, Protective Behaviors, and Work-Life Stress During the COVID-19 Pandemic. *The Journal of Extension*, 58(6), Article 5. <https://doi.org/10.34068/joe.58.06.05>
- Jenkinson, C. E., Dickens, A. P., Jones, K., Thompson-Coon, J., Taylor, R. S., Rogers, M., Bamba, C. L., Lang, I., & Richards, S. H. (2013). Is volunteering a public health intervention? A systematic review and meta-analysis of the health and survival of volunteers. *BMC Public Health*, 13(1), 773. <https://doi.org/10.1186/1471-2458-13-773>

- Kiptot, E., Karuhanga, M., Franzel, S., & Nzigamasabo, P. B. (2016). Volunteer farmer-trainer motivations in East Africa: practical implications for enhancing farmer-to-farmer extension. *International Journal of Agricultural Sustainability*, *14*(3), 339–356. <https://doi.org/10.1080/14735903.2015.1137685>
- Kirk-Ballard, H., Lang, K., McGinnis, E., Smith, K., & Bradley, L. (2024). Dynamic volunteer engagement and impactful educational outreach taking us into the next 50 years of the extension master gardener program. *Horttechnology*, *34*(1), 8-12. <https://doi.org/10.21273/horttech05297-23>
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. SAGE Publications.
- Lopez, B., Kennedy, C., Field, C., & McPhearson, T. (2021). Who benefits from urban green spaces during times of crisis? perception and use of urban green spaces in new york city during the covid-19 pandemic. *Urban Forestry & Urban Greening*, *65*, 127354. <https://doi.org/10.1016/j.ufug.2021.127354>
- Mak, H., & Fancourt, D. (2021). Predictors of engaging in voluntary work during the COVID-19 pandemic: analyses of data from 31,890 adults in the UK. *Perspectives in Public Health*, *142*(5), 287–296. <https://doi.org/10.1177/1757913921994146>
- Miao, Q., Schwarz, S., & Schwarz, G. (2021). Responding to COVID-19: Community volunteerism and coproduction in China. *World Development*, *137*, 105128. <https://doi.org/10.1016/j.worlddev.2020.105128>
- Mohd Rashid, N., Ma'amor, H., Zamzuri, N. H., Ramli, N., Ghazali, A. R., & Saridan, S. (2023). Assessing Event Volunteer Motivational Factors and Quality of Life among University Students. *Information Management and Business Review*, *15*(4(SI)I), 478-485. [https://doi.org/10.22610/imbr.v15i4\(SI\)I.3623](https://doi.org/10.22610/imbr.v15i4(SI)I.3623)
- Okun, M. A. (1994). *The relation between motives for organizational volunteering and frequency of volunteering by elders*. *Journal of Applied Gerontology*, *13*(2), 115–126. <https://doi.org/10.1177/073346489401300201>
- Osafo, E. (2020). Engaging Communities in Challenging Times: Lessons Learned from the Master Gardener Program During the COVID-19 Pandemic. *Advances in Developing Human Resources*, *23*(1), 75-87. <https://doi.org/10.1177/1523422320972142> (Original work published 2021)
- Peachey, J., Lyras, A., Cohen, A., Bruening, J., & Cunningham, G. (2013). Exploring the motives and retention factors of sport-for-development volunteers. *Nonprofit and Voluntary Sector Quarterly*, *43*(6), 1052–1069. <https://doi.org/10.1177/0899764013501579>

- Posner, B. Z. (2015). An investigation into the leadership practices of volunteer leaders. *Leadership & Organization Development Journal*, 36(7), 885–898. <http://dx.doi.org/10.1108/LODJ-03-2014-0061>
- Principi, A., Lucantoni, D., Quattrini, S., Di Rosa, M., & Socci, M. (2022). Changes in Volunteering of Older Adults in the Time of the COVID-19 Pandemic: The Role of Motivations. *International Journal of Environmental Research and Public Health*, 19(22), 14755. <https://doi.org/10.3390/ijerph192214755>
- Röder, M., Both, A., & Hinneburg, A. (2015). Exploring the space of topic coherence measures. In *Proceedings of the eighth ACM international conference on Web search and data mining* (pp. 399–408). Association for Computing Machinery. <https://doi.org/10.1145/2684822.2685324>
- Strong, R., & Harder, A. (2011). Interactions Among Instructional Efficacy, Motivational Orientations, and Adult Characteristics on Master Gardener Tenure. *Journal of Agricultural Education*, 52(4), 65–75. <https://doi.org/10.5032/jae.2011.04065>
- Stukas, A. A., Snyder, M., & Clary, E. G. (2014). Volunteerism and community involvement: Antecedents, experiences, and consequences for the person and the situation. In D. A. Schroeder & W. G. Graziano (Eds.), *The Oxford handbook of prosocial behavior* (Oxford Library of Psychology). Oxford Academic. <https://doi.org/10.1093/oxfordhb/9780195399813.013.012>
- Van Sickle, J., Pierce, D., & Diacin, M. (2015). Volunteer motivations at the 2012 Super Bowl. *International Journal of Event and Festival Management*, 6(3), 166–181. <https://doi.org/10.1108/ijefm-12-2014-0029>
- Winton, S. R., Buchko, O., & Falcone, L. (2023). Volunteers' stewardship action-taking experiences during the COVID-19 pandemic were predicted by their motivation toward engagement and ability to teach others. *Journal of Human Sciences and Extension*, 11(3), 2. <https://doi.org/10.55533/2325-5226.1416>

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