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Research Paper

Assessment of Training Barriers Among Underserved Virginia Value-added Food Producers: A Proposed Structure for Improving Parity in Food Safety Educational Interventions

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ABSTRACT

Food manufacturing businesses, regardless of size, must comply with appropriate food safety education requirements, but guidance on effectively training small, minority-owned producers is lacking in key areas, such as preferred formats and knowledge of current perceived barriers to compliance. This study aimed to understand the greatest barriers to knowledge gain and behavior change for underserved value-added food producers in Virginia. An anonymous 10-question survey was administered to Virginia food producers through various channels, including email links, flyers, electronic tablets, or physical copies provided in person. The survey queried demographic information about the producer, factors that inhibited their learning, and suggestions for improved education and outreach. Responses (n = 124) were analyzed using descriptive statistics and logistic regression in RStudio version 4.2.3. The results indicated that many producers identify location as the primary barrier to attending and learning about food safety, followed by the frequency of available training events. Additionally, the three preferred learning tools for producers were factsheets, interactive sessions with trainers and/or materials, and prerecorded videos. While there is no single method to meet all the needs related to food safety training for small producers, it is crucial for Cooperative Extension to consider these factors when planning food safety training and workshops to ensure broader outreach to more producers to achieve parity in food safety education.

Food producers of all sizes must produce food products of suitable quality for safe consumption to ensure consumer health. Effective education of these producers relies heavily on Extension efforts that emphasize tackling community and societal issues at the grassroots level. New, small, and minority-owned food manufacturing businesses (including those producing value-added foods on-farm) face critical capacity challenges with workforce, food safety training, and regulatory compliance understanding which directly impact their ability to produce safe value-added food products and can interfere with their capability to grow and enhance long-term economic viability of their businesses (Richard et al., 2023). Large-scale surveys and other studies have identified several challenges specific to small businesses, including limited financial resources, inadequate training access, and high compliance costs (Magiya, 2023; Yapp & Fairman, 2006). These barriers are compounded by small producers often operating in underserved areas or employing a workforce that does not speak English as their first or preferred language (Boone et al., 2004; Yapp & Fairman, 2006).

Cooperative Extension services through land-grant universities across the U.S. provide services crucial to bridging these gaps by providing educational resources, technical assistance, and support to food processors, handlers, and producers, among others (Snyder et al., 2018). These services are vital for disseminating food safety knowledge and practices, particularly to small, value-added food producers

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who may lack the resources of larger enterprises (Barone et al., 2020; Snyder et al., 2018). However, there are significant barriers to achieving parity across Cooperative Extension. Small producers frequently report logistical constraints, including inconvenient training times and locations, language barriers, and culturally inappropriate training materials (Fox, 2020). Programs like the Food Producer Technical Assistance Network at Virginia Tech and the Small Farm Outreach Program at Virginia State University work closely with producers to bridge some of these barriers to improve learning outcomes (such as improved food safety practices like handwashing). However, educators engaged in this work must first identify their constituent member needs so they may provide these producers with effective education, which may include providing materials in variable formats or languages.

Virginia's food businesses have developed significantly over the past fifteen years and are the Commonwealth's second-largest manufacturing sector and fastest-growing industry. Employment in this sector has grown by 15% over the past five years, the second-highest rate in the Southeast (Virginia Economic Development Partnership, 2022). According to the Virginia Department of Agriculture and Consumer Services (VDACS) Office of Dairy and Foods, Virginia is home to over 1,000 home-based manufacturing operations (Miles, 2018), which allowed for smaller businesses to mobilize and provide food products into the distribution chain during the height of the pandemic crisis. Producers utilized shared-use kitchens, community kitchens, as well as home kitchens to launch businesses, which must meet specific regulatory requirements depending on the type of food product produced, how it will be sold, and which regulatory agency inspects that operation. These food businesses continue to be in crisis mode and are dually affected by the economic repercussions of the health crisis as well as the need to comply with newly adopted food regulations that came into effect in 2019.

As a result of the adoption of 21 CFR Part 117 in Virginia, VDACS has mandated that all food manufacturing businesses, including home operations, comply with food safety education. Educators have a strong understanding of the types of food safety topics that are relevant to small producers (Harrison et al., 2016), but guidance is still missing about how to effectively train these producers. Small producers have less flexibility to send personnel for off-site training while maintaining business output. A 2021 Virginia Specialty Food and Beverage survey showed that most (80%) businesses preferred online educational formats over in-person (proprietary data); although, existing research shows trainee satisfaction ratings and student engagement have been observed to be lower across virtual platforms compared to in-person (Dickinson et al., 2022; Mallonee et al., 2018). New, small, and minority-owned operations do not identify with many established training courses as the course examples show compliance in larger food production settings, in addition to being inaccessible to regional, cultural, and other training concerns. Strategies to overcome these barriers may include increasing accessibility and frequency of training sessions, reducing training costs, or developing culturally relevant and language-appropriate education materials (Fox, 2020). Additionally, creating more flexible and adaptive training formats, such as online modules and hybrid learning opportunities, could be other ways to accommodate these producers' varied schedules and preferences. However, these strategies all require a significant cost investment to adapt and produce new training materials, resources, or other educational outputs; thus, it is necessary to understand which factors present the greatest barriers to food safety knowledge gain and behavior change prior to undertaking the work and cost of developing additional programming. Therefore, the objectives of this study were to identify (i) barriers to learning at Extension trainings, (ii) preferred formats for future food safety educational interventions, and (iii) resource needs to improve behavior change postintervention.

Materials and methods

Survey development and dissemination. A survey instrument was developed to understand which factors presented the greatest barriers to knowledge gain and behavior change in underserved value-added producers across Virginia (Supplemental material 1). Survey questions were developed by three industry experts across two institutions and reviewed independently by five experts across five industry, government, and university institutions (the advisory committee) to ensure adherence to the project objectives and accessibility to the target population. Questions were screened and approved by Institutional Review Boards at Virginia Tech (23-674) and Virginia State University (1923-018).

The survey was designed to anonymously collect feedback from various value-added food businesses across the Commonwealth, with an emphasis on minority individuals defined in the Code of Virginia as "an individual who is a citizen of the United States or a legal resident alien and who satisfies one or more of the following definitions: 'African American'…'Asian American'…'Hispanic American'…'Native American'" (Va. Code Ann. § 2.2-1604). In instances when demographic terminology or definitions were deemed by the advisory committee to be unintentionally exclusive or inaccurate to the cultural identity(-ies) of the target population, the survey instrument was adjusted and open text boxes were included to amend these concerns prior to survey dissemination.

To facilitate survey dissemination to Hispanic and Asian or Asian-American producers, the survey instrument, consent forms, and recruitment materials were also translated into Spanish and Korean, respectively. These languages were most commonly spoken by foreign national store operators and were identified by the research team as additional key target populations of interest. Certificates of accuracy were obtained for each language translation. The survey was disseminated in-person via paper copies and online via a Qualtrics™ link through multiple proprietary email lists (e.g., Virginia Cooperative Extension, Virginia State University Small Farm Outreach Program), local Cooperative Extension offices, and at relevant events (e.g., educational workshops, trade association meetings). Data were collected from June 2023 to April 2024.

Statistical analysis. Statistical analysis was conducted using RStudio version 4.2.3. Incomplete surveys (i.e., surveys that respondents did not submit) or those that did not include value-added food producers were removed prior to statistical analysis. Surveys that were completed in Spanish or Korean were exported from Qualtrics™ as letter responses, but open-text responses were exported and translated to Spanish or Korean for qualitative analysis by Drs. Parraga or Kim, respectively. Demographic responses related to household annual income were converted for analysis to income brackets based on those described by (Bennett et al., 2020): "Low" = < $50,000, "Middle" = $50,000–$150,000, and "High" = > $150,000. Descriptive statistics were utilized to describe initial trends in demographic groups of interest (income bracket, race/ethnicity, and years in operation). Logistic regression and odds ratios were utilized to compare these components among demographic groups of interest. Reference groups were "Low-income", "White", and "Less than 1 year". Odds ratio plots were included in Supplemental material 2.

In vivo coding was conducted to identify meaningful patterns and themes among the reflections by two coders to enhance interrater reliability in the data (Charmaz, 2006), which was used to identify patterns and organize the open-ended, write-in responses systematically (Saldaña, 2021). Data could receive one or multiple codes. After open coding, focused coding was employed to refine initial categories into broader themes that aligned with the objective of identifying barriers to and resource needs to support effective training (Charmaz, 2014). Focused codes grouped similar insights by comparing data points and highlighting connections between

responses. Axial coding was conducted as the final step, integrating categories and identifying overarching themes related to the above objective (Corbin and Strauss, 2014). The codes represented the action-oriented language of participants, capturing their perceptions and experiences regarding food safety educational barriers and resource needs (Roth, 2008). The quotes used in this paper are presented as originally written by respondents without any changes. Any grammatical error, mistake, or specific formatting in a quote is identified by "(sic)". For transparency, all quotes are included in Figures 3 and 5.

Results

Of the 150 survey responses initiated across English (122), Spanish (28), and Korean (0) versions, 124 were completed by value-added food producers (82.67%). Of the 26 excluded responses, 11 were not completed, 13 did not consent to participate in the survey (i.e., did not respond to/sign the survey consent, answered "No"), and 2 were completed by individuals outside of the target value-added food producer response group (e.g., Extension agents who did not operate a value-added food business).

Respondent demographics. Most respondents (106/124; 85.48%) reported producing only one of the following categories of products: ready-to-eat (RTE; 52/124; 41.94%), fresh produce (45/124; 36.29%), meat/poultry/seafood (23/124; 18.55%), pet food (5/124; 4.03%), or others (20/124; 16.13%) such as "herbal culinary", "frozen-need to heat before serving soups + stews", or "cooked-made to order food". Most respondents (93/124; 75.00%) identified as the manager or owner of their food business, followed by an employee (20/124; 16.13%), unpaid apprentice or assistant (1/124; 0.81%), or "Other" (4/124; 3.23%).

Most respondents reported annual household income that categorized them as low-income (52/124; 41.94%), followed by middle (31/124; 25.00%) and high (7/124; 5.65%); however, 25% of respondents (31/124) chose not to answer this question (Fig. 1). While 54 respondents (43.55%) identified as "White", most survey respondents were non-White (66/124; 53.23%), identifying as "African or African-American" (13/124; 10.48%), "Asian or Asian-American" (9/124; 7.26%), "Hispanic" (37/124; 29.84%), "Multiracial" (3/124; 2.42%), or "Other" (4/124; 3.23%) which included "Arab", "Iranian", "African or African-American and white", and "Arab-Egyption (sic)" (Fig. 1). Respondents reported a variety of years of experience operating a food business (Fig. 1), ranging from less than one year (27/124; 21.77%) to more than five years (49/124; 39.52%).

Food safety training barriers. When asked to identify the situations that impacted respondents' abilities to attend and learn at food safety training events, concerns related to location of the training (24), frequency of the offered training (20), the training format (19), and timing trainings to occur during regular work hours (19) emerged (Fig. 2A). However, respondents selected "Other" reasons most often (36), including "I have terrible internet [redacted] + can't stream", "no computee (sic)", "never have heard of an event like this", "need more sessions in the off season-Dec and Jan", and "They have nothing to do with what I actually need to do or need to know in my small food business", among others (Fig. 3). Thirty-three respondents (26.61%) identified more than one barrier to attending and learning at food safety training events. Businesses in operation 1–3 years were less likely than businesses in operation less than 1 year to identify location as a barrier to attending and learning ($p = 0.0148$). Hispanic producers were less likely than White producers to identify other barriers to attending and learning at food safety training events ($p = 0.0129$). Qualitative analysis of "Other" responses identified lack of resources (12) and the need for greater advanced notice (8) about the training event as additional barriers (Fig. 3). Themes suggested that some producers did not identify barriers to attending food safety trainings (11); however, this may have been impacted by the fact that some producers, as part of the survey dissemination strategy, may have received the invitation to complete this survey at food safety trainings. Additionally, some open-text responses communicated that producers already had previous knowledge about food safety prior to completing the survey (9).

When asked to identify the best format(s) for learning about food safety, respondents identified factsheets (57), interactive formats that allow for interaction with the trainer and/or materials (50), prerecorded videos (45), hybrid formats that include a mix of in-person and online content (44), and presentations (35) most often (Fig. 4A). Seventy-one respondents (57.26%) selected more than one preferred format for instruction. High-income producers were more likely than low-income producers to select factsheets as a preferred format ($p = 0.0336$). Hispanic producers were less likely than White producers to prefer factsheets ($p = 0.0411$) or presentation-style formats of instruction ($p = 0.0437$). Respondents who identified as a different race/ethnicity than listed in the survey (i.e., "Other") were more likely than White producers to select one-on-one instruction as a preferred format ($p = 0.0411$).

Resources. When asked to identify which lack of resources contributed to why food safety training was not effective for them, respondents reported "I do not have facilities that would allow me to implement food safety practices (for example, three-compartment sink or refrigerator)" (28), "I do not know who to talk to or ask about food safety concerns if I have questions" (27), and "I do not have the equipment that would allow me to implement food safety practices (for example, pH meters or thermometers)" (14). However, respondents overwhelmingly identified other reasons than those listed (43), including "Time to wrap my head around how to implement the general idea in my situation and figure out the details", "A clear outlined area where all the information is available. It's like going through a dark dungeon with no light trying to find all the information. And often the language is obtuse", "'-Dealing with too many organizations -Lack of clarity as how everything connects -Contradiction between state rules and county rules", and "It is not leveled to my small business. Trainings are always for those who have heavy equipment or factories or restaurants", among others (Fig. 5). Most of the open-text responses indicated that training was effective (22); however, some of these respondents also included responses that reflected a misunderstanding of or misinformation about food safety (5; e.g., "I follow all USDA/FDA protocols", "do not sell prepared food that has food safety concerns"). A small number of all responses (7/124; 5.65%) indicated that they had the necessary resources for food safety training to be effective.

Producers were also asked about their general knowledge and understanding of food safety in relation to their products. Most respondents (112/124; 90.32%) understood that foodborne illnesses could result after consuming unsafe food products which could lead to further financial concerns for business owners, while five respondents reported not being aware (4.03%). Seven producers (5.65%) did not respond to this question. No one demographic group was more or less likely than the reference groups to report this foodborne illness awareness ($p > 0.05$).

Food safety communication. When producers were asked their preferred method(s) of contact about food safety educational trainings, 42 (33.87%) selected more than one contact method. Overall, respondents highly preferred email (76), followed distantly by text messages (24), visiting a website (21), flyers in the mail (20), and others (Fig. 6A). Middle-income respondents were more likely than low-income respondents ($p = 0.0117$) and businesses in operation greater than five years were less likely than businesses in operation less than one year ($p = 0.0183$) to prefer email correspondence, respectively. Businesses in operation greater than 5 years were more likely than businesses in operation less than 1 year to prefer phone calls ($p = 0.0371$).

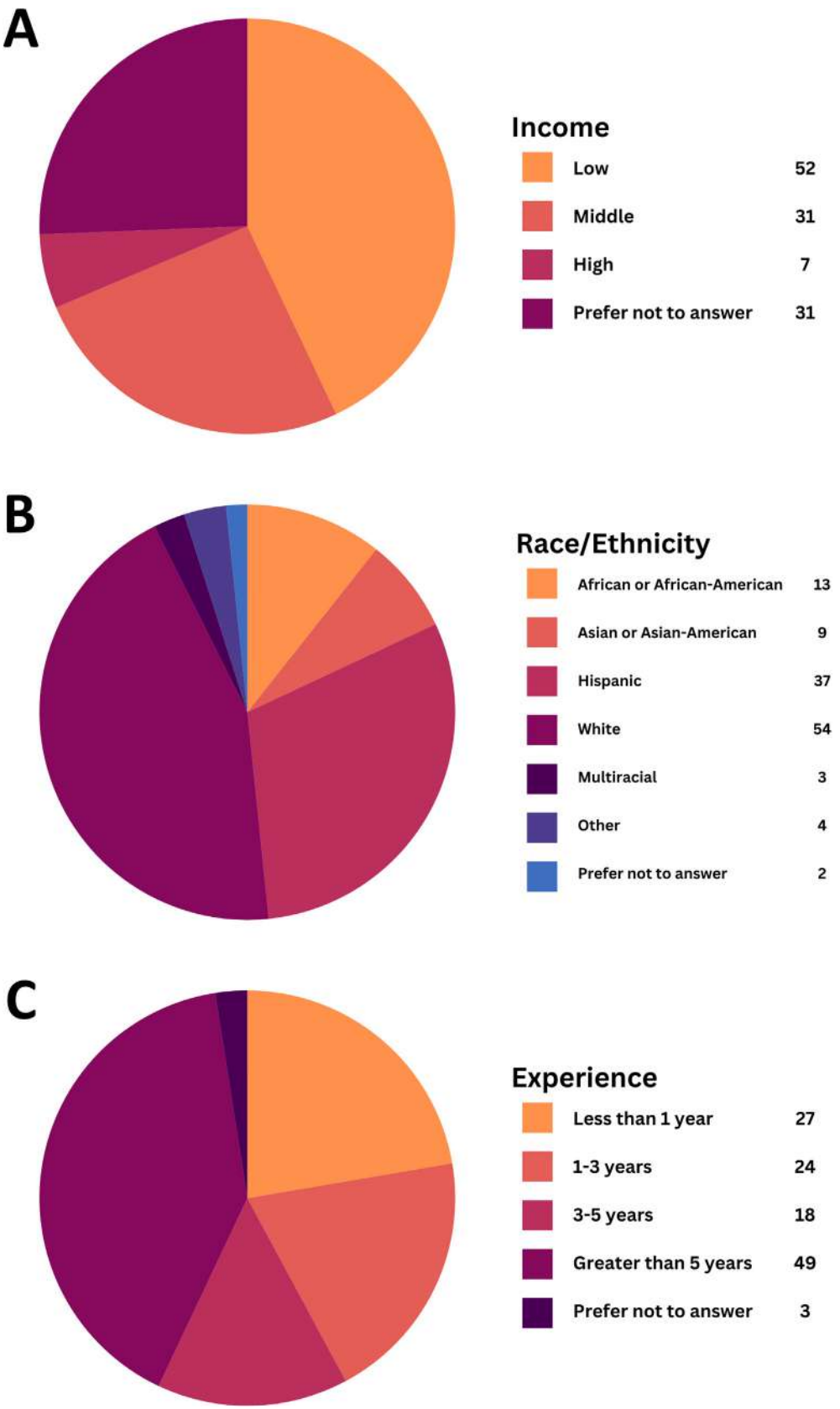


Figure 1. Respondent demographics by income bracket (A), race/ethnicity (B), and years of experience operating a food business (C).

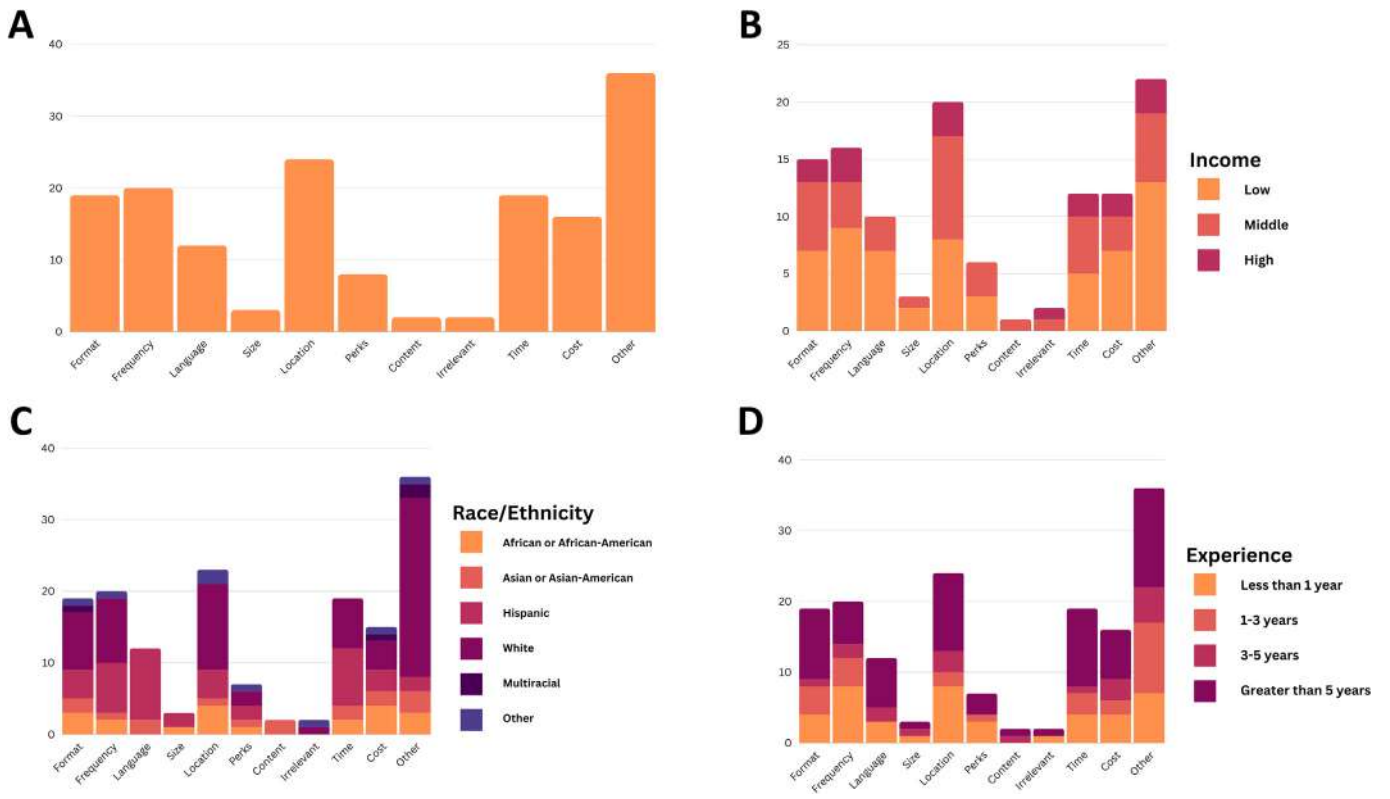


Figure 2. Factors that impacted respondent ability to attend and learn at food safety training events overall (A) and by income bracket (B), race/ethnicity (C), and years of experience operating a food business (D).

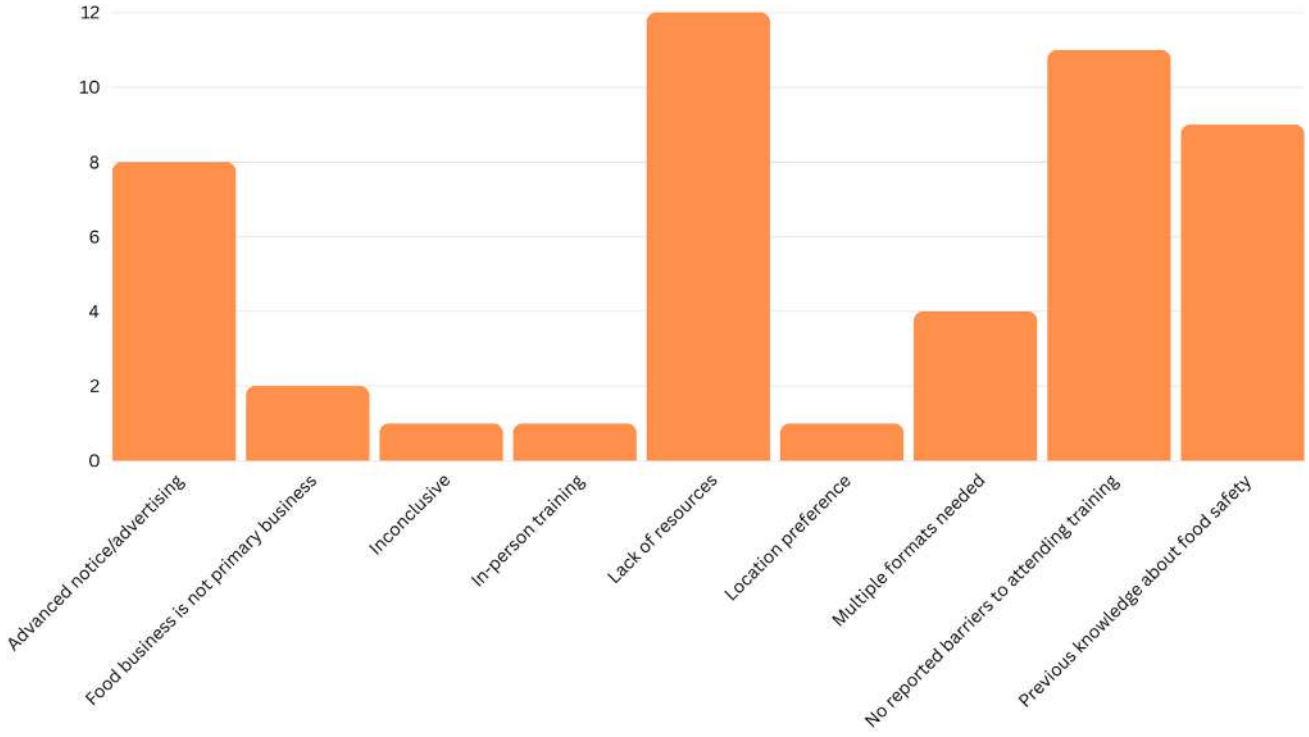
Discussion

Widespread bias (the use of educational formats, communication styles, and resources that were less likely to be selected by any one demographic group) in Virginia's approach to Extension education and outreach was not observed in this study. When other demographic selections are held constant, producer preferences for food training barriers, resources, and communication did not fall clearly across one demographic selection (e.g., one income group was not significantly more likely to have selected a preference for a specific method of instruction), indicating that achieving parity in food safety educational efforts is a deeply complex aim. This is consistent with other studies that have found significant challenges to program evaluation, which were related to program participant uniqueness (Lamm et al., 2016), interconnected agrarian and personal histories (Graddy-Lovelace et al., 2023), Extension system and educator capacity (Kennedy et al., 2022), and target audience bias against existing Extension representatives (Saldaña et al., 2005), among others. Regardless, findings emerged that show a combination of short-term tactical (practices to emphasize) and long-term strategic (barriers to remove and resource management) initiatives will be critical for enhancing food safety education and outreach effectiveness.

Barriers to remove. Barriers to food safety knowledge gain and behavior change remain complex and contextual, as was evidenced by the number of participants who selected the open-ended "other" text box (Fig. 2). To streamline efforts to reach diverse producers, educators are encouraged to prioritize location equity in designing workshops and outreach activities. Location as a driver of educational success has been discussed extensively in studies evaluating or advocating for more effective, resilient adult education (Lindemann et al., 2022; Spears et al., 1986; Tiffany, 2017; Townsend, 2008). Specifically, (Tiffany, 2017) found that interactive geospatial mapping of program activities was necessary to facilitate assessment and improvements in integrating outreach efforts. The location of an adult education event could facilitate an individual's opportunity to explore their own cultural and social identity in a way that promotes the development of new, more resilient, and collaborative social networks (Rudnick et al., 2009; Scott, 2006; Townsend, 2008), which could also provide an opportunity to improve existing biases of target demographics against existing Extension representation by providing a more holistic approach to culturally responsive adult learning events.

In addition, the frequency of the training offered was one of the most selected barriers by the respondents. This could also be related to location as, in many cases, training is not offered frequently in the same location. Extension agents and specialists usually have several programs and might offer only a few training courses related to food safety, which means that people in need of these training courses must travel farther to attend. Even though cost was not identified as the greatest barrier, removing location and frequency barriers to effective education will undoubtedly require subsidizing other costs (e.g., lodging, transportation) to ensure that cost does not become a greater barrier to effective education (Barone et al., 2020).

Practices to emphasize. This survey indirectly identified several programmatic approaches that have allowed Virginia Cooperative Extension to reach a broad audience of producers. Communication through short communications (i.e., factsheets) and developing interactive, prerecorded video, and hybrid training options will continue to be important for meeting producer needs, particularly as barriers are removed and resource management strategies change (Arnold et al., 2022; Leal et al., 2017). Broadly, when developing or innovating education and outreach initiatives, these forms of instruction should be prioritized over others (e.g., one-on-one instruction or posters), unless specific demographic groups of interest expressly prefer it (i.e., instructional format preferred by "other" races/ethnicities above) (Quinlan, 2013).



Write-in responses include

"This training at [specific location] is just right"

"Have to know well in advance to be able to take time off from work"

"some of the above, however I make it work eventually"

"I am attending food safety training"

"I have terrible internet [redacted] + can't stream, [specific location] is very convenient for me"

"(N/A)"

"no computee (sic)"

"I do food safety training at the school"

"have done class before"

"never have heard of an event like this"

"monthly analysis of training seems excessive"

"no training"

"I am not even aware of trainings available. It would be helpful to maybe add anyone that reaches out for VDACS assistance automatically onto a newsletter"

"Never looked into your food safety training"

"The training I've taken so far has been adequately priced and in a good format with good accessibility and flexibility. As a producer I would like a class that is an intro to a starting business to let you know what products need what training and examples of required equipment and logs"

"online certified easy to access"

"I have no (sic) accessing training"

"I have attended some of the online training as my schedule allows, I also work as (sic) a full time corporate job"

"Have not attempted to attend in any of the training but would love to"

"not available"

"need more sessions in the off season-Dec and Jan"

"N/A"

"have attended numerous such events in the past and feel well trained enough for now."

"have certification"

"we have attended food safety classes for our prepared foods"

"we have attended classes before"

"no problem attending"

"nothing"

"I have food safety training"

"I have not taken any training & don't know how or where they are offered"

"They have nothing to do with what I actually need to do or need to know in my small food business"

"Im (sic) able to attend"

"lack of information about the courses offered"

"our management never trained personnel and when they do it is in English"

Figure 3. Distribution of respondent codes and write-in responses to "Please select all of the following situations that you feel impact your ability to attend and learn from food safety trainings".

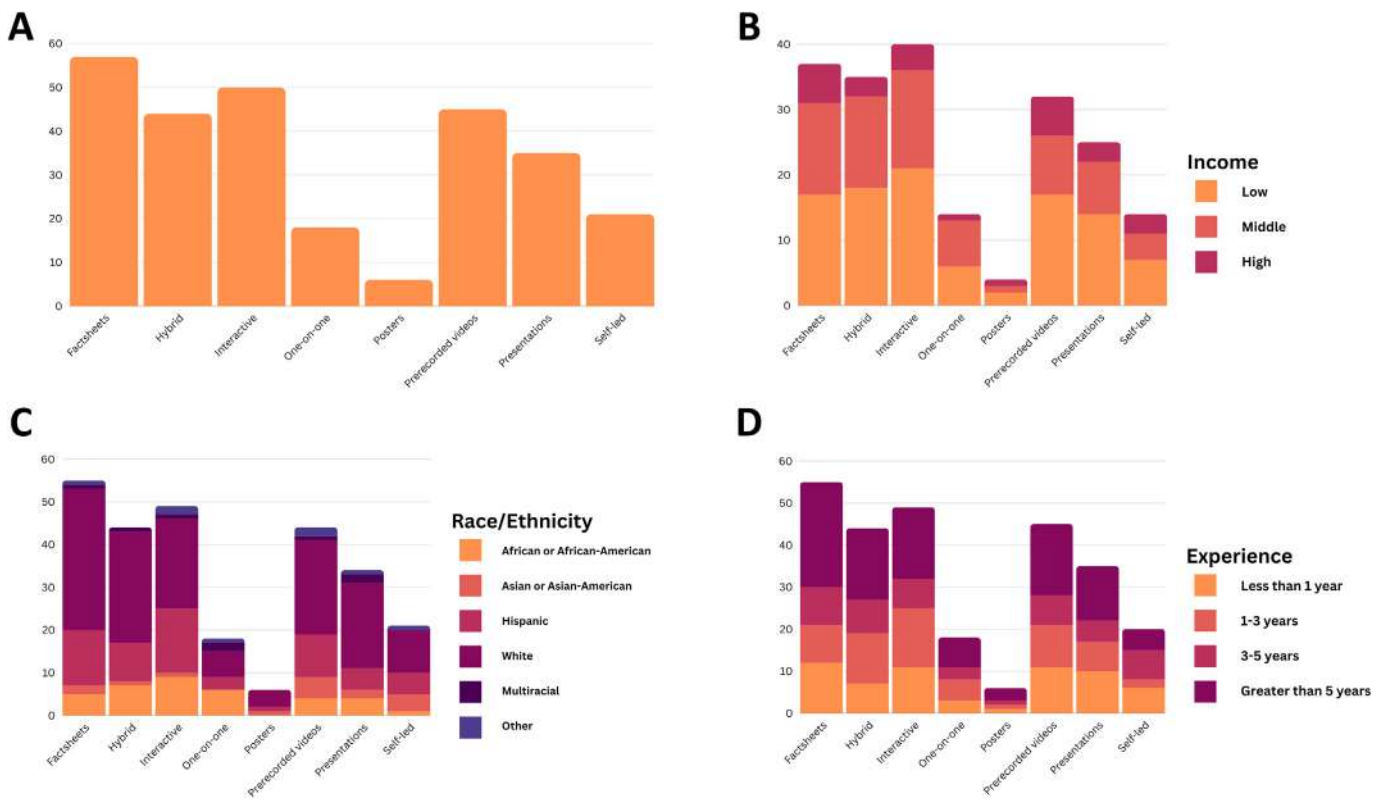
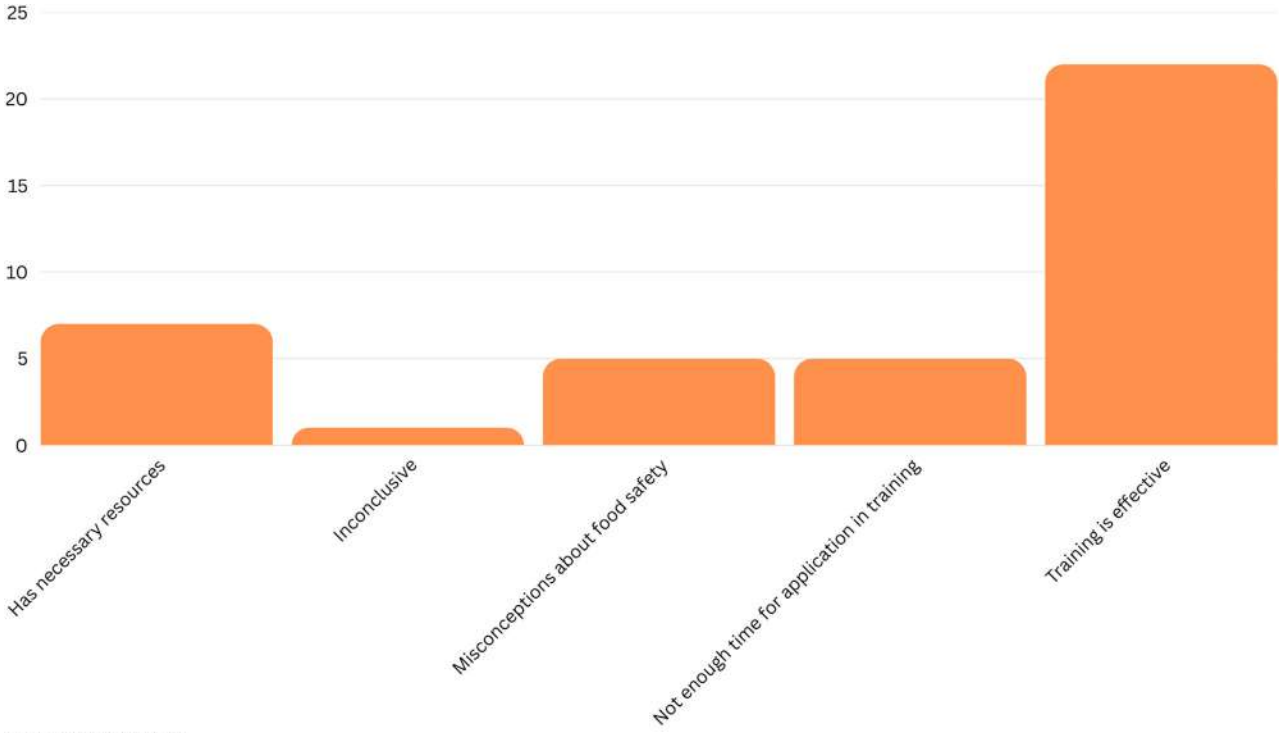


Figure 4. Preferred formats for food safety education overall (A) and by income bracket (B), race/ethnicity (C), and years of experience operating a food business (D).

Respondents overwhelmingly preferred email as the primary form of communication about education and outreach events. This was especially true for new food businesses (i.e., businesses in operation for less than one year), which should be considered when planning educational events for beginning food producers. Educators are encouraged to develop (or, if already established, continue to manage) email listservs for contacting target audiences. Institutional policies preventing the use or development of these communication streams should be revisited to ensure community member needs can be effectively met. Some responses also suggest that value-added producers are not aware of the full extent of Cooperative Extension's capabilities to support food safety initiatives for all business sizes and types. This is likely due to a combination of factors, such as not advertising training events with sufficient advanced notice, community resource barriers that prevent sufficient, effective communication (e.g., lack of reliable internet access), and using less preferred communication formats. This is consistent with a previous assessment of state Extension services that showed the organization was "slow to adopt and integrate" a variety of communication channels in their communication strategies (Butler, 2022).

Perhaps more interestingly, participants did not select newer outreach models that have been emphasized as more innovative or relational, such as social media (Ashley Bramlett & Harrison, 2012; Mou & Lin, 2014; Winer, 2009). This could be due to the variety of user experiences when engaging with "new" educational materials, such as the "unpleasant symptoms" reported in virtual reality-assisted educational events (Grassini & Laumann, 2020). This is likely due to a variety of reasons, but this finding is consistent with other studies that have evaluated the platform as a means of engaging in educational activities, such as (Burke et al., 2016) which found that, even though young adults may be aware of these educational opportunities, social media was not a preferred communication platform. Further, a study evaluating the use of mobile learning platforms (e.g., personal cell phones) found that the disconnect between personal expectations and digital skills, particularly in elder participants, negatively impacted intended content bridging outcomes (Ranieri & Pachler, 2014). In situations when one of the demographic groups included in this study (e.g., low-income, specific race/ethnicity, new business owners) is specific, educators should prioritize factors, formats, and outreach methods that were selected at higher frequencies when developing programmatic interventions (Figs. 2B–D, 3B–D, 4B–D).

Resource management and continued evaluation efforts. Although (Nieto-Montenegro et al., 2008) showed that well-constructed knowledge systems (e.g., educational materials) can produce significant increases in knowledge and simple food safety practice adoption (i.e., handwashing), it will continue to be difficult for producers to apply more complex practices (e.g., sanitizer management, food safety plan development) gained through food safety education interventions when they lack the resources to effectively adapt their behavior (Parker et al., 2012). Respondents identified other barriers to effective education at the individual and community levels, including those related to facility infrastructure, internet access, technology access (e.g., computers), being unaware of training events, and needing more unique timing of activities (such as in December and January for some businesses' self-identified "off season"; Fig. 3). Removing community-level barriers will be considerably more challenging but remain necessary (Ellinda-Patra et al., 2020). It is in these instances that shared facilities and equipment can help provide additional, necessary resources until widespread individual barriers can be removed. However, a study evaluating food safety management practices in a shared-use or community-moderated environment (i.e., food pantry) can be a significant source of and way to perpetuate poor food safety behavior if improperly managed (Chaifetz & Chapman, 2015), further highlighting the need for accessible, practical food safety education that is appropriately designed to meet producer needs in the settings in which they operate. These findings also show an



Write-in responses include

"Doesn't affect"
"It is effective for me"
"Time to wrap my head around how to implement the general idea in my situation and figure out the details"
"N/A"
"none"
"(N/A)"
"N/A"
"none"
"none"
"food safety training is effective"
"none of the above"
"none apply- I have these at work) (sic)"
"it is quite effective because of monthly analysis"
"N/A"
"N/a"
"A clear outlined area where all the information is available. It's like going through a dark dungeon with no light trying to find all the information. And often times the language is obtuse"
"'-Dealing with too many organizations -Lack of clarity as how everything connects -Contradiction between state rules and county rules"
"USDA provided excellent resources"
"have not yet attended"
"I follow all USDA/FDA protocols"
"I am already involved with VDALS (sic) and getting emails from VSU, The biggest problem I have with many presentation is that too many presenters read word for word from the slides"
"I would not sat (sic) if not effective, we do practice it"
"He is involved in mandatory health inspection and food safety"
"learning"
"we are good"
"n/a"
"do not sell prepared food that has food safety concerns"
"n/a"
"it is effective for us"
"no problem"
"N/A"
"neccesary (sic) time"
"It is not leveled to my small business. Trainings are always for those who have heavy equipment or factories or restaurants. We need one for VDACs specific small food businesses and what we actually work with/come into contact to"
"I have adequate resources."
"I don't have any difficulties, I have everything I need for my work."

Figure 5. Distribution of respondent codes and write-in responses to "Which of the following lack of resources is the primary (most important) reason why food safety training is not effective for you?".

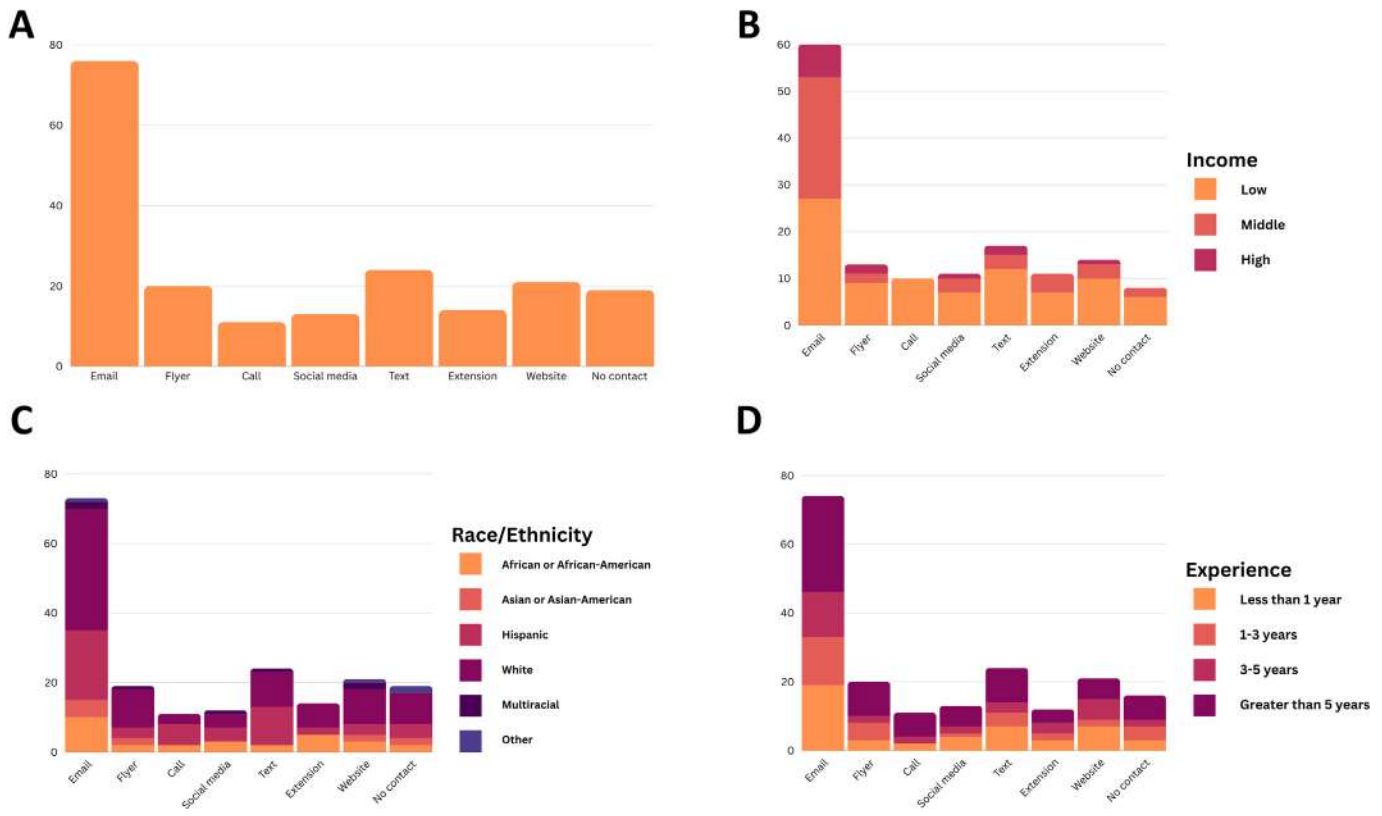


Figure 6. Preferred outreach methods for food safety education overall (A) and by income bracket (B), race/ethnicity (C), and years of experience operating a food business (D).

interesting coalescence of adequate and misinformation through the majority awareness of foodborne illnesses, declaration of training effectiveness and lack of barriers, and misinterpretations of food safety information. Examples include the mistaken belief that a single operation can fully comply with all regulations from both the Food and Drug Administration (FDA) and the United States Department of Agriculture (USDA) or the notion that they produce a zero-risk food product. Respondents may not be aware of these conflicting results, potentially due to the lack of training and development around critical thinking with regard to food safety. (Diekman et al., 2023) highlights difficulties in fostering critical thinking in food and nutrition science communicators that require a knowledgeable, interdisciplinary support system of other experts, which value-added food producers are unlikely to have or foster on their own.

Cooperative Extension services are highly valued by the community and are typically tailored to meet their specific needs. However, when considering food safety training, it is crucial to also consider factors such as company size, years in business, number of employees, and the demographics of both owners and employees. This study suggests that extension agents should carefully consider the location and frequency of training sessions before offering existing programs. Providing courses only once a year or in inaccessible locations can lead to low attendance and increased costs for participants seeking training in their areas of interest. Incorporating a variety of instructional formats will be important for ensuring that target audiences can engage with training content in preferred ways, and these data can provide guidance when developing new or innovating existing programming to more effectively reach target audiences.

CRediT authorship contribution statement

Katheryn Parraga: Writing – original draft, Supervision, Methodology, Investigation, Funding acquisition. **Liv Huselton:** Writing – review & editing, Investigation, Data curation. **Mohamed Salem:** Writing – review & editing, Visualization, Formal analysis. **Xinlei Zhang:** Writing – review & editing, Visualization, Formal analysis. **Tiffany Drape:** Formal analysis, Writing – review & editing. **Chyer Kim:** Writing – review & editing, Supervision, Methodology, Investigation, Funding acquisition, Data curation. **Alexis M. Hamilton:** Writing – review & editing, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization.

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

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