




Evaluating impacts of R3 workshops for first-time hunters at universities across the United States

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Abstract

Declines in hunter numbers across the United States make hunter recruitment, retention, and reactivation (R3) a high priority for wildlife management. As wildlife management agencies and nongovernmental organizations seek to reach new audiences, college campuses present a unique opportunity to cultivate nontraditional path hunters. Despite recent proliferation of R3 initiatives, little research has evaluated effects of hunting programs on knowledge, attitudes, and behaviors of new hunters. We designed and implemented Getting Started Outdoors:

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Hunting 101 workshops specifically targeting college students without previous hunting experience, and we assessed workshop efficacy with a theoretically-grounded approach to workshop evaluation. Using quantitative and qualitative analysis of surveys conducted before, shortly after, and 12–18 months after workshops, we assessed impacts of R3 efforts at large public universities in 16 different U.S. states. Across all states, 19 workshops attracted 314 total participants, with 255 completing both pre- and post-workshop assessments and 133 completing the follow-up surveys. Workshops significantly increased participants' confidence in hunting, reduced barriers related to inadequate knowledge and skills, and fostered positive views of hunters and hunting. Immediately after workshops, most participants said they would definitely (50%) or probably (34%) hunt in the future; 82% said they would likely (or very likely) purchase a hunting license. Over one year after the workshops, 34% of workshop participants reported having hunted, and another 45% said they would probably hunt in the future. Overall, workshops attracted a diverse population of potential hunters, increased interest in future hunting, and created hunting advocates. Findings highlight the potentially powerful impact that R3 programs focused on diverse college students can have on the future of hunting across the United States.

KEYWORDS

attitudes, behaviors, college students, evaluation, hunting, recruitment, retention, university, wildlife management

Hunting is an important activity for many reasons: it is a component of North American culture and heritage (Reiger 2001), an important wildlife management tool (Loveridge et al. 2006), and a major source of revenue for conservation (Mahoney and Jackson III 2013, Winkler and Warnke 2013). Declining rates of hunting participation (Larson et al. 2014, U.S. Fish and Wildlife Service 2016) are therefore concerning to wildlife management agencies, who increasingly emphasize hunter recruitment, retention, and reactivation (R3) initiatives to address the problem (Responsive Management and National Shooting Sports Foundation [RM and NSSF] 2017).

Attempts to identify best practices for R3 programs abound (RM and NSSF 2017, Price Tack et al. 2018). However, scientific evaluation of R3 programming remains limited, and efforts that exist typically lack theoretical grounding in their curriculum and evaluation (Enck et al. 2000, Larson et al. 2014) and tend to focus on singular outputs such as post-program license sales (Wildlife Management Institute 2022). For example, R3 programs designed to minimize potential barriers to hunting rarely account for the full array of constraints identified by previous research (Wright et al. 2001, Miller and Vaske 2003, Metcalf et al. 2015, Stodolska et al. 2020). Crawford et al. (1991) described a hierarchical model of constraints where intrapersonal, interpersonal, and structural constraints are nested, and individuals must negotiate intrapersonal constraints before other barriers can be addressed. Other theories consider motivations and constraint negotiation simultaneously, highlighting many

interacting factors that influence an individual's desire and ability to hunt (Barro and Manfredi 1996, Hubbard and Mannell 2001, Metcalf et al. 2015, Vayer et al. 2021). The Theory of Planned Behavior (TPB) offers additional explanations for hunting adoption, suggesting that beliefs, attitudes, norms, and behavioral controls drive an individual's intent to perform a behavior (Ajzen 1991, Hrubec et al. 2003). The Outdoor Recreation Adoption Model (ORAM), a theoretical framework designed with R3 programs in mind (Byrne and Dunfee 2018), focuses on social support, a key aspect of hunting at the recruitment, retention, and reactivation stages (Larson et al. 2014). Collectively these theories highlight prospective antecedents of hunting behavior (e.g., motivations, constraints, perceived behavioral control, behavioral intent, beliefs and attitudes about hunting, social support), yet such factors rarely are incorporated into R3 program design and assessment.

Historically, R3 program design has focused on specific skill development such as shooting skills and hunter safety (RM and NSSF 2017), and R3 program evaluation has focused on attendance outputs and license-purchasing behavior following workshops (Wildlife Management Institute 2022). However, program evaluation literature highlights a number of additional factors that should be considered when assessing the efficacy of R3 efforts. Effective evaluation should consider both outputs (products and services delivered) and intermediate and end outcomes (short-term and longer-term results) that a program hopes to achieve (Newcomer et al. 2015). For R3 programs, evaluation might include measures of service quality and customer satisfaction as well as broader outcomes such as beliefs about hunting and behaviors related to hunting (e.g., preparing game meat). Effective evaluation must also consider the contextual factors affecting the extent to which program activities achieve desired results (Newcomer et al. 2015), particularly in outdoor education settings (Powell et al. 2023). Strategic integration of the theoretical constructs noted above, as well as systematic investigation of the programmatic factors that influence them, could help managers design and implement R3 programs that address barriers to hunting and cultivate interest and social support needed for long-term success.

Despite expanding R3 initiatives nationally, and perhaps because rigorous evaluation procedures have rarely been employed to assess them, evidence of R3 efficacy has been mixed (RM and NSSF 2017). Seng et al. (2007) and Larson et al. (2013) discussed reasons why R3 programs fail, including an emphasis on single events, inadequate evaluation of program effectiveness, lack of resources, expertise, and support, misunderstanding of the market and marketing tactics, and managers' reluctance to adapt and change. Many R3 efforts tend to attract traditional hunters, typically White males from rural areas, likely already socialized into the hunting community (Stedman and Heberlein 2009, Ryan and Shaw 2011). Continued emphasis on youth recruiting programs, a staple for many wildlife agencies and conservation organizations, may therefore be cost-ineffective if the goal is attracting new hunters (Price Tack et al. 2018), primarily because these youth come from families that already provide support around hunting (Decker et al. 1984). Current iterations of R3 are often piecemeal and opportunistic, and they struggle to expand the social habitat for hunting in ways that resonate across diverse cultures—an expansion that is needed to increase the overall number of hunters as demographic transitions progress and traditional hunting populations decline (Larson et al. 2014).

To expand participation in and support for hunting and become more socially relevant, agencies are increasingly turning to nontraditional audiences (Lee et al. 2014, Quartuch et al. 2017, Ringelman et al. 2020). Quartuch et al. (2017) defined nontraditional path hunters (NTPH) as hunters who enter the hunting community as adults, have limited previous hunting experience, have little or no familial or social support for hunting, or are from typically underrepresented groups within the hunting community (e.g., women and racial/ethnic minorities). To recruit NTPHs, practitioners must develop and implement strategies and messaging that align with hunting-related beliefs and motivations of individuals who are new (Ryan and Shaw 2011). Research suggests that while both NTPHs and traditional hunters report some similar motivations (e.g., obtaining local, free-range meat) and barriers (e.g., perceived lack of skill and access), social support and relationships may be critical to recruiting and retaining NTPHs (Larson et al. 2014, Quartuch et al. 2017, Birdsong et al. 2022). Furthermore, NTPHs are heterogeneous, with recruitment and retention motivations varying across different demographic and cultural classes (Birdsong et al. 2022). Although simultaneously reaching all NTPHs may be impossible, one group contains many potential hunters

that are easily identified and reached, yet largely overlooked in the R3 agenda: college students (Larson et al. 2017, Vayer et al. 2021).

Nearly 41% of young adults ages 18–24 (about 23 million people) in the United States currently attend some type of college (National Center for Education Statistics [NCES] 2021). Among undergraduate students in the United States, 57% identify as female, 48% identify as non-White, and most are from urban areas (NCES 2021). About 2 million of these diverse students are enrolled in the smaller subset of land-grant universities, which often feature wildlife and natural resource-oriented majors and courses (Congressional Research Service 2017). A study of land grant universities across the country suggests that as many as 22% of these students constitute potential hunters (Vayer et al. 2021). There are many reasons why R3 efforts targeting college students might be effective (Ringelman et al. 2020). As emerging adults, most college students are in a developmental stage characterized by independence, exploration, boundary testing, and identity development (Arnett 2000, 2007). For many Americans, the college experience is a period of leisure activity experimentation (Luyckx et al. 2006, Ravert 2009) and cognitive and spiritual development (Johnson et al. 2011). Colleges and universities also provide dynamic and supportive social environments where, although unique constraints (e.g., lack of time, lack of money) may be present, new outdoor recreation activities (such as hunting) can thrive. In short, college students may be naturally inclined to try new activities such as hunting, and the college atmosphere may help to nurture such exploratory behavior.

Working with university and state wildlife agency collaborators across the United States, we created, implemented, and evaluated an R3 program specifically developed for college students without prior hunting experience. Our program evaluation process assessed changes in theoretical constructs designed to fill a key gap in the R3 literature: the need for science and data-driven decision making to improve program efficacy. Here, we address 4 research questions (RQ): (RQ 1) Who registered for these beginners' hunting workshops, and what were their motivations for signing up?; (RQ 2) How did R3 workshops affect participants' confidence in hunting, attitudes and beliefs about hunting, and perceived constraints to hunting?; (RQ 3) How did R3 workshops influence participants' engagement in hunting and future hunting-related behaviors; and (RQ 4) What workshop attributes (e.g., format, focal species, setting, mentored hunt option) were most strongly associated with future hunting participation? Through this evidence-based approach, we evaluated if a targeted R3 workshop for college students could effectively recruit new hunters and hunting advocates.

METHODS

Study context and participant recruitment

Working with state wildlife agencies, nongovernmental organizations (NGOs), and university collaborators, we developed a framework for a Getting Started Outdoors: Hunting 101 workshop designed specifically for college students without previous hunting experience. The workshop's purpose was to teach students basics of hunting, to highlight broader benefits of hunting, and to inspire students to adopt positive hunting-related beliefs, attitudes and behaviors. Workshop content and format were modeled after existing R3 programs around the country, with particular emphasis on programs with demonstrated success attracting NTPHs in general (e.g., Hunt for Food in Wisconsin, Field to Fork in Kentucky and Georgia) and college students specifically (e.g., Conservation Leaders for Tomorrow; D.J. Case and Associates 2019, Ringelman et al. 2020). All workshops across participating states focused on hunting-related topics appropriate for entry-level audiences. Common themes included hunters' role in conservation and hunting ethics, scouting/tracking tips and hunting scenarios, proper use of hunting stands, gear, and equipment, firearm safety, shooting practice, and game recovery/processing and meat preparation. Most workshops also included opportunities to specifically discuss student concerns regarding barriers to hunting, beliefs about hunters and hunting, and other hunting-related behaviors.

Although workshop content was similar, formats varied by state based on existing infrastructure and available resources. In 12 states, the workshops were one-day (approximately 8-hour) events at local hunting clubs or state game lands near campus. However, some collaborators—especially those with previously established programs for college students and/or NTPHs—altered workshop structure to suit their needs. For instance, some used a multi-day approach. About half of the workshops centered on deer (*Odocoileus* spp.) hunting, but focal species varied by state and season. For example, some states conducting spring workshops focused on turkey (*Meleagris gallopavo*), and other states focused on pheasants (*Phasianus* spp.) and waterfowl (Table 1). All but 3 workshops included a field component. Most (68%) offered a mentored hunt experience for interested participants following workshop completion. Workshop implementation was coordinated and directed by agency partners in each state, with support from collaborators at associated universities. Volunteers from state wildlife agencies, hunting NGOs, and local community members helped staff the workshops.

TABLE 1 Overview of 19 R3 workshops for college students held across 16 US states from fall 2018 through spring 2020.

Year	State (School)	Focal Species	Total Workshop Participants	Survey Respondents			
				Pre	Post	Pre & Post	Follow Up
Oct 2018	NC (NC State Univ.)	Deer	20	26	21	20	14
Oct 2018	SC (Clemson Univ.)	Deer	22	22	22	22	12
Feb 2019	GA (Univ. of Georgia & ABAC)	Squirrel	21	17	21	16	3
Mar 2019	MI (Michigan Tech. University)	Deer	21	19	11	10	NA
Apr 2019	KS (Kansas State Univ.)	Pheasant	11	15	9	9	NA
Apr 2019	NY (Cornell Univ.)	Pheasant	16	18	15	13	6
Aug 2019	WI (Univ. of Wisconsin Madison)	Deer	9	7	6	6	3
Oct 2019	KY (Univ. of Kentucky)	Deer	12	12	6	5	3
Oct 2019	NC (NC State Univ.)	Deer	24	36	24	24	15
Oct 2019	SD (South Dakota State Univ.)	Pheasant and Deer	11	11	11	11	7
Oct 2019	SC (Clemson Univ.)	Deer	19	17	17	17	12
Nov 2019	SC (Clemson Univ.)	Deer	22	22	22	22	17
Nov 2019	CO (Univ. Northern CO)	Deer	17	19	17	17	8
Nov 2019	TX (Texas A&M Univ.)	Deer	13	21	12	12	8
Apr 2019	MT (Univ. of Montana)	Deer	13	13	NA	NA	NA
Apr 2019	TN (Univ. of Tennessee)	Other	10	8	4	2	NA
Jan 2020	OR (Oregon State Univ.)	Duck	20	14	15	13	12
Feb 2020	VA (Virginia Tech.)	Squirrel	15	24	8	8	3
Nov 2020	FL (Univ. of Florida)	Deer	31	30	28	28	10
Total			327	351	269	255	133

Note: Web-based pre-workshop surveys were available to all individuals who registered for the workshop in advance. Not everyone who registered attended the workshop, however, resulting in cases where the number of completed pre-workshop surveys were higher than the number of actual participants. Additionally, not everyone who attended the workshops completed a pre and/or post survey, also leading to differences in the respective sample sizes. No post-workshop surveys were administered in Montana, hence the NA.

The level of variation, though perhaps not ideal, is relatively common in multisite evaluation research (Newcomer et al. 2015). In an effort to maintain fidelity and comparability across sites, we followed best practices for multisite data collection (Newcomer et al. 2015, Powell et al. 2023). Specifically, we maintained common protocols and utilized shared assessment criteria (allowing for some degree of customization based on site context). Additionally, we maintained clear communication through the program implementation and evaluation process to help ensure consistency. Finally, with respect to assessment and data analysis, we focused on common ingredients across all programs to compare the effects of different contextual factors on relevant outputs and outcomes. Our approach therefore facilitated multisite comparisons to the greatest extent possible, while still allowing for variability that is inevitable across any type of outdoor education program evaluation conducted at this geographic and temporal scale (Powell et al. 2023).

Collaborators at participating universities coordinated recruitment of a self-selected sample of students to participate in R3 workshops, specifically targeting individuals without previous hunting experience. Recruitment efforts varied by university but, in addition to the zero or limited previous hunting experience criterion, aimed to attract diverse participants based on gender, race/ethnicity, and academic major. First, we invited students who had expressed interest in hunting on a campus-wide survey (Vayer et al. 2021). Second, we publicized events by posting flyers around campus, talking with large lecture classes, meeting with student organizations, and distributing information via college and departmental email lists. Broadcasting these learn-to-hunt workshop opportunities on college campuses inevitably attracted a small number of nonstudent applicants (recent graduates, university employees, etc.). Because these individuals were also integral parts of the larger campus community, we decided to welcome them into the programs as well. During fall 2018 through spring 2020, we implemented 19 different hunting workshops with participants from 17 large public universities in 16 U.S. states (Figure S1, available online in Supporting Information).

Study design, survey administration, and instrument composition

We used a pre-post survey approach, along with a delayed follow-up survey, to collect data from workshop participants and evaluate the efficacy of R3 workshops across all states. Similar approaches have been used in other education program evaluation studies (Ozogul et al. 2019), though rarely with R3 programming. At most universities, workshop leaders sent a web-based questionnaire via Qualtrics to registered participants about one week before the event (Survey S1, available in Supporting Information). Participants were sent a second web-based questionnaire via Qualtrics the week following the workshop (Survey S2, available in Supporting Information). In a few cases, paper questionnaires were completed on-site following workshop completion. We collected follow-up survey data 12–18 months after the workshops to assess self-reported behavior around hunting (Survey S3, available in Supporting Information). If participants did not respond to a particular round of surveys (i.e., the pretest, posttest, or follow-up), they were sent an additional email reminder.

Project leaders at North Carolina State University developed survey instruments with input from project collaborators. Both instruments were designed to assess the influence of R3 workshops with respect to discrete themes. Following best practices in evaluation research (Newcomer et al. 2015), we intentionally selected output and outcome variables that were meaningful and relevant, goal-oriented (with respect to R3 program objectives), comprehensive (with respect to the range of outputs and outcomes assessed, not limited to future hunting behavior), and both reliable and valid. For constructs consisting of multiple scaled items, we used a Principal Components Analysis (PCA) with an orthogonal rotation to confirm factor structure and aggregate individual items into larger thematic categories with composite scores for analysis. In the PCA, items with factor loadings <0.4 for a particular construct were excluded from future analyses, and scales with Cronbach's alpha values >0.8 were considered to have good internal consistency.

Background information and motivations to participate

During workshop registration, we collected participants' demographic information including gender identity, race/ethnicity (using U.S. census designations), college major, and self-reported population size of the area where a participant grew up (e.g., urban vs. rural). We also measured any level of participation in other outdoor recreation activities including adventure sports, bird watching, camping, canoeing, kayaking, hiking, jogging, running, swimming, and wildlife viewing, or photography using a binary (yes/no) approach. Because a growing body of research highlights links between hunting and a preference for locally produced food (Tidball et al. 2013, Stedman et al. 2017), we assessed previous engagement with local food using a checklist including participating in cooking classes, edible gardening, foraging, and shopping at farmer's markets.

To assess motivations for hunting prior to workshops, we synthesized items from previous studies to identify potential reasons for hunting (Decker et al. 2015, RM and NSSF 2017). Possible motivations included engaging in sport or recreation (e.g., seeking a new outdoor recreational challenge), obtaining local free-range meat, spending time with friends or family, and maintaining ecological balance (e.g., preventing overabundance of wildlife). We asked participants to rate the importance of each potential reason for hunting using a 4-point unipolar rating scale, ranging from (1) not at all important to (4) very important. The PCA (Table S1, available in Supporting Information) identified 4 categories of motivations that aligned with the hunting motivation structure identified by Vayer et al. (2021): food-related motivations focused on obtaining meat (2 items, Cronbach's $\alpha = 0.775$), altruistic reasons focused on community benefits of hunting such as contributing to conservation or controlling wildlife damaging ecosystems (3 items, Cronbach's $\alpha = 0.905$), egoistic motivations focused on personal reasons for hunting such as spending time with friends and family and connecting with nature (6 items, Cronbach's $\alpha = 0.838$), and hunting to obtain a trophy (one item).

Confidence in hunting-related skills and knowledge

Before and after workshops, we asked about overall confidence in hunting skills on a unipolar rating scale from (1) not at all confident to (5) extremely confident. We also asked participants to use the same scale to report their confidence with respect to specific hunting skills such as firearm safety, shooting, ethical shot placement, field recovery, and game meat preparation.

Beliefs and attitudes about hunters and hunting

Before and after workshops, we asked participants to rank their level of agreement with 9 items measuring attitudes and beliefs about hunters and hunting on a scale from (1) strongly disagree to (5) strongly agree, with higher scores indicating more positive beliefs about hunters and hunting. These items followed previous studies (RM and NSSF 2017, Vayer et al. 2021) and included belief statements such as hunting is a safe activity, hunters behave responsibly and follow hunting laws, and hunters financially contribute to wildlife conservation. The PCA (Table S2, available in Supporting Information) revealed 2 overarching categories of beliefs, including beliefs about the value of hunting (5 items, Cronbach's $\alpha = 0.843$) and beliefs about hunters and hunting safety (3 items, Cronbach's $\alpha = 0.669$).

Perceived constraints to hunting

We assessed perceived constraints to hunting before and after workshops. We listed 18 potential barriers designed to measure intrapersonal (individual), interpersonal, and structural (context) constraints (Stodolska et al. 2020), matching the 5-factor hunting constraint structure described in Vayer et al. (2021). These factors were as follows:

individual constraints focused on morality and comfort such as reluctance to personally kill an animal and discomfort around firearms and hunting equipment (4 items); skills and knowledge constraints such as lack of the knowledge/skills to prepare game meat to eat and uncertainty about how/where to store equipment and firearms (6 items); logistical constraints such as lack of transportation to hunting areas and uncertainty about where to hunt (6 items); judgement and experience constraints such as feeling discouraged by past negative experiences in the outdoors or feeling uncomfortable due to a lack of racial and ethnic diversity associated with hunting (3 items); and alternative activities constraints such as preference for other activities (one item). All items were based on potential hunting constraints identified in previous studies (Metcalfe et al. 2015, RM and NSSF 2017) and were rated as a yes or no binary variable from a check-all-that-apply question.

Hunting participation

We assessed participants' previous hunting experience (before the workshop), future intent to hunt (immediately following workshops), and then self-reported hunting participation (12–18 months after the workshops). On the pre-survey instrument, we asked "have you ever hunted before?" Response options included (1) yes, (2) I have accompanied someone hunting but did not personally hunt, or (3) no. Pre-survey items also evaluated participants' social support for hunting. For example, we asked participants to indicate if any of the following people in their lives hunt: father, mother, brother/sister, grandparent, other family member, friends, or other (specify).

To gauge participants' future intent to hunt on the post-workshop survey, we asked "how likely are you to hunt in the future?", with response options of (1) I will definitely not hunt to (5), I will definitely hunt. If a participant answered (3), (4), or (5), we asked an additional question regarding how often they thought they would hunt with response options of (1) Might try it once, (2) Rarely (once every few years), or (3) Regularly (at least once per year). To explore intent to participate in other hunting-related behaviors, we asked participants how likely they were to engage in various actions such as purchasing a hunting license, hunting deer, or becoming friends with a hunter, on a scale from (1) very unlikely to (5) very likely.

To assess participation in hunting activities 12–18 months following the workshops, we asked "Not counting the mentored hunt, have you gone hunting any other times since you attended the Hunting 101 workshop this past year?" We also inquired about participation in other hunting-related activities by asking the following: "Have you done any of the following since you attended the Hunting 101 workshop this past year?", with response options of "No, and I'm not likely to do it", "No, but I'm likely to do it", and "Yes, I've done it". The list of activities was identical to those listed on the post-workshop survey and included purchasing a hunting license.

Data analysis

To address RQ1 and better understand workshop participants, we used descriptive statistics to explore demographic characteristics, other background information (e.g., past experience with hunting and other outdoor recreation activities), and motivations of those who registered. To address RQ2 and evaluate post-workshop score changes, we used paired t-tests to compare responses on both the pre- and post-workshop surveys (for participants who completed both) for themes related to confidence in hunting skills, beliefs and attitudes about hunting, and perceived constraints to hunting. We also compared post-workshop scores to the responses on the follow-up survey 12–18 months later. To address RQ3, we used descriptive statistics to assess future hunting likelihood and intent to engage in a variety of hunting-related behaviors immediately following the workshop, as well as actual participation 12–18 months after the workshop. To address RQ4, we then examined associations among different workshop attributes (reported by workshop leaders following each event), demographic characteristics of participants, and future hunting behavior using 2 generalized linear mixed models (GLMM) with a binomial logit link.

We interpreted odds ratios (OR) to identify significant relationships. Binary outcome variables in the post-workshop models were (a) likely to hunt in the future and (b) likely to purchase a hunting license in the future. Binary outcomes for the follow-up models were (a) self-reported hunting participation and (b) self-reported license purchasing. Workshop attributes included format (single-day vs. multi-day), focal species (deer vs. small game), and mentored hunt option (mentored hunt opportunity vs. no hunt). We did not include workshop setting (indoor only vs. field component) as a separate attribute because very few participants attended indoor-only workshops. Demographic attributes included race/ethnicity (White vs. all other categories), gender (men vs. women or non-identifying), childhood upbringing (rural vs. urban), and college major (agriculture or natural resources vs. all other majors). To account for potential statistical dependence among participants in the same workshop, models included a random effect for the 19 different workshops. Identical independent variables and model structures were used to predict actual hunting and license purchase behaviors reported in the follow-up surveys; however, the lower number of participants completing the follow-up survey ($n = 133$) precluded the calculation of interclass correlation coefficients (ICC) for these models. We also used participant responses to a final open-ended question to better understand broader impacts of workshops. Mixed models were fit using R 4.1.1 (R Core Team 2021) and the lme4 package (Bates et al. 2015; Code S1, available in Supporting Information). Results presented in this paper are based on data pooled from R3 workshops across all participating states.

To estimate possible non-response bias, we used the wave analysis methodology employed in other human dimensions research (Barrett and Rodriguez 2021). We compared demographic attributes and responses to a specific subset of key variables (e.g., beliefs about hunting, future hunting intent) to assess potential differences among respondents who completed all waves of the survey and those who dropped out after the first or second round.

RESULTS

In the 19 different hunting workshops held across 16 different states, the number of participants ranged from 9 to 31 per workshop. Across all states, 351 participants completed the pre-workshop survey as a part of registration, but only 327 of these individuals attended an actual workshop. Among all workshop participants, 269 completed the post-workshop questionnaire and 133 completed a follow-up survey (Table 1). Overall, 82% of workshop attendees completed both pre-workshop and post-workshop questionnaires ($n = 255$), and 37% completed all 3 survey waves ($n = 120$).

Description of workshop participants

Most (72%) people who registered for workshops (referred to as registrants) were undergraduate students, 24% were graduate students, and 4% were recent graduates, university employees, or partners/spouses of current students. About 30% of registrants were 21 years or younger, 75% were under age 25, and 90% were younger than 30 years old. Almost half (42%) of registrants were women. Only 17% of registrants were from small towns or rural areas, with many coming from large cities (29%), medium-sized cities and suburbs (23%), and small cities (28%). Approximately 70% of registrants were White; other racial/ethnic groups represented in our sample were Asian (13%), Hispanic (10%), Black (4%), and Middle Eastern, Indigenous American, mixed race and Pacific Islander (6%). Student participants came from a variety of academic disciplines. About half (48%) of participants were in majors focusing on agriculture or natural resource management-related fields (e.g., wildlife and fisheries, parks recreation and tourism management, agriculture). However, 33% of students were studying other STEM disciplines (e.g., engineering, life sciences, math, tech), 9% were majoring in social sciences or humanities (e.g., anthropology, communication, psychology, health and human sciences), and 5% were majoring in business or management-related disciplines (e.g., accounting, business, economics).

Most (83%) workshop participants had never been hunting before, including 7% that had accompanied a hunter into the field previously but had not hunted themselves. Of 61 students that had previous hunting experience, 42% had their first hunting experience after age 15, and more than half (62%) had not hunted during the past 12 months. Registrants had relatively little previous exposure to hunting through their families (e.g., 24% had parents/guardians or siblings who hunt), while the predominant connection to hunting was through friends who hunt (36%). Few registrants engaged in activities related to hunting prior to the workshop experience; participating in recreational shooting (16% participated often or very often) and viewing media about hunting (e.g., blogs, social media posts, YouTube videos; 15%) were the most common activities. Although most participants reported limited previous engagement with hunting and the hunting community, they engaged in a variety of other outdoor recreation activities including hiking (84%), camping (70%), canoeing or kayaking (55%), jogging (55%), and adventure sports (e.g., snowboarding, rock climbing; 51%). Over half (62%) of participants had shopped at local farmers' markets and 32% engaged in edible gardening, highlighting an interest in local and ethically sourced food products among many participants.

Workshop participants' strongest motivation for hunting was to be closer to nature (51% rated it as very important). To contribute to wildlife conservation (50%), to obtain local, free-range meat (45%), and to control wildlife populations that are damaging to ecosystems (43%) were the next most popular motivations (Table 2). The least important motivations appeared to be to harvest a trophy animal (4%) and to engage in sport and recreation (15%). Overall, participants were highly motivated to participate in hunting for altruistic and food-related motivations.

TABLE 2 Mean ratings of motivations for hunting reported by students who registered to attend a "getting started outdoors" hunting workshop ($n = 351$).

Motivations for Hunting	% Very Important	Mean Rating
Food Motivations	48% ^a	3.07
To obtain local, free-range meat	45%	3.10
To connect more closely to sources of food	41%	3.03
Altruistic Motivations	40% ^a	3.04
To contribute to wildlife conservation	50%	3.22
To control wildlife populations that are damaging ecosystems	43%	3.04
To control wildlife populations that are causing problems for people	33%	2.86
Egoistic Motivations	26% ^a	2.92
To be closer to nature and the outdoors	52%	3.32
To seek a new adventure	43%	3.21
To test and challenge my outdoor skills	36%	3.02
To relax or escape from everyday life	26%	2.73
To spend time with family and friends	26%	2.73
To engage in sport and/or recreation	15%	2.46
Trophy Motivations	4% ^a	1.56
To harvest a trophy animal	4%	1.56

Rated on a scale from 1 = Not at all important to 4 = Very important; includes pre-workshop survey data only ($n = 351$).

^aPercentage of participants with index score greater than 3.5.

Short-term effects of workshops on hunting-related skills, beliefs, and attitudes

Participants rated their overall experience in workshops as very positive, reporting a mean score of 4.75 (on a scale ranging from 1 = Very negative to 5 = Very positive); 99% of participants said their overall experience was positive or very positive. For many participants, the most enjoyable aspects of workshops were skills sessions on general hunting skills and knowledge (noted by about 57% of respondents), firearm skills and safety (35%) and game meat and food preparation (31%). About 19% of participants mentioned that simply having demographically diverse volunteers that were enthusiastic and knowledgeable, or getting the opportunity to talk with current hunters and confront stereotypes, were highlights of the workshop. See supporting information for more details regarding participants' assessment of the overall workshop experience (Workshop Evaluation Summary S1, available in Supporting Information).

Entering workshops, registrants reported low levels of confidence in most hunting-related skills except firearm safety (Table 3). Participants were significantly more confident in every hunting-related skill after completing workshops. Following workshops, 41% of participants said they were confident (or extremely confident) in their overall hunting-related skills and knowledge; 75% of participants were confident in ethical shot placement, 68% were confident in their ability to safely handle a firearm, and 57% of participants were confident in shooting skills. Substantial increases in confidence were reported with other skills such as cooking and preparing game meat, knowledge of hunting regulations, and choosing the right hunting gear (Table 3). Fewer participants expressed confidence with respect to field recovery, butchering and preserving game meat, and scouting hunting locations, though all of these ratios were significantly higher than those on pre-workshop surveys.

Participants generally expressed positive views about the value of hunting prior to workshops, but their views about hunters and hunting safety were more variable (Table 4). After workshops, participants' positive beliefs about hunters and hunting increased significantly, with major gains noted for every item and the overall scales. For example, 97% of participants agreed or strongly agreed that hunters financially contribute to conservation, 96%

TABLE 3 Mean ratings of confidence in various hunting-related skills reported by college students before and after attending hunting workshops ($n = 255$).

Hunting-Related Skill	Pre-Workshop Mean	Post-Workshop Change Mean Diff.	Pre-Workshop % Confident	Post-Workshop % Confident
Overall Confidence	1.69	+1.58***	5%	41%
Ethical shot placement	2.01	+1.89***	13%	75%
Hunting regulations (seasons, license requirements, etc.)	1.74	+1.70***	7%	48%
Field recovery/dressing of game	1.48	+1.65***	6%	38%
Choosing the right hunting gear	1.69	+1.66***	7%	46%
Butchering and preserving game meat	1.43	+1.47***	6%	36%
Scouting and selecting good hunting spots	1.45	+1.54***	5%	31%
Cooking harvested game meat	2.20	+1.50***	21%	65%
Shooting skills	2.53	+0.98***	27%	57%
Firearm safety	2.92	+0.93***	41%	68%

Items rated on a scale from 1 = "Not at all confident" to 5 = "Extremely confident"; includes pre and post-workshop survey data. Means were calculated using only pre/post paired sample ($n = 255$), percentages using individual samples ($n = 351$ for pre, $n = 269$ for post). "% Confident" includes "confident" or "very confident" scale ratings. *, **, *** denote statistically significant paired t-test at $\alpha = 0.05$, 0.01, and 0.001, respectively.

TABLE 4 Mean ratings for beliefs about hunters and hunting reported by college students before and after attending hunting workshops ($n = 255$).

Statements About Hunting	Pre-Workshop (Mean)	Post-Workshop Change (Mean Diff.)	Sig. Diff.	Pre % Agree	Post % Agree
Overall beliefs about the value of hunting	4.26	+0.35	***	74%^a	93%^a
Hunting can be an ethical means to acquire locally sourced meat	4.39	+0.29	***	91%	99%
Hunting provides a direct way to connect with nature and ecosystems	4.38	+0.30	***	92%	99%
Hunters financially contribute to wildlife conservation	4.21	+0.44	***	81%	97%
People who want to hunt should be provided an opportunity to do so	4.17	+0.33	***	85%	96%
Hunting has a positive impact on wildlife conservation	4.03	+0.40	***	73%	94%
Overall beliefs about hunters and hunting safety	3.73	+0.48	***	44%^a	77%^a
Hunters care about conserving wildlife and natural resources	3.83	+0.58	***	66%	91%
Hunters behave responsibly and follow hunting laws	3.76	+0.43	***	61%	84%
Hunting is a safe activity	3.61	+0.45	***	61%	83%

Items rated on a scale from 1 = "Strongly Disagree" to 5 = "Strongly Agree"; includes pre and post-workshop survey data. Means were calculated using only pre/post paired sample ($n = 255$), percentages using individual samples ($n = 351$ for pre, $n = 269$ for post). "% Agree" includes "agree" or "strongly agree" scale ratings. *, **, *** denote statistically significant paired t-test at $\alpha = 0.05$, 0.01, and 0.001, respectively.

^aDenotes percentage of students with mean index score of 4.0 or higher.

thought people who want to hunt should be provided an opportunity to do so, 94% agreed that hunting has a positive impact on wildlife conservation, and 81% thought hunting was a safe activity. After the workshop, the number of participants who expressed positive beliefs about the value of hunting increased by 19%, and the number of participants who expressed positive beliefs about hunters and hunting safety increased by 33% (Table 4).

Prior to the workshop experience, the most common barriers to hunting centered on a lack of knowledge and skills (Table 5). The workshops successfully minimized many barriers to hunting, and especially barriers related to knowledge and skills. However, several other patterns emerged. There was essentially no difference between pre- and post-workshop perception of costs as a barrier to hunting, suggesting that even with workshops, college students still perceive financial barriers to participating in hunting. While there was a significant decrease in students referencing not having anyone to hunt with as a barrier to participation, 53% of students still noted this as problematic after workshops, making it the second most prominent post-workshop barrier. Additionally, following workshops, more students were likely to report lacking free time required to hunt.

Short-term effects of workshops on hunting-related behaviors

Following the workshop experience, 50% of participants said they would definitely hunt in the future, 34% said they would probably hunt in the future, and 13% said they were not sure about hunting in the future (Figure 1).

TABLE 5 Barriers to hunting reported by college students before and after attending hunting workshops (n = 255).

Potential Barriers to Hunting ^a	% of Respondents Reporting Barrier		Sig. Diff.
	Pre-Workshop	Post-Workshop	
Time Competition			
Would rather do other activities	17%	17%	
Moral Objections and Comfort			
Have a moral/ethical objection to hunting	6%	2%	**
Don't feel comfortable around hunters and hunting culture	12%	4%	***
Don't feel comfortable around firearms or hunting equipment	14%	8%	**
Reluctant to personally kill an animal	21%	15%	**
Lack Skills and Knowledge			
Unsure of how/where to store equipment and firearms	35%	25%	**
Costs associated with hunting (license, tags, equipment, firearms, travel, etc.)	51%	51%	
Lack of knowledge about hunting and firearm laws	60%	17%	***
Have not completed a hunter education course	62%	30%	***
Lack knowledge/skills required to prepare game meat to eat	72%	28%	***
Lack knowledge/skills required to hunt	80%	28%	***
Logistics			
Moved away from the area I typically hunt to attend college	10%	9%	
Lack transportation to get to hunting areas	10%	10%	
Lack of available hunting land where I currently live	27%	15%	**
Lack free time required to hunt	41%	58%	***
Don't know where I'm allowed to hunt	63%	25%	***
Don't have anyone to go hunting with	71%	53%	***
Judgement and Experiences			
Feel discouraged or frightened by negative experiences I've had in the outdoors	2%	0%	*
Worried non-hunting family and friends may judge me	8%	6%	
Don't feel comfortable due to the lack of racial/ethnic diversity associated with hunting	9%	4%	*

^aBarriers rated as yes/no binary variable from a "check all that apply" survey question. *, **, *** denote statistical significance of pre-post survey paired t-test comparison a $\alpha = 0.05, 0.01, 0.001$, respectively (n = 255).

Additionally, most participants indicated that they were likely or very likely to participate in hunting-related behaviors following the workshop experience. For example, 95% said they would eat game meat obtained through hunting, 92% said they would befriend a hunter, 83% said they would take an additional hunter's education course, and 82% said they would purchase a hunting license (Table S3, available in Supporting Information). About 75% said they would likely hunt deer after the workshop and 73% said they would hunt another species (e.g., turkey, pheasant, grouse, elk). About 54% of participants said they would likely hunt with another participant from the workshop.

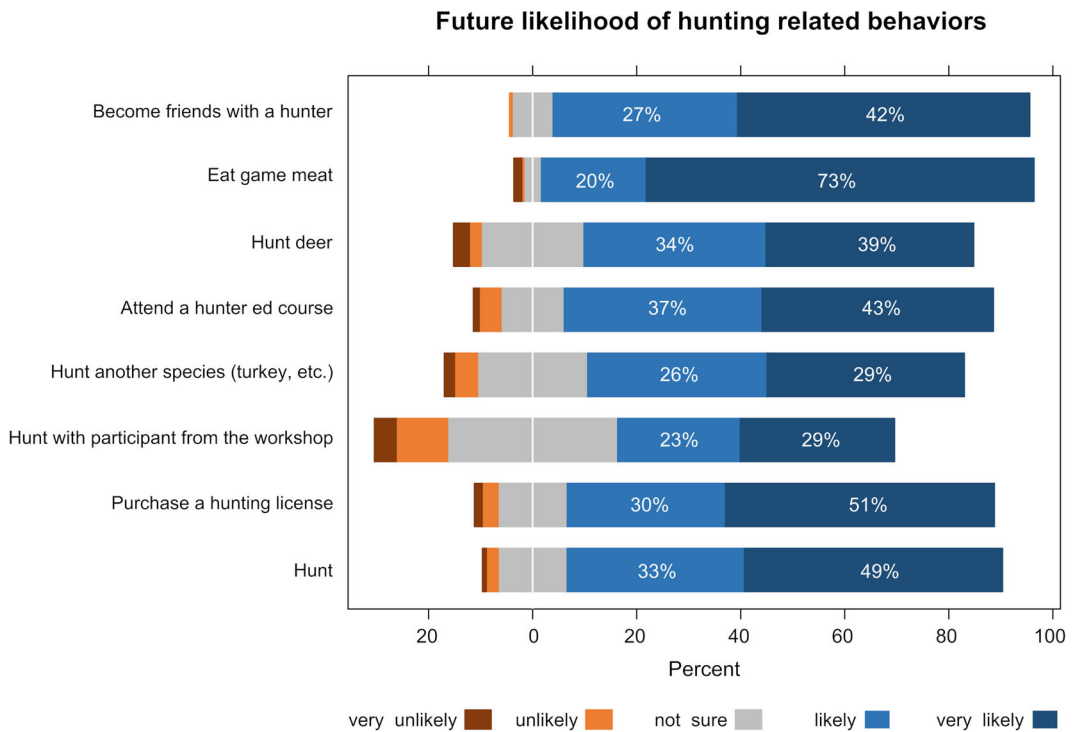


FIGURE 1 College students' self-reported intent to participate in hunting-related behaviors based on survey responses following R3 workshops ($n = 269$). Items rated on a scale from 1 = "Very Unlikely" to 5 = "Very Likely", "Hunt" item was rated on a scale from 1 = "I will definitely NOT hunt" to 5 = "I will definitely hunt".

Regression analysis suggested that likelihood of hunting and license purchasing after workshops was more strongly associated with participant attributes than workshop attributes (Table 6). Male participants were more likely than female participants to report intent to hunt ($OR = 2.59$, $P = 0.002$) or purchase a hunting license ($OR = 2.54$, $P = 0.003$). Participants with rural upbringings were more likely to purchase a hunting license after workshops than participants from urban areas ($OR = 1.82$, $P = 0.007$). Surprisingly, future hunting ($OR = 0.58$, $P = 0.107$) and license purchasing ($OR = 0.61$, $P = 0.141$) was less likely among agriculture and natural resource majors than participants who were majoring in other subjects, but these differences were not statistically significant. Although workshop attributes were not statistically significant predictors of future of hunting behaviors, patterns suggest that multiday workshops that focus on multiple species (e.g., not just deer) and mentored hunts increased the odds of future hunting or license purchasing (Table 6).

Long-term effects of workshops on hunting-related skills, beliefs, attitudes, and behaviors

Data collected from the subset of participants (41%) who completed follow-up surveys suggested demographic attributes were similar to the larger group who completed the pre-test and post-test surveys. After 12–18 months, approximately one-third (34%) of workshop participants reported having hunted; of those who had not, 45% said they would probably hunt in the future. Since the workshop, 28% of participants had purchased a hunting license and 52% said they were likely to in the future. Other hunting-related behaviors were measured as well (Table S4, available in Supporting Information); about one-quarter of participants had attended another workshop (24%), more than half had eaten game meat (59%), and about a third had befriended a hunter (38%). Overall confidence levels

TABLE 6 Parameter estimation (Beta) and odds ratios (OR) from generalized logistic regression mixed models predicting (a) likelihood to hunt in the future and (b) likelihood to purchase hunting license in the future based on participant attributes and workshop attributes, adjusting for the random effect of workshop. Sample of university students from 17 workshops across 16 universities in the United States ($n = 269$).

Variables in model	Proportion in Category	(a) Future Hunt ^a			(b) Future License Purchase ^b		
		Beta	SE	OR	Beta	SE	OR
Constant		-0.319	0.608	-	-0.926	0.589	-
Participant Attributes^c							
Race/ethnicity (White)	0.76	0.092	0.357	1.097	0.298	0.352	1.346
Gender (male)	0.56	0.952	0.313	2.591***	0.933	0.309	2.541***
Childhood location (rural)	0.47	0.367	0.307	1.443	0.599	0.305	1.821**
College Major (Ag. or Nat. Res.)	0.47	-0.544	0.337	0.580	-0.490	0.333	0.612
Workshop Attributes^d							
Timeline (multiday)	0.17	-0.018	0.658	0.982	0.424	0.628	1.527
Mentored Hunt (yes)	0.22	0.291	0.511	1.338	0.530	0.481	1.698
Game Type (deer only)	0.66	-0.649	0.498	0.523	-0.253	0.468	0.776

^aModel marginal pseudo $R^2 = 0.118$ (fixed effects only) and conditional pseudo $R^2 = 0.221$; adjusted intra-class correlation coefficient (ICC) = 0.118 and conditional ICC = 0.104.

^bModel marginal pseudo $R^2 = 0.121$ (fixed effects only) and conditional pseudo $R^2 = 0.204$; adjusted intra-class correlation coefficient (ICC) = 0.095 and conditional ICC = 0.084.

^cReference categories for the participant attribute variables were non-White, female or non-identifying, urban, and major other than agriculture or natural resources.

^dReference categories for the workshop attribute variables were single day, no mentored hunt, multiple species (not just deer), and classroom-based instruction (no field component).

*, **, *** denote statistically significant odds ratios at $\alpha = 0.1, 0.05, 0.01$, respectively, with liberal significance thresholds designed to minimize false negatives.

remained high, and only 7% expressed that they were not at all confident in their hunting skills and knowledge. Perceived barriers to hunting participation were largely similar between the post-test and follow-up survey (Table S5, available in Supporting Information); the most prominent barriers remained a lack of free time (56%) and not having someone to hunt with (58%). The proportion of participants noting skills and knowledge barriers around hunting, game meat preparation, and hunting and firearm laws increased slightly (8–10%) despite a significant reduction of these barriers between the pretest and posttest (Table S5). However, some barriers decreased with a similar magnitude (e.g., cost associated with hunting, hunter education, and free time to hunt). Beliefs about hunters and hunting measured in the follow-up survey remained high, and some actually increased (Table S6, available in Supporting Information).

Multinomial logistic regression models with follow-up survey data measured predictors of actual hunting and license purchase behavior in the 12–18 month period following the workshops (Table 7). Unlike intended behaviors, these self-reported behaviors aligned more strongly with workshop attributes rather than demographics. While workshop participants from a rural childhood location remained more likely to report hunting participation (OR = 3.39, $P = 0.007$), no other demographic factors significantly increased the odds of hunting or purchasing a license. However, odds of participating remained higher for male participants. Participants who attended workshops featuring a mentored hunt were slightly more likely to have hunted afterward (OR = 2.29, $P = 0.148$) and to have purchased a hunting license (OR = 2.38, $P = 0.120$), though these differences were not statistically significant.

TABLE 7 Parameter estimation (Beta) and odds ratios (OR) from multinomial logistic regression models predicting (a) hunt participation and (b) hunting license purchase 12–18 months following the workshop based on participant demographics and workshop attributes. Sample of university students from 15 workshops across 13 universities in the United States, ($n = 133$).

Variables in model	Proportion in Category	(a) Hunt (since workshop) ^a			(b) License Purchase (since workshop) ^b		
		Beta	SE	OR	Beta	SE	OR
Constant		-1.263	0.762	-	-0.943	0.752	-
Participant Attributes^c							
Race/ethnicity (White)	0.80	-0.558	0.553	0.572	-0.308	0.554	0.735
Gender (male)	0.58	0.596	0.475	1.815	0.533	0.470	1.705
Childhood location (rural)	0.47	1.223	0.455	3.397***	0.457	0.445	1.580
College Major (Ag. or Nat. Res.)	0.42	0.115	0.485	1.122	-0.199	0.485	0.820
Workshop Attributes^d							
Timeline (multiday)	0.09	0.380	0.850	1.463	-0.372	0.951	0.690
Mentored Hunt (yes)	0.15	0.828	0.574	2.290	0.865	0.557	2.376
Game Type (deer only)	0.76	-0.355	0.569	0.701	-0.396	0.554	0.673

^aModel Nagelkerke pseudo $R^2 = 0.160$.

^bModel Nagelkerke pseudo $R^2 = 0.090$.

^cReference categories for the participant attribute variables were non-White, female or non-identifying, urban, and major other than agriculture or natural resources.

^dReference categories for the workshop attribute variables were single day, no mentored hunt, multiple species (not just deer), and classroom-based instruction (no field component).

*, **, *** denote statistically significant odds ratios at $\alpha = 0.1, 0.05, 0.01$, respectively, with liberal significance thresholds designed to minimize false negatives.

DISCUSSION

Although R3 efforts alone may not be a sufficient strategy for addressing the contemporary wildlife conservation funding crisis or for enhancing the social relevance of hunting, existing policies and infrastructure and the longstanding role of hunting in conservation suggest efforts to recruit and retain new hunters should be a high priority (Larson et al. 2021). Our R3 workshops for college students explored the extent to which such programs could be used to create new hunters and/or broader hunting advocates. The workshops attracted substantial interest among diverse students, helped them build their knowledge and skills, and increased their likelihood of hunting in the future. Moreover, 34% of participants said they had gone hunting in the year following the workshop, and an additional 45% indicated they still intended to hunt in the future. Although these post-program hunting participation rates are lower than those of average R3 event attendees across the United States (Wildlife Management Institute 2022), they are encouraging when considering the prevalence of nontraditional path hunters in our sample. Participants also noted increased and sustained interest in other pro-hunting behaviors such as purchasing a hunting license, befriending a hunter, and eating game meat obtained through hunting. These findings highlight the importance of integrating and measuring broader outcomes and key hunting behavior antecedents in R3 efforts (Vayer et al. 2021). Overall, our study suggests that growing attempts to recruit new hunters and hunting advocates from nontraditional hunting backgrounds may be fruitful (Quartuch et al. 2017, Vayer et al. 2021),

revealing specific recommendations to improve recruiting and program design and highlighting several challenges and limitations to consider.

Diversifying hunting participation

Workshop participants represented a diverse pool of potential hunters. Compared to traditional hunters who are typically White males from rural areas (Larson et al. 2014), participants in our workshops included individuals who were women, BIPOC (Black, Indigenous, or People of Color), and from urban areas. Our results support other studies demonstrating interest in hunting among nontraditional hunting populations on college campuses (Vayer et al. 2021), and they highlight potential opportunities to expand the social habitat for hunting by developing programs for diverse audiences (Larson et al. 2014).

The strongest motivating forces reported by workshop participants, being close to nature and contributing to wildlife conservation, may reflect a shift in public perceptions of hunting and wildlife in general (Manfredo et al. 2016), particularly among younger generations (Manfredo et al. 2020). These motivations are more altruistic and less egoistic than those seen in traditional hunting populations, and they appear to resonate among nonhunters in other studies as well (Decker et al. 2015, Blascovich and Metcalf 2019, Vayer et al. 2021). High levels of engagement in other forms of nonconsumptive outdoor recreation (e.g., hiking, camping, adventure sports) underscore college students' desire to connect with nature and highlight potential crossover activities (Recreational Boating and Fishing Foundation and Responsive Management 2020). Many workshop participants also shopped at local farmer's markets and engaged in edible gardening, highlighting their desire for local and ethically-sourced food and illuminating potential connections between hunting and the local food movement (Tidball et al. 2013, Stedman et al. 2017). A desire to obtain local meat was another strong motivator for prospective hunters in our sample. Our collective findings reveal the existence of a pool of new hunters that exists outside of traditional hunting spaces—a pool that might be accessed through connections with environmentally conscious outdoor and nature-based recreation organizations and clubs on college campuses.

Our study also builds on past research examining hunting constraints faced by traditional sportspersons (Metcalf et al. 2015, Hinrichs et al. 2020, Schummer et al. 2020), demonstrating that barriers may be different among individuals considering hunting for the first time. Other than a general absence of social support, limited hunting-related knowledge and skills were the primary obstacle to participation for NTPHs in our sample. Matching the larger U.S. population (Byrd et al. 2017), most workshop participants held positive views of hunters and hunting and did not report feeling constrained by moral or ethical concerns. Even acknowledging that these participants self-selected into the workshops, our results challenge assumptions that nonhunters universally object to hunting (Knezevic 2009). Many nonhunters (such as college students in our study) appreciate hunting in different contexts and for different purposes, and some were even willing to try it. This result, coupled with previous studies (Stedman and Decker 1996), highlights the critical role that nonhunters play in the larger hunting landscape as informal hunting advocates and supporters.

Assessing R3 program impacts and factors associated with program success

Overall, our evaluation suggested that the R3 workshops we studied were effective in multiple ways. Despite the self-selection inherent to voluntary programs of this nature, we observed significant post-workshop gains in participants' confidence with respect to every hunting-related skill assessed, ranging from gear selection and firearm use to game meat recovery and preparation. Participants' beliefs and attitudes about hunters and hunting were sustained during the following 12–18 months, and some even became slightly more positive. Workshops effectively addressed students' most significant barrier to hunting prior to the workshop—a lack of knowledge and

skills. Responses also revealed that R3 workshops fueled participants' desire and ability to hunt and positively contribute to the hunting community. While participants were highly satisfied with all aspects of the workshops, it was the session on firearm safety and marksmanship that they often enjoyed most. Participants also liked game meat processing and food preparation sessions, often desiring more hands-on activities and time for butchering and processing. Some expressed a desire to learn more about connections between hunting and conservation, reflecting a key motivation for participation. All of these topics could be more strongly emphasized to increase their appeal of future R3 programs among diverse NTPH audiences.

Although specific workshop attributes were not strongly associated with future hunting behavior, several patterns emerged that did predict actual hunt participation in the follow-up survey. Participants who engaged in multi-day workshops and/or post-workshop mentored hunts were more likely to express intent to hunt in the future, and follow-up survey data confirmed that these attributes (i.e., multi-day timeline and mentored hunt) were significant correlates of actual hunting. Such relationships underscore the value of continued instruction and the importance of social support for hunting that is well articulated in ORAM (Byrne and Dunfee 2018). These types of authentic, supported experiences may be especially important for college students who lack connections to the larger hunting community (Larson et al. 2014, Vayer et al. 2021). Other aspects of workshop design, including focal species, may be less important. Although recent research suggests a growing interest in big-game species (e.g., deer) among NTPH (Quartuch et al. 2017), past research has pointed toward pursuit of small game as a pathway into hunting (Purdy et al. 1989). Our results indicated opportunities to pursue both types of game might be a prudent strategy for appealing to the interests of diverse young adult hunters.

Opportunities for R3 program improvement

In addition to highlighting successful outcomes, our research also revealed potential areas for improvement. In the follow-up surveys, we discovered that a majority of workshop participants had not yet been hunting. Many still hoped to hunt on their own, but it was clear that some persistent barriers—costs associated with hunting, lacking free time to hunt, and lacking someone to hunt with—remained substantial obstacles after the workshops. As the most significant pre-workshop barrier—lack of knowledge and skills—was reduced, logistical constraints became more prominent. These patterns suggest hierarchical, nested constraints (Shores et al. 2007, Godbey et al. 2010); once novice hunters overcome one set of barriers, they are faced with other previously unknown constraints they must negotiate (Jackson et al. 1993).

Our findings have multiple implications for R3 workshops targeting college students. First, financial barriers to hunting (e.g., equipment costs) are, and will continue to be, substantial for college students. We suggest offering workshops as free or low-cost opportunities for students and strategically featuring cost-efficient gear and resources to help college students negotiate financial barriers after workshops. Second, negotiating time constraints for college students (the most cited barrier post-workshop) will remain a persistent challenge. Yet, while free time is increasingly limited among contemporary college students, they often choose to spend their time on activities that enhance social and psychological well-being (Kim et al. 2015); hunting could become one of those activities. Third, social support is a persistent barrier for students new to hunting, especially after the conclusion of workshops. Social support could be fostered during workshops by allowing time for critical discussion and reflection among students and instructors about challenges, potential moral/ethical dilemmas, assumptions about hunters and hunting culture, and unique pathways into hunting. Social support might be fostered post workshop through cultivated experiences, including mentored hunts (Enck et al. 1996, Ringelman et al. 2020) and opportunities for students to connect with fellow hunters on campus. It is also important to remember that perceived constraints to hunting also vary by species, and this should be considered when designing programs and follow-up activities. These collective strategies could help lead to higher hunting uptake and license purchasing rates following workshops.

The variety of participant feedback, coupled with differential impact of workshops on different demographic groups of students, highlights limitations of a one-size-fits-all approach to R3. Despite our efforts to design programming that would resonate with college students, our workshops were most likely to promote pro-hunting behaviors in the same demographic subgroup that represents most of the traditional hunting population: White males from rural areas. Women reported lower hunting rates than men following workshop participation, and BIPOC students were less likely to participate than White students. Similar patterns, though not statistically significant, held in the follow-up surveys as well: students who were White, male, and from rural areas were most likely to report hunting or buying a license over a year after the workshops. With approximately half the workshop participants identifying as female, efforts to create an atmosphere where women's voices are central and amplified could attract more women and gender nonconforming individuals from the pool of potential hunters (Griffith 2010), helping to enhance and sustain otherwise consistently low levels of women's participation in hunting (Heberlein et al. 2008). Increasing instructor diversity, both in terms of demographic characteristics and hunting experience (Dee 2005, Holmes et al. 2007), could also help to ensure program impacts and outcomes are equitably distributed. Students from nontraditional hunting backgrounds wanted instructors who understood that they, unlike many hunters, did not grow up with positive views of hunting and the hunting community. Students found it easier to relate to instructors who looked like them, who were closer in age, and who did not start hunting until later in life. Although we were not able to document the specific demographic attributes of instructors in our workshops, most across all states were White males. To successfully recruit diverse participants, it is crucial that managers carefully consider who is staffing R3 programs and what messages and images they reinforce or disseminate.

Our study also highlights the importance of considering diverse metrics of success in R3 program assessment. Integration of multiple performance measures is often a hallmark of effective program evaluation (Newcomer et al. 2015), yet such an approach is rarely utilized in R3. In most cases, R3 program efficacy is measured by the number of hunters it creates, license sales, and financial contributions to conservation (RM and NSSF 2017, Price Tack et al. 2018). By these metrics alone, the success of our workshops could be debated. However, students' increasingly positive views of hunters and hunting and their growing connections to the broader hunting community (via eating game meat, befriending hunters, etc.) highlight the workshops' broader capacity to transform nonhunters into hunting advocates. These advocates may become individuals who will support pro-hunting policies, discuss broader benefits of hunting, and financially support hunting and conservation even if they elect not to hunt themselves (Vayer et al. 2021). Improving nonhunters' attitudes towards conservation is critical for generating public support for conservation and wildlife management (Decker et al. 2015, Blasovich and Metcalf 2019), a growing concern among wildlife agency professionals hoping to remain relevant in contemporary society (Serfass et al. 2018, Jewell et al. 2020). A workshop that effectively addresses broader benefits of hunting may therefore be critical to recruiting and retaining not just new hunters but also hunting advocates, helping to ensure that a larger and more diverse segment of the U.S. population will have a voice and space in the hunting community. This supports the strategic priority of improving cultural acceptance of hunting, a key pillar of the National Hunting and Shooting Sports Action Plan (Council to Advance Hunting and the Shooting Sports 2016).

Limitations and future research

Future evaluation of R3 efforts could address several limitations of this study. While our sample captured a substantial range of geographical contexts, it only included public universities in 16 states. Many states and certain types of institutions (e.g., private schools, smaller public schools) were excluded. Furthermore, our primary focus on land grant universities, which might be uniquely pro-hunting (given their strong connection to natural resources), could yield different results in other types of institutional settings. Self-selection bias of participants was also a concern, but this bias is omnipresent and impossible to avoid in evaluation research where individuals volunteer to participate in programs (Keating 1989). To minimize bias, we attempted to standardize student recruitment, but actual methods varied by institution and yielded slightly different results (e.g., overreliance on natural resource

majors at some schools). Therefore, although our recruitment strategies yielded a diverse array of students, the sample may not accurately represent the demographic distribution or hunting-related perspectives of the larger population of college students across the country. Nevertheless, past research shows that such an approach to program evaluation can still yield meaningful and relevant results (Keating 1989, Newcomer et al. 2015).

Our pooled approach to analysis did not fully account for potentially variable responses to workshops among subgroups of participants (e.g., women, students not majoring in natural resource-related disciplines). Within-group differences and interactions among different groups (e.g., women from urban areas, Latinx students who were not natural resource majors) may be particularly important when considering ways to make future workshops more culturally sensitive (Bixler et al. 1994, Floyd et al. 1994, Shinew et al. 2006, Metcalf et al. 2015), but our sample size was too small to test for these interactions. Similarly, despite integration of a random effect in models, our data pooling approach might not fully account for variation across states and programs. Because collaborators in each state possessed substantial freedom and flexibility with respect to workshop implementation, variation in workshop structure was also common. We attempted to account for this in regression models examining effects of different workshop attributes, transforming that variability into an analytical advantage. Additionally, our study did not investigate best practices for selecting and training instructors and volunteers—a critical component of any successful R3 effort (Quartuch et al. 2021). Future research could examine training strategies to find ways to enhance cultural sensitivity and raise the pedagogical prowess of R3 staff and volunteers.

Potential social desirability bias might have influenced participants' responses to the survey items and scales (King and Bruner 2000), particularly on the post-workshop and follow-up questionnaires. To reduce this risk, we waited to administer post-workshop surveys until several days after the program and waited over a year before implementing follow-up surveys, providing participants with ample time to reflect on their experience and respond without instructors present. Future research might consider other options such as anonymous feedback mechanisms, third-party researchers, and qualitative data collection to reduce response bias.

Our follow-up survey 12–18 months after the workshop shed some light on long-term program impacts, but additional longitudinal studies could illuminate the sustainability of these effects, enabling researchers to infer if the intervention helped participants progress toward more advanced stages of recreation adoption (Decker and Purdy 1986, Byrne and Dunfee 2018). Attrition is a perpetual issue in longitudinal survey research, especially with a transient population such as college students. This challenge was also exacerbated during the COVID-19 pandemic, which made communication even more difficult. Our declining response rates at each stage of data collection reflect these challenges, and only 37% of students who attended the workshop completed all 3 survey waves. This made longitudinal data analysis difficult. Our checks for non-response bias revealed minimal demographic or behavioral differences between multi-wave participants and dropouts (e.g., intent to hunt among each group was similar), but it is conceivable that students who continued to complete surveys were more likely to hunt and support hunting than those who did not respond. Additional research with a larger sample displaying lower levels of attrition could help researchers better understand the specific attributes of R3 workshops that are the most effective mechanisms for generating long-term hunting participation and support.

MANAGEMENT IMPLICATIONS

College students are a large, untapped pool of potential hunters that may be receptive to R3 efforts. Our study demonstrated substantial interest in hunting among diverse college students, highlighting the growing importance of nontraditional pathways into hunting. Findings revealed many positive impacts of R3 workshop participation on students' hunting-related skills, beliefs, attitudes, and behaviors, with many participants choosing to hunt (or expressing an intent to hunt) following the programs. Efforts to sustain social support for hunting (via mentored hunts and other activities) and create a more inclusive hunting community (by amplifying the voices and perspectives of historically underrepresented populations) would enhance interest in and relevance of hunting

across diverse student populations, helping to sustain long-term participation. Although not every college student who attends a workshop will become a hunter evidence also shows that many will become more vocal hunting advocates with the capacity to contribute to conservation in other ways. For all of these reasons, government agencies and nongovernmental organizations hoping to expand and enhance R3 efforts might strongly consider programs that focus on college students. Overall, our study highlights the need for more comprehensive, mixed methods evaluation of the short- and long-term impacts of R3 efforts targeting diverse audiences. Lessons learned through this research can help managers develop more effective and culturally relevant R3 tools and strategies as they seek to reverse declines in hunting participation by targeting nontraditional hunting populations.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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ETHICS STATEMENT

This human-subjects research project was reviewed and approved through the Institutional Review Board of North Carolina State University (IRB12676), whose approval was upheld through reliance agreements at other collaborating institutions. Informed consent was obtained from all individuals who participated in the project.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

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SUPPORTING INFORMATION

Additional supporting material may be found in the online version of this article at the publisher's website.

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