Measuring the efficacy of state R3 efforts: A quantitative approach

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Executive Summary

Purpose- The goal of this research is to improve the way we recruit, retain, and reactivate hunters and anglers by quantifying the effectiveness of state R3 programs.

Background- Recruitment, retention, and reactivation (R3) of hunters and anglers is paramount to preserving our outdoor heritage, despite waxing workloads and waning resources for program evaluation. In early years, R3 events were either not evaluated, or they were evaluated using post-event surveys. Later, agencies recognized the need for more rigorous evaluations and began to evaluate R3 events using pre- and post-event comparisons. While this approach is valuable for programmatic evaluation and measuring *outputs* at the individual level (behavioral intentions), a different statistical approach is needed to measure program *outcomes* at the population level (ROI and buying behaviors across time). Additionally, evidence indicates R3 event attendees are significantly more involved/avid than the general hunting and fishing public. Therefore, if attendees' behavior is different after the R3 event, agencies cannot disentangle selection effect (different *before* the event) from the treatment effect (different *because* of the event).

Approach- To address this information need, we partnered with eight participating states to compare license purchasing behaviors of R3 event attendees to match-paired lookalikes who did not attend an event. We examined 60,000 R3 event attendees and used Matched Pairing (Mahalanobis Distance in *n*-dimensional space) to identify lookalikes from 13 million hunters and anglers. We analyzed attendees and their lookalikes according to their purchasing regularity across time, or lack of churn (*Participation*), and their annualized license purchasing volume (*Engagement*).

Findings- We found convincing evidence in all states that R3 events generate customers who churn less (*Participation*) and buy more licenses (*Engagement*). Because our study design contained matched-pair lookalikes, who acted as a counterfactual for attendees, we determined R3 event attendees were different (more avid) from the average customer *before* attending the R3 event, but also were different *because* of the R3 event. In general, R3 events focused on basic, introductory activities tended to have better *Participation* and *Engagement* outcomes, and events focused on advanced techniques, difficult quarry, or using specialized equipment were less effective. In this longitudinal analysis, youth under 18 generally produced the lowest lift in *Participation* and *Engagement*, and adults 25-50 generally showed the highest lift. There is some evidence suggesting repeat attendance has a marginal benefit (in *Participation* and *Engagement)* over attending just one event. Finally, many attendees (27-93%) purchased a license in a license year before attending the R3 event, suggesting they were already recruited to some extent before attending an R3 event, and much of the gains are *compensatory recruitment*, rather than additive recruitment.

Implications- R3 events are effective in lifting *Participation* and *Engagement*, but to increase expected ROI, agencies with limited resources should prioritize adult R3 programs over youth programs. Additionally, agencies should consider screening their events to prioritize individuals new to hunting and fishing and/or first-time attendees. Agencies should also consider deprioritizing R3 events that are not immediately scalable.

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Background

In North America, hunting and fishing are inextricably intertwined with wildlife conservation. Today, there are 400,000 fewer hunters and anglers than in 1991, yet the U.S. population has grown by 76 million people during the same period[1][2]. This trend is expected to continue into the immediate future. This is a remarkable societal change and has resulted in fewer people contributing financially to wildlife conservation (thru the purchase of licenses and permits), while more people are benefiting from outdoor recreation. Recruitment, retention, and reactivation (R3) of participants in conservation-related recreation is paramount to preserving our outdoor heritage. However, restricted R3 resources and inadequate personnel time often limit R3 efforts. Therefore, it is crucial to evaluate the efficacy of R3 programs and strategies in order to invest resources into the specific programs that have demonstrated success and to divest resources from ineffective programs.

Early in R3 efforts, post-event surveys were collected to evaluate events. Those early efforts were primarily satisfaction surveys and resulted in little more than giving agencies accolades, as attendees were justifiably delighted with the financial, technical, and social aspects of R3 events. As agencies recognized the need for more rigorous evaluations, they elevated their efforts to include pre- and post-event comparisons. This method contrasts elements of "recruited-ness" from before and after the event. Agencies reasoned that the delta between the two data collection points would be the effect or 'lift' of the R3 event. The pre-/post event evaluation approach is valuable for programmatic evaluation and measuring outputs at the individual level (behavioral intentions); however, it is not intended to measure behavioral outcomes across long time periods. These pre-/post evaluations are also not intended to measure return on investment (ROI) within and across populations. For those analyses, a more complex statistical approach is needed. Additionally, ample anecdotal evidence suggest R3 event attendees are significantly more involved/avid than the general hunting and fishing public. Therefore, there is a need to determine if R3 event attendees are different even before attending the event or if they are different for having had attended the event. Only through analysis that compares the attendee to a counterfactual (a lookalike who is similar to the attendee on many facets but did not attend an event) can we disentangle the effects of selection into attendance (different before the event) from the effects of the treatment (different because of the event).

Research Questions

Given limited agency budgets, there is a clear and present need to determine if R3 events result in an incontrovertible and appreciable lift in participation, license sales, or customer loyalty. Therefore, our research questions are:

1. Do R3 events result in a lift in participation, license sales, or another desirable outcome variable in attendees?
2. If R3 events result in a detectable lift, what is the magnitude of that lift?
3. Are there R3 events, or types of R3 events, that consistently generate greater lift?

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[1] US Fish and Wildlife Services. 1991 & 2021. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.
[2] US Census Bureau. 2022 American Community Survey.

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Methods

Sample

To illustrate the general data processing for each state, we will use Georgia for illustrative purposes. The raw data from Georgia originally contained 12,967,283 records. We removed 481,528 duplicates, most of which were short-term licenses (e.g., multiple 1-day licenses purchased by the same person), such that 12,485,755 records remained. These data were converted from long to wide format, resulting in 1,575,484 customer records. We removed 31,805 duplicates (or customers who did not have the requisite data), and 1,543,679 unique customers remained.

We merged the Georgia R3 database containing 4,183 unique records (784 duplicates removed) with the Georgia license database. Over 92% (3852 of 4183) of R3 attendees were matched with the license database. This potential 8% loss comes from 1) people who participated in an R3 event but did not purchase a license (e.g., free fishing days, etc.) and 2) R3 event attendees whose unique identification variable was mis-keyed or did not match the unique identifier in the license database. This loss due to matching is minimal in states like Georgia, which has a unique identifier that can be used as a "key" to link the R3 event database with the license database. For states that did not have unique identifiers, a concatenation of birthdate, name, and zip code was used as a unique identifier. In those states, more data was lost during the process of linking the databases. The corresponding information for other participating states is found in Table 1.

Table 1. The portion of R3 attendees is small in proportion to the number of customers in each state.

	Years	License Records	Customers	Attendees
Connecticut	2013-2020	5,394,197	1,072,862	489
Georgia	2011-2020	12,485,755	1,543,679	3,852
Iowa	2009-2020	23,582,542	1,673,797	2,245
Massachusetts	2011-2021	2,374,514	758,741	1,085
Missouri	2011-2021	31,078,855	3,872,979	46,894
New Mexico	2013-2020	1,609,313	328,613	1,479
North Dakota	2009-2021	3,681,972	429,158	869
Tennessee	2009-2021	14,228,428	3,119,946	2,792
TOTAL		**94,435,576**	**12,799,775**	**59,705**

Approach

Customers who had attended an R3 event in each state (attendees) were then match-paired with another customer of the same state who appeared in the license database but who had not participated in an R3 event (lookalikes). These matched-pair lookalikes were matched as closely as possible on date of birth, the year of first license purchase, sex, race, and latitude and longitude. In this way, only a 15-year-old male with three years of license purchases from the Northeast side of Atlanta would be compared to another 15-year-old male with three years of license purchases from the same area. The latitude and longitude variables were remarkably effective in the pairing process, because they take advantage of

Tobler's Law (1970[3]) of spatial autocorrelation; that is, the fact that people who live closer to one another tend to be more alike on a variety of attributes than those who live further away from each other. In theory, if lookalikes are matched closely enough, other confounding variables are reduced so just the effect of attending an R3 event can be analyzed in isolation. This approach is particularly useful in analyses involving situations when there is a selection bias. Selection bias occurs when the people who volunteer to participate in an event or program are systematically different from the rest of the population. We know, through anecdotal evidence, that individuals who sign up for open-enrollment R3 events, or who bring their children to open-enrollment R3 events, are different from the general hunting public, as they tend to be more involved recreationists, more avid consumptive consumers, and they believe that hunting and fishing is more central to their lifestyles. If those who attend an R3 event churn less, buy more licenses, or are better customers on some other metric, we cannot definitively state if the behaviors are a result of R3 event itself or if R3 events simply attract people who already exhibit these behaviors.

Because of these confounding issues, we selected lookalikes as matched-pairs and then conducted a paired analysis between the lookalike and attendee groups. Specifically, we used Match-Pairing using Mahalanobis Distance Matching in *n*-dimensional space facilitated by the **MatchIt: Nonparametric Preprocessing for Parametric Causal Inference** package[4] in R Statistical Software. The variable 'sex' was constrained throughout the matching process, such that no individual in the attendee group had a matched pair of the opposite sex. Additionally, the 'year of first license purchase' and 'state of residence' variables were also constrained in the matching process, so that people with different tenures of hunting or states of residence were compared to lookalikes from the same state and same duration of hunting or fishing. The other variables were allowed to freely vary in the matching process. Variables of interest were then compared using a matched-pair t-tests, means comparisons (t, F, and r^2), and, where appropriate, eta (η) or eta-squared (η^2) to measure the effect sizes. For tests of significance, *p*-values of less than 0.05 were considered significant.

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[3] Tobler W., (1970) A computer movie simulating urban growth in the Detroit region. *Economic Geography, 46*: 234-240.
[4] Ho, D., Imai, K., King, G., & Stuart, E. (2007). Matching as Nonparametric Preprocessing for Reducing Model Dependence in Parametric Causal Inference. *Political Analysis, 15*(3), 199-236.

Findings

Variables of Interest

To reduce confusion surrounding the outcome variables, the terminology is defined as follows:

Licenses - Any license, tag, permit, stamp, or any other product that conveys the privilege of hunting and/or fishing, or any product that augments the privilege to hunt and/or fish in the respective state.

Licenses Bought- This variable is the calculation of the average of the number of licenses that a customer purchased in any given year. If this number is less than one, the customer did not buy licenses in every year that data were available. In the literature, this is abbreviated as Y.

Total Licenses - The number of licenses that customers purchased in all the years of data made available for each state. This number is not comparable between states, as each agency has a unique license structure (some states have all-inclusive licenses and other states have a basic license plus many stamps and endorsements). In the literature, this is abbreviated as Σ_Y.

Engagement - The average number of licenses a customer purchased in any given year divided by the total eligible years. Eligible years are defined as the number of years between 2020 and the year in which the customer attended an R3 event (for attendees), or as the number the years between 2020 and the first year the customer appears in the license database (for lookalikes). This number is calculated by dividing the value of *Total Licenses* by the applicable years for each customer.

Percent Bought- If a customer purchased one or more license in a license year, that customer is recorded as a *'1'*. If a customer did not make a purchase, they are recorded as a *'0'*. When averaged, the result is the portion of years a customer purchased a license out of the years in which data were provided by each state. This value is abbreviated as C.

Total Years - The number of years the customer purchased at least one license. The number of years that data were provided is different for each state; this number is therefore not comparable between states. This variable is abbreviated as Σ_C.

Participation - The number of years the customer purchased at least one license divided by the total eligible years. Eligible years is defined as the number of years between 2020 and the year in which the customer attended an R3 event (for attendees), or as the number of years between 2020 and the first year the customer appears in the license database (for lookalikes). This number can be thought of as analogous to *Percent Bought*, but only for applicable years. It is also the inverse of churn that is discussed in other literature (Participation = 1- Churn). Therefore, if a state provided license data for 2011-2020, and a customer attended an R3 event in 2016 and bought a license in 2016, 2017, 2019, and 2020, their participation would be 80% (4 out of 5 applicable years), or they churned in and out of the population 20%.

Before- If a customer purchased one or more licenses in a license year before the license year in which they attended an R3 event, that customers is recorded as a *yes*. If a customer did not make a purchase in a prior license year, they are recorded as a *no*. When averaged, the result is the percent of customers who hunted and/or fished prior to attending an R3 event.

State Findings

Connecticut

The average customer from Connecticut purchased nearly four and a half licenses, tags, or stamps between 2011 and 2021 ($M_{licenses}$=4.54). When comparing those who participated in an R3 event (attendees) to matched-pair lookalikes of the R3 event attendees (lookalikes) there was not a significant difference on the variables of sex, age, latitude/longitude, or starting year. This is expected because these were some of the variables that were held constant, and this consistency acts as a quality-control, quality-assurance check indicating the Mahalanobis distance match pairing was successful. However, in comparison to the average customer from Connecticut, the attendees and lookalikes were more likely to be male, slightly younger, and more rural (i.e., the geographic-weighted center for all customers from Connecticut was about a third of the way from New Haven to Hartford, and the geographic-weighted center for both the attendees and lookalikes was more north and east, or further from the New Haven-Bridgeport-Stamford Metropolitan Area).

In comparison to the average customer from Connecticut, the lookalike group purchased more licenses, had higher participation, and had hunted or fished in more years ($M_{Licenses}$ = 14.02, $M_{Participation}$ =0.54, $M_{TotYears}$ = 1.31) (Table 2). This suggests there is a moderate selection effect, meaning that customers from Connecticut who opt-in to R3 events are very likely to be more avid even *before* they participated in the R3 event. However, the attendee group had lift above and beyond the lookalike group in that they purchased more licenses, had higher participation, and hunted or fished in more years than the lookalike group ($M_{Licenses}$=29.65, $M_{Participation}$=0.88, $M_{TotYears}$=3.82). This indicates that, in addition to the moderate selection effect, attending an R3 event results in a true lift, as attendees are likely to be more avid *because* they participated in the R3 event. The attendee group bought more licenses year over year (higher engagement [$M_{Engagement}$=3.82]), than both the lookalike group and the average customer from Connecticut. This finding indicates the effects of attending an R3 event induces a portion of attendees to buy more licenses, and further indicates this effect lasts several years after attending an event. An important note is that Connecticut R3 events did not attract many new customers, as the great majority (85.3%) of R3 event attendees had purchased a license in at least one license year prior to attending an R3 event. This finding indicates six out of every seven attendees were highly likely to have already been recruited to some extent before attending an R3 event.

Table 2. Topline comparisons of variables of interest between R3 event attendees (attendees), matched-pair lookalikes (lookalikes), and all customers of Connecticut Department of Energy and Environmental Protection (Connecticut).

	Attendees	Lookalikes	Connecticut
Male	90.5%	90.5%	80.1%
Age	49.41	49.41	51.77
Latitude	41.5824	41.5822	41.3733
Longitude	72.6501	72.6479	73.3563
Starting year	2012.29	2012.29	2014.02
Total licenses	29.65	14.02	4.54
Participation	0.88	0.54	0.39
Engagement	3.82	1.31	0.61
Total Years	8.51	5.22	2.71

For each year analyzed, Connecticut R3 event attendees bought between 0.09 and 1.41 more licenses than their matched-pair lookalikes, which themselves were slightly higher than the average customer from Connecticut (Figure 1). Although the number of licenses bought is variable by year, after 2016 the attendees are an average of 0.96 licenses above the baseline of the lookalikes and 1.94 licenses above the average customer from Connecticut.

Figure 1. The average licenses bought is consistently higher for the attendee group.
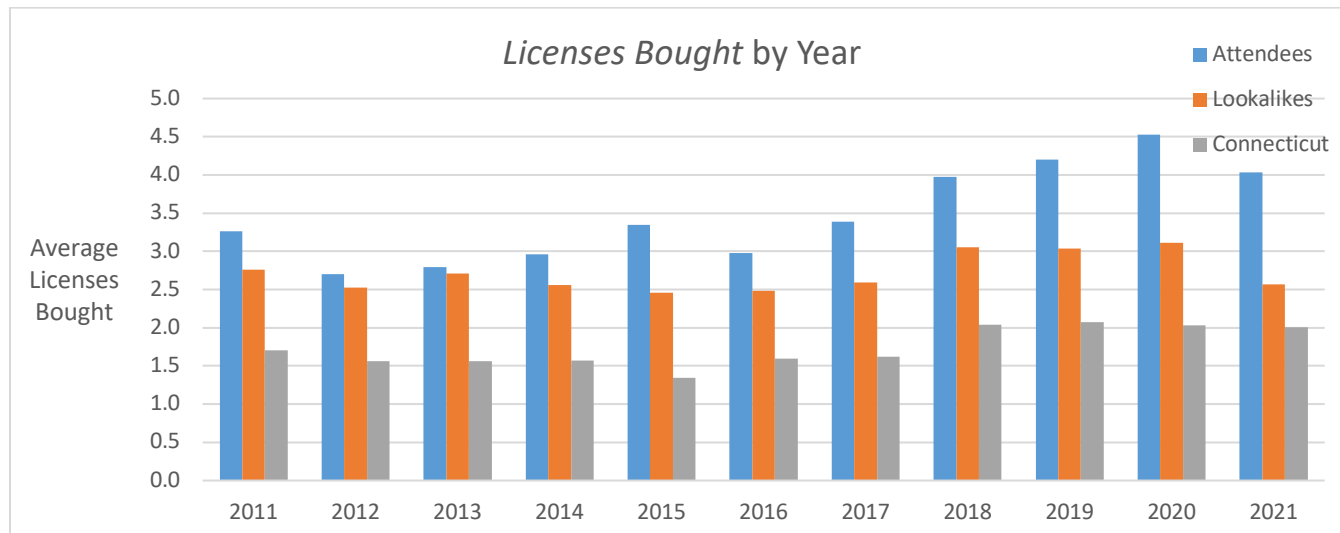
The attendee group differed significantly from the lookalike group and differed even more from all customers from Connecticut. The average percent of customers from Connecticut who bought a license across time was relatively stable between 18-21% (discounting the anomalous 2015, which is likely a result of a data handling error, rather than a true one-time lift) (Figure 2).

Figure 2. Attendees buy license more regularly as time goes on. Attendees buy licenses more regularly than their lookalikes.
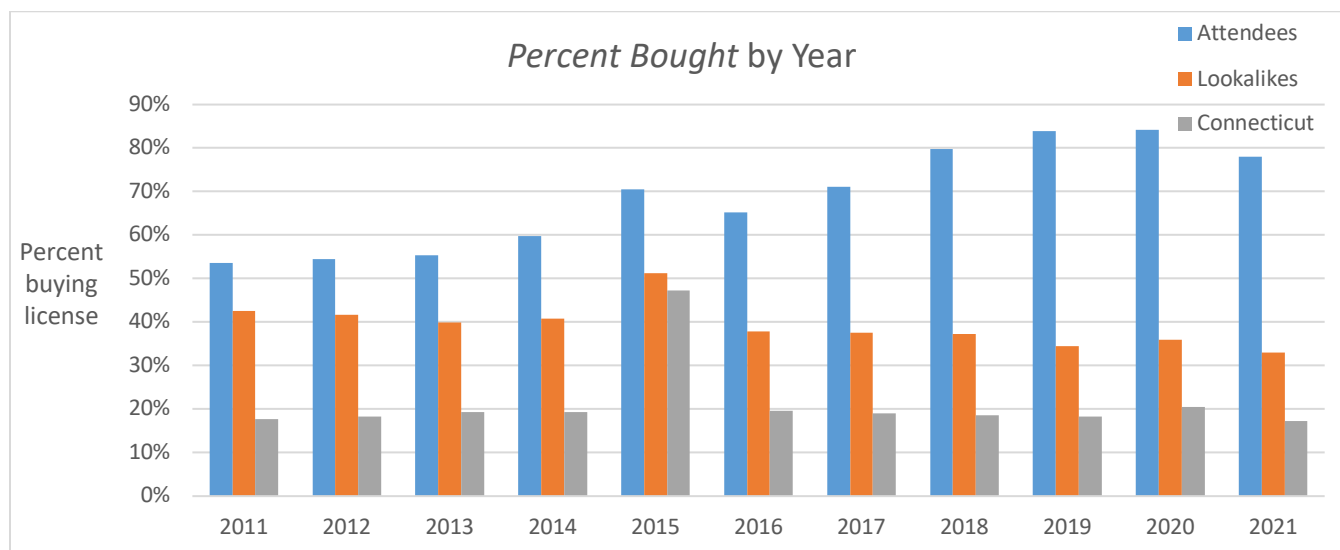
The lookalike group closely parallels this pattern, though they purchase licenses at about an 18% higher rate, on average. The *percent bought* was even higher for attendees and became increasingly more divergent in more recent years. This pattern suggests that there is an improvement in terms of *percent bought* by some, simply by virtue of being a lookalike and even more by being an attendee. This result is consistent with the finding that attendees were more avid **before** the R3 event and are even more so **because** of the R3 event.

Figure 3. Attendees have better year-over-year participation, or attendees churn less than their matched-pair lookalikes.
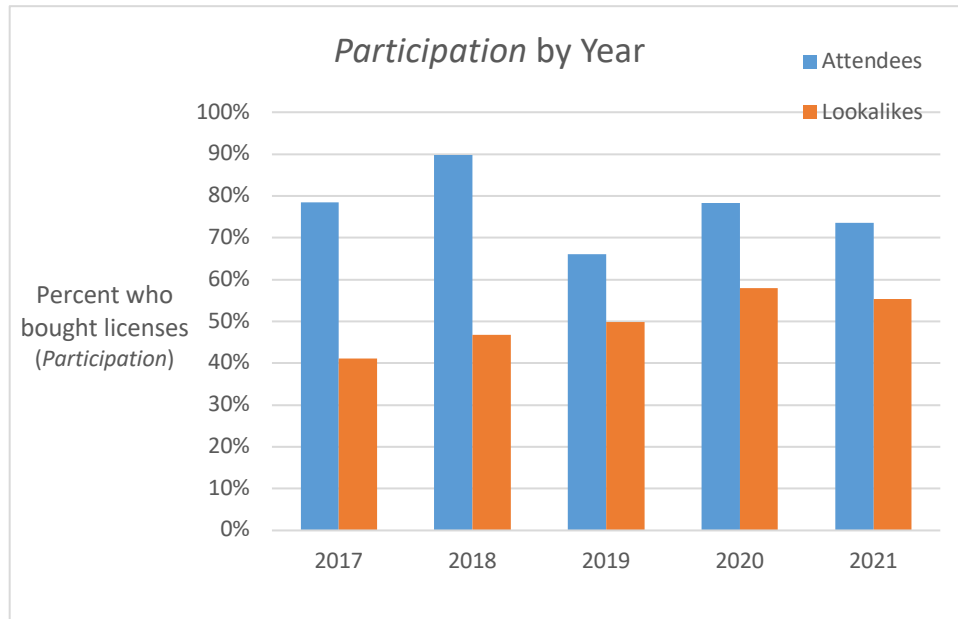
When attendees and lookalikes are compared for the years 2017-2021, participation is 30-48% higher for attendees (i.e., the attendee blue line is higher than the lookalike orange line) (Figure 3). This lift was understandably diminished in 2020 and 2021, presumably due to restrictions resulting from the COVID-19 pandemic. The distance between the lookalike and attendee groups is the amount of difference between the groups, in this case, R3 attendees churn 36% less, on average, than matched-pair lookalikes.

When attendees and lookalikes are compared according to the year, attendee engagement is initially higher by about 1.64 licenses per year, on average as a group (Figure 4). Engagement is variable between years, but, on average, attendees' purchases remain 2.20 licenses above the lookalikes, and in 2021 ends up 1.77 licenses higher ($M_{LOOKALIKE} = 2.77$, $M_{ATTENDEE} = 1.00$). This finding suggests that R3 events initially induced attendees to buy more licenses and that these events then continued to induce additional purchases for a portion of attendees.

Figure 4. Attendees buy more licenses than their matched-pair lookalikes.
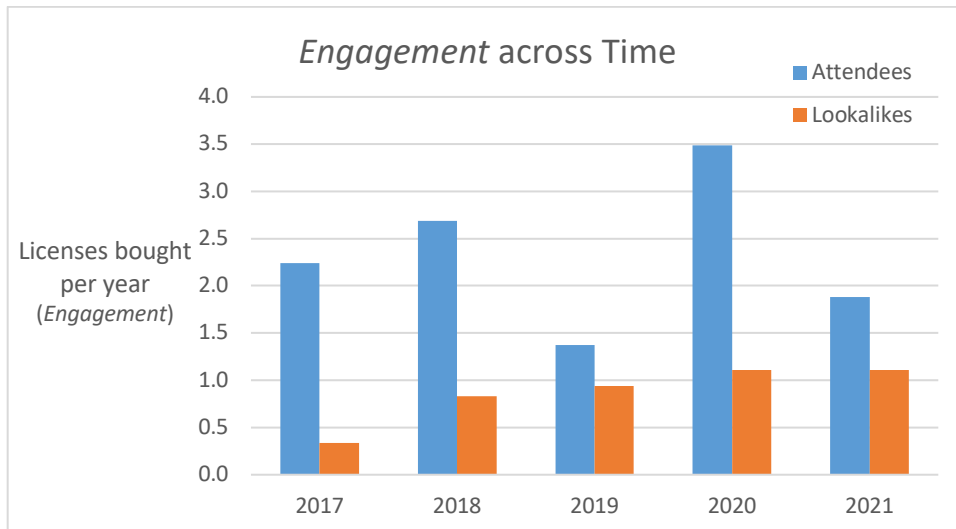
Data from Connecticut suggest that, regardless of the age of the adult R3 event attendee, there is a lift in participation. The greatest lift in participation is for attendees aged 25-35, followed by attendees aged 18-25 (Figure 5). This indicates that if the goal of R3 events is to generate additional customers year over year, a focus on attendees aged 18-35 will yield the best return on investment. Please note that attendees who were minors did not occur in sufficient quantities to be included in analyses for Connecticut.

Figure 5. The increase in participation in R3 events is greatest for attendees who are aged 18-35.
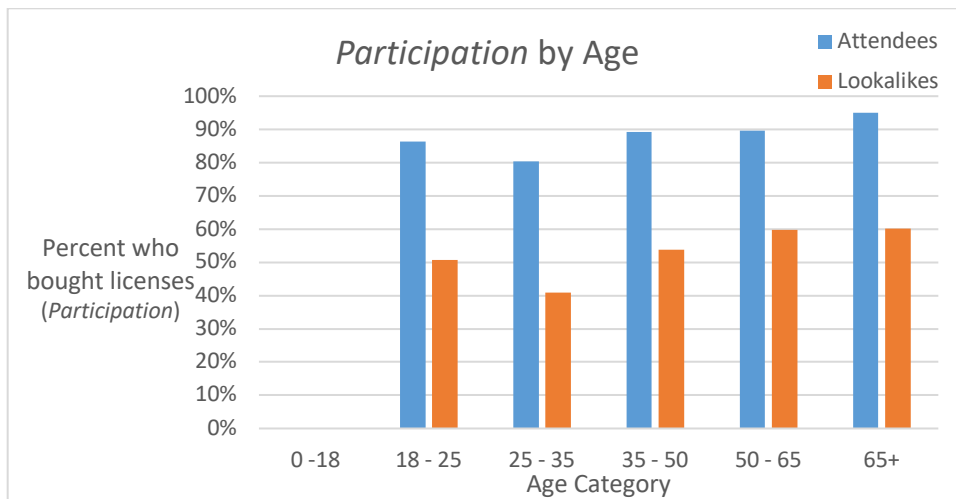
Connecticut data also indicate there is a lift in engagement for all adult age categories of R3 event attendees (minors did not occur in sufficient quantities to be included in engagement analyses). Adult attendees aged 65 and older saw the largest lift in engagement, from 2.14 to 5.24 license purchases per year (Figure 6). Other age groups show similar levels of lift, from 2.15 to 2.59 additional licenses purchased per year. Focusing on attendees of specific age groups would not yield meaningfully different returns on investment in terms of engagement, with the exception of adults 65 years of age or older.

Figure 6. Attendees aged 65 years or older saw the greatest lift in engagement, although there was a lift for all adult-aged attendees.
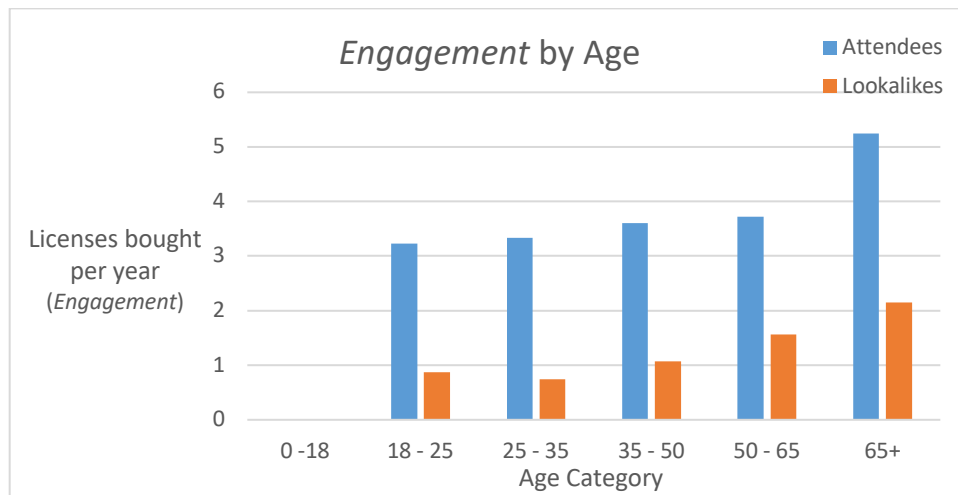
Within Connecticut, there were some R3 events that resulted in attendees having higher overall participation, when compared to their matched-pair lookalikes (Figure 7). In Connecticut, there were too many different events to analyze at the event level, so events were categorized into similar groups prior to analysis. Events such as *Women's Pheasant* hunts and *Waterfowl* hunts resulted in the greatest lift.

Figure 7. R3 event types are listed left to right in order of their impact on participation, with the most effective events on the left.
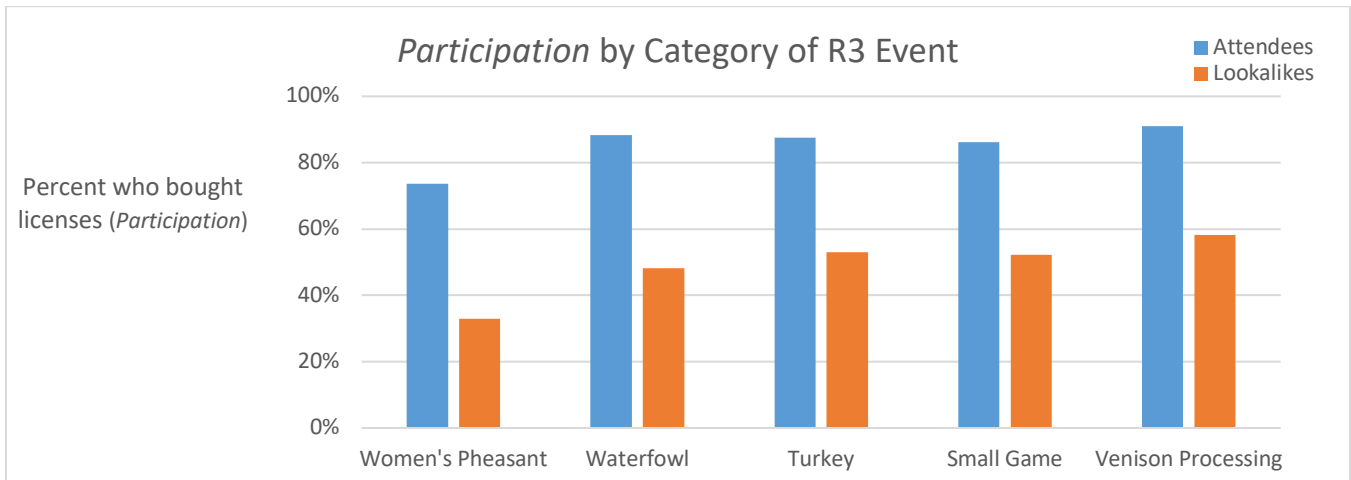
Events such as *Women's Pheasant* hunts and *Waterfowl* hunts resulted in the greatest lift in terms of engagement (Figure 8). Again, Connecticut was slightly different than other states in that events or event types were not vastly different in their resultant lift in engagement, with perhaps the exception of *Venison Processing,* which resulted in a slightly lower lift in engagement.

Figure 8. The R3 event categories are listed left to right in same order as Figure 7. In Connecticut there was not a significant difference in engagement between events.

Engagement by Category of R3 Event
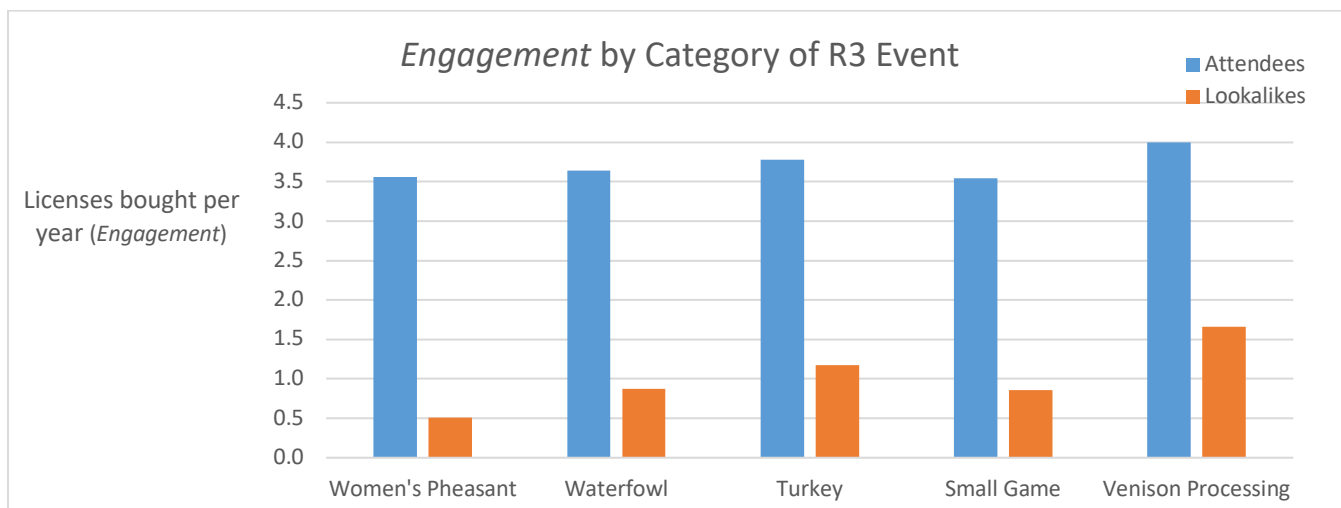
The average customer from Georgia purchased nearly 8 licenses, tags, or stamps between 2011 and 2021, though there was large variation between customers ($M_{licenses}$=7.93, SD=9.73). When comparing those who participated in an R3 event (attendees) to matched-pair lookalikes of the R3 event attendees (lookalikes) there was not a significant difference on the variables of sex, age, latitude/longitude, or starting year. This is expected because these were some of the variables that were held constant, and this consistency acts as a quality-control, quality-assurance check indicating the Mahalanobis distance match pairing was successful. However, in comparison to the average Georgia customer, the attendees and lookalikes were more likely to be male, younger, and more rural (i.e., had a geographic-weighted center that was more southeast, or further from the Atlanta Metropolitan Area).

In comparison to the average Georgia customer, the lookalike group purchased more licenses, had slightly higher participation, and had hunted or fished in slightly more years ($M_{Licenses}$=9.42, $M_{Participation}$=0.47, $M_{TotYears}$=4.00) (Table 3). This suggests there is a moderate selection effect, meaning that Georgia customers who opt-in to R3 events are likely to be more avid *before* they participated in the R3 event. However, the attendee group had lift above and beyond the lookalike group in that they purchased more licenses, had slightly higher participation, and hunted or fished in more years than the lookalike group ($M_{Licenses}$=14.60, $M_{Participation}$=0.64, $M_{TotYears}$=5.64). This indicates that, in addition to the moderate selection effect, attending an R3 event results in a true lift, as attendees are likely to be more avid *because* they participated in the R3 event. The attendee group bought more licenses year over year (higher engagement [$M_{Engagement}$=1.35]), than both the lookalike group and the average Georgia customer. This indicates the effects of attending an R3 event induces a portion of attendees to buy more licenses, and further indicates this effect lasts several years after attending an event. An important note is that Georgia R3 events did not attract many new customers, as the majority (86.1%) of R3 event attendees had purchased a license in at least one license year prior to attending an R3 event. This indicates six out of every seven attendees were highly likely to have already been recruited to some extent before attending an R3 event.

Table 3. Topline comparisons of variables of interest between R3 event attendees (attendees), matched-pair lookalikes (lookalikes), and all customers of Georgia's DNR-Wildlife Resources Division (Georgia).

	Attendees	Lookalikes	Georgia
Male	79.0%	79.0%	77.3%
Age	41.90	41.93	51.9
Latitude	33.2457	33.2456	33.3023
Longitude	83.5627	83.5625	83.9302
Starting year	2012.69	2012.69	2012.62
Total licenses	14.60	9.42	7.93
Participation	0.64	0.47	0.39
Engagement	1.349	1.024	1.091
Total Years	5.64	4.00	3.38

Across time, Georgia R3 event attendees bought between 0.13 and 0.31 more licenses than their matched-pair lookalikes and the average Georgia customer (Figure 9). Although the number of licenses bought is variable by year, the attendees are consistently an average of 0.23 licenses above the baseline of either the lookalikes or Georgia customers in general.

Figure 9. The average licenses bought is consistently higher for the attendee group.
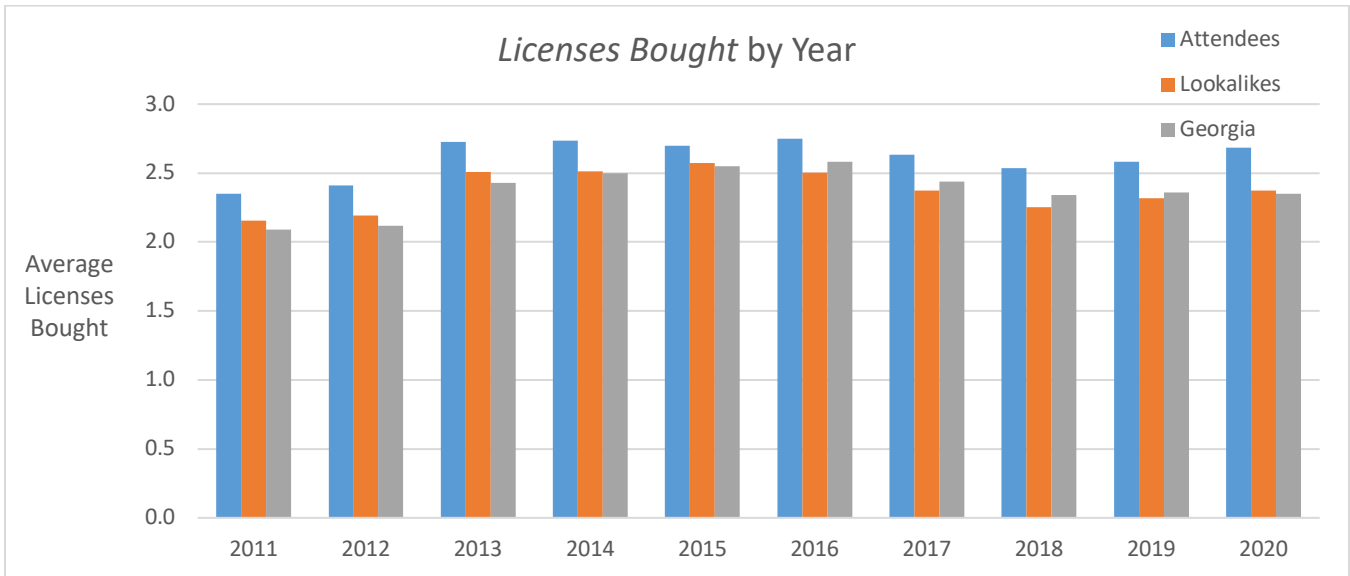
The attendee group differed in significant ways from the lookalike group and differed even more from all Georgia customers (Figure 10). The average percent of Georgia customers who bought a license across time was on a relative decline from about 40% per year to about 25% per year before COVID-19 restrictions, after which there was a slight recovery (27%). The lookalike group similarly saw declines, though the trend was not as steep as for all Georgia customers, as the lookalike group declined from 43% to 37% during this timeframe. This divergence from all Georgia customers suggests that the attendees had lower levels of churn (the inverse of *Percent Bought*). This improvement is simultaneously attributable to a difference **before** the R3 event as well as **because** of the R3 event.

Figure 10. Individuals buy license more regularly as time goes on. Attendees buy licenses more regularly than their lookalikes.
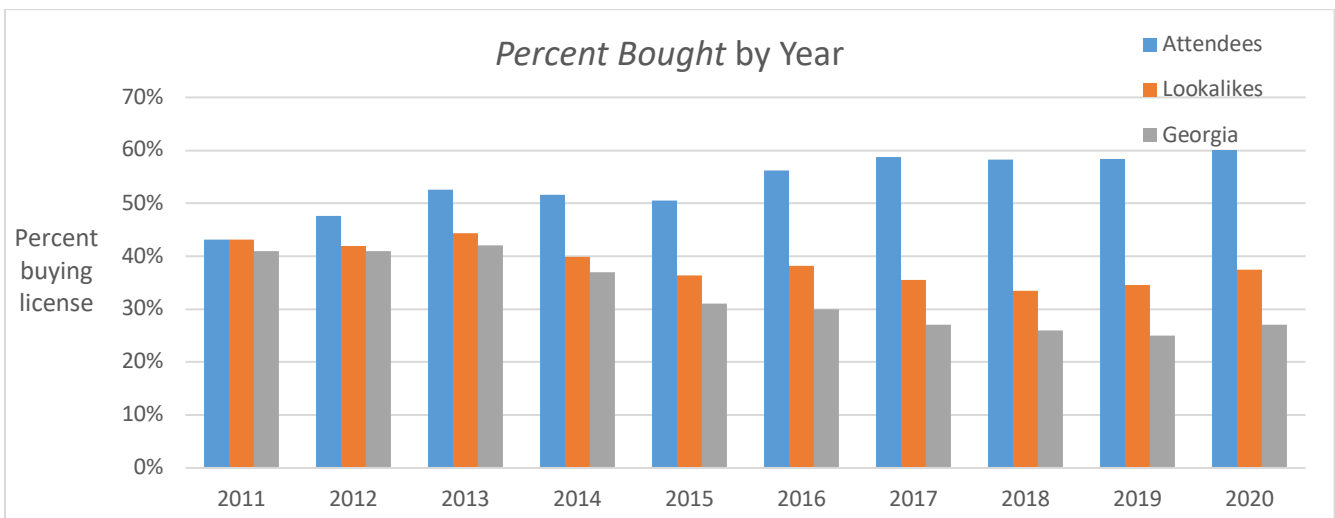
When attendees and lookalikes are compared by year, participation is consistently 14-19% higher for attendees (i.e., the attendee blue line is consistently higher than the lookalike orange line) (Figure 11). This lift was understandably diminished in 2020, presumably due to restrictions resulting from the COVID-19 pandemic. The distance between the lookalike and attendee groups is the amount of difference between the two groups, in this case, R3 attendees churn about 15% less than their matched-pair lookalikes.

Figure 11. Attendees have better year-over-year participation, or attendees churn less than their matched-pair lookalikes.
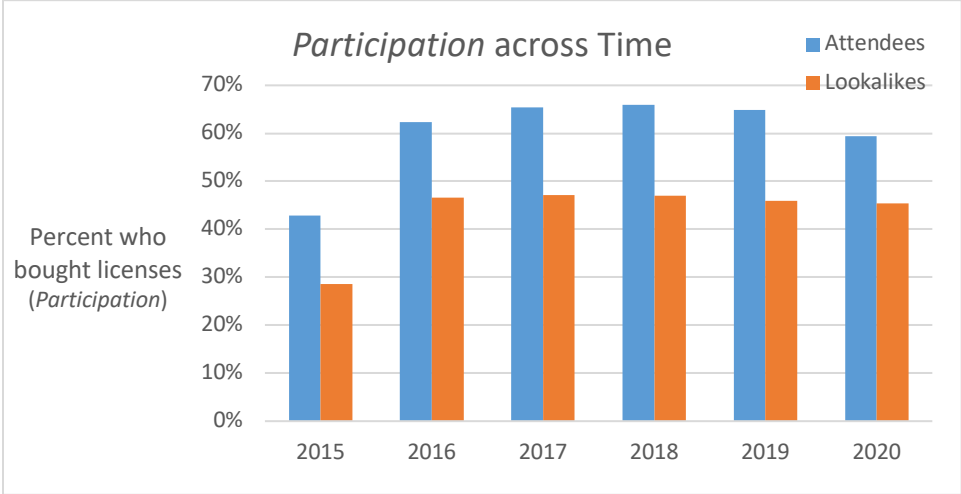
Again, when attendees and lookalikes are compared by year, engagement is initially higher by about 0.80 licenses per year, on average as a group (Figure 12). Engagement then continues to increase to 1.45 more licenses purchased per year in 2020 ($M_{LOOKALIKE} = 1.08$, $M_{ATTENDEE} = 2.53$). This suggests that R3 events initially induced attendees to buy more licenses, and that these events then continued to induce additional purchases for a portion of attendees.

*Figure 12. Attendees buy more licenses than their matched-pair lookalikes.*
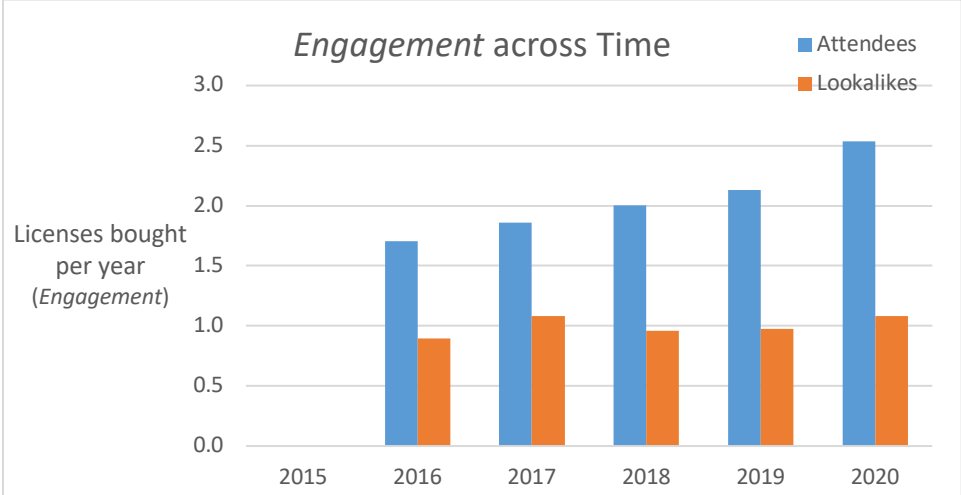
Data from Georgia suggest that regardless of the age of the R3 event attendee, there is a lift in participation (Figure 13). However, the lift gained from attendees in comparison to the lookalikes is the least for youth under 18 years of age and for retirees older than 65. The greatest lift is for attendees aged 25-35 and 35-50. This indicates that if the goal of R3 events is to generate additional customers year over year, a focus on attendees aged 25-50 yields the best return on investment.

Figure 13. The increase in participation in R3 events is greatest for attendees who are aged 25-50. Conversely, the reduction of churn attributable to R3 event attendance is the least for minors.
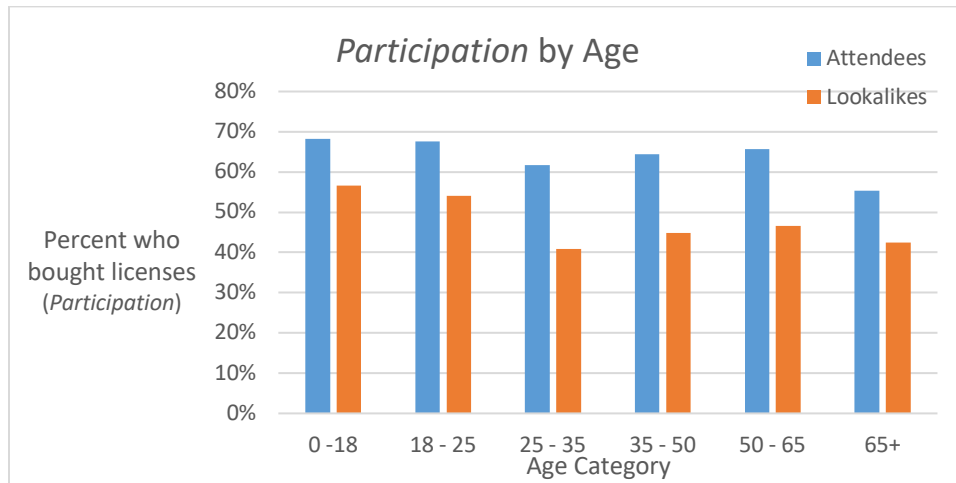
Georgia data also indicate there is a lift in engagement for all age categories of R3 event attendees. Youth attendees under age 18 had the smallest lift, with just 0.32 additional licenses purchased per year. However, adult attendees aged 25-35 had a lift from 1.10 to 2.11 license purchases per year, and the 35-50 age group had the largest lift with 1.07 to 2.19 licenses purchased per year. Focusing on attendees between the ages of 25 and 50 will yield the best returns on investment in terms of engagement. This is especially true for young adults 25-35, as this effect seems to be consistent.

Figure 14. Attending an R3 event does not meaningfully increase the number of licenses bought by minors. However, adult R3 attendees buy nearly twice the number of licenses annually than their matched-pair lookalikes.
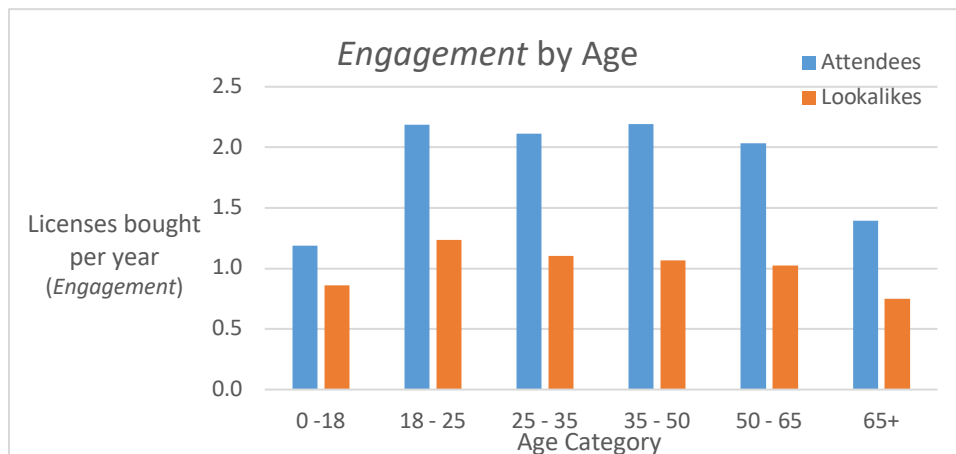
Within Georgia, there were some R3 events that resulted in attendees having higher overall participation when compared to their matched-pair lookalikes (Figure 15). The *Hunt and Learn* and *Field to Fork* R3 events resulted in the greatest lift, whereas the *Give it a Shot* and the *Learn to Hunt* events resulted in the lowest lift in terms of participation.

Figure 15. R3 events (or types of events if the sample was small) are listed left to right in order of their impact on participation, with most effective events on the left.
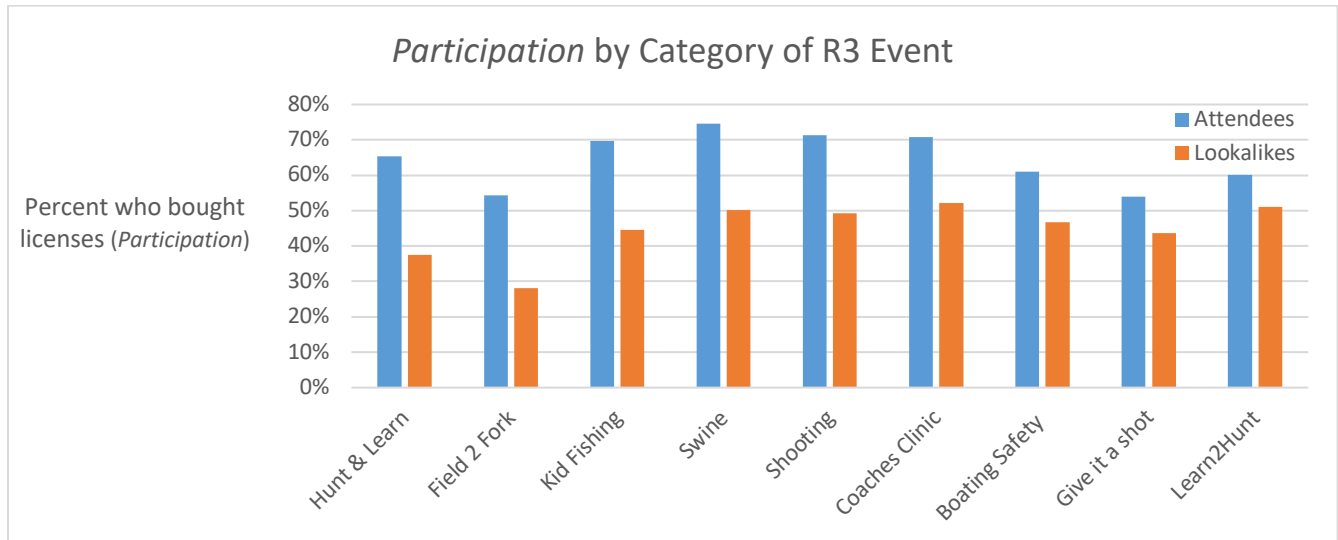
The *Hunt and Learn* events resulted in over a 2-license-per-year increase (0.89 vs 2.92) (Figure 16). Interestingly, the *Coaches Clinic* and the *Learn to Hunt* events also resulted in large increases in licenses purchased by year. The *Boating Safety* and the *Give it a Shot* programs resulted in the lowest lift in terms of engagement.

Figure 16. R3 events (or types of events if the sample was small) are listed left to right in same order as Figure 15. R3 events focused on shooting and boating safety result is the smallest lift in terms of licenses purchased.
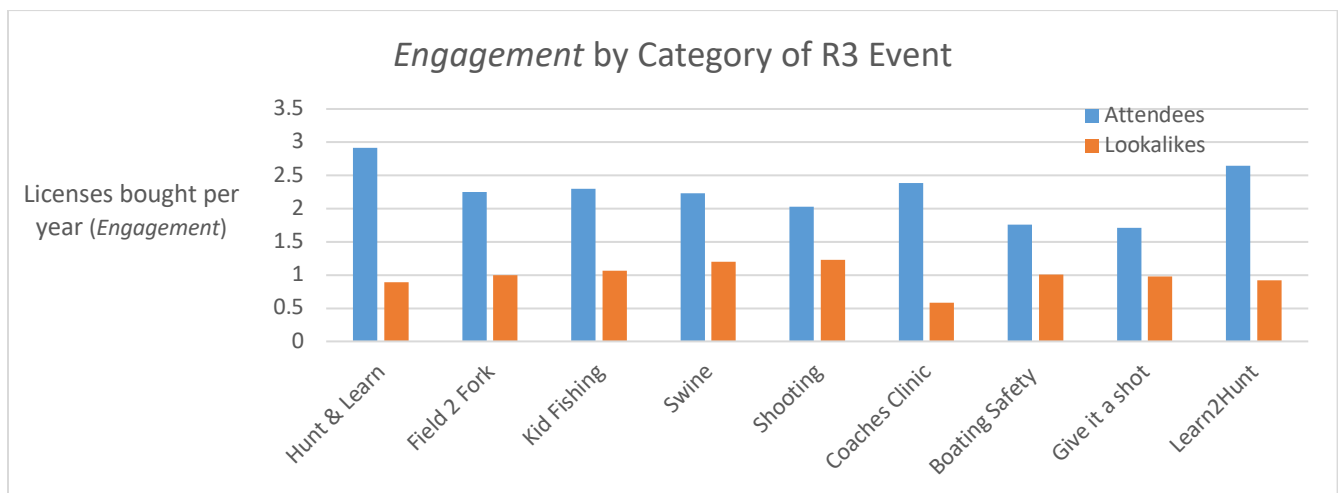
Iowa

The average customer from Iowa purchased more than 13 licenses, tags, or stamps between 2009 and 2020 ($M_{licenses}$=13.33). When comparing those who participated in an R3 event (attendees) to matched-pair lookalikes (lookalikes) there was not a significant difference on the variables of sex, age, latitude, longitude, or starting year. This is expected because these were some of the variables that were held constant, and this consistency acts as a quality-control, quality-assurance check indicating the Mahalanobis distance match pairing was successful. However, in comparison to the average Iowa customer, the attendees and lookalikes were more likely to be female, younger, and more rural (i.e., the geographic-weighted center for all Iowa customers was within the Des Moines Metropolitan Area, but the geographic-weighted center of both the attendees and lookalikes was further north and east).

In comparison to the average Iowa customer, the lookalike group purchased slightly fewer licenses, had higher participation, and had hunted or fished in slightly fewer years ($M_{Licenses}$=11.60, $M_{Participation}$=0.49, $M_{TotYears}$=5.04) (Table 4). The difference observed between the 'normal' customer and the lookalike group suggests there is a moderate selection effect, meaning that Iowa customers who opt-in to R3 events are more likely to consistently purchase licenses year after year. The attendee group had lift above the lookalike group in that they purchased more licenses, had higher participation, and hunted or fished in more years than the lookalike group and average Iowa customers ($M_{Licenses}$=21.04, $M_{Participation}$=0.68, $M_{TotYears}$=7.42). This indicates that, in addition to the moderate selection effect, attending an R3 event results in a true lift, as attendees are likely to be more avid *because* they participated in the R3 event. The attendee group bought more licenses year over year (higher engagement [$M_{Engagement}$=2.29]), than both the lookalike group and the average Iowa customer. This indicates the effects of attending an R3 event induces a portion of attendees to buy more licenses, and further indicates this effect lasts for a few years after attending an event. An important note is that Iowa R3 events may not have attracted as many new customers as anticipated, as many R3 event attendees (82.9%) had purchased a license in at least one license year prior to attending an R3 event. This statistic indicates five out of every six attendees were likely to have already been recruited to some extent before attending an R3 event.

Table 4. Topline comparisons of variables of interest between R3 event attendees (attendees), matched-pair lookalikes (lookalikes), and all customers of Iowa's Department of Natural Resources.

	Attendees	Lookalikes	Iowa
Male	54%	54%	72%
Age	40.86	40.88	50.96
Latitude	41.8552	41.8547	41.9697
Longitude	93.2156	93.2137	93.0781
Starting year	2009.53	2009.54	2006.83
Total licenses	21.04	11.60	13.33
Participation	0.68	0.49	0.41
Engagement	2.29	0.81	0.77
Total Years	7.42	5.04	5.37

For each year data were available, Iowa R3 event attendees bought between 0.38 and 0.91 more licenses than their matched-pair lookalikes, who in turn bought slightly fewer licenses than the average Iowa

customer (Figure 17). Although the number of licenses bought is variable by year, the attendees are an average of 0.60 licenses above the baseline of the lookalikes.

Figure 17. The average licenses bought is consistently higher for the attendee group.
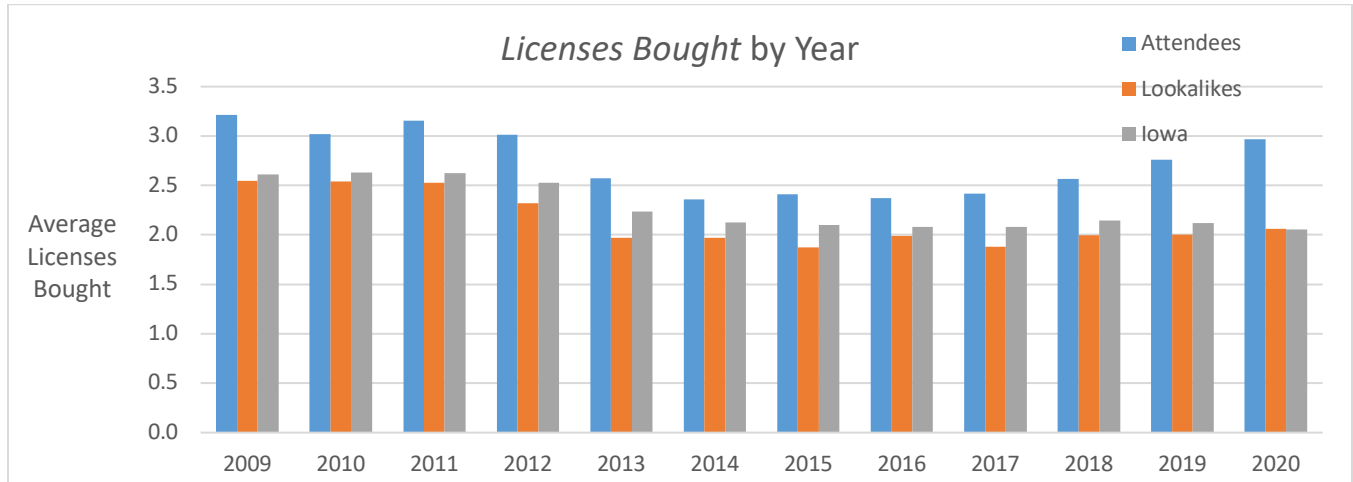
The attendee group differed from the lookalike group and differed even more from all Iowa customers, particularly in later years (Figure 18). The average Iowa customer, after buying their initial license, bought a license on average 23-28% of the following years. However, both the attendees and lookalikes bought licenses more consistently year to year, especially in more recent years. The attendee group was approximately 17% higher than the lookalikes, though that estimate increases with more recent years. This difference in more recent years indicates that attendees and lookalikes buy licenses more consistently than average Iowa customers. This improvement is simultaneously attributable to a difference **before** the R3 event as well as **because** of the R3 event.

Figure 18. Attendees buy licenses more consistently than their lookalikes. Attendees and lookalikes buy licenses more consistently in more recent years.
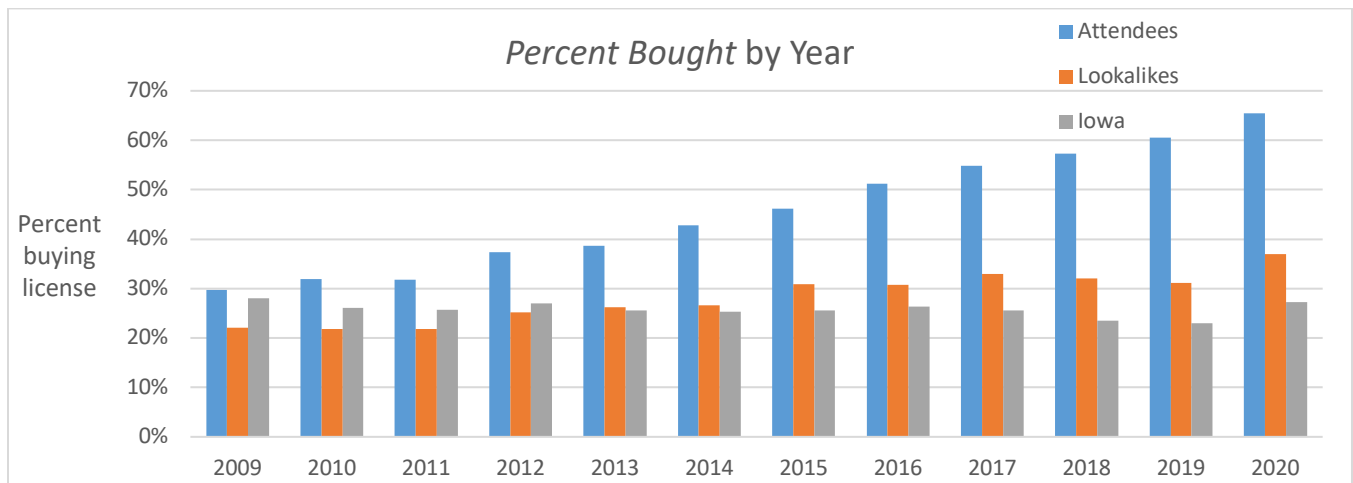
When attendees and lookalikes are compared by year, participation is 10-29% higher for attendees after 2011 (i.e., the attendee blue line is higher than the lookalike orange line) (Figure 19). The distance between the lookalike and attendee groups is the amount of difference between the two groups, in this case, R3 attendees churn about 17% less than their matched-pair lookalikes, but this churn is variable year to year.

Figure 19. Attendees have better year-over-year participation, or attendees churn less than their matched-pair lookalikes.
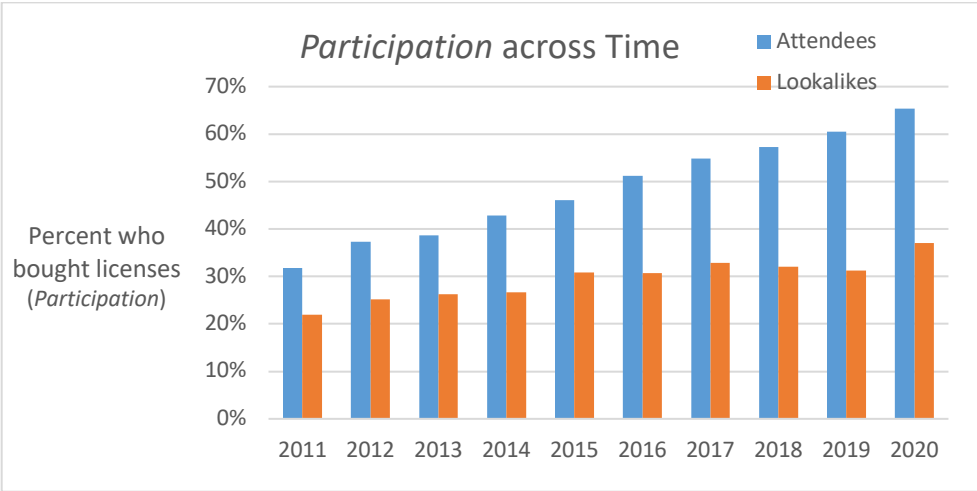
When attendees and lookalikes are compared by year, engagement is 0.31-0.81 licenses higher during the license years analyzed (Figure 20). Between 2011 and 2020, attendees bought 0.56 more licenses per year than did the lookalike group. Engagement then continues to increase to 0.81 more licenses purchased per year in 2020 ($M_{LOOKALIKE} = 2.99$, $M_{ATTENDEE} = 2.18$). These data suggest that R3 events initially induced attendees to buy more licenses, and that these events then continued to induce additional purchases for a small portion of attendees.

*Figure 20. Attendees buy more licenses than their matched-pair lookalikes.*
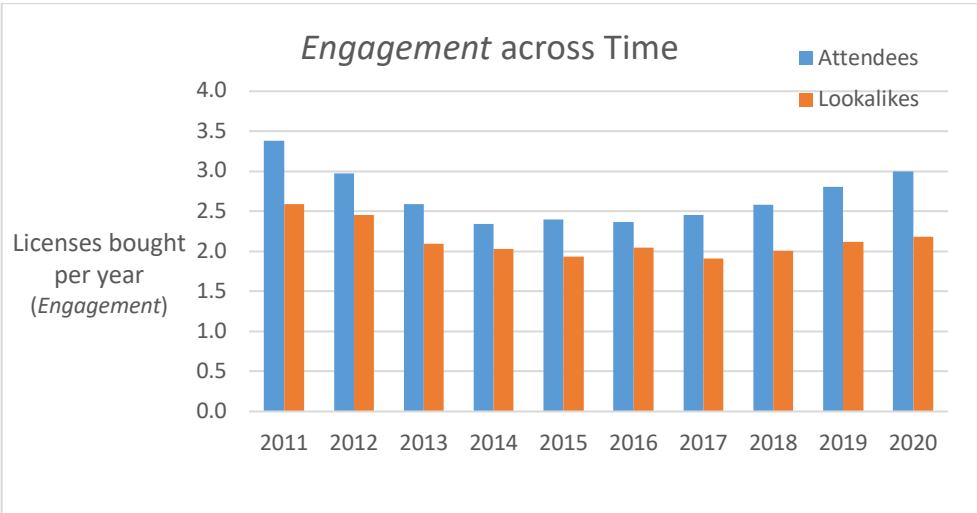
Data from Iowa suggest that, regardless of the age of the R3 event attendee, there is a lift in participation (Figure 21). However, the lift gained from attendees in comparison to the lookalikes was minimal for youth under 18 years of age. The greatest lift in participation was for the attendees aged 25-35. The second greatest lift was for attendees aged 18-25. This finding indicates that focusing on attendees aged 18-35 yields the best return on investment.

Figure 21. The increase in participation in R3 events is greatest for attendees who are aged 18-35. Conversely, the reduction of churn attributable to R3 event attendance is the least for minors.
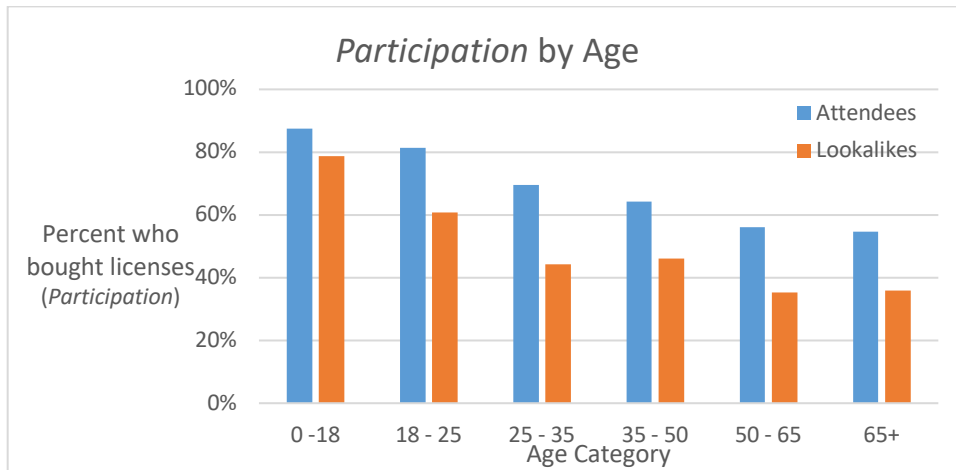

Iowa data also indicate there is a lift in engagement for all age categories of R3 event attendees (Figure 22). Youth attendees under age 18 had the smallest lift. However, adult attendees aged 25-35 and 35-50 annually purchased 2.23 and 1.88 additional licenses over their lookalikes. Focusing on adult attendees will yield the best returns on investment in terms of engagement, as adults buy more licenses per year. Youth attendees did not respond with a similar lift.

Figure 22. Attending an R3 event does not meaningfully increase the number of licenses bought by minors. However, adult R3 attendees buy nearly twice the number of licenses annually than their matched-pair lookalikes.
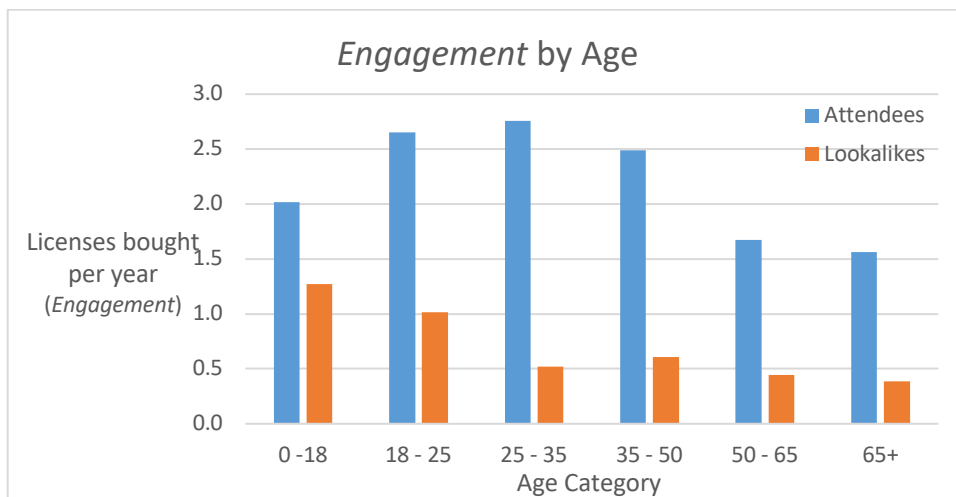
Within Iowa, there were some R3 events that resulted in attendees having higher overall lift when compared to their matched-pair lookalikes (Figure 23). The *Learn to Hunt*, *Duck* hunting, and *Virtually* delivered workshop R3 events resulted in the greatest lift, whereas the *Field to Fork* and *Becoming an Outdoor Woman* events resulted in the lowest lift in terms of participation. As noted earlier, R3 events aimed at *youth* were less effective in terms of increasing participation.

Figure 23. R3 events (or types of events if the sample was small) are listed left to right in order of their impact on participation, with most effective events on the left.
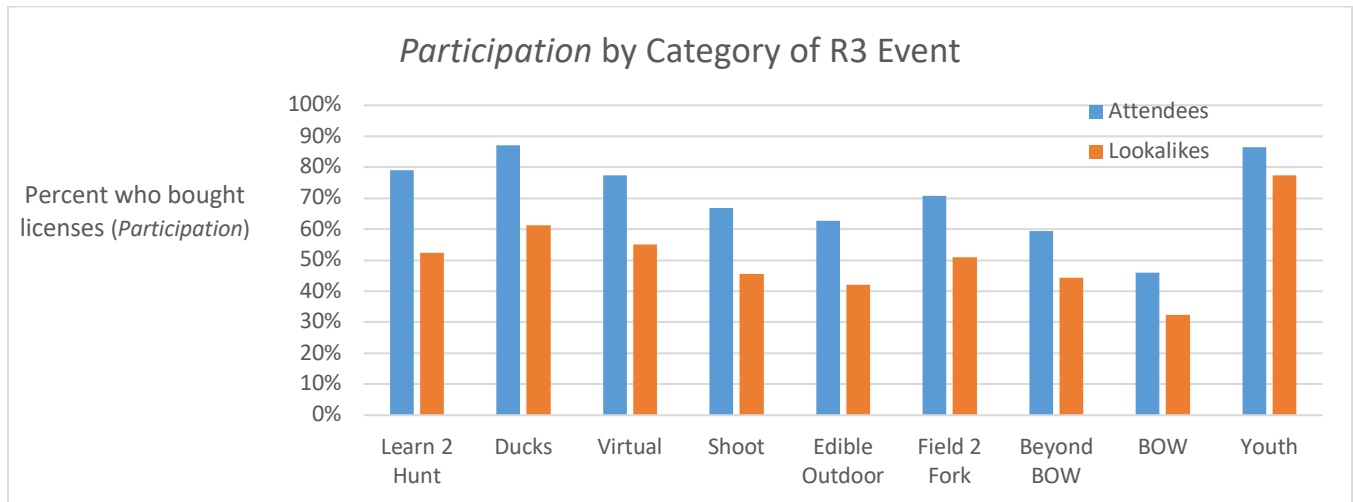
The *Edible Outdoor* and the *Field to Fork* were the most effective R3 events in terms of engagement (Figure 24). The *Becoming an Outdoor Woman* and *Shooting* oriented R3 events were the least effective. Just as with participation, R3 events targeting youth performed poorly in terms of increasing engagement.

Figure 24. R3 events (or types of events if the sample was small) are listed left to right in same order as Figure 23. R3 events focused on BOW, Shooting, and Youth result is the smallest lift in term of engagement.
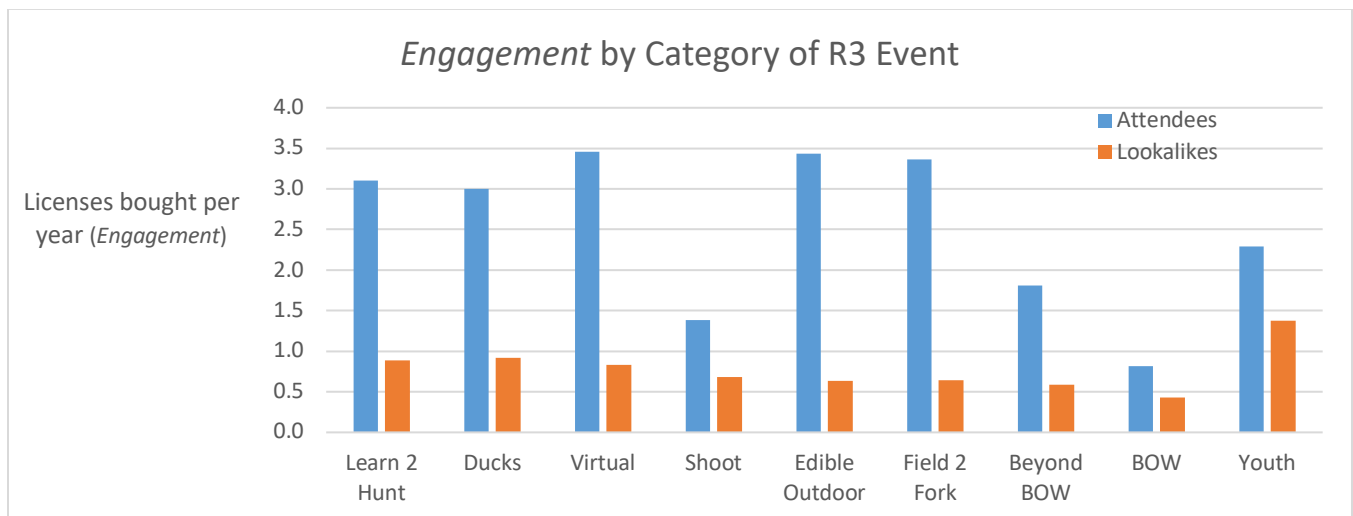
The data were structured in some states, including Iowa, that permitted analysis in determining if attending multiple events resulted in a difference in retention effects. In Iowa, there were enough attendees and events to conduct analysis on attendance in up to three R3 events (some in the attendee group had attended up to six events, but the small sample size precluded any analysis). We found no evidence to suggest that attending more than one event had any additional marginal benefit over attending just one event, in terms of participation (Figure 25).

Figure 25. Attending more R3 events does not result in higher participation.
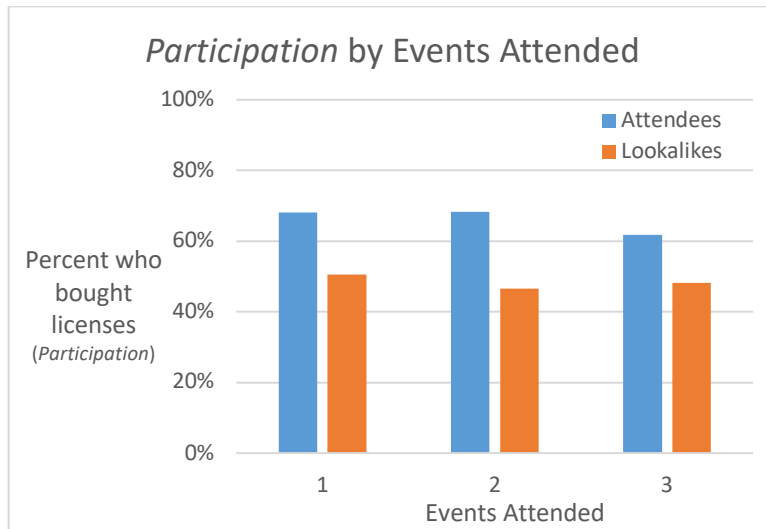
We also compared attendees who attended multiple events to those who attended just one event (Figure 26). We found that the lift in engagement for those who attended one event versus two or more events was very similar. We found no evidence to suggest that attending more than one event had any additional marginal benefit over attending just one event, in terms of engagement.

Figure 26. Attending more R3 events does not result in higher engagement.
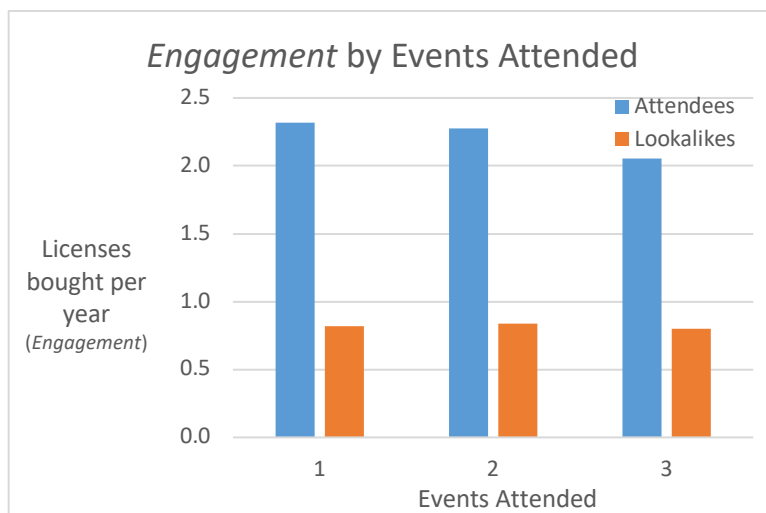
Massachusetts

The average customer from Massachusetts purchased just over 3 licenses, tags, or stamps between 2013 and 2020 ($M_{licenses}$=3.13). When comparing those who participated in an R3 event (attendees) to matched-pair lookalikes of the R3 event attendees (lookalikes) there was not a significant difference on the variables of sex, age, latitude/longitude, or starting year. This is expected because these were some of the variables that were held constant, and this consistency acts as a quality-control, quality-assurance check indicating the Mahalanobis distance match pairing was successful. However, in comparison to the average customer from Massachusetts, the attendees and lookalikes were more likely to be female, markedly younger, and less rural (i.e., all customers from Massachusetts had a geographic-weighted center that was spread between Boston, Springfield, and Worcester; however, the geographic-weighted center of the attendees and lookalikes was slightly north and further east, just outside the Boston Metropolitan Area).

In comparison to the average customer from Massachusetts, the lookalike group purchased more licenses, had slightly higher participation, and had hunted or fished in slightly more years ($M_{Licenses}$=4.49, $M_{Participation}$=0.57, $M_{TotYears}$=3.49) (Table 5). This suggests there is a moderate selection effect, meaning that customers from Massachusetts who opt-in to R3 events are very likely to be more avid *before* they participated in the R3 event. However, the attendee group had lift above and beyond the lookalike group in that they purchased more licenses, had slightly higher participation, and hunted or fished in more years ($M_{Licenses}$=8,51, $M_{Participation}$=0.80, $M_{TotYears}$=5.00). This indicates that, in addition to the moderate selection effect, attending an R3 event results in a true lift, as attendees are likely to be more avid *because* they participated in the R3 event. The attendee group bought more licenses year over year (higher engagement [$M_{Engagement}$=1.55]) than both the lookalike group and the average customer from Massachusetts. This finding indicates the effect of attending an R3 event induces a portion of attendees to buy more licenses, and further indicates this effect lasts several years after attending an event. An important note is that Massachusetts R3 events did not attract many new customers, as many (47.0%) R3 event attendees had purchased a license in at least one license year prior to attending an R3 event. This statistic indicates about half of the attendees were highly likely to have already been recruited to some extent before attending an R3 event.

Table 5. Topline comparisons of variables of interest between R3 event attendees (attendees), matched-pair lookalikes (lookalikes), and all customers of Massachusetts' Department of Fish and Game (Massachusetts).

	Attendees	Lookalikes	Massachusetts
Male	73.2%	73.2%	82.8%
Age	31.71	31.95	48.78
Latitude	42.2847	42.2823	42.0818
Longitude	71.8528	71.8551	72.2522
Starting year	2015.63	2015.63	2015.47
Total licenses	8.51	4.49	3.13
Participation	0.80	0.57	0.50
Engagement	1.55	0.73	0.52
Total Years	5.00	3.49	3.02

Across time, Massachusetts R3 event attendees bought between 0.16 and 0.60 more licenses than their matched-pair lookalikes and 0.37 to 0.82 more licenses than the average customer from Massachusetts (Figure 27). Although the number of licenses bought is variable by year, the attendees bought an average of 0.36 to 0.59 more licenses than the lookalikes or all customers from Massachusetts, respectively.

Figure 27. The average licenses bought is consistently higher for the attendee group.
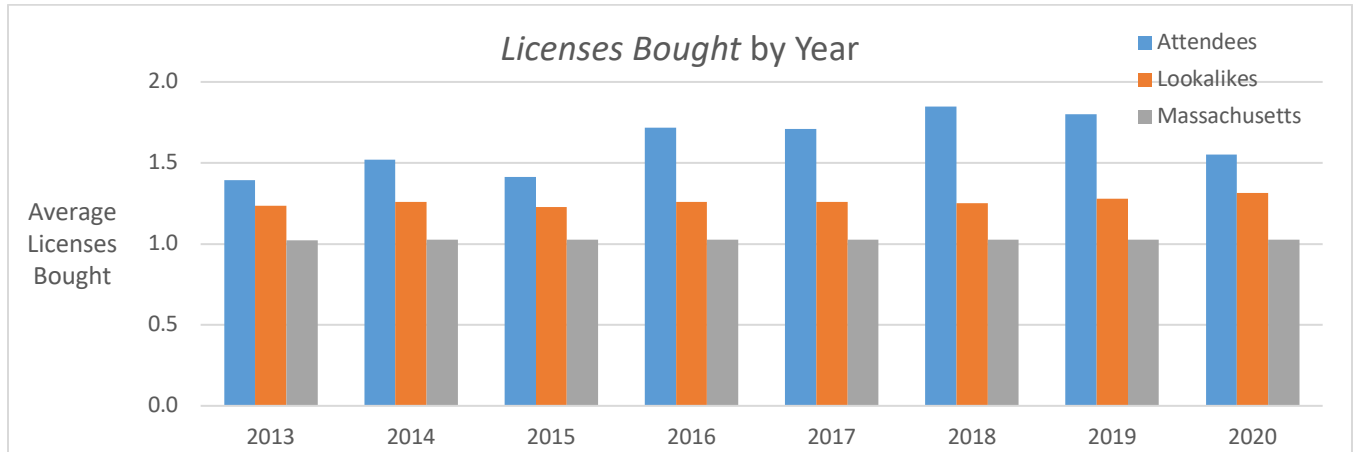
The attendees group differed in significant ways from the lookalike group and differed even more from all customers from Massachusetts (Figure 28). After purchasing their initial license, the average customer from Massachusetts bought a license 28-36% of subsequent years. After 2016, both the attendees and lookalikes saw stable increases in *Percent Bought*, with lookalikes increasing from 40% to 46% and attendees increasing from 57% to 72%. This divergence from all customers from Massachusetts suggests that the attendees had lower levels of churn (the inverse of *Percent Bought*). This improvement is simultaneously attributable to a difference **before** the R3 event as well as **because** of the R3 event.

Figure 28. Individuals buy licenses more regularly as time goes on. Attendees buy licenses more regularly than their lookalikes.
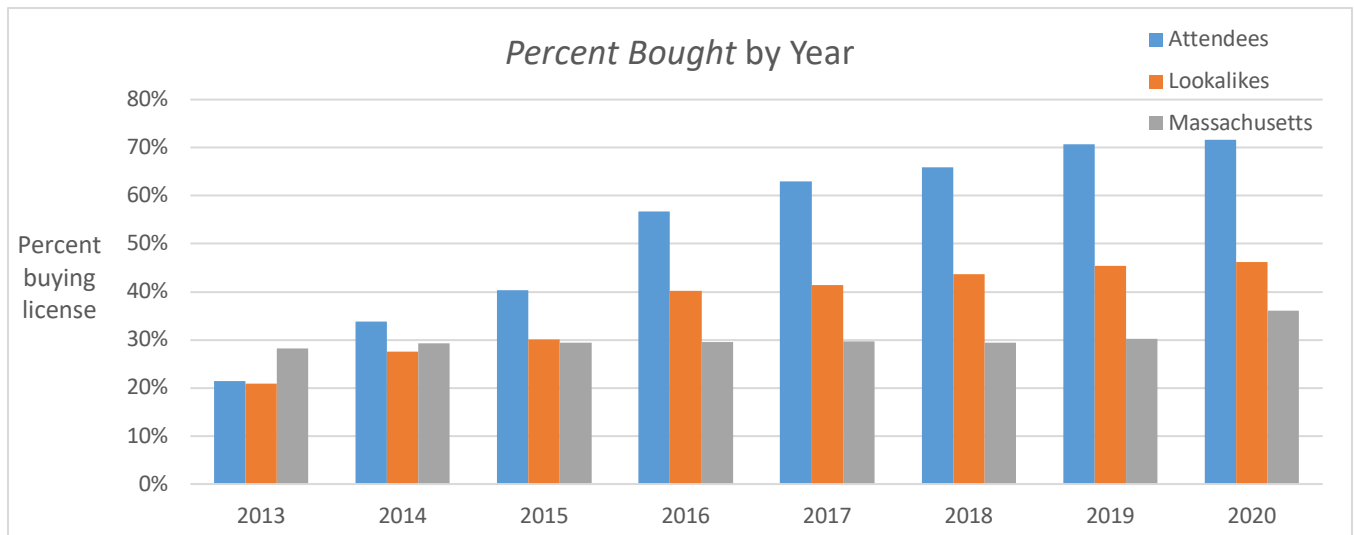
When attendees and lookalikes are compared by year, participation is 20-28% higher for attendees (i.e., the attendee blue line is consistently higher than the lookalike orange line) (Figure 29). The distance between the lookalikes and attendee groups is the amount of difference between the two groups, in this case, R3 attendees churn about 24% less, on average, than their matched-pair lookalikes.

Figure 29. Attendees have better year-over-year participation, or attendees churn less than their matched-pair lookalikes.
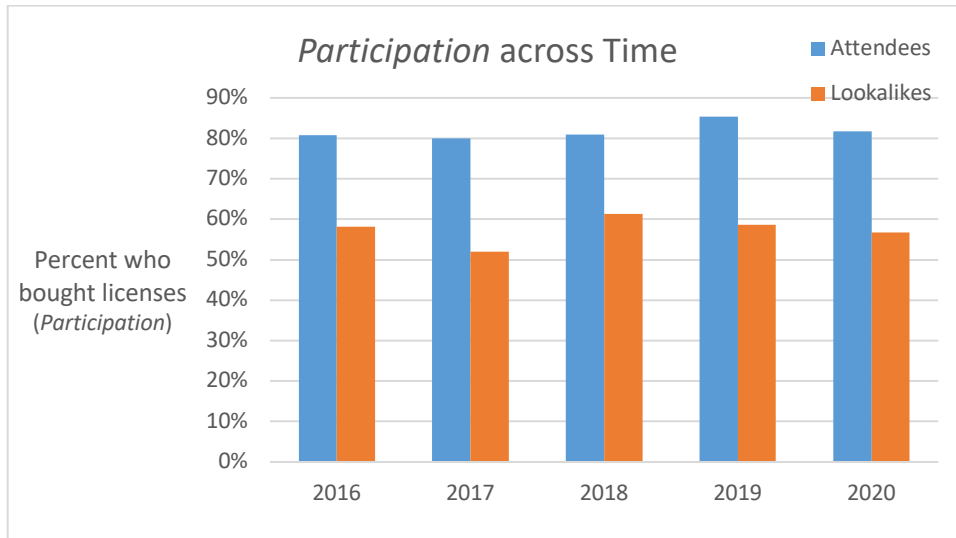
When attendees and lookalikes are compared by year, engagement is initially higher by about 0.69 licenses per year, on average as a group (Figure 30). Engagement then continues to increase to 1.09 more licenses purchased per year in 2019 and 0.94 more licenses purchased per year in 2020 ($M_{LOOKALIKE} = 0.58$, $M_{ATTENDEE} = 1.53$). This suggests that R3 events initially induced attendees to buy more licenses, and that these events then continued to induce additional purchases for a portion of attendees.

Figure 30. Attendees buy more licenses than their matched-pair lookalikes.
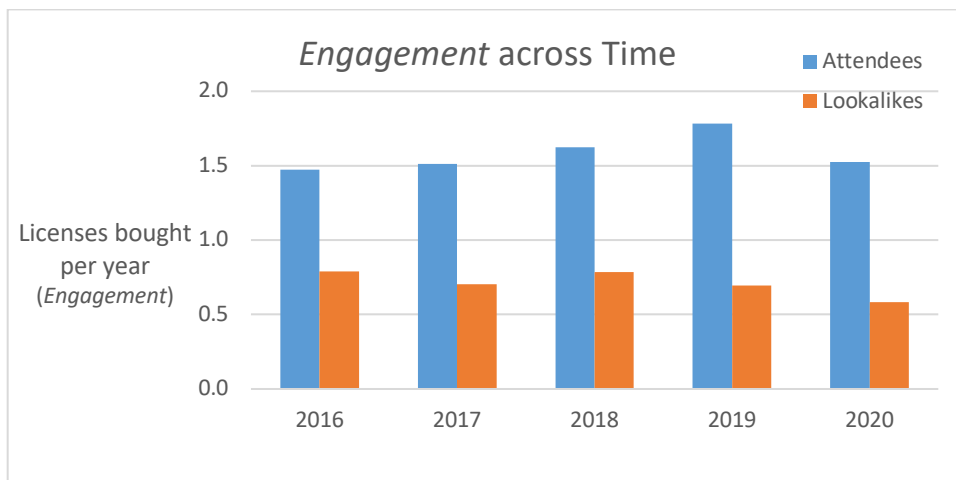
Data from Massachusetts suggest that, regardless of the age of the R3 event attendee, there is a lift in participation (Figure 31). The greatest lift in participation was for attendees aged 35-50 (30%) followed by ages 25-35 (28%). However, the lift gained from attendees in comparison to the lookalikes was the least for ages 18-25, followed by minors under 18 years of age. This indicates that if the goal of R3 events is to generate additional customers who consistently buy licenses year over year, a focus on attendees aged 25-50 yields the best return on investment.

Figure 31. The increase in participation in R3 events is greatest for attendees who are aged 25-50. Conversely, the reduction of churn attributable to R3 event attendance is the least for attendees aged 25 and under.
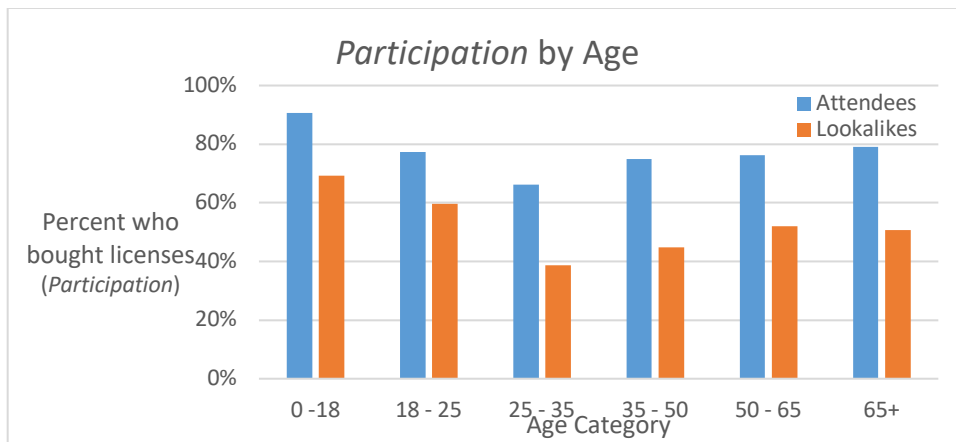
Massachusetts data also indicate there is a lift in engagement for all age categories of R3 event attendees (Figure 32). Diverging from the findings of other states, youth attendees under age 18 had the largest lift, with 1.57 additional licenses purchased per year. Adult attendees aged 18-25 had the next highest lift, with 0.86 to 1.55 license purchases per year. Further investigation would be needed to explain why Massachusetts experienced a lift in engagement within the under-18 age group when other states did not.

Figure 32. Massachusetts differed from other states in that the largest increase in engagement was seen in the younger age ranges.
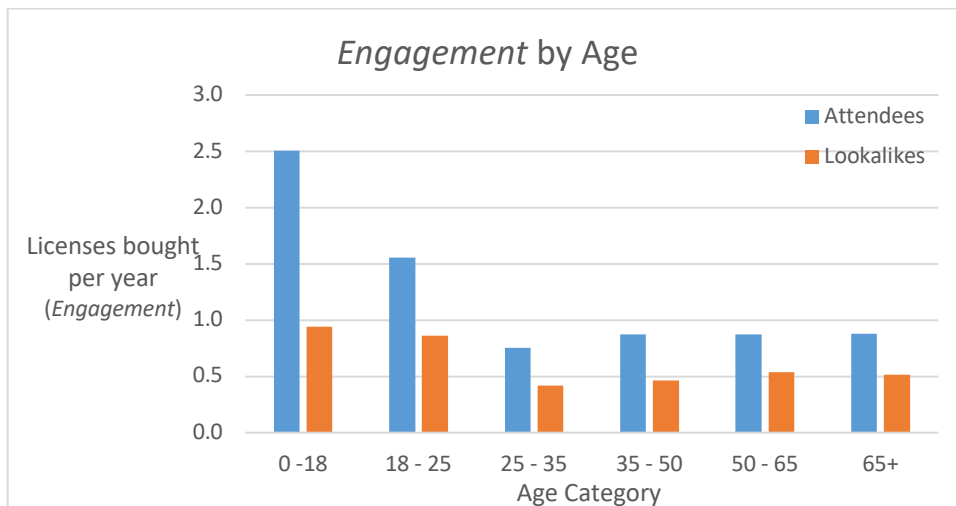
Within Massachusetts, there were some R3 events that resulted in attendees having higher overall participation, when compared to their matched-pair lookalikes (Figure 33). The *Becoming an Outdoor Woman-Deer* and *Youth Pheasant* hunt R3 event types resulted in the greatest lift, whereas the *Turkey* and the *Youth Turkey* events resulted in the lowest lift, in terms of participation.

Figure 33. R3 events (or types of events if the sample was small) are listed left to right in order of their impact on participation, with most effective events on the left.
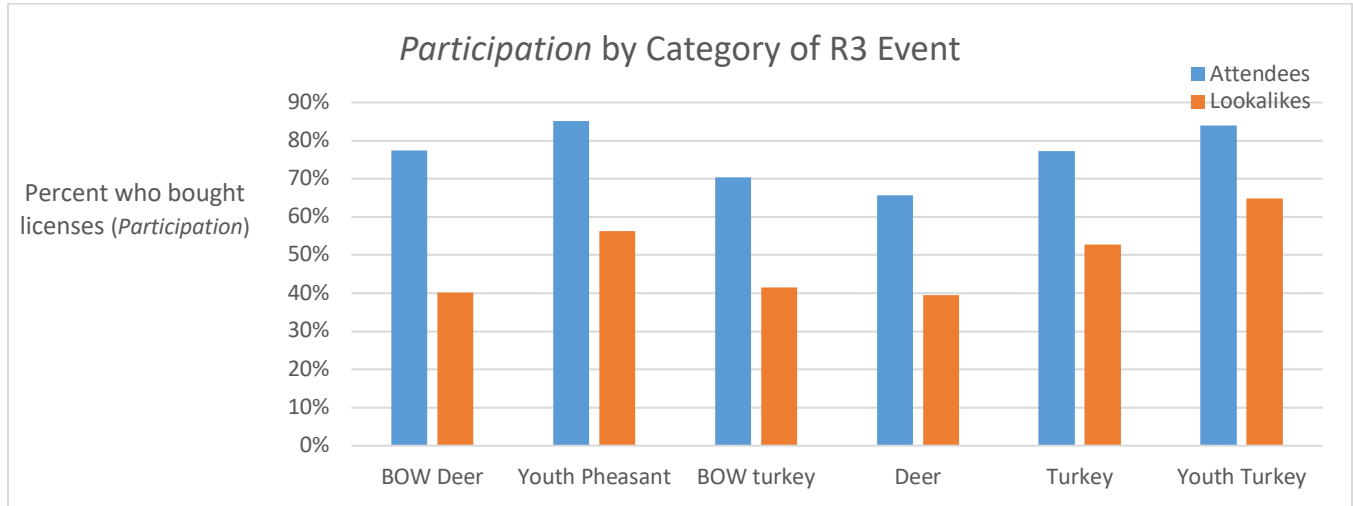
Interestingly, the *Youth Pheasant* and *Youth Turkey* event types resulted in significant lifts in engagement, with approximately double the licenses purchased per year (Figure 34). The *Becoming an Outdoor Woman-Turkey* and the *Turkey* hunt event types resulted in the lowest lift, in terms of engagement. Further investigation is needed to comprehend why the engagement lift for youth events in Massachusetts differ from the remainder of the states.

Figure 34. R3 events and event types are listed left to right in same order as Figure 33. R3 events focused on youth pheasant and youth turkey resulted in the biggest lift, in terms of licenses purchased.
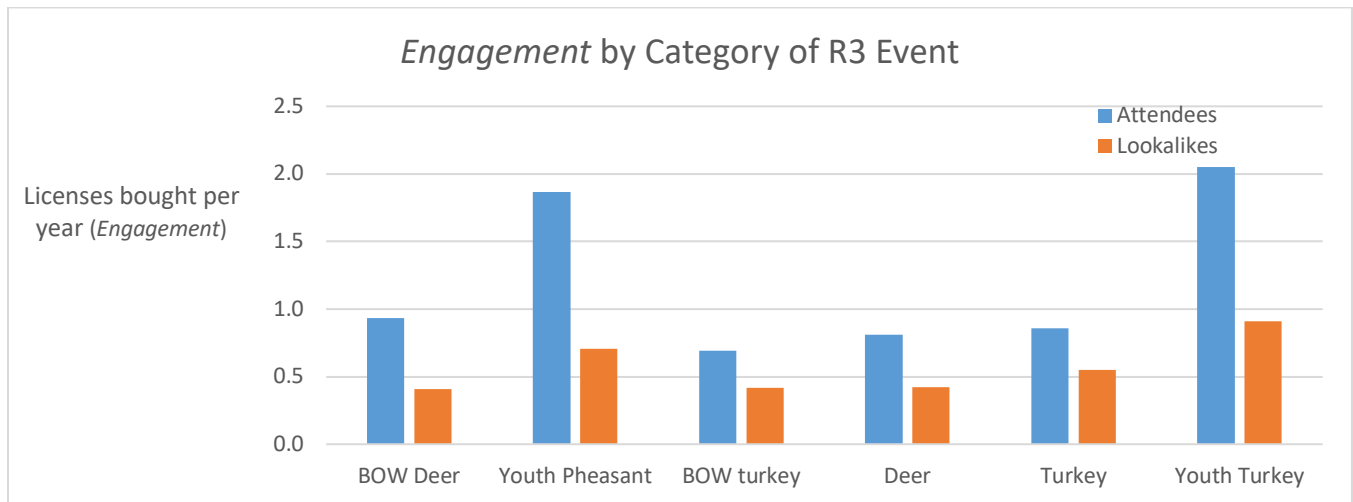
The data were structured in some states, including Massachusetts, that permitted analysis in determining if attending multiple events resulted in a difference in retention effects. In Massachusetts, there were enough attendees and events to conduct analysis on attendance in up to three R3 events (some in the attendee group had attended more events, but the small sample size precluded any analysis). We found that for those who attended one, two, or three events, the participation lift was 21%, 38% and 39%, respectively (Figure 35). The most lift came from attending one event, an additional lift came from attending a second. However, there is no additional lift in participation for those attending three or more events. More research is needed to understand why, in Massachusetts, attending a second event resulted in additional lift, when all other states did not manifest such a lift in participation.

Figure 35. Attending more than two R3 events does not result in higher participation.
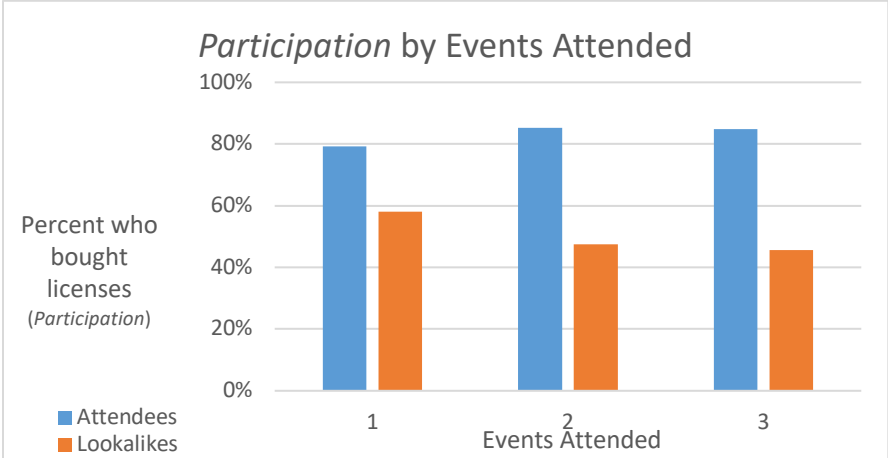
We also compared attendees who attended multiple events to those who attended just one event; the lift in engagement for those who attended one event versus two or more events was similar. We found that, regardless of the number of R3 events an attendee participated in, the lift in engagement was consistently between 82% to 89% (Figure 36). Consequently, we found no evidence that suggests attending more than one R3 event had any additional marginal benefit over attending just one event.

Figure 36. Attending more R3 events does not result in higher engagement.
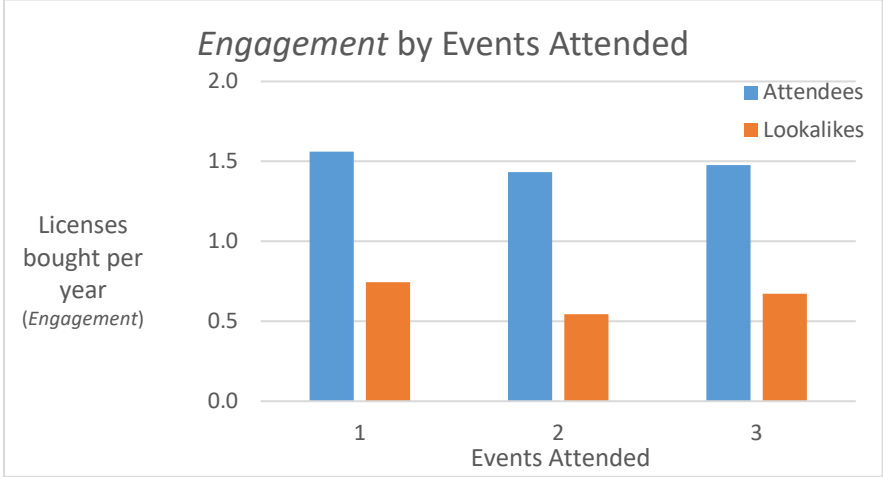
Missouri

The average customer from Missouri purchased just over 8 licenses, tags, or stamps between 2009 and 2021 ($M_{licenses}$=8.08). When comparing those who participated in an R3 event (attendees) to matched-pair lookalikes (lookalikes) there was not a significant difference on the variables of sex, age, latitude, longitude, or starting year. This is expected because these were some of the variables that were held constant, and this consistency acts as a quality-control, quality-assurance check indicating the Mahalanobis distance match pairing was successful. However, in comparison to the average Missourian customer, the attendees and lookalikes were more likely to be slightly more male, significantly younger, and slightly more rural (i.e., the geographic-weighted center for all Missourian customers was split, but centered within the triangle formed between Kansas City, St. Louis, and Springfield. The geographic-weighted center of both the attendees and lookalikes was further north and east).

In comparison to the average Missouri customer, the lookalike group purchased slightly fewer licenses, had higher participation, and had hunted or fished in slightly more years ($M_{Licenses}$=7.70, $M_{Participation}$=0.52, $M_{TotYears}$=3.19) (Table 6). The difference observed between the 'normal' customer and the lookalike group suggests there is a moderate selection effect, meaning that Missouri customers who opt-in to R3 events are likely to be more avid *before* they participated in the R3 event. However, the attendee group had lift above and beyond the lookalike group in that they purchased more licenses, had slightly higher participation, and hunted or fished in more years than the lookalike group ($M_{Licenses}$=14.50, $M_{Participation}$=0.78, $M_{TotYears}$=5.09). This indicates that, in addition to the moderate selection effect, attending an R3 event results in a true lift, as attendees are likely to be more avid *because* they participated in the R3 event. The attendee group bought more licenses year over year (higher engagement [$M_{Engagement}$=0.72]), than both the lookalike group and the average Missouri customer. This finding indicates the effects of attending an R3 event induces a portion of attendees to buy more licenses, and further indicates this effect lasts for a few years after attending an event. An important note is that Missouri R3 events may not have attracted as many new customers as anticipated, as many R3 event attendees (41.6%) had purchased a license in at least one license year prior to attending an R3 event. This statistic indicates three out of every seven attendees were highly likely to have already been recruited to some extent before attending an R3 event.

Table 6. Topline comparisons of variables of interest between R3 event attendees (attendees), matched-pair lookalikes (lookalikes), and all customers of Missouri's Department of Conservation.

	Attendees	Lookalikes	Missouri
Male	71.8%	71.8%	71.0%
Age	24.03	24.07	45.06
Latitude	38.3154	38.3133	38.1765
Longitude	92.3999	92.4012	92.5462
Starting year	2015.13	2015.13	2013.87
Total licenses	14.50	7.70	8.08
Participation	0.78	0.52	0.45
Engagement	0.72	0.51	0.44
Total Years	5.09	3.19	3.13

For each year data were available, Missour R3 event attendees bought between 0.04-1.30 more licenses than their matched-pair lookalikes (Figure 37). In years after 2016, lookalikes paralleled the average customer from Missouri, with only slightly more licenses bought. Although the number of licenses bought is variable by year, after 2016 the data stabilize, and the attendees are an average of 1.00 licenses above the baseline of the lookalikes.

Figure 37. The average licenses bought is higher for the attendee group.
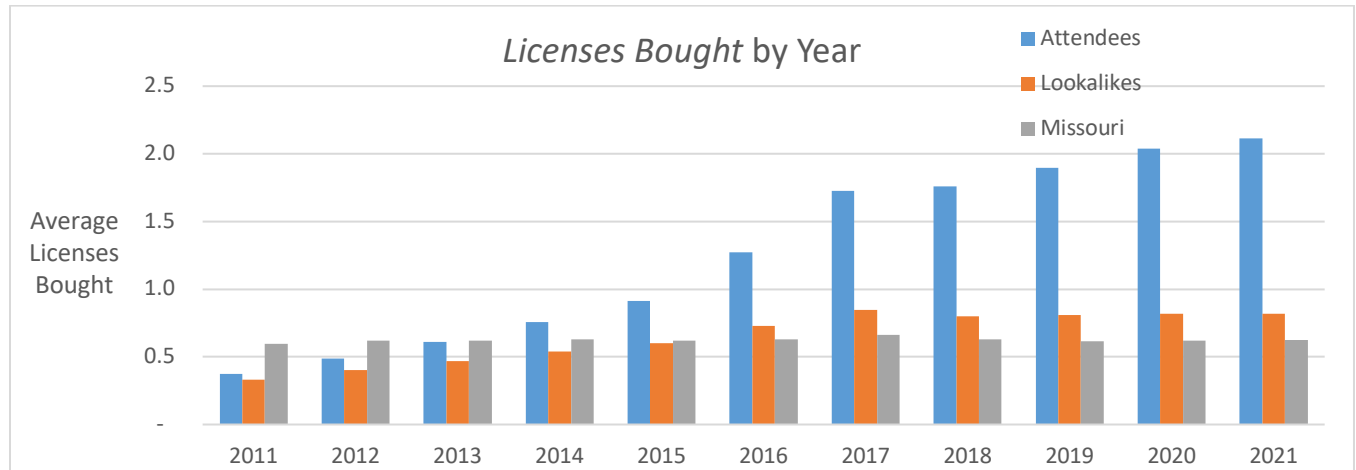
The attendee group differed from the lookalike group and differed even more from all Missouri customers, particularly in later years (Figure 38). The average Missouri customer, after buying their initial license, consistently bought a license on average 28-29% of the following years. However, for license years after 2016, both the attendees and lookalikes more consistently bought licenses year to year. The attendee group was approximately 27% higher than the lookalikes, regardless of the year they initially purchased a license. This difference in more recent years indicates that attendees and lookalikes buy licenses more consistently than average Missourians. This lift for attendees is simultaneously attributable to a difference *before* the R3 event as well as *because* of the R3 event.

Figure 38. Attendees buy licenses more consistently than their lookalikes. Attendees and lookalikes bought licenses more consistently in more recent years.
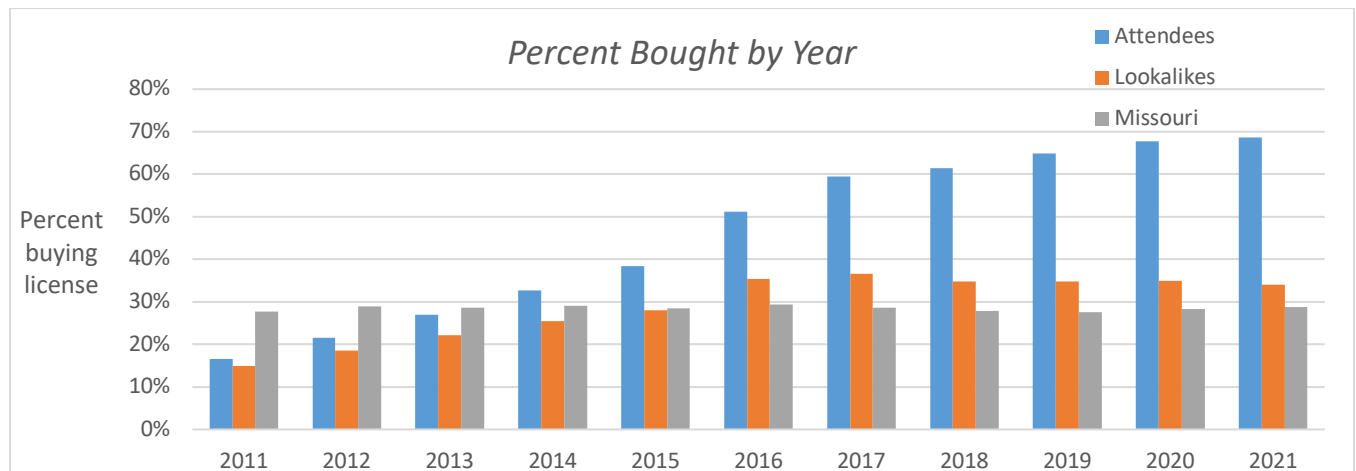
When attendees and lookalikes are compared by year, participation is 19-29% higher for attendees after 2016 (i.e., the attendee blue line is higher than the lookalike orange line) (Figure 39). The distance between the lookalike and attendee groups is the amount of difference between the two groups, in this case, R3 attendees churn about 25% less than their matched-pair lookalikes, but this churn is variable year to year.

Figure 39. Attendees have better year-over-year participation, or attendees churn less than their matched-pair lookalikes.
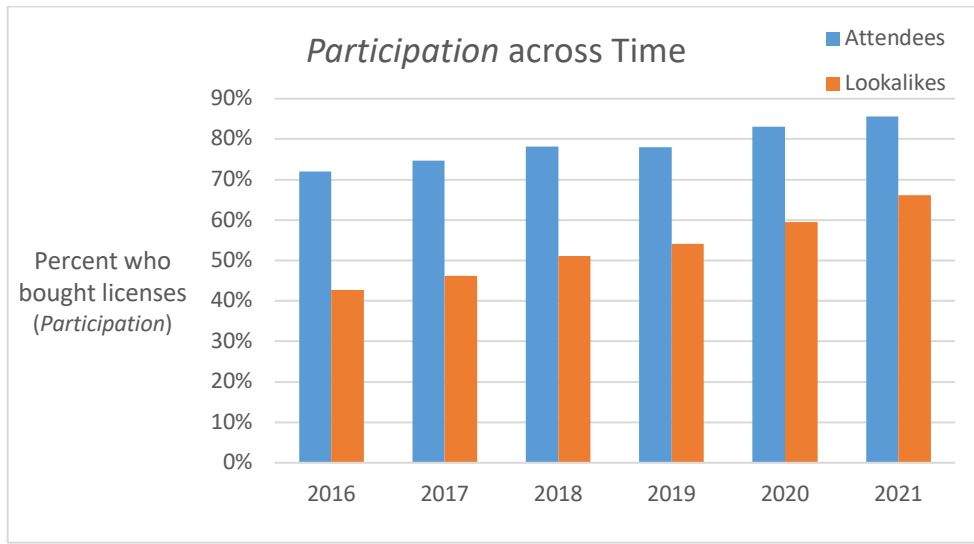
When attendees and lookalikes are compared by year, engagement is 0.16-0.25 licenses higher (Figure 40). Between 2016 and 2021, attendees bought 0.20 more licenses per year than did the lookalike group. In 2021, attendees bought 0.18 more licenses per year ($M_{LOOKALIKE} = 0.66$, $M_{ATTENDEE} = 0.84$). These data suggest that R3 events initially induced attendees to buy more licenses, and that these events then continued to induce additional purchases for a small portion of attendees.

Figure 40. Attendees buy more licenses than their matched-pair lookalikes.
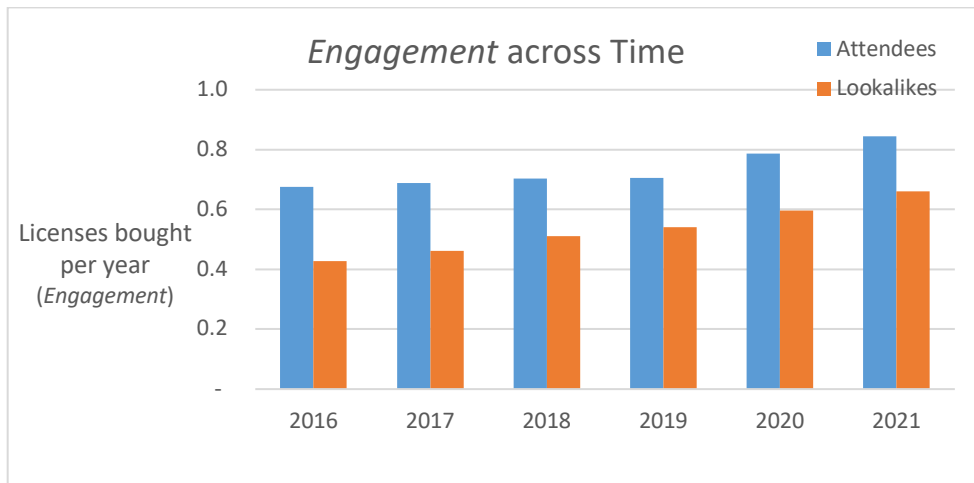
Data from Missouri suggest that, regardless of the age of the R3 event attendee, there is a lift in participation (Figure 41). The greatest lift in participation was for attendees aged 25-35. Missouri diverged from the findings of other states in that the participation lift gained from attendees under the age of 18 was not significantly lower than other age groups. These findings indicate that focusing on attendees aged 25-35 yields the best return on investment in terms of participation.

Figure 41. The increase in participation in R3 events is greatest for attendees who are aged 25-35.
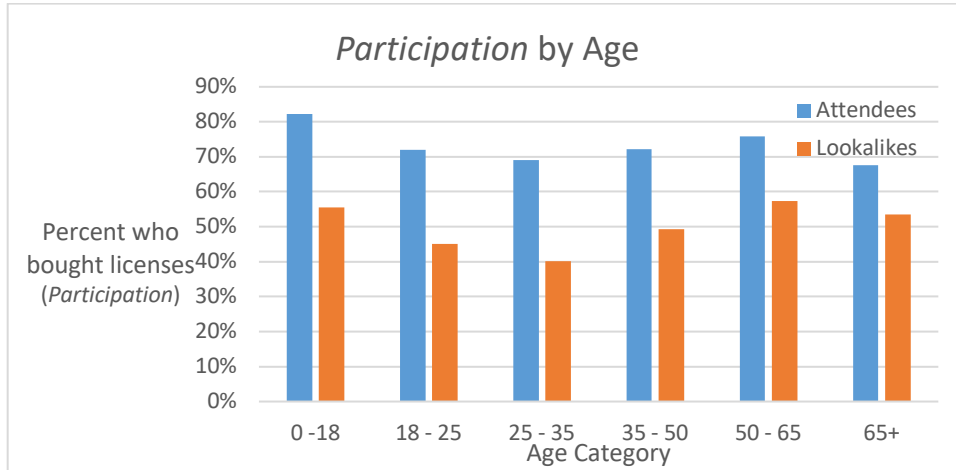
Missouri data also indicate there is a lift in engagement for all adult-age categories of R3 event attendees (Figure 42). Adult attendees aged 25-35 and 35-50 annually purchased 0.28 and 0.22 additional licenses over their lookalikes. Missouri again diverged from the findings of other states in that the engagement lift gained from attendees under the age of 18 was not significantly lower than other age groups. Although Missouri is more effective with their youth programs, focusing R3 efforts on adult attendees aged 25-50 will yield the best returns on investment in terms of engagement, as adults buy more licenses per year.

Figure 42. Adult R3 attendees buy nearly twice the number of licenses annually than their matched-pair lookalikes.
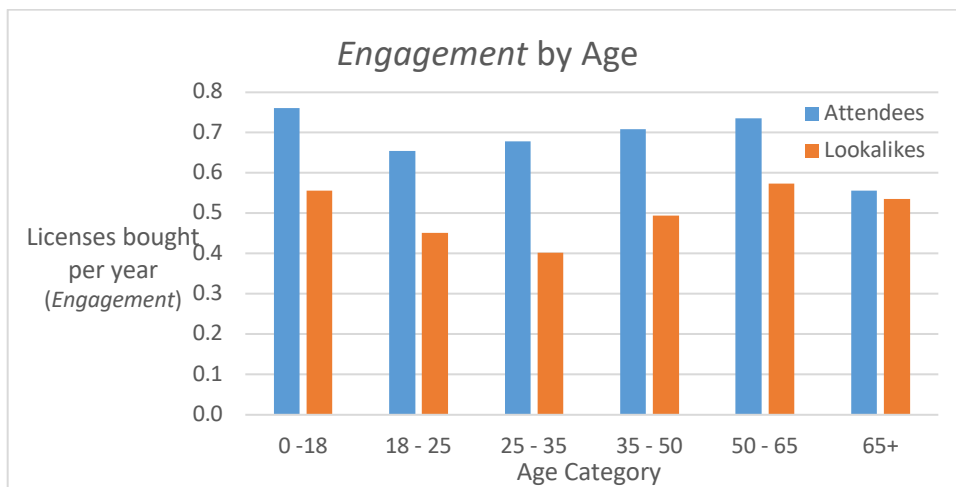
Within Missouri, there were some R3 events that resulted in attendees having higher overall lift in participation (Figure 43) and Engagement (Figure 44) when compared to their matched-pair lookalikes. R3 event types such as *Hunter Education Skills* and *Bow Hunter Education* resulted in the greatest lift, whereas the *Discover Nature* and *Shooting* events resulted in the lowest lift in terms of participation. The R3 event types such as *Hunter Education Skills* and the *Bow Hunter Education* also resulted in more lift in terms of engagement. The *Discover Nature* and *Shooting* events resulted in the lowest lift in terms of engagement.

Figure 43. Types of R3 events are listed left to right in order of their impact on participation, with the most effective events on the left.
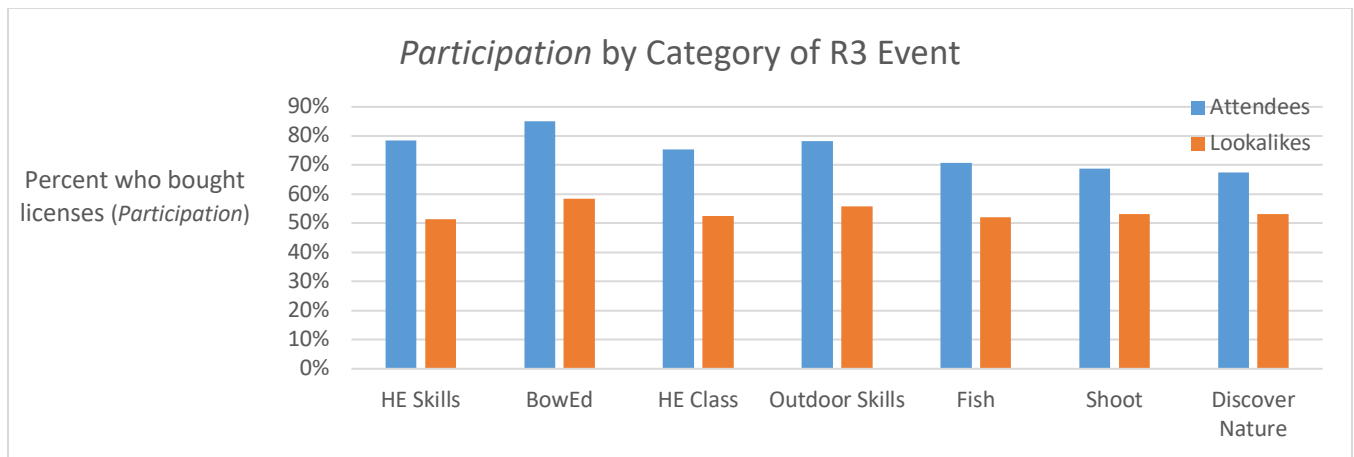
Figure 44. Types of R3 events are listed left to right in same order as Figure 43, with similar results in terms of engagement.
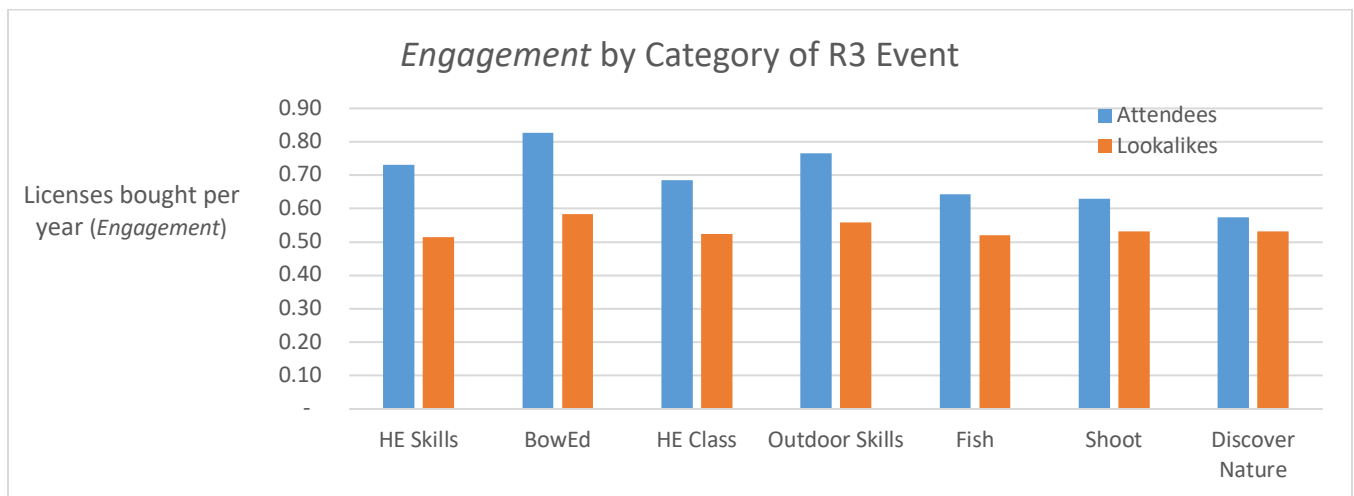
The data were structured in some states, including Missouri, that permitted analysis in determining if attending multiple events resulted in a difference in retention effects. In Missouri, there were enough attendees and events to conduct analysis on attendance in up to six R3 events (some in the attendee group had attended more events, but the small sample size precluded any analysis). We found that,

regardless of the number of R3 events an attendee participated in, the lift in participation was consistently between 20 and 26% lift, and the most lift came from attending one event (Figure 45). Consequently, we found no evidence to suggest that attending more than one R3 event had any additional marginal benefit over attending just one event, in terms of participation.

Figure 45. Attending more R3 events does not result in higher participation.
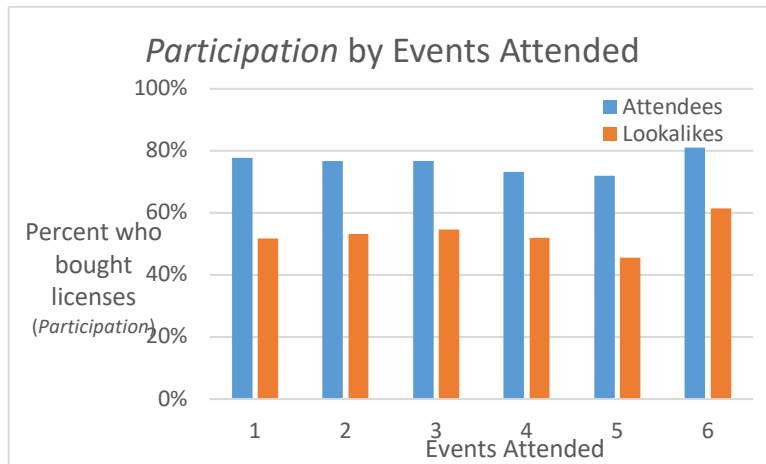
We also compared attendees who attended multiple events to those who attended just one event. The lift in engagement for those who attended one event versus two or more events was very similar (Figure 46). We found that, regardless of the number of R3 events an attendee participated in, the lift in engagement was consistently between 13 and 22%. Consequently, we found no evidence that suggests that attending more than one R3 event had any additional marginal benefit over attending just one event, in terms of engagement.

Figure 46. Attending more R3 events does not result in higher engagement.
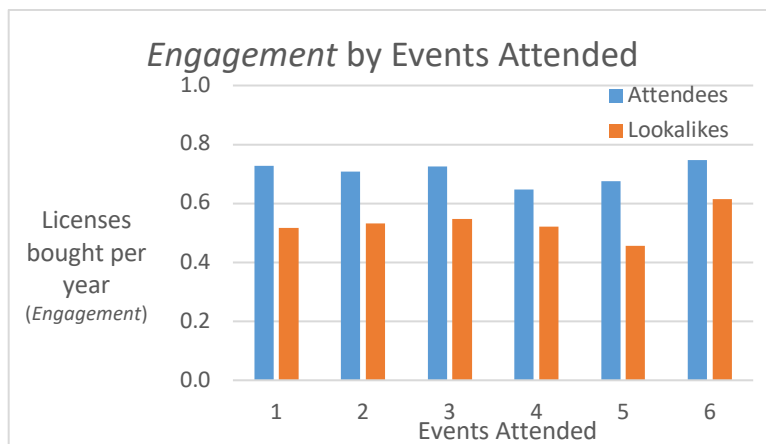
New Mexico

The average customer from New Mexico purchased just under 5 licenses, tags, or stamps between 2013 and 2020 ($M_{licenses}$= 4.88) (Table 7). When comparing those who participated in an R3 event (attendees) to matched-pair lookalikes (lookalikes) there was not a significant difference on the variables of sex, age, latitude, longitude, or starting year. This is expected because these were some of the variables that were held constant, and this consistency acts as a quality-control, quality-assurance check indicating the Mahalanobis distance match pairing was successful. However, in comparison to the average New Mexico customer, the attendees and lookalikes were more likely to be female (69% vs 84% male) and younger (31 vs 47 years of age). In New Mexico, zip codes were not reliably available and matched-pairing that included latitudes and longitudes resulted in an unacceptably small sample, therefore geographic-weighted centroids were not available for analysis in New Mexico.

In comparison to the average New Mexico customer, the lookalike group purchased slightly fewer licenses, had similar participation, and had hunted or fished in slightly fewer years ($M_{Licenses}$=3.36, $M_{Participation}$=0.56, $M_{TotYears}$=2.19). The difference observed between the 'normal' customer and the lookalike group is different from other states (that showed a moderate selection effect). This is likely not because New Mexico is systematically different, but because the Mahalanobis distance match pairing was of lower quality because latitudes and longitudes were not considered during the matching process.

Table 7. Topline comparisons of variables of interest between R3 event attendees (attendees), matched-pair lookalikes (lookalikes), and all customers of New Mexico's Department of Game and Fish.

	Attendees	Lookalikes	New Mexico
Male	69.2%	69.2%	84.5%
Age	31.42	31.41	46.72
Latitude	--	--	--
Longitude	--	--	--
Starting year	2016.13	2016.13	2016.28
Total licenses	7.65	3.36	4.88
Participation	0.75	0.56	0.56
Engagement	1.02	0.95	0.82
Total Years	4.32	2.19	2.96

The attendee group was higher than both the lookalike group and all New Mexico customers in terms of total licenses purchased, participation, and years in which they hunted or fished ($M_{Licenses}$=7.65, $M_{Participation}$=0.75, $M_{TotYears}$=4.32). This indicates that attending an R3 event results in a lift, as attendees are likely to be more avid *because* they participated in the R3 event. The attendee group bought more licenses year over year (higher engagement [$M_{Engagement}$=1.02]), than both the lookalike group and the average New Mexico customer. This indicates the effects of attending an R3 event induces a portion of attendees to buy more licenses, and further indicates this effect lasts for a few years after attending an event. An important note is that New Mexico R3 events may not have attracted as many new customers as anticipated, as a portion of R3 event attendees (27.3%) had purchased a license in at least one license year prior to attending an R3 event. In comparison to other states, New Mexico is doing a relatively good job attracting new customers, as this statistic indicates only two out of every seven attendees were highly likely to have already been recruited to some extent before attending an R3 event.

For each year data were available, New Mexico R3 event attendees bought between 0.09-0.30 more licenses than their matched-pair lookalikes, and 0.08-0.36 more licenses than the average New Mexico customer (Figure 47). Although the number of licenses bought is variable by year, the attendees are an average of 0.19 licenses above the baseline of the lookalikes.

Figure 47. The average licenses bought is slightly consistently higher for the attendee group.
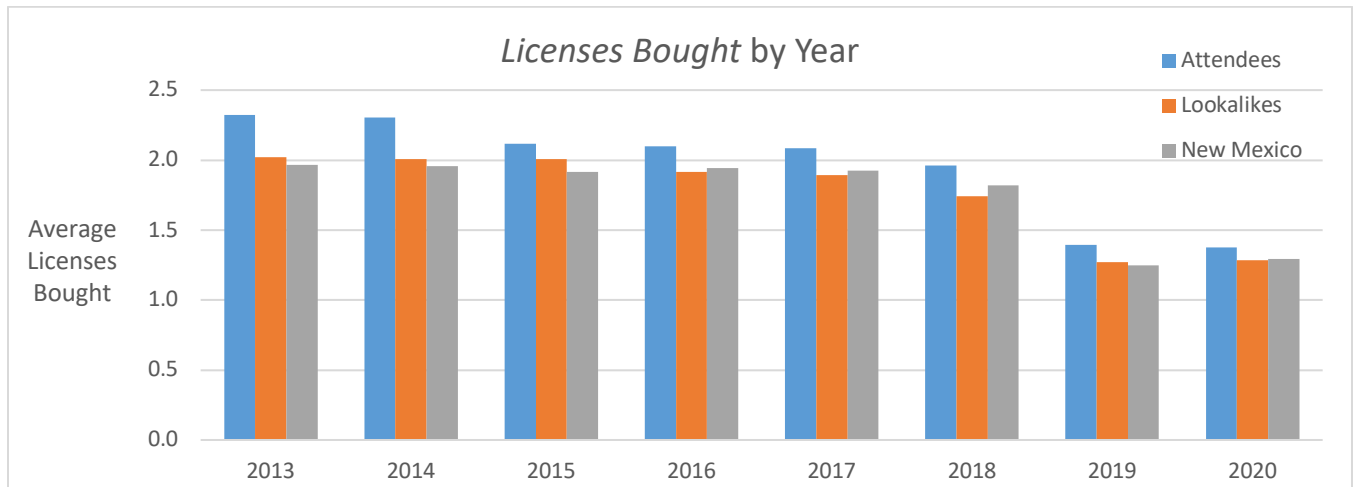
The attendee group differed from the lookalike group and differed even more from all New Mexico customers, particularly in later years (Figure 48). The average New Mexico customer, after buying their initial license, bought a license on average 28-40% of the following years. However, both the attendees and lookalikes bought licenses more consistently year to year, especially in more recent years. The attendee group was approximately 27% higher than the lookalikes, though that estimate increases with more recent years. This difference in more recent years indicates that attendees buy licenses more consistently than their lookalikes as well as average New Mexico customers. This improvement is simultaneously attributable to attendees being different *before* and *because* of an R3 event, but what portion of the observed lift is due to attending an R3 event is unclear.

Figure 48. Attendees buy licenses more consistently than their lookalikes.
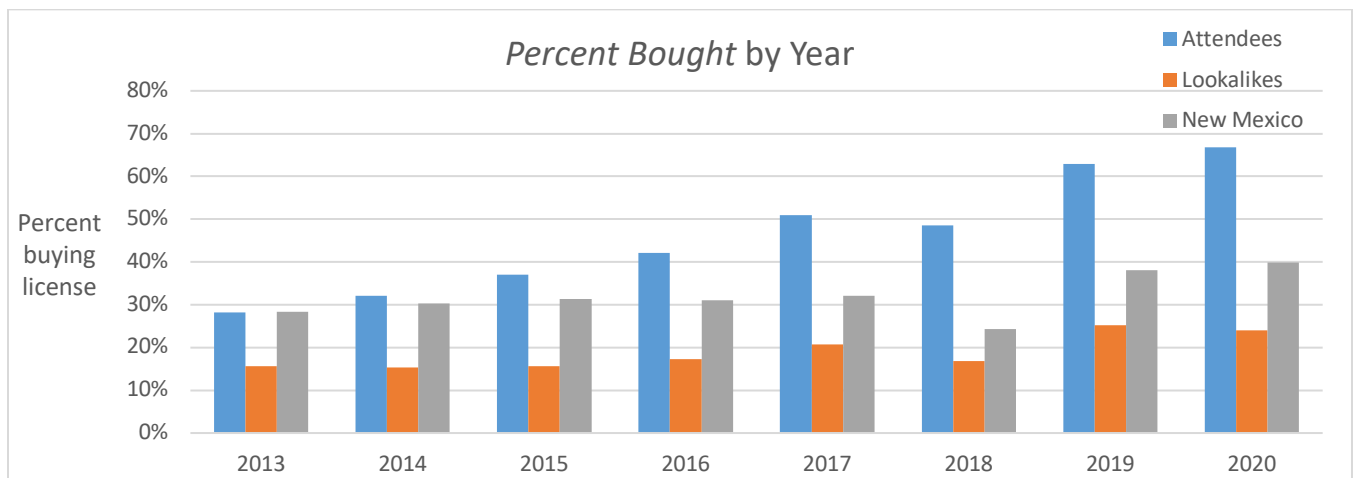
When attendees and lookalikes are compared by year, participation is between 25% lower and 10% higher for attendees after 2013 (i.e., the attendee blue line is higher than the lookalike orange line in 2016, 2017, 2018, and 2020) (Figure 49). The distance between the lookalike and attendee groups is the amount of difference between the two groups, in this case, R3 attendees churned at approximately the same rates as their matched-pair lookalikes in each year.

Figure 49. Attendees and lookalikes churned at approximately the same rate.
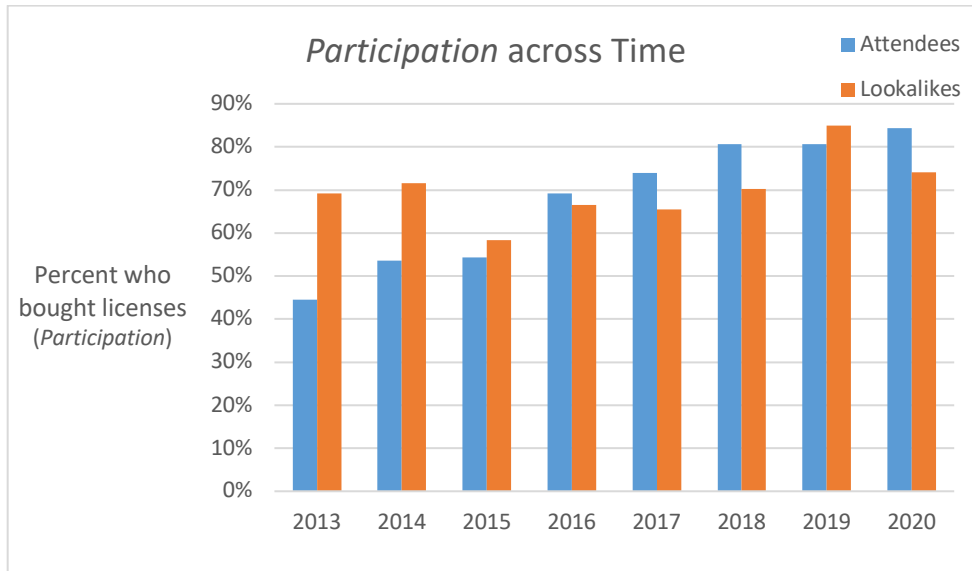
When attendees and lookalikes are compared by year, engagement is approximately similar for the license years analyzed. Between 2013 and 2020, attendees bought 0.06 more licenses per year than did the lookalike group (Figure 50). Engagement for the two group diverges significantly in 2020, when the attendee group bought 0.50 more licenses per year ($M_{LOOKALIKE} = 1.41$, $M_{ATTENDEE} = 0.91$). It should be noted that the divergence in the last year available is likely due more to data management than a true difference in engagement between 2013-2019 and the 2020 license year.

Figure 50. Attendees buy more licenses than their matched-pair lookalikes.
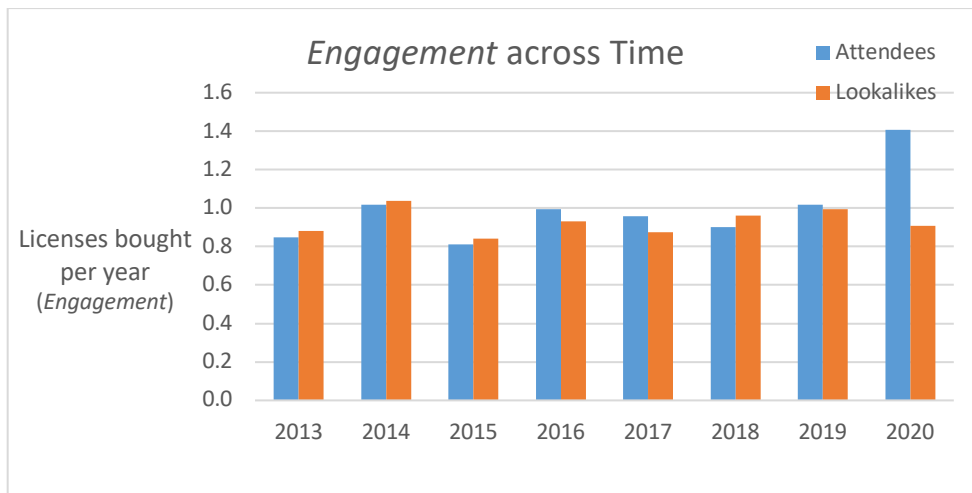
Data from New Mexico suggest that, regardless of the age of the R3 event attendee, there is a minimal amount of lift in participation (Figure 51). The greatest lift in participation (6%) was for the attendees aged 50-65. The second greatest lift was for attendees aged 25-35 The lift observed in youth attendees under 18 years of age was imperceptible. This finding indicates that focusing on adult attendees yields the best return on investment.

Figure 51. The increase in participation in R3 events is greatest for attendees who are aged 50-65. Conversely, the reduction of churn attributable to R3 event attendance is the least for minors.
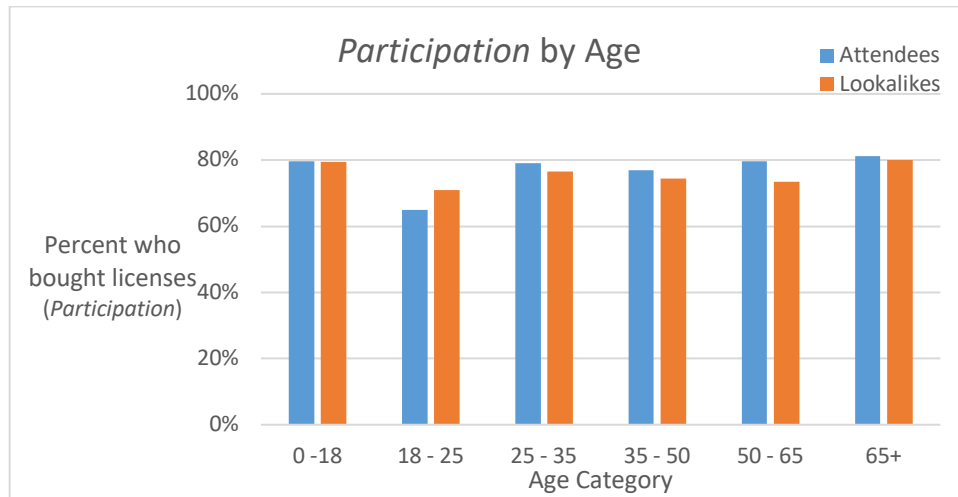
New Mexico data also indicate there is a lift in engagement for R3 attendees aged 25 years of age and older (Figure 52). Youth attendees under age 18 had no lift above and beyond their lookalikes. However, adult attendees aged 25-35 annually purchased 0.45 additional licenses over their lookalikes. Focusing on adult attendees will yield the best returns on investment in terms of engagement, as adults buy more licenses per year. Youth attendees did not respond with a similar lift.

Figure 52. Attending an R3 event does not meaningfully increase the number of licenses bought by minors. However, adult R3 attendees buy more licenses annually than their matched-pair lookalikes.
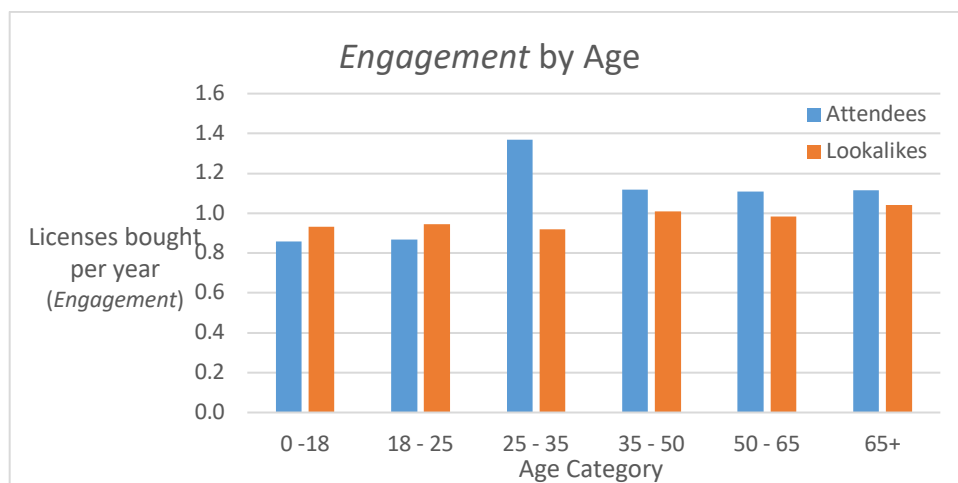
Within New Mexico, there were some R3 events that resulted in attendees having higher overall lift when compared to their matched-pair lookalikes (Figure 53). Events focused on *Turkey* and *Skills Courses of Hunter Education* resulted in the greatest lift, whereas events focused on *Elk* and *Small Game* resulted in the lowest lift in terms of participation.
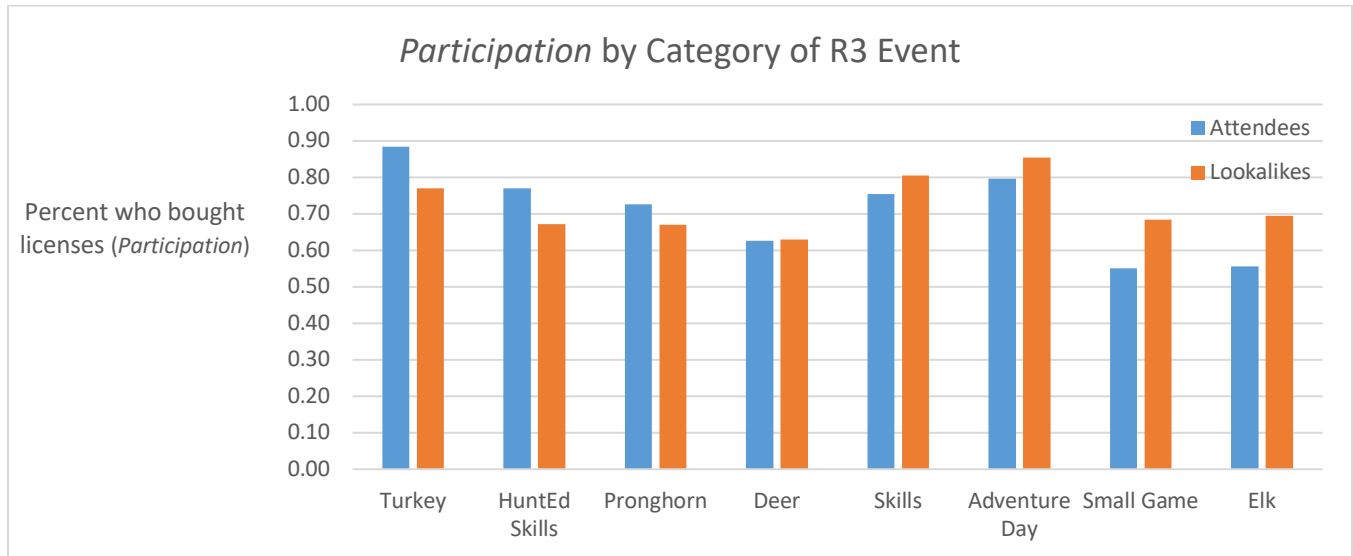
Turkey, *Pronghorn*, and *Adventure Day* R3 events were the most effective R3 events in terms of engagement (Figure 54). The *Skills, Small Game,* and *Elk* R3 events were the least effective, in fact the matched-pair lookalikes outperformed the attendees in these categories. Because geographic location data were not available for New Mexico, there is greater uncertainty associated with the findings by R3 event than other participating states.
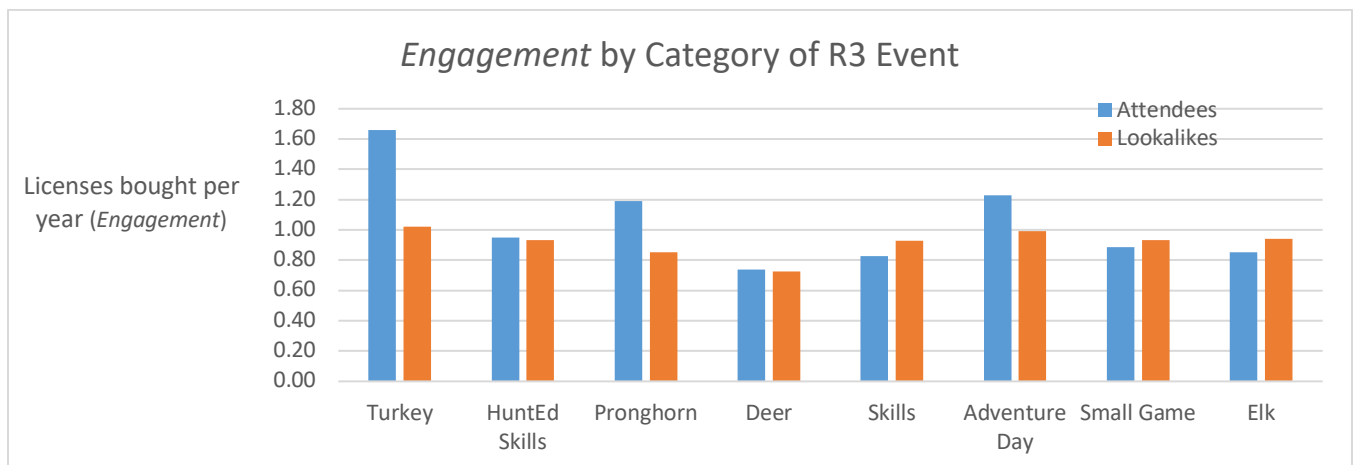
North Dakota

The average customer from North Dakota purchased over 8 licenses, tags, or stamps between 2009 and 2021 ($M_{licenses}$=8.58). When comparing those who participated in an R3 event (attendees) to matched-pair lookalikes (lookalikes) there was not a significant difference on the variables of sex, age, latitude, longitude, or starting year. This is expected because these were some of the variables that were held constant, and this consistency acts as a quality-control, quality-assurance check indicating the Mahalanobis distance match pairing was successful. However, in comparison to the average North Dakota customer, the attendees and lookalikes were more likely to be female, younger, and more rural (i.e., the geographic-weighted center for North Dakota customers was split between Fargo and Bismarck, but the geographic-weighted center of both the attendees and lookalikes was further north and west).

In comparison to the average North Dakota customer, the lookalike group purchased more licenses, had slightly higher participation, and had hunted or fished in slightly more years ($M_{Licenses}$=9.97, $M_{Participation}$=0.73, $M_{TotYears}$=5.14) (Table 8). The difference observed between the average customer and the lookalike group suggests there is a moderate selection effect, meaning that North Dakota customers who opt-in to R3 events are likely to be more avid *before* they participated in the R3 event. However, the attendee group had lift above and beyond the lookalike group in that they purchased more licenses, had slightly higher participation, and hunted or fished in more years than the lookalike group ($M_{Licenses}$=12.27, $M_{Participation}$=0.82, $M_{TotYears}$=6.07). This indicates that, in addition to the moderate selection effect, attending an R3 event results in a true lift, as attendees are likely to be more avid *because* they participated in the R3 event. The attendee group bought more licenses year over year (higher engagement [$M_{Engagement}$=1.53]), than both the lookalike group and the average North Dakota customer. This indicates the effects of attending an R3 event induces a portion of attendees to buy more licenses, and further indicates this effect lasts for a few years after attending an event. An important note is that North Dakota R3 events may not have attracted as many new customers as anticipated, as many R3 event attendees (31.2%) had purchased a license in at least one license year prior to attending an R3 event. This statistic indicates one out of every three attendees were highly likely to have already been recruited to some extent before attending an R3 event.

Table 8. Topline comparisons of variables of interest between R3 event attendees (attendees), matched-pair lookalikes (lookalikes), and all customers of North Dakota's Game and Fish Department.

	Attendees	Lookalikes	North Dakota
Male	77%	77%	87.8%
Age	25.10	25.16	46.86
Latitude	47.1900	47.1892	44.8745
Longitude	99.5148	99.5128	97.0515
Starting year	2014.22	2014.22	2012.52
Total licenses	12.27	9.97	8.58
Participation	0.82	0.73	0.50
Engagement	1.53	1.33	1.01
Total Years	6.07	5.14	4.27

For each year data were available, North Dakota R3 event attendees bought between 0.03 and 0.19 more licenses than their matched-pair lookalikes, but a similar number of licenses as the average North

Dakota customer (Figure 55). Although the number of licenses bought is variable by year, the attendees are an average of 0.07 licenses above the baseline of the lookalikes.

Figure 55. The average licenses bought is consistently higher for the attendee group.
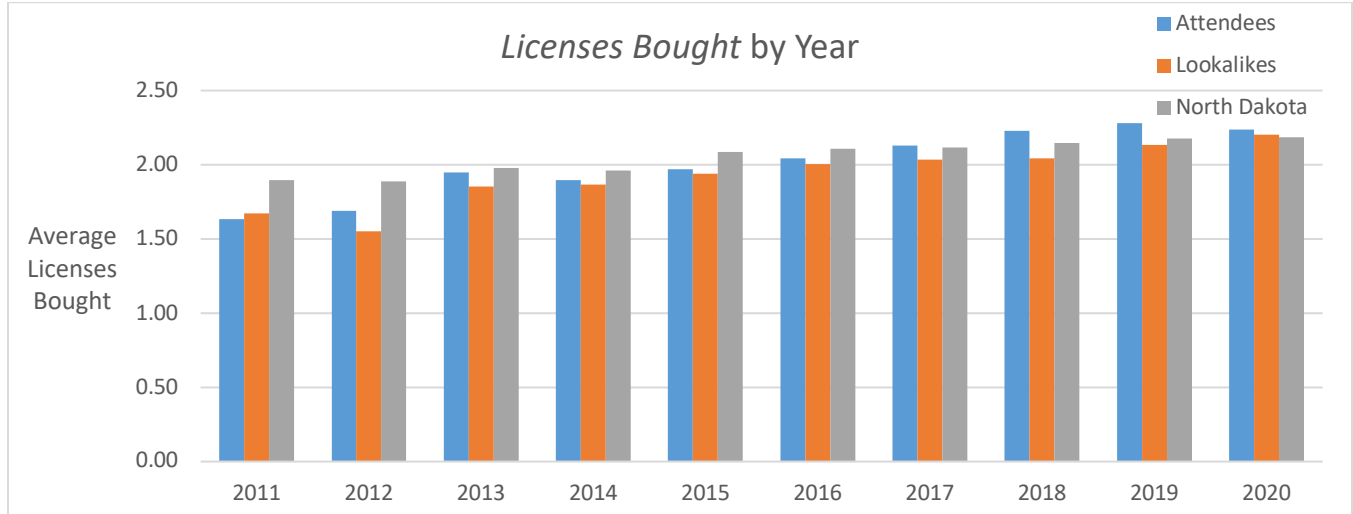
The attendee group differed from the lookalike group and differed even more from all North Dakota customers, particularly in later years (Figure 56). The average North Dakota customer, after buying their initial license, bought a license on average 32-36% of the following years. However, both the attendees and lookalikes more consistently bought licenses year-to-year, especially in more recent years. The attendee group was approximately 8% higher in license purchases than the lookalikes, regardless of the year they initially purchased a license. This difference in more recent years indicates that attendees and lookalikes buy licenses more consistently than average North Dakota customer. This improvement is simultaneously attributable to a difference *before* the R3 event as well as *because* of the R3 event.

Figure 56. Attendees buy licenses more consistently than their lookalikes. Attendees and lookalikes buy licenses more consistently in more recent years.
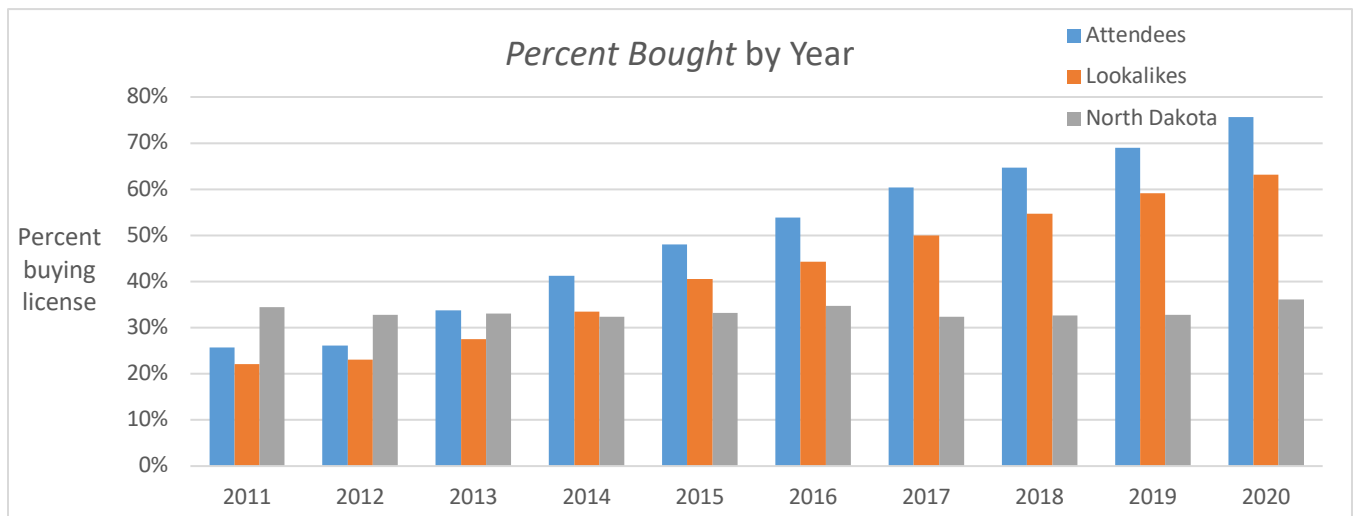
When attendees and lookalikes are compared by year, participation is consistently 4-23% higher for attendees after 2011 (i.e., the attendee blue line is higher than the lookalike orange line) (Figure 57). The distance between the lookalike and attendee groups is the amount of difference between the two groups, in this case, R3 attendees churn about 11% less than their matched-pair lookalikes, but this churn is variable year to year. The amount of annual variance is not likely true year-to-year variance but rather is attributable to lower sample sizes of attendees in earlier years.

Figure 57. Attendees have better year-over-year participation, or attendees churn less than their matched-pair lookalikes.
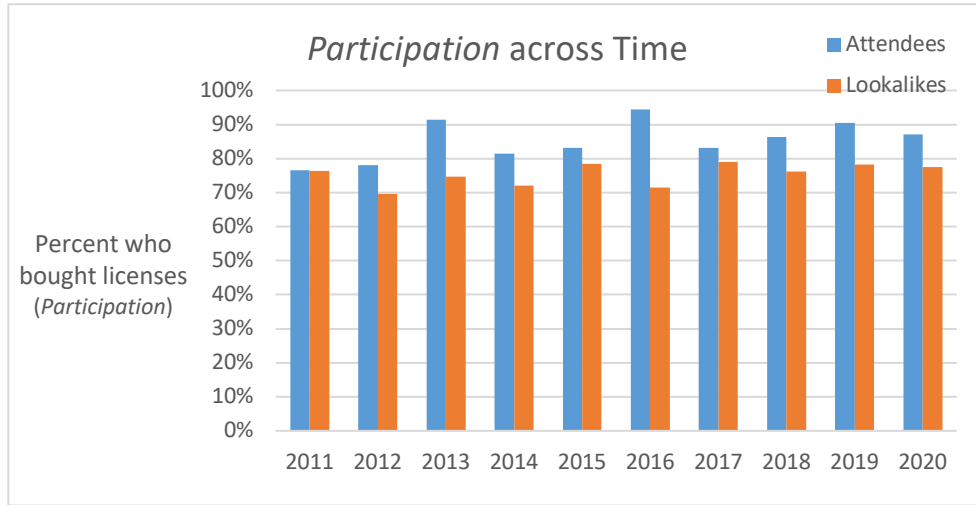
When attendees and lookalikes are compared by year, engagement is initially lower in 2011, but moves higher for all years (except 2015) (Figure 58). Between 2011 and 2020, attendees bought 0.25 more licenses per year than did the lookalike group. Engagement then continued to increase to 0.66 more licenses purchased per year in 2020 ($M_{LOOKALIKE} = 1.21$, $M_{ATTENDEE} = 1.87$). These data suggest that R3 events initially induced attendees to buy more licenses, and that these events then continued to induce additional purchases for a small portion of attendees.

Figure 58. Attendees buy more licenses than their matched-pair lookalikes.
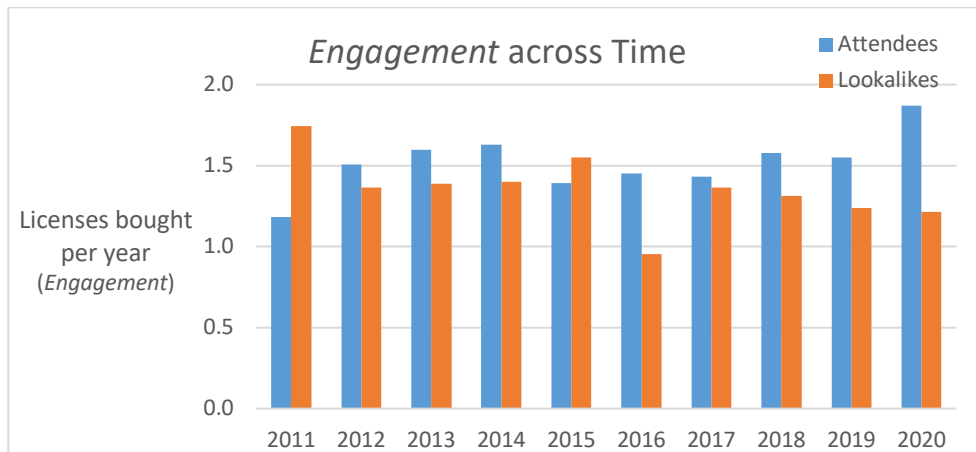
Data from North Dakota suggest that, regardless of the age of the R3 event attendee, there is a lift in participation (Figure 59). However, the lift gained from attendees in comparison to the lookalikes was minimal for youth under 18 years of age. The greatest lift in participation was for the attendees aged 65 and older. The second greatest lift was for attendees aged 25-35 and 35-50. This finding, in combination with the lifespan expectancy of customers, indicates that focusing on attendees aged 25-35 yields the best return on investment. This finding also indicates that North Dakota R3 event attendees older than 65 could consistently purchase licenses in the short term.

Figure 59. The increase in participation in R3 events is greatest for attendees who are aged 65 and older Conversely, the reduction of churn attributable to R3 event attendance is the least for minors.
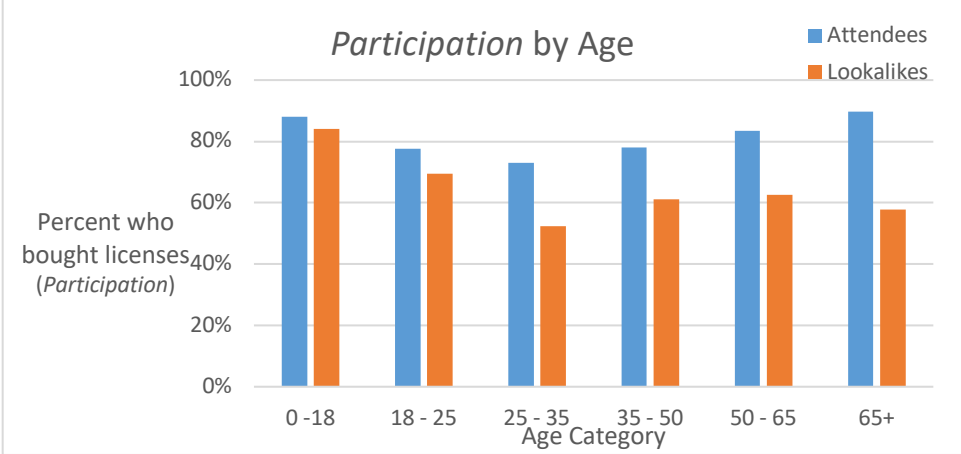
North Dakota data also indicate there is a lift in engagement for all adult-age categories of R3 event attendees (Figure 60). Youth attendees under age 18 had no lift and were too similar to their lookalikes to distinguish significant differences. However, adult attendees aged 25-35, 35-50, and 50-65 annually purchased 0.61, 0.69, and 0.82 additional licenses over their lookalikes. Focusing on adult attendees will yield the best returns on investment in terms of engagement, as adults buy more licenses per year. Youth attendees did not respond with a similar lift.

Figure 60. Attending an R3 event does not meaningfully increase the number of licenses bought by minors. However, adult R3 attendees buy nearly twice the number of licenses annually than their matched-pair lookalikes.
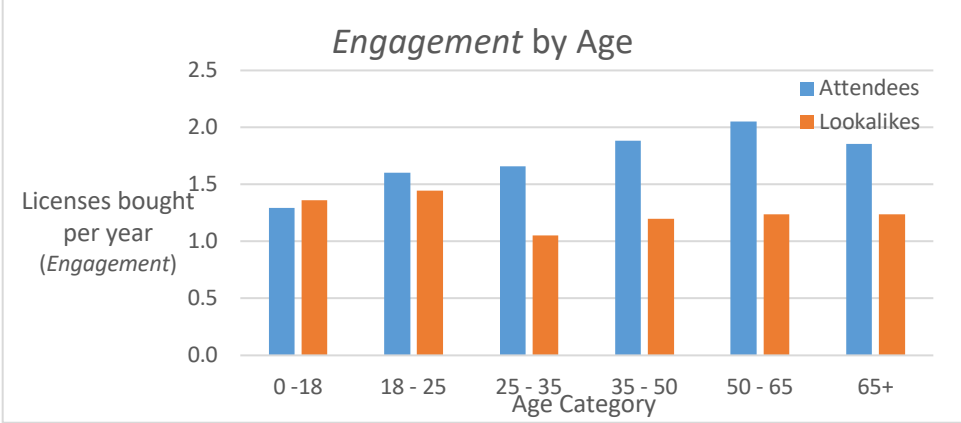
Within North Dakota, there were some R3 events that resulted in attendees having higher overall lift in participation when compared to their matched-pair lookalikes (Figure 61). The *Women's Shooting Clinic* and the *Family Fun Day* R3 events resulted in the greatest lift, whereas the *Norsemen Archers Youth 3D Shoot* and *Pheasants for The Future Youth Hunt* events resulted in the lowest lift in terms of participation. As noted earlier, many R3 events aimed at youth were less effective in terms of increasing participation.

Figure 61. R3 events (or types of events if the sample was small) are listed left to right in order of their impact on participation, with most effective events on the left.
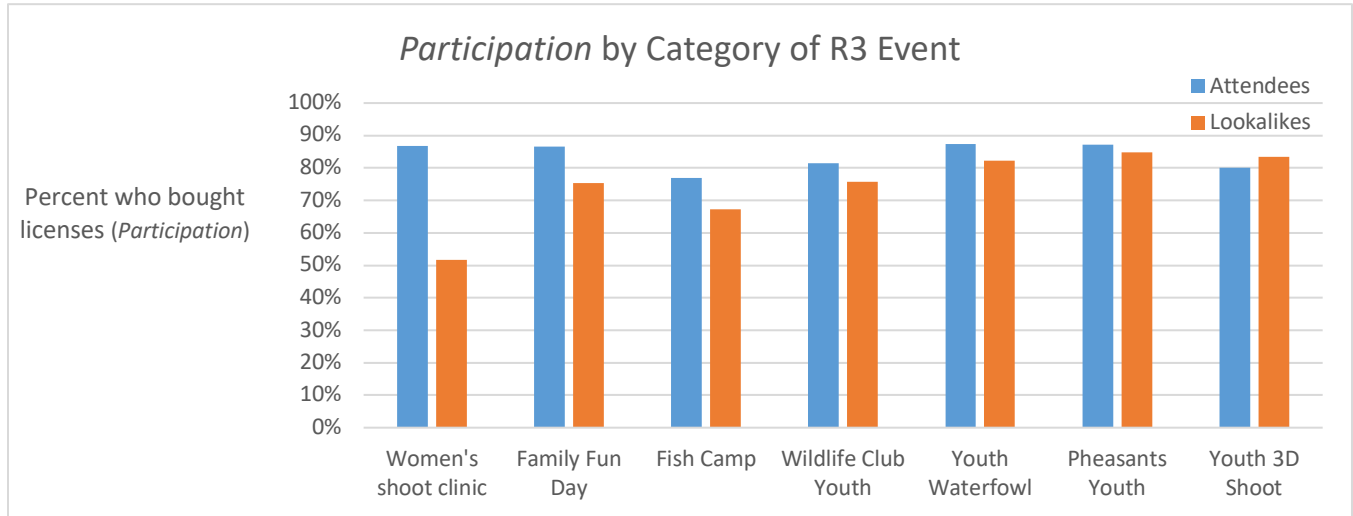
The *Women's Shooting Clinic* resulted in approximately twice as many annual licenses purchased; an over one-license-per-year increase (0.98 vs 2.10) (Figure 62). Interestingly, the lookalikes for *Wildlife Club Youth Series* and *Norsemen Archers Youth 3D Shoot* were more engaged than R3 event attendees. Just as with participation, R3 events targeting youth performed poorly in terms of engagement.

Figure 62. R3 events (or types of events if the sample was small) are listed left to right in same order as Figure 61. R3 events focused on youth result is the smallest lift in terms of engagement
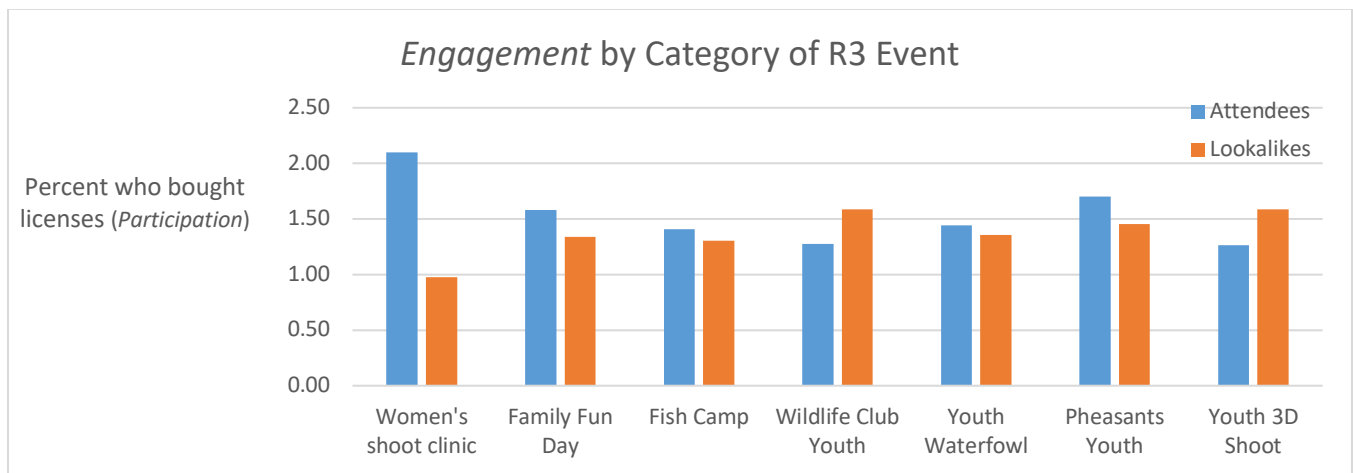
The data were structured in some states, including North Dakota, that permitted analysis in determining if attending multiple events resulted in a difference in retention effects. In North Dakota, there were enough attendees and events to conduct analysis on attendance in up to three R3 events (some in the attendee group had attended up to six events, but the small sample size precluded any analysis). We found no evidence to suggest that attending more than one event had any additional marginal benefit over attending just one event, in terms of participation (Figure 63).

Figure 63. Attending more R3 events does not result in higher participation.
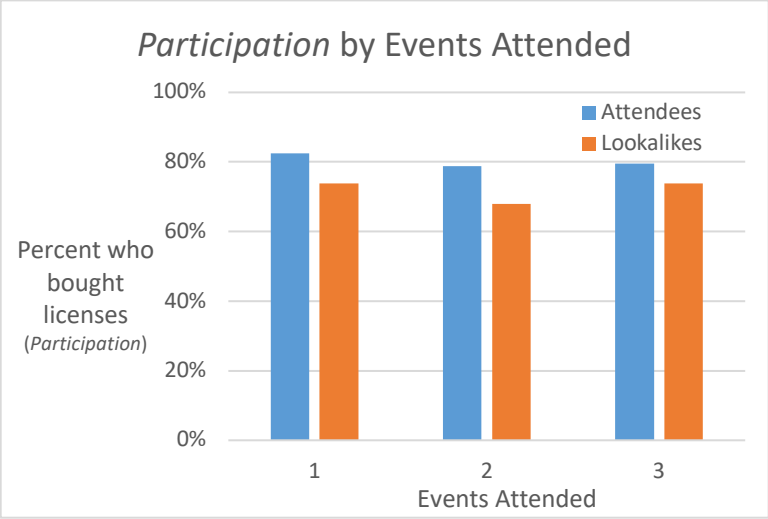
We also compared attendees who attended multiple events to those who attended just one event. We found that the lift in engagement for those who attended one event versus two events was very similar (Figure 64). However, the lookalikes engagement (as compared to attendees who participated in three events) was higher than attendees who participated in the R3 events. We found no evidence that suggests that attending more than one event had any additional marginal benefit over attending just one event, in terms of engagement.

Figure 64. Attending more R3 events does not result in higher engagement.
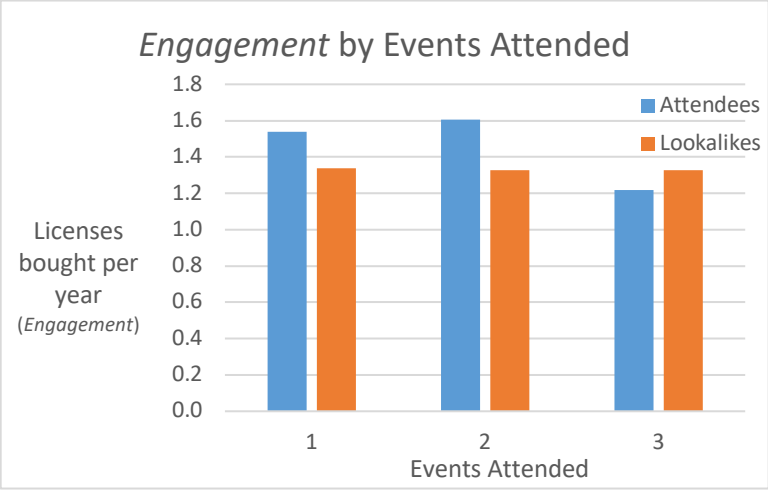
The average customer from Tennessee purchased nearly four and a half licenses, tags, or stamps between 2009 and 2021 ($M_{licenses}$=4.56). When comparing those who participated in an R3 event (attendees) to matched-pair lookalikes of the R3 event attendees (lookalikes) there was not a significant difference on the variables of sex, age, latitude/longitude, or starting year. This is expected because these were some of the variables that were held constant, and this consistency acts as a quality-control, quality-assurance check indicating the Mahalanobis distance match pairing was successful. However, in comparison to the average Tennessee customer, the attendees and lookalikes were more likely to be male, younger, and more rural (i.e., the geographic-weighted center for all customers from Tennessee was near Nashville, and the geographic-weighted center for both the attendees and lookalikes was more southeast, or further from the Nashville Metropolitan Area).

In comparison to the average Tennessee customer, the lookalike group purchased more licenses, had slightly higher participation, and had hunted or fished in slightly more years ($M_{Licenses}$ = 7.06, $M_{Participation}$ = 0.56, $M_{TotYears}$ = 4.17) (Table 9). This suggests there is a moderate selection effect, meaning that Tennessee customers who opt-in to R3 events are likely to be more avid *before* they participated in the R3 event. However, the attendee group had lift above and beyond the lookalike group in that they purchased more licenses, had slightly higher participation, and hunted or fished in more years than the lookalike group ($M_{Licenses}$=14.94, $M_{Participation}$=0.75, $M_{TotYears}$=5.89). This indicates that, in addition to the moderate selection effect, attending an R3 event results in a true lift, as attendees are likely to be more avid *because* they participated in the R3 event. The attendee group bought more licenses year over year (higher engagement [$M_{Engagement}$=2.81]), than both the lookalike group and the average Tennessee customer. This finding indicates that the effect of attending an R3 event induces a portion of attendees to buy more licenses, and further indicates this effect lasts several years after attending an event. An important note is that Tennessee R3 events did not attract many new customers, as the great majority (93.3%) of R3 event attendees had purchased a license in at least one license year prior to attending an R3 event. This finding indicates 14 out of every 15 attendees were highly likely to have already been recruited to some extent before attending an R3 event.

Table 9. Topline comparisons of variables of interest between R3 event attendees (attendees), matched-pair lookalikes (lookalikes), and all customers of Tennessee Wildlife Resources Agency (Tennessee).

	Attendees	**Lookalikes**	**Tennessee**
Male	79%	79%	74.00%
Age	37.36	37.39	45.92
Latitude	35.8403	35.8404	35.8861
Longitude	86.1955	86.1955	85.9167
Starting year	2013.28	2013.28	2013.92
Total licenses	14.94	7.06	4.56
Participation	0.75	0.56	0.47
Engagement	2.81	1.09	0.90
Total Years	5.89	4.17	2.91

For each year analyzed, Tennessee R3 event attendees bought between 0.66 and 1.21 more licenses than their matched-pair lookalikes, who themselves had slightly higher purchases than the average Tennessee customer (Figure 65). Although the number of licenses bought is variable by year, the attendees were consistently an average of 0.81 licenses above the baseline of the lookalikes and 1.02 licenses above average Tennessee customer.

Figure 65. The average licenses bought is consistently higher for the attendee group.
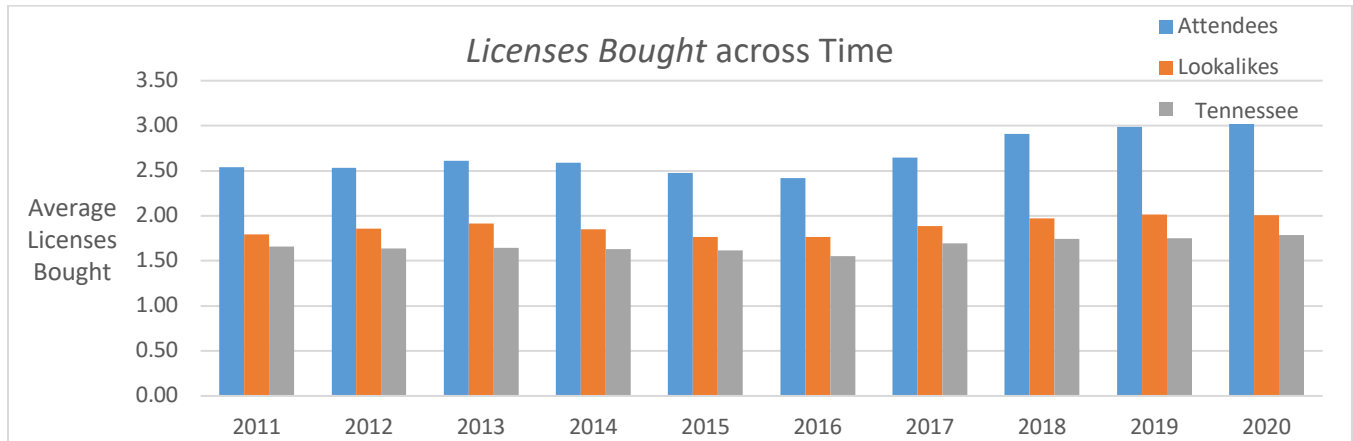
The attendee group differed in significant ways from the lookalike group and differed even more from all Tennessee customers (Figure 66). The average percent of Tennessee customers who bought a license across time was relatively stable between 23-27%. The lookalike group closely paralleled this pattern, though they purchased a license at about a 9% higher rate, on average. The *percent bought* was even higher for attendees and became increasingly more divergent in more recent years. This pattern suggests that there is an improvement in terms of *percent bought* by some, simply by virtue of being a lookalike and even more by being an attendee. This result is consistent with the finding that attendees were more avid **before** the R3 event and are even more so **because** of the R3 event.

Figure 66. Individuals buy license more regularly as time goes on. Attendees buy licenses more regularly than their lookalikes.
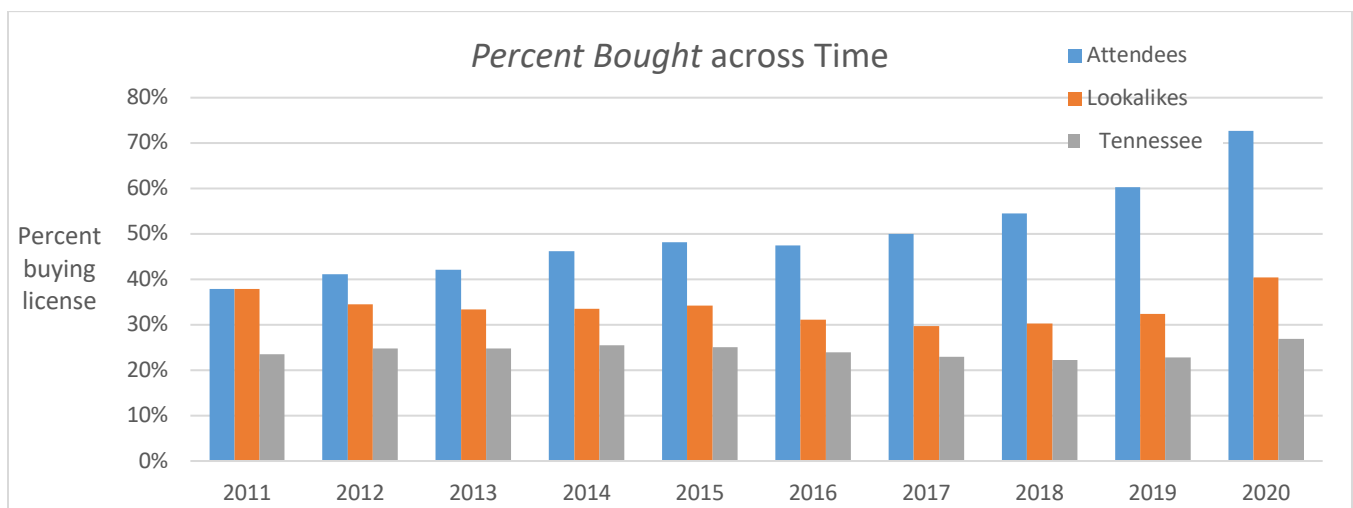
When attendees and lookalikes are compared for the years 2017-2021, participation is 16-43% higher for attendees (i.e., the attendee blue line is consistently higher than the lookalike orange line) (Figure 67). This lift was understandably diminished in 2020, presumably due to restrictions resulting from the COVID-19 pandemic. The distance between the lookalike and attendee groups is the amount of difference between the two groups, in this case, R3 attendees churn 27% less, on average, than their matched-pair lookalikes.

Figure 67. Attendees have better year-over-year participation, or attendees churn less than their matched-pair lookalikes.
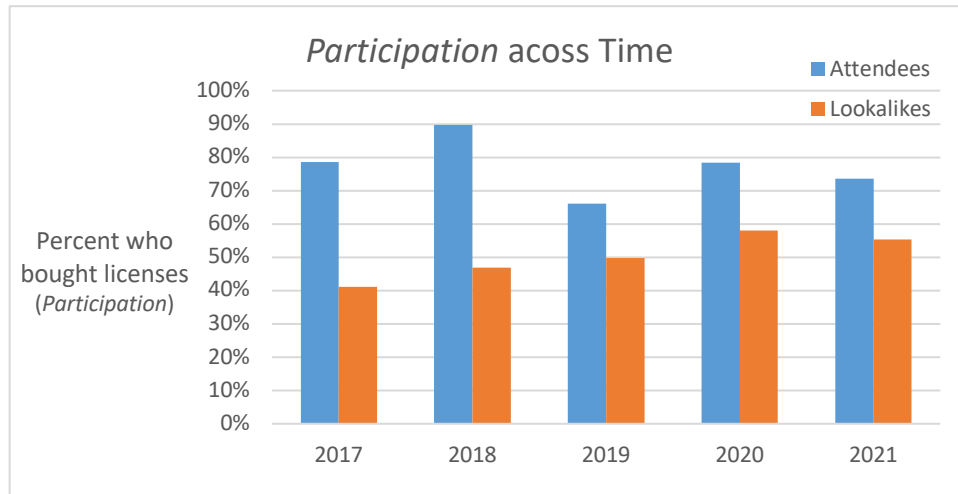
When attendees and lookalikes are compared according to the year, engagement is initially higher by about 1.91 licenses per year, on average as a group (Figure 68). Engagement is variable between years, but, on average, attendees' purchases remained 1.47 licenses above the lookalikes and in 2021 ended up 0.77 licenses higher ($M_{LOOKALIKE} = 1.11$, $M_{ATTENDEE} = 1.88$). This finding suggests that R3 events initially induced attendees to buy more licenses, and that these events then continued to induce additional purchases for a portion of attendees.

Figure 68. Attendees buy more licenses than their matched-pair lookalikes.
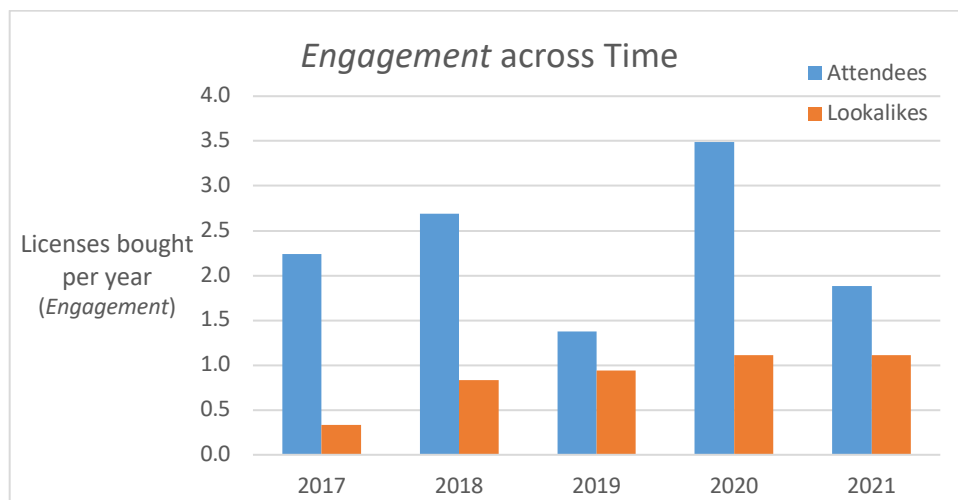
Data from Tennessee suggest that, regardless of the age of the R3 event attendee, there is a lift in participation (Figure 69). However, the lift gained from attendees (in comparison to the lookalikes) is the least for youth under 18 years of age. The greatest participation in lift is for attendees aged 25-35 and 35-50. This indicates that if the goal of R3 events is to generate additional customers year over year, a focus on attendees aged 25-50 will yield the best return on investment.

Figure 69. The increase in participation in R3 events is greatest for attendees who are aged 25-50. Conversely, the reduction of churn attributable to R3 event attendance is the least for minors.
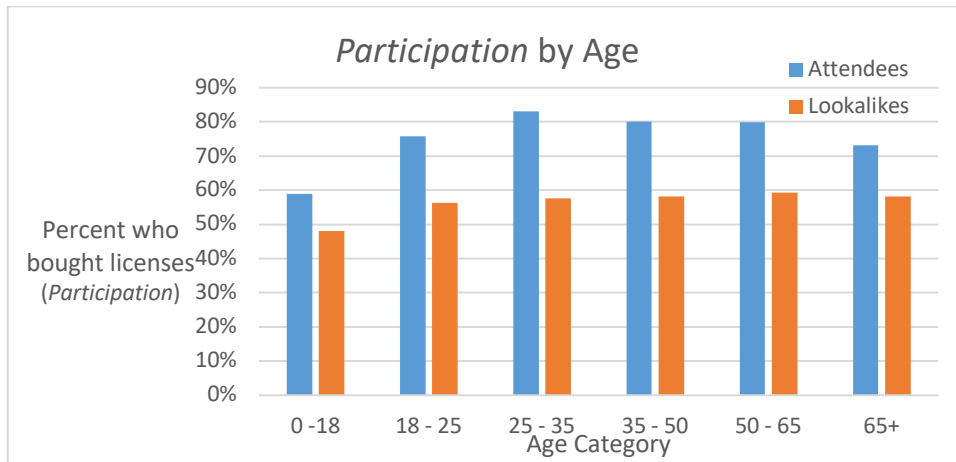
Tennessee data also indicate there is a lift in engagement for all age categories of R3 event attendees (Figure 70). Youth attendees under age 18 and attendees older than 65 had the smallest lift, with just 0.89 and 0.57 additional licenses purchased per year, respectively. However, adult attendees aged 25-35 had a lift from 1.13 to 3.78 license purchases per year, and the 35-50 age group had the largest lift with 1.08 to 2.24 licenses purchased per year. Focusing on attendees between the ages of 25 and 50 will yield the best returns on investment in terms of engagement. This is especially true for young adults aged 25-35.

Figure 70. Attending an R3 event does not meaningfully increase the number of licenses bought by minors. However, adult R3 attendees buy nearly twice the number of licenses annually than their matched-pair lookalikes.
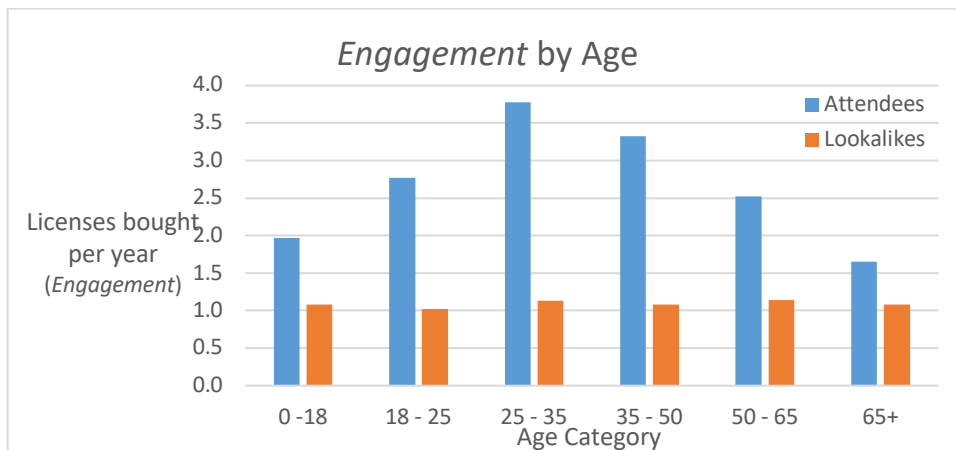
Within Tennessee, there were some R3 events that resulted in attendees having higher overall participation, when compared to their matched-pair lookalikes (Figure 71). In Tennessee, there were too many different events to analyze at the event level, so events were therefore categorized into similar groups prior to analysis. Events focused on *food* preparation, *deer* hunting, and *general hunting* resulted in the greatest lift, whereas events focused on boating, shooting, and advanced fishing techniques resulted in the lowest lift, in terms of participation.

Figure 71. R3 event types are listed left to right in order of their impact on participation, with the most effective events on the left.
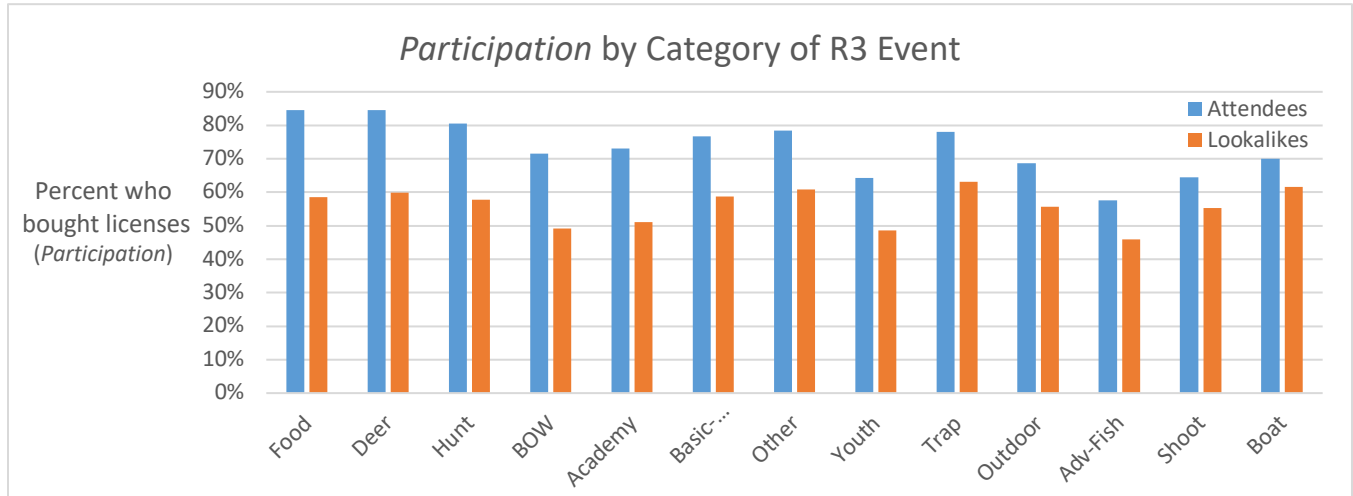
The *deer*, *Academy*, and *food* preparation R3 event categories resulted in the greatest lift, in terms of engagement (Figure 72). The *Boating, Trapping,* and *Advance fishing* categories of R3 events produced the smallest lift, in terms of engagement.

Figure 72. The R3 event categories are listed left to right in same order as Figure 72. R3 events focused on shooting and boating safety resulted in the smallest lift in terms of licenses purchased.
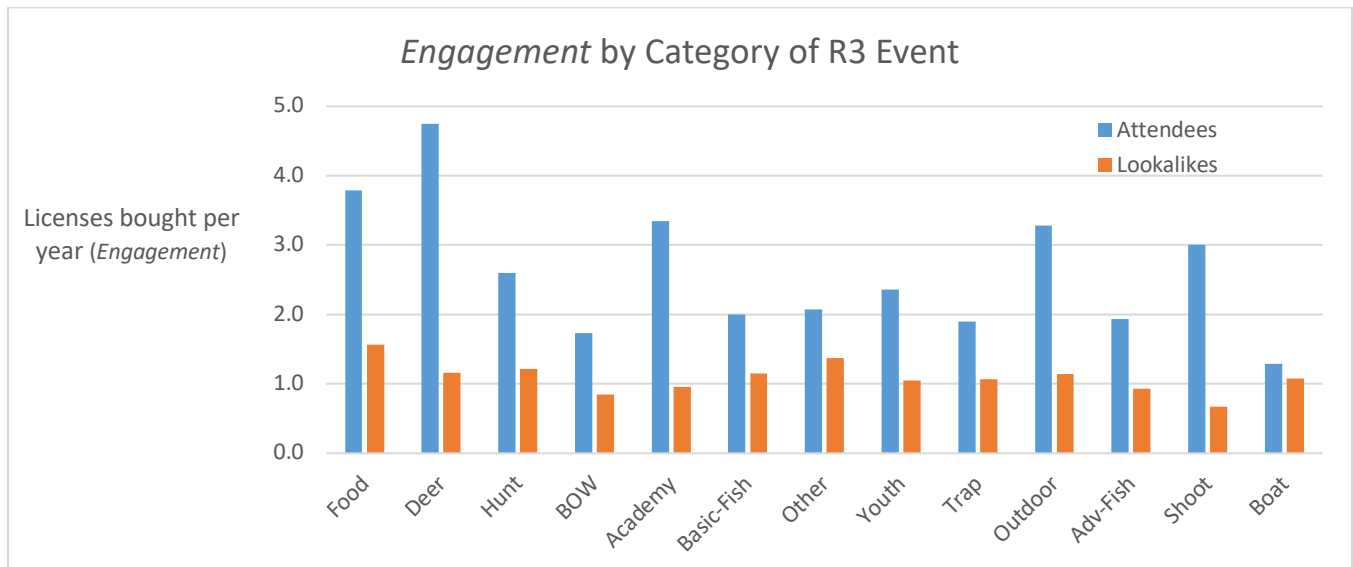
Overall Findings

The purpose of this study is to learn if R3 events result in a lift in participation, license sales, and other desirable outcome variables in attendees. Our approach isolates just the effect of attending events while accounting for (holding constant) other confounding variables. If attendees did experience a detectable lift over their lookalikes and the rest of a state's hunting and fishing customer base, we sought to understand the magnitude of that lift. Finally, we were seeking to understand if some R3 events or R3 event types generated more positive outcomes than others. Our findings are organized in the section below in terms of the outcome variables of *Participation* and *Engagement*, and then by influencing factors such age, R3 event (types), repeat attendees, and finally by hunting and fishing experience prior to attending an R3 event.

Participation

In all states, attendees had higher levels of participation than their lookalikes. Another interpretation of this finding is that people who attended an R3 event churned less than the same type of people who did not attend an R3 event. This is convincing evidence that R3 events result in people hunting and fishing more consistently after attending an R3 event. Additionally, because these data were analyzed with matched-pair lookalikes, this evidence is more compelling than pre-/post-event comparisons. However, in many states, the lookalikes were also significantly different from the remainder of a state's hunting and fishing population. This is a strong indication that the people who attend an R3 event are significantly different, often more avid, than the average customer. The difference observed between the average customer and the lookalikes indicates that the people who attend R3 events were different even before attending an R3 event. The difference observed between the average customer and the attendees, and the magnitude of that difference being greater than that of the lookalikes, indicates the people who attend R3 events have higher participation because of the R3 events. Therefore, any lift in participation can be attributable to both being different before and because of the R3 event (see Table 10).

Table 10. Attendees experienced a lift in Participation in all states analyzed.

	Attendees	Lookalikes	All Customers in State	Δ Attendees – Lookalikes	Δ Attendees – All Customers
Connecticut	88%	54%	39%	34%	50%
Georgia	64%	47%	39%	17%	25%
Iowa	68%	49%	41%	19%	27%
Massachusetts	80%	57%	50%	23%	29%
Missouri	78%	52%	45%	26%	32%
New Mexico	75%	56%	56%	19%	19%
North Dakota	82%	73%	50%	10%	32%
Tennessee	75%	56%	47%	19%	28%

Engagement

In all states, attendees had higher levels of engagement than their lookalikes. This means that after attendees attended the R3 event (or after the lookalikes first appeared in the license database), they purchased more licenses per annum than their lookalike counterparts. This is convincing evidence that R3 events result in people purchasing more licenses in each year as well as results in people purchasing licenses in more years (Table 11, 12). With the *Participation* variable, because these data were analyzed with matched-pair lookalikes, this evidence is more compelling than studies conducted without a matched-pair lookalike to act as a counterfactual. In many states, the lookalikes were also significantly different from the remainder of a state's hunting and fishing population. This is a strong indication that the people who attend an R3 event are significantly different (already purchasing more licenses) than the average customer. The difference observed between the average customer and the lookalikes indicates that the people who attend R3 events had a higher engagement even <u>before</u> attending an R3 event. The difference observed between the average customer and the attendees, and the magnitude of that difference being greater than that of the lookalikes, indicates the people who attend R3 events have higher engagement <u>because</u> of the R3 events. Therefore, any lift in engagement can be attributable to both being different <u>before</u> and <u>because</u> of the R3 event.

Table 11. Attendees experienced a lift in Engagement in all states analyzed.

	Attendees	Lookalikes	All Customers in State	Δ Attendees - Lookalikes	Δ Attendees – All Customers
Connecticut	3.82	1.31	0.61	2.51	3.22
Georgia	1.35	1.02	1.09	0.33	0.26
Iowa	2.29	0.81	0.77	1.48	1.52
Massachusetts	1.55	0.73	0.52	0.82	1.03
Missouri	0.72	0.52	0.45	0.21	0.27
New Mexico	1.02	0.95	0.82	0.07	0.19
North Dakota	1.53	1.33	1.01	0.20	0.51
Tennessee	2.81	1.09	0.90	1.72	1.92

Table 12. Attendees bought more hunting and fishing licenses in the license years available.

	Attendees	Lookalikes	All Customers in State	Δ Attendees - Lookalikes	Δ Attendees – All Customers
Connecticut	29.65	14.02	4.54	15.63	25.11
Georgia	14.60	9.42	7.93	5.18	6.67
Iowa	21.04	11.60	13.33	9.44	7.71
Massachusetts	8.51	4.49	3.13	4.03	5.38
Missouri	14.50	7.70	8.08	6.80	6.42
New Mexico	7.65	3.36	4.88	4.29	2.76
North Dakota	12.27	9.97	8.58	2.31	3.69
Tennessee	14.94	7.06	4.56	7.88	10.38

Age

For ease of analysis, attendees were split into six age categories, with breaks at age 18, 25, 35, 50, and 65, each representing a different life phase. In general, R3 events produced the most *Participation* and *Engagement* lift in adults aged 25-35 and 35-50. Youth under 18 produced the least lift of all age groups in terms of *Participation* and *Engagement*, and therefore R3 events designed for youth under 18 resulted in the lowest expected return on investment (ROI). Two states were an exception to this finding. The first exception was Missouri youth, who showed only slightly lower levels of *Participation* and *Engagement*, but at rates not as extreme as observed in other states. The second exception is youth under 18 in Massachusetts, who had higher *Engagement* than the other age categories in the state.

Event and Event Types

There is such high variability in the quality and execution of events from state to state that direct comparisons are not reasonable. Even events of the same name have different levels of effectiveness. However, there are general patterns of events that tend to be more effective. For example, in general, R3 events focused on basic, introductory activities tend to have better results in terms of *Participation* and *Engagement*. Conversely, R3 events focused on advanced techniques, more difficult quarry, or using specialized equipment were less effective at increasing *Participation* and *Engagement* (Table 13). This result could be because these advanced types of events are not pertinent to the average outdoor enthusiast entering into hunting or fishing or because the experience was too overwhelming to potential recruits, who might have been intimidated by the difficulty of the activity presented.

Table 13. List of more and less effective R3 events or event types by state.

	More Effective	**Less Effective**
CT	Women's Pheasant	Venison Processing
CT	Waterfowl hunting	Small Game
GA	Hunt and Learn	Learn to Hunt
GA	Field to Fork	Give it a shot
IA	Learn to Hunt	Youth events
IA	Duck hunting	BOW
MA	BOW-Deer	Youth Turkey
MA	Youth Pheasant	Turkey
MO	HE Skills	Discover Nature
MO	Bow Hunter Ed	Shooting
NM	Turkey hunting	Elk hunting
NM	Hunter Ed Skills	Small Game
ND	Women's shoot clinic	Youth 3D
ND	Family fun day	Pheasant Youth
TN	Food processing	Boating
TN	Deer hunting	Shooting

Repeat Attendees

Generally, there is no additional marginal benefit in attending more than one R3 event. Any benefit or lift in *Participation* and *Engagement* was achieved through attending one R3 event. Any further R3 event attendance resulted in either a diminished lift on the two outcome variables, or in a very minimal

increase. One exception is Massachusetts: attendees who attended a second R3 event did produce meaningful, additional lift in *Participation*, although attending a third event did not result in additional increases. However, attending a second (or more) event did not result in markedly improved *Engagement* in Massachusetts. This finding indicates that states should discontinue encouraging attendance at subsequent events, as the ROI on attending multiple events is not demonstrable. Further, agencies should strongly consider screening admittance to R3 events to only include people who have not attended an R3 event before. If screening is not possible, prior attendees should be deprioritized to make room for new customers.

Participation prior to attending an R3 event

R3 events in the states analyzed in this study did not attract as many new customers as may be expected, because 27% to 93% (depending on the state) of R3 event attendees had purchased a license in at least one license year prior to attending an R3 event. States such as New Mexico (27%) and North Dakota (31%) are likely making meaningful progress in recruiting new customers, but other states may want to screen for attendance at R3 events to only include those new to hunting and/or fishing, to avoid spending R3 resources on those who are already customers. As currently constituted, the effectiveness of R3 events is hindered in that there is less room for new customers to attend so they can be recruited, and many of these events are not designed or are not well-suited to retain or reactivate. As such, R3 events that are attended by so many people who have hunted before the event are likely already partially or fully recruited to hunting and fishing and are attending these R3 events out of convenience, for social interaction, or to reinforce their skills.

Table 14. Many attendees have hunted or fished in the license years prior to attending an R3 event.

	Years	Hunted/Fished prior to attending R3 event
Georgia	2011-2020	86.1%
North Dakota	2009-2021	31.2%
Tennessee	2009-2021	93.3%
Iowa	2009-2020	83.0%
New Mexico	2013-2020	27.3%
Missouri	2011-2021	41.6%
Connecticut	2013-2020	47.0%
Massachusetts	2011-2021	85.3%

Discussion

Participation and Engagement

In each state, the two outcome variables, *Participation* and *Engagement*, were higher for attendees of R3 events. This study provides evidence that R3 events result in people hunting and fishing more consistently, and that these customers buy more licenses year to year after attending an R3 event. These data were analyzed with Mahalanobis distance matched-pair lookalikes and provides more compelling evidence for the impact of R3 events than previous pre-/post-event comparisons. However, in many states the lookalikes were also significantly different from the remainder of a state's hunting and fishing population. This is an indication that the people who attend an R3 event are significantly different, often more avid, than the average customer. The difference observed between the average customer and the lookalikes indicate that the people who attended the R3 events were different even <u>before</u> attending an R3 event. The difference observed between the average customer and the attendees, and the magnitude of that difference being greater than that of the lookalikes, indicates the people who attended the R3 events have higher *Participation* and *Engagement* <u>because</u> of the R3 events. Therefore, any lift in *Participation* and *Engagement*, can be attributable to both being different **<u>before</u>** and **<u>because</u>** of the R3 event.

Prior Participation

In each state analyzed, a large portion of R3 event attendees had purchased a license in the license years before attending an R3 event. This might suggest that these events are not so much recruitment events but rather reactivation, or even **reinforcement** events. Many attendees purchased licenses for several license years prior to attending an R3 event. This suggests R3 events may create a source of ***compensatory recruitment***. As conservation professionals know, compensatory mortality is an additional cause of mortality to a population that results in no net increase in mortality. For example, the addition of predators to an ecosystem may not result in as much additive mortality as one would predict, because predators consume prey that would have died due to sickness or starvation. In similar fashion, *compensatory recruitment* is an additional source of recruitment to a population that results in no, or little, net increase in recruitment. For example, R3 events that recruit the children of avid outdoors enthusiasts are likely recruiting customers that would have been recruited otherwise. While the terminology might be new, the concept is over a decade old and is encapsulated in the oft-repeated tautology of "there's an awful lot of used camo in the R3 camps."

> **Compensatory Mortality** is an additional cause of mortality to a population that results in no net increase in mortality.
>
> **Compensatory Recruitment** is an additional cause of recruitment to a population that results in no net increase in recruitment.

There were also a portion of attendees who not only had hunted or fished in a license year prior to attending the R3 event but who had also attended another R3 event(s). This study provides evidence that there is no additional marginal benefit to an Agency when a customer attends more than one R3 event. Any benefit or lift in *Participation* and *Engagement* was achieved when a customer attended one R3 event (for all but one state). Any further R3 event attendance resulted in a diminishment of lift on the two outcome variables, or in very minimal increases. Intentionally serialized, closely related R3 events

could hold merit, as skills may build on top of one another, however, states should strongly consider limiting the attendance of R3 events to those who are new to hunting and fishing, as well as limiting attendance to only one R3 event per customer, to allow room for others to attend. At the very least, people who have been to an R3 event before should be deprioritized to make room for other attendees.

Scale of Impact

In this study, we examined about 94 million licenses purchased by nearly 13 million hunters and anglers in eight states. For the state of Missouri, there were 46,894 attendees (and lookalikes)at R3 events; the remaining seven states had between 489 and 3,852 R3 event attendees. Though there were undoubtedly more attendees at R3 events who were not recorded, and there were additional R3 events not documented, the number of R3 event attendees is significantly smaller than the number of license buyers. While it is encouraging to have so many license buyers, the attendees amount to 0.47% (0.14% if Missouri is excluded) of the license buyers. Once the attendees who have hunted or fished in a prior license year have been accounted for, that is, the attendees who were highly likely to be already recruited, the amount adjusts to 0.24% (0.036% if Missouri is excluded). Thus, despite R3 events resulting in higher *Participation* and *Engagement*, R3 events likely do not have a meaningful impact on hunting and fishing at the population level. This is not because R3 events are ineffective, but because the scale at which R3 events operate prevents them from achieving efficacy at a population level.

Recommendations

The following recommendations are proffered to assist state agencies that wish to maximize their ROI as they conduct, fund, and sponsor R3 events. Unsurprisingly, these recommendations are complementary to, and replicate several of, the recommendations found in the National Hunting & Shooting Sports Action Plan[5].

1. **Keep R3 event evaluations data driven**. From a data analysis perspective, there was a drastic difference between states who had a vendor managing their license database and states that managed their own database. The ease, cleanliness, and speed in which the data was transferred was considerably improved when the data was provided by a vendor-managed database. States who administer their own database, or don't have a CMS provider, will struggle to meet their future research needs.

2. **Evaluate R3 events the right way.** Evaluate R3 events using pre-/post-event assessments if the research objective is to learn about programmatic improvements and aggregated change at the individual level. If the research objective is to examine the behavior across time or to evaluate R3 events from an ROI standpoint, using a matched-pair lookalike to act as the counterfactual is the preferred method.

3. **Screen R3 events.** A customer who attends two (or more) events does not show greater engagement or participation than a customer who attends one event. Therefore, given the limited R3 resources available, state agencies should consider screening attendees for those who have attended another event, keeping as many spots open for those who have not had the opportunity to attend any R3 event.

4. **Screen R3 events again.** Many attendees had hunted or fished in the license years prior to attending an R3 event. This finding indicates that many attendees were likely to have already been recruited to some extent before attending an R3 event. State agencies should consider explicitly stating that R3 events are for those new to hunting and fishing and/or screening for attendees that have not purchased a license previously (or who only purchased a limited license).

5. **Focus on the family**. The greatest lift in *Participation* and *Engagement* was for adults aged 25 to 50. The least lift was for youth under the age of 18. Adults 25-50 are more likely have children of their own who could be indirectly recruited if the parent is recruited. State agencies should consider reallocating resources from youth R3 programs to adult-oriented events to improve ROI. The authors recognize that reducing youth R3 programs all at once may not be politically feasible, since commissions and decision-makers are often influenced by forces outside of science. Therefore, a secondary recommendation is that parents or guardians must be required to attend and participate in any youth R3 event.

6. **Keep R3 events scalable.** Event attendees provide ~ 1% lift to customer volume. Therefore, events run by agency personnel are not sustainable on longer time scales. It would be more efficient to consider delegating R3 activities to NGO's and other interest groups, so long as each group is operating under best business practices. Agencies should strongly consider reviewing any R3 event that is not immediately scalable.

7. **Keep R3 events scientific.** All R3 events funded by state agency monies should be run using best business practices and require, at a minimum, a pre- and post-event evaluation to be completed as a condition of being funded.

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[5] Frampton, J., Dunfee, M. et al. (2016). *National Hunting & Shooting Sports Action Plan.* Strategies for Recruiting, Retaining, and Reactivating Hunting and Shooting Sports Participants. A Technical Report to State Wildlife Agencies.

8. **Keep R3 events simple.** Events focused on basic, introductory activities tended to be more effective at lifting *Participation* and *Engagement*. Small-game hunting, simple fishing techniques, and introductory skills should be the focus of an R3 event if the intent is to recruit those new to outdoor recreation.

9. **Keep R3 events sustainable.** The quarry targeted at an R3 event should be relatively easy to hunt and plentiful to find, to encourage successful participation autonomously after the event. If a state has a draw or lottery for a specific species, that is an indication there is not enough biomass in the system to meet the customer demand for hunting opportunities. Recruiting a person to a species that has limited hunting opportunities results in newly recruited customers, or current customers, being unable to hunt. State agencies should strongly consider discontinuing R3 events that recruit to species, weapon-classes, or seasons that already have a draw/lottery and reallocating those efforts to hunting and fishing opportunities for which the state has a surplus.

Appendix A – Methods

A large portion of this project consisted of data management, which included decisions that may have an influence on the outcomes of this research. Therefore, documenting our process with sufficient detail so that our results are replicable is important. The license sales and R3 event datasets for each of the eight participating states were transferred to Chase & Chase Consulting using secured File Transfer Protocols. Using SPSS 26, each state license dataset was deduplicated for people who bought the same license in the same year. All license data was delivered in long format, which was reformatted to wide format. In this format, the variables of number of total licenses, licenses per year, and which years each customer bought a license could be calculated. The total amount of years the customer appeared in the database was also calculated. The R3 event dataset for each state was then imported into SPSS, deduplicated, and reformatted from long to wide formatting.

For states that had customer management systems, or for states who had unique customer identification numbers for the R3 events and in the license database, the two datasets were matched according to a unique ID. This matching resulted in the best merging of the two datasets. For states that did not have a CMS or a unique ID, we constructed a unique ID using a concatenation of the customers first name, last name, date of birth, and zip code. While this approach provided an acceptable merging of the databases, some R3 attendees were lost due to data infidelity or data errors. Once the datasets were fully merged, zip codes were used to assign a geographic-weighted latitude and longitude to each customer using a script from data provided by Dr. Richard Lawrence of Arizona Game and Fish. We computed population-weighted centroids for zip codes to act as surrogates for geo-referenced addresses of each customer, as zip codes that are consecutive in number are not always spatially adjacent to each other. In this way, we could get match-pairs to come from the same zip code, and, when that was not possible, from the closest neighboring zip code. This process was conducted in ESRI's ArcGIS Pro 2.6[6]. The centroids were population-weighted to account for the unequal distribution of citizens in their respective zip codes and to further take advantage of Tobler's Law of spatial autocorrelation.

The year of the first R3 event attended, as well as the first year in which each customer appeared in the license dataset, was calculated for each attendee. From these two variables, we were able compute if customers appeared in the license database in years before attending their first R3 event. Where possible or necessary, we estimated race (using surnames) as well as sex using R Statistical Software, by comparing the surnames in the data against the dataset of 167 thousand surnames from the United States Social Security Administration (SSA)[8]. No sex or race was assigned unless there was greater than a 70% probability of a correct match. This decision was made because we deemed it preferable to have some missingness in the data rather than have an incorrect sex or race estimated for hunting and fishing customers. Although including an estimate of a customer's sex improved the matching process, race did not improve match-pairing; therefore, race was not included as a variable used for matching.

We computed the *Participation* variable for attendees by taking the number of years they bought a license after first attending an R3 event divided by the total number of years after their first R3 event. *Participation* was computed for lookalikes by taking the number of years they bought a license after

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[6] Esri Inc. (2020). *ArcGIS Pro* 2.6. Esri Inc. https://www.esri.com/en-us/arcgis/products/arcgis-pro/overview.

[7] Tzioumis, K. (2018) Demographic aspects of first names, Scientific Data, 5:180025 [dx.doi.org/10.1038/sdata.2018.25].

[8] U.S.C.B. (2010). https://www.census.gov/topics/population/genealogy/data/2010_surnames.html.

buying their first license, divided by the total number of years after buying their first license. We were able to compute the *Engagement* variable for attendees by taking the average number of licenses purchased in years after attending their first R3 event. The *Engagement* variable was computed for the lookalikes by taking the average number of licenses purchased in years after first appearing in the license dataset.

We used Mahalanobis Distance Matching in *n*-dimensional space facilitated by the **MatchIt: Nonparametric Preprocessing for Parametric Causal Inference** package[9] in R Statistical Software. The parameter for the gender variable was constrained throughout the matching process, such that no individual in the attendee group had a matched pair of the opposite sex. Additionally, the year of first license purchase and state of residence was also constrained in the matching process, so that people with different tenures of hunting or states of residence were compared to lookalikes from the same state and same duration of hunting or fishing. The other variables were allowed to freely vary in the matching process. Variables of interest were then compared using a matched-pairs t-tests, means comparisons (t, F, and r^2). For tests of significance, *p*-values of less than 0.05 were considered significant. Often effect sizes were represented as eta (η), eta-squared (η^2), or Phi (ϕ). Cramer's *V* values were used to indicate the effect size for simple comparisons, and partial eta-squared (partial-η^2) values were used when relationships were being examined while accounting, or controlling, for other confounding variables.

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[9] Ho, D., Imai, K., King, G., & Stuart, E. (2007). Matching as Nonparametric Preprocessing for Reducing Model Dependence in Parametric Causal Inference. *Political Analysis, 15*(3), 199-236.

Appendix B – Key Personnel

Dr. Jonathan Gassett is the Southeastern Field Representative for WMI. Jon has more than 20 years' experience as experience as a biologist, strategic planner, supervisor, and administrator. Prior to joining WMI in 2013, he served as the Commissioner for the Kentucky Department of Fish and Wildlife Resources, which included oversight of all agency divisions including strategic planning, personnel management, program oversight, budget development and tracking, and statutory, regulatory, and policy development and implementation. Jon also served as Wildlife Division Director and Big Game Coordinator for Kentucky. Jon has served as President of the Association of Fish and Wildlife Agencies, the Southeastern Association of Fish and Wildlife Agencies, and the Midwest Association of Fish and Wildlife Agencies, and has chaired numerous committees in all three Associations. Jon serves on the Board of Directors of the National Conservation Leadership Institute. Jon is a graduate of the inaugural class of the National Conservation Leadership Institute and holds Ph.D. and M.S. Degrees in Forest Resources from the University of Georgia and a B.S. Degree in Biology from Kennesaw State University.

Dr. Steven Williams is the President of WMI, a 111-year-old, non-profit conservation organization dedicated to science-based, professional wildlife management. WMI's mission is to enhance North American wildlife populations, their habitat, and the continent's hunting heritage. Steve serves on the Blue-Ribbon Panel Relevancy Working Group (Co-Chair), National Deer Alliance (Co-Vice Chair), American Wildlife Conservation Partners, Council to Advance Hunting and Shooting Sports (Co-Vice Chair), and Board Chair of the National Conservation Leadership Institute. He is a professional member of the Boone and Crockett Club and The Wildlife Society. Prior to joining WMI, Steve served as Director of the U. S. Fish and Wildlife, the Kansas Governor's Cabinet Secretary of the Department of Wildlife and Parks, Deputy Executive Director of the Pennsylvania Game Commission, and Assistant Director for Wildlife and Deer Project Leader of the Massachusetts Division of Fisheries and Wildlife. He received his B.S. and Ph.D. Degrees from The Pennsylvania State University and an M.S. Degree from the University of North Dakota.

Dr. Loren Chase - Loren is a social scientist and research methodologist with degrees in wildlife biology and human dimensions of wildlife. He has nearly a decade of experience within state wildlife agencies, working as a Human Dimensions Research Coordinator and as a Manager of Budget & Economic Analysis. He was instrumental in groundbreaking human dimensions research that led to increases in conservation revenues and participation in hunting and fishing. He served as Chair and Vice Chair of the WAFWA HD Committee, Chair of The Wildlife Society HD Working Group, and Director-at-Large of the Arizona Wildlife Federation. He is a peer-review editor for six academic journals and regularly publishes articles in peer-reviewed journals, as well as lay articles regarding people and wildlife. Loren is currently the primary at Chase & Chase Consulting, a research firm with expertise in data mining, program evaluation, and business intelligence, with an emphasis in wildlife conservation. Notable research work includes the appearance of The Future of Hunting and Fishing project on NPR, a social justification of hunting on NBC, and the recruitment of hipster hunters in *The Wall Street Journal*.