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# Using Social Media to Estimate the Size and Demographic Characteristics of Hard-to-Reach Sport Communities: The Case of Disc Golf

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Some measures suggest that disc golf is a fast-growing sport and recreational activity that provides notable physical and social benefits. However, little is known about those who play. Like many new and nonnormative sport communities, the population of disc golfers is small, geographically dispersed, and therefore hard to study. This article offers a novel method for studying disc golfers and other hard-to-reach sport and leisure communities. Drawing on a random sample of 2,551 Facebook profiles, it provides new evidence about the size and characteristics of the organized disc-golfer population. The study shows how social variables including gender, race, geography, age, education, and group size predict disc-golf-related behaviors on Facebook. It also reveals that disc-golf-related activities on social media are positively correlated with actual disc-golf play. Guidance for future research on emerging sport communities is offered.

**Keywords:** age, constraints, emerging sports communities, gender, geography, public parks, race

Communities of participants in new and nonnormative sports are often small, geographically dispersed, and therefore hard to study. Given the low incidence rate of regular participants, a typical, large-scale survey would return such a small number of players that statistically accurate demographic analyses would be untenable (Kalton, 2014). Oversampling respondents from small-sport communities is possible but may be impractical or too expensive. Onsite data collections could be more effective, but the size and geographical reach of the sampling frame would still be limited under cost-constrained circumstances (Teitler, Reichman, & Sprachman, 2003). In some cases, equipment-sales figures might provide insight on small-sport participants, but these data are usually proprietary and privately owned manufacturers are rarely willing to share them.<sup>1</sup>

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Many researchers have responded to the challenges of studying low-prevalence, hidden, or hard-to-reach populations by using social media sites for data collection (Bhutta, 2012; Genoe, Liechty, Marston, & Sutherland, 2016; King, O'Rourke, & DeLongis, 2014; Rife, Cate, Kosinski, & Stillwell, 2016; Schneider, Burke-Garcia, & Thomas, 2015). However, few researchers have used social media to study small-, emerging-sport communities. Addressing this deficit, this study examined the disc-golfer population in the United States using a large random sample of Facebook profiles. The study provides new empirical evidence about the size and demography of disc golfers. In addition, it reveals how social variables predict disc-golf-related behaviors on social media and how social media activities are correlated with actual disc-golf play. The study concludes by offering empirically and theoretically grounded suggestions for future research.

## The Social Significance of Disc Golf

Some measures suggest that disc golf is a fast-growing sport in the United States. The number of disc-golf courses began increasing exponentially in the mid-2000s (Oldakowski & Mcewen, 2013). By 2017, there were 5,863 courses in the United States (PDGA, 2018). Membership in the Professional Disc Golf Association (PDGA), the sport's governing body, has grown consistently for much of the twenty-first century. In 2017, the total number of PDGA members stood at 41,067 worldwide, 32,744 in the United States (PDGA, 2018). News coverage of disc golf is also increasing faster than coverage of many other sports (Woods, 2017b).

If optimistic predictions hold, the 2020s will mark a notable shift in U.S. disc-golf recreation (Plansky, 2013). The emergence of disc golf as a mainstream sport would lead to new manufacturing and tourism industries and increase the use of public parks, where roughly 90% of disc-golf courses are located (Oldakowski & Mcewen, 2013). Judging from research on other sports and recreational activities, a rapid increase in the disc-golfer population would likely have positive effects on community health and well-being (Centers for Disease Control and Prevention, 2001; Crompton, 2000; Kahn et al., 2002; Maller, Townsend, Brown, & St Leger, 2008; Maroko, Maantay, Sohler, Grady, & Arno, 2009). During a typical 18-hole round, disc golfers walk an average of 5,613 steps, or about 3 miles (Menickelli, Barney, Grube, & Cooper, 2016). The sport may also attract participants who are less interested in traditional sports (Vernegaard, Johansen, & Haugen, 2017).

Compared with traditional golf courses, which use hazardous fertilizers and require 6–7 times the land area, disc-golf courses are environmentally friendly (Plansky, 2013). Some research has also shown that disc golfers would be willing to play at courses built in underutilized urban spaces such as utility corridors, urban washes, and abandoned factories, which would alleviate the problems associated with deindustrialization while making disc golf available to the diverse communities of large urban centers (Plansky, 2013).

A proliferation of disc-golf clubs might also strengthen community ties, promote social capital, and encourage volunteerism (Perks, 2007; Putnam, Leonardi, & Nanetti, 1994). Most disc-golf facilities and clubs have been created by volunteers and funded through local donations (Palmeri & Kennedy, 2015). Based on a survey of 158 experienced disc-golf course designers, 65% of them had

never been paid for their design work, and 74% had never been paid for their installation and construction jobs (Leekha & Woods, 2018). The disc-golf infrastructure represents an ongoing community-development project that has been paid for and built in large part by grassroots groups.

Despite the potential social benefits of disc golfers, little is known about this community. The indicators mentioned herein—PDGA membership, PDGA events, new course construction, news coverage—are not direct measures of the broader population. Disc golf has not appeared in a nationally representative sport-participation survey. The available guesswork on the size of the population has produced widely varying estimates, from 90,000 to 2 million (Woods, 2016b). The available academic studies related to disc golf come primarily from the literature on public-park use (Jun, Kyle, & Mowen, 2009; Mowen, Alan, Barret, & Godbey, 2015; Mowen, Payne, & Scott, 2005). Several of these studies examined disparities in people's use of specific park attractions such as traditional golf courses, swimming pools, museums, and playgrounds (Jun, Kyle, & O'Leary, 2008; Rideout & Legg, 2000; Wiltse, 2014). Researchers have also shown how behavioral constraints can be lifted by strategic actions carried out by recreational agencies, including the creation of new amenities (Mowen et al., 2005; Scott & Jackson, 1996; Scott & Mowen, 2011). However, few studies have examined how disc golf might be affecting participation in public parks, and no study has estimated the demographics of this emerging sport community.

## Literature Review

### Gender

Women are probably underrepresented among disc golfers. Per the PDGA (2018), between 1999 and 2017, the percentage of women among PDGA members ranged from 6% to 8%. The available survey data on disc golfers offer similar or lower estimates (Hegeman, 2016; Nelson, Jones, Runstrom, & Hardy, 2015; Rahbek & Nielson, 2016), while studies based on interviews at disc-golf courses suggest that women make up around 12% of the population (Mohoney, 2014; Oldakowski & McEwen, 2013). Research on public-park visitation and outdoor recreation further suggests that men are more likely to play disc golf than women (Anderson & Shinew, 2001; Culp, 1998; Johnson, Bowker, Bergstrom, & Cordell, 2004; Jun & Kyle, 2012; Little, 2002; Scott & Jackson, 1996). According to a meta-analysis by Zanon, Doucouliagos, Hall, and Lockstone-Binney (2013), all the known park-participation constraints are perceived as greater by women than by men, including a shortage of time, health, interest, knowledge, transportation, and someone to participate with; distance to the park; and the costs involved. A second review of literature offered similar findings (Shores, Scott, & Floyd, 2007).

### Race

Little is known about the racial composition of disc golfers. The PDGA does not collect data on the racial characteristics of its members. Most small-scale surveys also neglect race as a variable. The most authoritative estimate comes from a study by Oldakowski and McEwen (2013), who found, based on a small, geographically

limited sample, that roughly 95% of players are White. Two additional studies based on nonrepresentative samples produced similar estimates (Siniscalchi, 2004; Woods, 2016a). An underrepresentation of minority groups has also been found in participation studies on other types of outdoor recreation and public-park use (Cordell, Green, & Betz, 2002; Mowen et al., 2015; Payne, Mowen, & Orsega-Smith, 2002; Wolch & Zhang, 2004).

## Geography

More is known about the geographical barriers to playing disc golf. The PDGA tracks the opening and closing of all disc-golf courses in the country. As expected, states with large populations, such as California and Texas, tend to have more disc-golf courses, more PDGA members, and a greater number of PDGA-sanctioned events (tournaments and leagues) than small states (Oldakowski & Mcewen, 2013). However, when controlling for population size, public access to disc-golf courses appears to be limited in large states with highly populated cities. For example, California has the largest, most urbanized population but ranks 36th in PDGA members per 100,000 people, 38th in PDGA events per 100,000, 42nd in disc-golf courses per 100,000, and 29th in courses per 1,000 square miles (Woods, 2017a). In contrast, Iowa, which ranks 30th in population size and 40th in the percentage of residents living in urban areas, ranks first in PDGA members per capita, first in PDGA events per capita, first in courses per capita, and seventh in courses per 1,000 square miles.

Although early disc-golf communities developed strongholds near large metropolitan areas, the diffusion of disc-golf activity over the last 2 decades has been driven primarily by “the availability of existing parkland to accommodate a disc-golf course or the creation of new parks” (Oldakowski & Mcewen, 2013, p. 367). This availability likely favors the largely suburban and rural populations of the Midwest over the more urbanized Pacific Coast and mid-Atlantic regions. Among the four Census regions, the West and Northeast have significantly higher percentages of the population residing in urban areas than do the Midwest and South (U.S. Census Bureau, 2012).

## Education and Socioeconomic Status

Several studies have revealed socioeconomic disparities in the distribution of recreational resources, public parks, and green spaces, where roughly 90% of disc-golf courses are located (Estabrooks, Lee, & Gyurcsik, 2003; Moore, Diez Roux, Evenson, McGinn, & Brines, 2008; Wen, Zhang, Harris, Holt, & Croft, 2013; Wolch, Wilson, & Fehrenbach, 2005). Most of these studies found that as the poverty of neighborhoods increases, the distance from these neighborhoods to parks and green spaces increases. Neighborhoods with higher percentages of Blacks and Hispanics also tend to be located at greater distances from parks and green spaces. Even when nearness to parks is more equitable across low- and high-income neighborhoods, there are more facilities and resources available in the parks located in high-income areas than in those in low-income areas (Moore et al., 2008).

Financial costs have been shown to reduce the participation of lower-income people in several types of outdoor recreation (Zanon et al., 2013). The studies in

Zanon et al.'s meta-analysis suggest that people of higher socioeconomic status have greater access to disc-golf courses, more money to cover the cost of equipment, and therefore higher participation rates than people of lower socioeconomic status. Although only one aspect of socioeconomic status—education—was measured in this study, an overrepresentation of college-educated people in the disc-golfer population is expected.

## Age

Based on cross-sectional studies, older people report lower participation rates in many sports than younger people, especially for strenuous activities (Cozijnsen, Stevens, & Van Tilburg, 2013; Eime et al., 2016; Palacios-Ceña et al., 2012; Physical Activity Council, 2017; Rudman, 1989). As people age, concerns about physical ability may lead to less disc-golf participation among older adults. However, some studies based on longitudinal analyses show that sport activity increases with increasing age (Breuer & Wicker, 2009). There is also greater stability in participation throughout life in low-impact sports and recreation such as swimming, walking, fishing, cross-country skiing, and disc golf (Son, Kerstetter, & Mowen, 2008). Some evidence suggests that disc golf attracts participants from all age groups. For instance, the 2017 State of Disc Golf Survey showed that almost one third of competitive disc golfers were over the age of 41 (Durrant, 2017). Given the mixed findings of previous studies, the effects of age on participation are an open question.

## Group Size

All the subjects of this study belong to at least one disc-golf group on Facebook, but the size of these groups varies greatly. Previous research suggests that group size may both enable and constrain the behaviors of members (Butler, 2001; Fulk, Flanagan, Kalman, Monge, & Ryan, 1996; Kim, 2013; McPherson, 1983; Rafaeli & LaRose, 1993; Shaw, 2013). Given the nature of online disc-golf groups, however, there is likely a positive association between group size and membership participation. Some of the groups in the sample were created many years prior to the emergence of Facebook. Group size, in this case, may simply be an indirect measure of the institutional integrity that existed in the groups before the rise of social media.

## Method

Most demographic studies of sport and leisure communities are based on surveys. As noted herein, however, survey methods might not be appropriate for studying small, emerging sports. The social media site Facebook might be one of the only feasible tools for establishing a reasonably large sampling frame of disc golfers. In recent years, Facebook users have become more representative of the population. In 2015, 72% of adults who use the Internet had a Facebook account (Duggan, 2015). Among Facebook users, roughly three out of four access their accounts daily (Smith & Anderson, 2018). Women (83%) are only slightly more likely to

use Facebook than men (75%). While younger Americans are more active on Facebook than older people, the rate of use is similar among a large age cohort (age 18–49), and variance across income and education levels is small (Greenwood, Perrin, & Duggan, 2016). Differences in use across racial-ethnic background and region are also minor (Krogstad, 2015). Facebook includes users that are more representative of the U.S. population than any other social media platform (Krogstad, 2015).

To construct a sampling frame for this study, I searched Facebook for disc-golf groups. At the time of the initial data collection in late 2016, searches using multiple terms simultaneously were deemed unreliable. Given that the sport has multiple monikers, I tested three different search terms. The dominant label *disc golf* returned 2,612 U.S.-based groups. The term *Frisbee golf* returned a set of Facebook groups similar to that of the *disc golf* search. However, the term *frolf* (an alternative name that combines the words Frisbee and golf) returned fewer groups. Among the 601 *frolf* groups, only 12 contained the term *disc golf* in the title. For this reason, a random-number generator was used to select an equivalent proportion of groups (3.8%) from the two populations (100 of the 2,612 *disc-golf* groups and 23 of the 601 *frolf* groups), resulting in a total sample of 123 groups. There was not a single case of overlap between the two samples. Groups based outside the United States were excluded from the sample. Facebook groups intended for the sale or exchange of disc-golf equipment were also excluded.

Next, 30 individual profiles from each of the 123 groups were selected using a random procedure. If the group comprised fewer than 30 members, all members of the group were selected. This resulted in a total sample of 2,551 individual Facebook profiles. Redundant profiles were excluded. The sampling procedure was completed in early 2017. This sample can be considered “random” because each of the Facebook groups in the population had an equal probability of being chosen. Likewise, the sampling units in each group were selected through a random procedure. This kind of multistage cluster sampling approach is justified when a complete sampling frame is unavailable (Babbie, 1999).

For each profile, the researchers attempted to collect the following demographic data: state of residence, sex, racial/ethnic characteristics, education, date of birth, and size of Facebook group. Caution should be used when drawing assumptions about a person’s race and sex based on photographs. Although coding these variables based on visual assessment is a common practice of communication researchers (e.g., Bruce, 2004), the results should be understood as *perceived* race and sex, as opposed to self-described measures. Still, these two indicators were shown to be reliable via intercoder testing. Two coders examined 30 profiles and agreed in all cases using dichotomous codes (White/racial minority, male/female).

To estimate the disc-golfer population, each name in the sample was cross-checked with the publicly available PDGA directory, which gives the PDGA membership status of each player and his or her official rating. PDGA player ratings are based on a sophisticated, proprietary formula that measures average player performances in PDGA-sanctioned tournaments and league events.<sup>2</sup> Akin to a batting average in baseball, a PDGA player rating is a well-accepted performance measure in the disc-golf community.

Finally, as a preliminary attempt to gauge an individual's level of online disc-golf activity, the researchers coded seven behavioral markers in each profile: past or present PDGA membership (yes/no), disc-golf-related profile picture (yes/no), disc-golf-related cover picture (yes/no), at least one of the first 10 timeline entries being disc-golf related (yes/no), at least one of the first 10 page likes being disc-golf related (yes/no), member of two or more disc-golf-related groups (yes/no), and proportion of total groups that are disc-golf related. These seven indicators were combined in an index. The disc-golf activity index is an exploratory measure. While it may be reasonable to weight some indicators differently in a future study, particularly PDGA membership, this preliminary study used an equal-weights approach. For this reason, the index ranged from 0 to 7. Based on a subsample of subjects with a PDGA rating, the validity of the index will be assessed by examining the correlation between index scores and PDGA ratings. As discussed, a PDGA rating is a direct measure of disc-golf behavior. If people's online disc-golf activity is a valid measure of their involvement in the sport, there should be a positive correlation between the index scores and the ratings.

## Results

### Descriptive Statistics

A brief summary of disc-golfer demographics is as follows:

- Year of first disc-golf group on Facebook: 2007
- Percentage of disc golfers who are members of the Professional Disc Golf Association: 15
- Geographical region with highest number of disc golfers: South
- Geographical region with highest number of disc golfers per capita: Midwest
- Percentage male: 85
- Percentage White: 91
- Percentage reporting some college education: 36
- Mean age: 33 years

The number of members in disc-golf groups on Facebook ranged from 1 to 2,582, with a mean of 134 and a median of 26. The lifetime of Facebook groups had a range of 8 years, a mean of 2.4 years, and a median of 1.7 years. The earliest groups formed in 2007. The number of active groups in the sample increased uniformly between 2008 and 2015 but decreased slightly in 2016. Among the 2,551 disc golfers in the sample, 380 (14.9%) were active members of the PDGA in 2017. In that year, the total U.S. active PDGA membership stood at 32,744. Using PDGA membership data as an anchor, the study's 2017 estimate of the disc-golfer population is 252,502. This estimate does not account for the sample's known limitations, which are described in Discussion section.

The subjects' place of residence differed greatly across the four Census regions: 684 were from the South (0.56 per 100,000 residents based on 2016 Census data), 643 from the Midwest (0.95 per 100,000 residents), 460 from the West (0.60 per 100,000 residents), and 256 from the Northeast (0.46 per 100,000



residents).<sup>3</sup> Five-hundred eight subjects did not include their state of residence. Based on visual assessment, the sample was 85% male ( $n = 2,551$ ). Roughly 91% of subjects ( $n = 2,497$ ) appeared to be White. About 36% of the sample reported at least some college education ( $n = 2,551$ ). Mean and median age for those reporting it ( $n = 650$ ) were 33 and 30, respectively. Roughly one third of the subjects were 15 to 26 years old, one third were 27 to 35, and one third were 36 to 63.

Twelve percent of the Facebook profiles displayed a disc-golf-related profile picture, 11% displayed a disc-golf related cover picture, 29% had at least one disc-golf-related page Like among their 10 most recent Likes, 26% had at least one disc-golf-related post among their 10 most recent timeline posts, and 1,357 disc golfers belonged to two or more disc-golf groups on Facebook. Mean and median scores on the disc-golf activity index were 1.97 and 1.30, respectively, with a standard deviation of 1.9. The index had good internal consistency, with a Cronbach's alpha of .81.

PDGA player ratings were available for 364 subjects. Based on this subsample, there was a moderate positive correlation between the disc-golf activity index and player ratings ( $r = .25, p < .001$ ). Five of the seven indicators in the index were positively and significantly correlated with PDGA player ratings: disc-golf-related profile picture ( $r = .19, p < .001$ ), disc-golf-related cover picture ( $r = .11, p < .05$ ), at least one of the first 10 timeline entries being disc-golf related ( $r = .19, p < .001$ ), at least one of the first 10 page Likes being disc-golf related ( $r = .13, p < .05$ ), and proportion of total groups that are disc-golf related ( $r = .229, p < .001$ ). The correlation between PDGA ratings and PDGA membership status could not be calculated, because all subjects in the subsample ( $n = 364$ ) were PDGA members. PDGA ratings were also positively related to membership in two or more disc-golf-related groups, but not significantly ( $r = .08, p > .05$ ).

## Bivariate Analysis

The relationships between the independent variables—perceived race and sex, geography, education, age, and group size—and the disc-golf activity index were examined. Independent-samples  $t$  tests were conducted to compare disc-golf activity scores on the dichotomous variables, which included education and perceived race and sex. There was no significant difference in scores for Whites ( $M = 1.99, SD = 1.92$ ) and racial minorities ( $M = 1.77, SD = 1.73$ ),  $t(267) = 1.77, p = .078$ , or between those reporting at least some college education ( $M = 1.91, SD = 1.93$ ) and no college education ( $M = 2.0, SD = 1.88$ ),  $t(2549) = 1.14, p = .254$ . There was a significant difference in disc-golf activity scores for men ( $M = 2.09, SD = 1.91$ ) and women ( $M = 1.32, SD = 1.69$ ),  $t(568) = 8.05, p < .001$ .

A one-way analysis of variance (ANOVA) was conducted to examine the influence of geographical region on disc-golf activity scores. There was a statistically significant difference in disc-golf activity scores for the four Census regions,  $F(3, 2039) = 16.66, p < .001$ . Post hoc comparisons using Tukey's HSD (honestly significant difference) test indicated that the mean score for the Midwest ( $M = 1.67, SD = 1.92$ ) was significantly lower than the scores for the Northeast ( $M = 2.47, SD = 1.98$ ), South ( $M = 2.28, SD = 1.93$ ), and West ( $M = 2.25, SD = 1.97$ ). The Northeast, South, and West did not differ significantly from each other.

Age could only be determined for 650 of the 2,551 subjects. Among these subjects, there was a significant, positive correlation between years of age and disc-golf activity scores ( $r = .20, p < .001$ ). There was also a statistically significant difference in disc-golf activity scores across three age groupings, Welch(2, 428) = 14.83,  $p < .001$ . Post hoc comparisons using Tukey's HSD test indicated that the mean score for the young age group (15–26;  $M = 1.42, SD = 1.69$ ) was significantly lower than the scores for the middle (27–35;  $M = 2.0, SD = 1.88$ ) and old age groups (36–63;  $M = 2.36, SD = 1.95$ ). The middle and old age groups did not differ significantly from each other, although the difference neared significance ( $p = .10$ ).

There was also a significant positive correlation between the number of members in disc golfers' Facebook groups and their disc-golf activity scores ( $r = .198, p < .001$ ). Breaking group size into three equal categories and using Welch's ANOVA, a statistically significant difference in disc-golf activity scores for the small, medium, and large groups was found, Welch(2, 1688) = 105.69,  $p < .001$ . Post hoc comparisons using Tukey's HSD test indicated that the mean score for small groups ( $M = 1.30, SD = 1.64$ ) was significantly lower than those of the midsize ( $M = 2.07, SD = 1.90$ ) and large groups ( $M = 2.53, SD = 1.94$ ). The midsize and large groups also differed significantly from each other, with large groups having the highest mean score on the disc-golf activity index.

## Multivariate Analysis

To further investigate the relationships discussed herein, a multiple-regression analysis was conducted. The disc-golf activity index served as the dependent variable. The independent variables included perceived race and sex, geography, education, and group size. Age could not be used in the model because only a small percentage of subjects indicated their date of birth. During model construction, the basic assumptions and potential shortcomings of regression were considered and found to be unproblematic. As shown in Table 1, three of the five independent variables contributed significantly to the explained variance in disc-golf activity scores, while controlling for the other variables. Men produced significantly higher scores than women (beta = .138,  $p < .001$ ). Subjects from the Midwest scored significantly lower than those from other regions (beta = .054,  $p = .005$ ). Members of larger Facebook groups produced significantly higher scores than members of

**Table 1 Regression Model Showing Standardized Regression Coefficients for Five Predictors of Disc-Golf Activity on Social Media**

	Standardized regression coefficient	<i>p</i>
Sex: female = 0, male = 1	.138	<.001
Region: Midwest = 0, Northeast, South, or West = 1	.054	.005
Group size: small = 0, medium = 1, large = 2	.254	<.001
Race: minority = 0, White = 1	.026	.163
Education: 0 = no college, 1 = some college	.005	.773
$R^2$	.093	<.001

smaller Facebook groups ( $\beta = .254, p < .001$ ). In line with the findings from the bivariate analysis, the perceived race and education of subjects did not affect disc-golf activity scores significantly, while controlling for the other variables.

## Discussion

Disc golf deserves attention from academic researchers and park administrators for at least three reasons. First, some evidence suggests that the sport is growing quickly (Oldakowski & Mcewen, 2013; PDGA, 2018; Woods, 2017b, 2018). Given that roughly 90% of disc-golf courses are in public parks (Oldakowski & Mcewen, 2013), such growth may be having a meaningful effect on park visitation rates in some regions of the country. Second, the known health benefits of playing (Menickelli et al., 2016) may be going to participants who are less likely to get regular exercise from traditional sports (Vernegaard et al., 2017). Third, the disc-golf community consists of thousands of grassroots organizations and clubs, which are responsible for funding, constructing, and maintaining numerous disc-golf courses on public land (Leekha & Woods, 2018).

Despite the potential social benefits of disc golf, little is known about the size and demographic characteristics of this community. As in many new and nonnormative sports, the population of disc golfers is small and geographically dispersed. These characteristics present considerable challenges to researchers. This study contributes to the literature by outlining a method for studying not only disc golfers but also other emerging-sport communities with similar characteristics. Employing multistage cluster sampling of Facebook profiles, the researchers collected a random sample of 2,551 subjects from a large, geographically diverse sampling frame at no cost. The sample includes individuals from every state in the nation except Hawaii.

The analysis demonstrated that disc-golf-related behaviors on social media are significantly related to actual disc-golf play. Subjects who displayed a greater number of disc-golf-related words, phrases, and images in their Facebook profiles had significantly higher PDGA ratings than those who exhibited fewer of such online behaviors. Although using social media as an information source has notable limitations, it offers a feasible way to collect demographic data from hard-to-reach sport and leisure communities.

This study also contributes to the literature by producing the first probabilistic estimate of the size and demographic characteristics of the disc-golfer population in the United States. Among the 2,551 subjects, roughly 15% were active members of the PDGA in 2017, which leads to a population estimate of 252,502. This number almost certainly underestimates the total population. There are four types of disc golfers who are not likely to be members of a disc-golf Facebook group or the PDGA and therefore are not included in this estimate.

First, surveys have shown that fewer people in the extreme low and high age groups use Facebook (Duggan, 2015; Greenwood et al., 2016). For multiple reasons, these people are also less likely to pay the fee and become members of the PDGA than people in the middle of the age distribution. Although the age range of the sample is relatively wide (15–63), it excludes many young and old players. The State of Disc Golf Survey found that at least 5% of disc golfers fall in the extreme

high and low age categories (below 15 or above 63) (Durrant, 2017). It can be speculated, therefore, that the population is at least 5% larger, or 265,127.

Second, the sample may not account for disc golfers who are new to the sport. For many participants, becoming a disc golfer involves a gradual socialization process during which they learn more about the sport, improve their skills, increase their rate of play, internalize roles, and then seek out larger, more formal groups for the benefits of competition, enjoyment, or social identity (Rarick & Adams, 1973). Those who are new to the sport are less likely to join Facebook groups or the competitive ranks of the PDGA than veteran players. The number of disc golfers in this early stage of development is surprisingly large. According to a 2014 State of Disc Golf survey, approximately 50% of those surveyed had been playing disc golf for 3 years or less (Infinite Discs, 2014). A second survey estimated that 50% of disc golfers have been playing disc golf for 2 years or less (Oldakowski & Mcewen, 2013). These findings suggest that up to half the population may be playing disc golf regularly without being affiliated with a club, league, association, or even a circle of regular disc-golf partners. Such speculation leads to a population estimate that is up to twice that of the age-adjusted estimate, or approximately 530,254.

Third, this study's population estimate does not account for non-PDGA members who play in dyads or alone. Solo players and members of very small groups are less likely to benefit from or participate in disc-golf groups on Facebook, which are primarily used to organize players in larger groups. This segment of the population is unknown. It represents a key limitation of the estimate.

Finally, the number of people who play disc golf on rare or special occasions is also unknown. While there may be millions of one-off participants, they do not occupy the same social category as the individuals in this study. There are considerable differences in the attitudes, beliefs, and behaviors of those who play disc golf on rare occasions and those who are members of disc-golf groups, clubs, or friendship circles. The 2017 estimate of 530,254 participants represents the organized disc-golfer population in the United States. Given the novelty of this study's methodological approach, this estimate should be treated as preliminary evidence that requires confirmation from future studies.

In addition to estimating the size of the population, this study also explored the factors that might encourage and constrain people's play. Specifically, six social antecedents of participation, including perceived sex and race, geography, education, age, and group size, were investigated. Constraints to playing appear to be greater for women than for men. Although this study's estimate of women disc golfers is higher than that of previous studies (Hegeman, 2016; Nelson et al., 2015; Rahbek & Nielson, 2016), and two times greater than the percentage of women among PDGA members, a clear majority (85%) of disc golfers are men. Women also exhibit significantly fewer disc-golf-related behaviors on social media than men do.

Looking to the future, the social benefits of disc golf will depend in part on whether the stakeholders of the community can close the gender gap in participation. Future research should investigate the social and psychological mechanisms that limit women's participation. Such research should be considered important to anyone interested in attracting more women to the sport.

Few studies have examined the racial composition of the disc-golfer population. Offering the first large-scale estimate, this study found that 91% of disc golfers

appear to be White. This estimate is lower than that of other studies (Oldakowski & Mcewen, 2013; Siniscalchi, 2004), but Blacks, Latinos, and other racial/ethnic minorities are clearly underrepresented in the disc-golfer population. As in the case of women, there may be normative constraints that limit the participation of minority groups. Whites may also, on average, live closer to disc-golf courses than people of color and therefore perceive the sport as a more viable option. Although racial minorities are underrepresented, those who do get involved exhibit disc-golf-related behaviors online at roughly the same frequency as Whites. Future studies should examine whether race-related constraints are felt more at the entry points of disc golf than at later points in the lives of regular players. Working to reverse the racial inequality in participation is essential to the sport's continued growth and to its potential for strengthening community ties and promoting social capital.

In line with previous studies (Oldakowski & Mcewen, 2013; Woods, 2017a), the Midwest has the largest per-capita disc-golfer population. It exceeds the populations in the Northeast, South, and West by 50–100%. These findings confirm the expected positive correlation between a region's number of players and its number of disc-golf courses, PDGA events, and PDGA members. However, disc golfers of the Midwest exhibited significantly fewer online disc-golf behaviors than participants from the Northeast, South, and West. Future studies are needed to unravel disc golf's "Midwestern paradox" and explain why this region is both a positive outlier in population size and a negative outlier on the disc-golf activity index.

The results suggest that disc golfers tend to have a surprisingly low level of education. Only 36% of the sample reported at least some college education, whereas 59% of American adults have completed at least some college (Ryan & Bauman, 2016). This low estimate might be explained in part by the underreporting of college attainment on Facebook profiles. Given that the proportion of underreporting is unknown, the finding that disc golfers have lower educational levels than the average American remains suggestive. Still, the possibility that disc golf, unlike many other sports, attracts a disproportionately large number of people of lower socioeconomic status deserves further scholarly attention.

The findings on the age of disc golfers further refute the stereotypical notion that youthful college students represent the typical disc golfer. One in three players are 36 years old or above. Older players also scored significantly higher on the disc-golf activity index than younger players. These findings contradict previous studies that showed a negative correlation between age and participation in sports and recreation (Cozijnsen et al., 2013; Eime et al., 2016; Palacios-Ceña et al., 2012; Physical Activity Council, 2017). At the same time, this study's cross-sectional data cannot confirm that the rate of adoption increases with age. Given the nature of the research design, however, the study can be replicated later and produce evidence of individual-level change based on longitudinal panel data.

The results left little question about the relationship between Facebook group size and the involvement of members. Whether measured at the continuous or ordinal level, disc golfers belonging to larger groups scored significantly higher on the disc-golf activity index. Although the mechanism behind this relationship cannot be identified, the simplest explanation is that some of the groups in the sample existed for several years before the rise of Facebook. As they emerged on social media, they brought their large, committed communities with them, which naturally aligned group size with online behavioral involvement. This theory, however, discounts the

importance of online social interaction. Future studies should control for preexisting group history and further examine how Facebook group size and other online-community variables influence membership attitudes, norms, and behaviors.

## Limitations

In the strictest sense, this study focuses on people's disc-golf-related behaviors online, not disc-golf participation per se. It is possible that someone could join a disc-golf Facebook group but have no interest in playing. Someone might even Like a disc-golf page or post a disc-golf-related timeline entry without having thrown a single disc. Although this epistemological limitation should be acknowledged, online behaviors, particularly those involving disc-golf groups on Facebook, are likely to be positively correlated with offline behaviors. First, given the sport's relative obscurity, it is hard to imagine that many of the subjects sought out (or accepted entry into) a group without having at least some interest in disc golf. Second, almost all the Facebook groups in the sample clearly stated their objectives as playing disc golf, finding disc-golf partners, running leagues and tournaments, building and maintaining disc-golf courses, or other real-world interactions. Third, based on a subsample of 364 subjects, a moderately strong positive correlation was found between online behaviors (the disc-golf activity index) and actual participation in the field (PDGA ratings). For these reasons, the subjects of this study should be recognized as members of organized disc-golf groups, even if their participation in the sport was not observed.

Another potential downside of using Facebook as a research tool involves the potential inaccuracy of self-reported data on social media. Although this may be a shortcoming, several studies have shown that Facebook profiles contain valid information about their creators (Back et al., 2010; Kosinski, Stillwell, & Graepel, 2013). Like most Facebook friendships (Lampe, Ellison, & Steinfield, 2006; Ross et al., 2009), members of disc-golf groups have real-world experiences with each other, which makes it difficult to provide erroneous identities or falsify key demographic details on social media (Pempek, Yermolayeva, & Calvert, 2009). With that said, the researchers did encounter at least a few cases where a user's name was clearly a humorous alias or parodied codename. These cases were excluded from the sample.

This study considered six predictors of disc-golf-related behaviors on Facebook, including perceived sex and race, geography, education, age, and group size. A future study might expand this list to include variables related to the subjects' amount of discretionary time, marital status, and family composition.

Drawing on Facebook profiles for information also raises ethical concerns (Bruckman, 2002; Herring, 1996). Following the guidelines proposed by Kosinski et al. (2013), data from the profiles were anonymized after the collection process. The researchers did not interact or communicate with the individuals in the sample. None of the subjects were identified or quoted. All the information in this study was made publicly available by the subjects themselves. The anonymized data were only reported in the aggregate and used for academic purposes. It is reasonable to assume that the information collected for this study was not controversial, sensitive, or meant to be private. Indicators such as profile pictures, cover pictures,

or page Likes are intended for public consumption. For these reasons, the researchers did not ask for the participants' consent or deem it necessary to do so.

## Conclusion

This study makes two contributions to the literature on sport and leisure. First, it offers a cost-effective approach to studying small-, nonnormative-sport communities that are hard to reach with traditional research methods. Second, it produced the first large-scale probability sample of disc golfers and estimated the size and demographic characteristics of this population. In 2017, the organized disc-golfer population in the United States stood at roughly half a million. The proportions of women (15%) and racial minorities (9%) exceeded previous estimates, but there is a clear need for greater diversity in the population. The mean age of disc golfers (33) was surprisingly high, while the percentage of disc golfers with some college education (36%) was surprisingly low. Confirming previous studies, disc golf appears to be more popular in the Midwest than in the Northeast, South, and West. In sum, the demographic data suggest that there are social constraints to playing disc golf involving sex, race, and geography but that old age and low socioeconomic status do not limit participation and may encourage it.

## Notes

1. For this study, I contacted seven disc-golf manufacturers and one online disc-golf store. All the companies were either unwilling or unable to provide sales figures that could reveal the size or demographic characteristics of the U.S. disc-golfer population.
2. For more about PDGA player ratings, see the PDGA document "PDGA Player & Course Rating System" (<https://www.pdga.com/ratings>).
3. The four census regions include the Northeast (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, and Pennsylvania), Midwest (Indiana, Illinois, Michigan, Ohio, Wisconsin, Iowa, Nebraska, Kansas, North Dakota, Minnesota, South Dakota, and Missouri), South (Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas), and West (Arizona, Colorado, Idaho, New Mexico, Montana, Utah, Nevada, Wyoming, Alaska, California, Hawaii, Oregon, and Washington).

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Social media handles related to this research include my academic blog, <https://parkeddiscgolf.org/>; Twitter, @ADiscGolfBlog; Facebook, @ParkedADiscGolfThinkTank; and Instagram, @parkeddiscgolf.

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