

Can the Behavioral Biases in Opt-In Online Panels be Eliminated or Reduced through Corrective Weighting?



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INTRODUCTION

The Social and Economic Impact of Expanded Gambling in Massachusetts (SEIGMA) team has a need for a cost-effective and accurate way to: a) establish population prevalence rates of gambling attitudes, motivations, behavior, and harm; and b) track changes in these rates over time.

Historically SEIGMA has established **population prevalence rates** using ‘address-based sampling (ABS)’ (Harter et al., 2016; Iannacchione, 2011) combined with multimodal survey completion. This involves mailed solicitations to a random sample of residential addresses from the population of residential addresses provided by the U.S. Postal Service. The solicitation asks participants to go online to complete the survey, or alternatively, to complete a paper and pencil version or potentially participate in a telephone interview. Financial incentives for survey completion are typically provided. This ABS+multimodal approach was utilized in SEIGMA’s Baseline General Population Survey (BGPS) in 2013/2014, our Follow-Up General Population Survey (FGPS) in Sep 2021 – Feb 2022, and our Baseline and Follow-Up ‘Targeted Surveys’ in the Plainville region in 2014 and 2016/2017 and the Springfield region in 2015 and 2019/2020. In North America, the ABS+multimodal approach is currently considered the best way to obtain a representative sample by virtue of very high population coverage combined with reasonably good response rates (Link et al., 2008; Messer & Dillman, 2011; Olson et al., 2021). However, ABS+multimodal is: (a) very resource intensive and time consuming; (b) very expensive (\$1.4M for the Follow-Up General Population Survey); and (c) has experienced declining response rates in recent years (< 20%).

Historically SEIGMA has established **changes in population prevalence rates** through a) changes in the above-described cross-sectional ABS+multimodal surveys from baseline to follow-up; and b) annual changes within the 3,139 individuals who were part of the Massachusetts Gambling Impact Cohort (MAGIC) (MAGIC Research Team, 2021). However, (a) no further SEIGMA ABS+multimodal surveys are planned or financially viable; and (b) funding for MAGIC was terminated in 2019 after five waves.

A potential alternative to ABS+multimodal surveys are **opt-in online panel surveys**. The advantages of online panel surveys are that (a) the validity of answers to ‘sensitive questions’ (e.g., gambling) tends to be higher in self-administered formats (Tourangeau & Smith, 1996; van der Heijden, van Gils, Bouts, & Hox, 2000); (b) everyone has agreed and expects to be contacted (unlike telephone surveys); (c) the results can be obtained in a much shorter period of time; and (d) they are much less expensive (e.g., ~\$30K for sample of 3,000 MA residents) (Olson et al., 2021).

The main limitation of online panels is that panelists are not randomly selected but rather have self-enrolled. While online panel companies generally stratify their samples to be demographically representative of the population, significant behavioral biases typically remain that are not corrected by this stratification or by demographic weighting (e.g., Pickering & Blaszczynski, 2021; Williams, Lee & Back, 2013). Opt-in online panels have also been utilized in SEIGMA in the 2013/2014 Baseline Online Panel Survey (BOPS), Follow-Up Online Panel Survey (FOPS) in March 2022, and most recently in the March/April 2023 Online Panel Survey (OPS23). However, their utilization in SEIGMA has been to capitalize on these behavioral biases for the purpose of obtaining a higher ‘yield’ of problem gamblers¹ (as heavy gambling involvement is one of these reliable behavioral biases) so that the demographic and behavioral pattern of this important subgroup can be better understood. Thus, while opt-in online panels have some utility in

¹ The problem gambling rates in SEIGMA online panels have always been many times higher than the comparable rates in our ABS+multimodal samples (e.g., 11.1% in the 2022 FOPS).

assessing *changes* in behavior from one time period to the next (as these biases are fairly constant across surveys and time), opt-in online panels do not provide a good estimate of population prevalence rates.

Hence, the question addressed in the present investigation is *whether adding additional demographic and/or behavioral weights to opt-in online panels can correct these behavioral biases so as to provide reasonably accurate gambling prevalence rates.*

METHOD

The present investigation has three sets of sequential analyses:

1. Identifying all the demographic and behavioral variables that differentiate the FGPS from the FOPS after raked weighting of each dataset to the demographic census profile of Massachusetts.² (Note that the FOPS questionnaire is virtually identical to the FGPS questionnaire and the surveys were fielded in roughly the same time period). One complication of this analysis is that the idea for the present investigation occurred after the FGPS survey had been finalized and data collection began in September 2021. Thus, some of the variables that theoretically might best differentiate online panelists from non-online panelists were not included in the FGPS but *were* included in the FOPS that was fielded in March 2022. Thus, to make the datasets comparable, in October 2022 an email request to complete a set of 10 supplemental questions (Follow-Up General Population Survey – Supplemental; FGPS-S) was sent to the 4,472 FGPS participants who had provided an email address. The questions chosen for this supplemental survey (Appendix A) were identified from a scan of the very limited research literature on the characteristics of online panelists; suggestions from NORC who have conducted the SEIGMA ABS+multimodal surveys and who also have a probability-based online panel ([AmeriSpeak](#));³ and general speculation about motivations for joining an online panel. A total of 1,267 individuals completed the FGPS-S, which represents a 20.1% response rate from the 6,293 FGPS completers.

Two stepwise binary logistic regressions were conducted to identify variables differentiating membership in the FGPS versus the FOPS:

- a) The first compared the FOPS sample ($n = 3,038$) to the **entire** FGPS sample ($n = 6,293$) excluding the 10 supplemental variables that were collected in the FGPS-S and the FOPS. This analysis involved a total of 44 variables.
- b) The second compared the FOPS sample ($n = 3,038$) to the **supplemental** sample of FGPS-S completers ($n = 1,267$). This involved a total of 54 variables (44 + 10).

It is important to know whether variables identified in the supplemental analysis are generalizable to the entire FGPS sample. Thus, if they are not one of the 10 supplemental variables, then they *must also be significant variables* in the first analysis that includes the entire FGPS sample. However, if they are one of the additional FGPS-S variables, caution must be exercised, as a binary stepwise logistic regression determined that there were some differences in the 1,267 people who completed the FGPS-S compared to the 5,026 people who did not. More specifically, the logistic regression found there to be a

² Using the demographic variables of region, age, sex, race, educational attainment as well as region x age; region x sex; region x race; region x education; age x sex; age x race; age x education; sex x race; sex x education; and race x education. (Note: FGPS did not use region as a variable, but FOPS did).

³ Probability-based online panels are panel memberships that have been recruited through ABS+multimodal or 'dual-frame' (landline + cell phone) recruitment.

63.6% concordance between predicted group membership and actual group membership (Gamma = .28). Compared to non-completers, people who did complete the FGPS-S tended to: have more positive attitudes toward the impacts of gambling in Massachusetts, be younger, have higher educational attainment, be more likely to identify gambling as a preferred recreational activity, use cannabis more frequently, and not use tobacco.

2. Identifying the variables with the greatest potential to be used as additional weighting variables. Although there are likely several variables that differentiate the FGPS from the FOPS, their utility as potential additional weighting variables depends on several factors. More specifically, they need to be variables that:
 - a) Have both a significant univariate (Rao score statistic at Step 0 in the stepwise logistic regression⁴) and multivariate (at final step) relationship with likelihood of being an online panelist.
 - b) Are assessed on an ongoing basis independent of SEIGMA, as any new weighting variable will need to be weighted relative to these reference points (e.g., census).
 - c) Produce highly reliable and valid responses.
 - d) Have a significant relationship to gambling behavior (i.e., not just be able to generally differentiate online panelists from non-online panelists) so that they have potential to correct the gambling biases we are trying to address.

3. Adding the strongest variables identified in steps 1 and 2 to our existing weighting in an attempt to correct the behavioral biases. Assuming that there are variables that meet the criteria specified in steps 1 and 2, then their number needs to be limited so as not to overly complicate future raking procedures that may include these additional variables in addition to the usual demographic weighting variables.

RESULTS

Differences between FOPS and FGPS with Gambling Variables Included

As expected, the logistic regression found robust differences between the FOPS and FGPS samples, with 88.4% concordance (Gamma = .77) between predicted group membership and actual group membership in the 'entire sample' analysis and 91.0% concordance (Gamma = .83). with the 'supplemental sample' analysis. Table 1 illustrates the relative importance of each variable in differentiating the FGPS from the FOPS in the logistic regression. The four columns on the left are the results of the 'entire sample' analysis and the four columns on the right are the results of the 'supplemental sample' analysis. Within each analysis the first two columns are the univariate Rao score statistics for each variable before entering the multivariate model (step 0) and the third and fourth columns are the results of the final step (step 41 and step 52 respectively) after all significant variables have been entered. Variable definitions are provided in Appendix B. Green-shaded variables are 'gambling-related' variables and yellow shaded cells represent the variables from the FGPS-S. Because of large sample sizes as well as weighting to the population almost all the variables in the table are highly significant well beyond a $p < .00001$ level, and thus have been ordered by the size of their test statistic.

Results show that gambling-related variables are actually among the strongest variables differentiating the FGPS from the FOPS, with attitudes toward the current availability of gambling in Massachusetts (ga4) individually being the strongest univariate and multivariate predictor in both analyses. Relative to the FGPS, members of FOPS were much more likely to indicate that the current availability of gambling was fine

⁴ The chi-square improvement in model fit when entering the variable compared to a constant-only model.

whereas FGPS members were much more likely to indicate that gambling was not available enough or too widely available. In addition, members of FOPS were more likely to indicate that gambling was an important recreational activity to them (gr1); to report engaging in a larger number of different gambling formats (#GAM_FOR); to have a higher total PPGM score (PPGM_TOT); and to have a higher total gambling frequency (GAM_FRE). Among non-gambling variables, FOPS members were more likely to be current tobacco users (ctobacco), to report being a member of more online panels (c2d), less likely to be employed (employ), to use cannabis more frequently (c8a), and less likely to be married (marital).

Table 1. Variables differentiating the FGPS from the FOPS

Entire Sample Analysis				Supplemental Sample Analysis			
Variable	Score Statistic (Step 0)	Variable	Wald Chi-Square (Step 41)	Variable	Score Statistic (Step 0)	Variable	Wald Chi-Square (Step 52)
ga4	2724987	ga4	1827705	ga4	770027	ga4	526337
gr1	1187060	employ	150181	c2d	413161	c2d	180520
#GAM_FOR	1153824	gr1	145580	#GAM_FOR	286117	ga6b	43674
PPGM_CAT	913418	c1	117515	gr1	273815	d12	38415
GAM_FRE	691687	#GAM_FOR	112388	PPGM_CAT	238153	#GAM_FOR	36043
ctobacco	653084	ga6a	94172	ctobacco	236973	marital	29747
PPGM_TOT	588675	marital	84207	GAM_FRE	178354	c2c_D	29261
Online	520894	c5	81908	income	174516	c5	28670
c8a	384048	d12	67900	ga5	144584	employ	26220
ga6a	338820	ctobacco	59850	c2c_D	133970	ctobacco	24366
c11	337890	ga6b	59180	employ	112822	c27_3	21580
ga5	335447	ga3a	53469	gp23	108088	gr1	21041
gp23	310884	education	47461	PPGM_TOT	101645	c1	20753
c9	301022	c11	43239	Online	97461	c26	20712
c1	297400	c4	39273	education	93575	c24	19749
income	264441	c8a	38316	c9	80856	ga1	18184
employ	257357	gp23	34822	c11	79861	ga6a	16318
c8	241356	race2	33949	marital	75693	ga3a	14518
depression	217457	d2	28885	c5	73462	PPGM_CAT	14309
c5	205228	PPGM_TOT	24814	c3	67547	c2a	13321
c10a	202827	ga1	24570	c8a	64655	gp23e	13282
marital	193454	income	23353	c1	62870	c11	11927
gp24	190713	gp23e	19955	ga6a	54876	gp23	11788
gpo1	177157	pa1	18817	ga1	52171	d7b	10619
gp23e	167875	c7c	17153	gpo1	49665	c2b	10017
pa2a	151527	d7b	14667	c26	49615	c8a	9429
c12	151057	GAM_FRE	13335	d12	47013	Online	6746
d12	112418	age	8891	d7b	46766	d2	6615
ga1	112287	Online	7495	c12	45336	race	6595
c3	91684	PPGM_CAT	7019	ghealth	40098	PPGM_TOT	5958
d7b	77105	alcohol use	6209	depression	36576	c4	5836
ga6b	75772	c9	5456	c8	35496	c25	5602
ga3a	74071	pa2a	4482	ga6b	34519	income	5211
ghealth	53436	gp24	3573	c10a	33954	education	4855
pa1	28112	c8	2757	c24	32533	ga5	4551
age	25146	ga5	2164	gp24	31975	GAM_FRE	4360
c4	18541	c10a	830	ga3a	30954	c9	3563

education	14413	ghealth	651	pa2a	30240	gp24	2848
d2	12174	c3	287	gp23e	23633	c7c	2688
alcohol use	8174	c12	236	age	23596	c27_2	2215
race_2	7478	gpo1	14	alcohol use	16391	alcohol use	1692
c7c	503			c27_2	15111	c10a	1550
GAM_\$	15			race_2	14004	c12	1504
				pa1	11154	pa1	1332
				c2b	11042	pa2a	1064
				d2	6133	ghealth	707
				c27_3	5718	c8	623
				c2a	4097	c27_1	576
				c27_1	3610	gpo1	383
				c7c	2690	c3	142
				c4	641	age	132
				c25	77	GAM_\$	28
				GAM_\$	7		

Differences between FOPS and FGPS with Gambling Variables Excluded

While illustrative, gambling-related variables cannot be used as weighting variables. Rather, our goal is to have gambling variables aligned between the FGPS and FOPS *as a result of controlling for other variables*. Hence the next set of analyses repeated the same logistic regressions after eliminating all gambling-related variables as well as a few variables that were very weak predictors (i.e., current level of stress (c4), current level of happiness (c5), and number of alcoholic drinks per occasion (c7c)). The following analyses are also ‘weighted to the sample’ rather than to the population to better facilitate meaningful statistical testing.⁵

Results are presented in Table 2, with only variables significant at the $p < .01$ level being reported (there were only two nonsignificant variables: race and alcohol use). As before, yellow shaded cells represent the supplemental questions from the FGPS-S. The present analysis found that the difference between the FGPS and the FOPS was not quite as strong with the gambling-related variables removed, but significant differences were nonetheless observed, with a 71.1% concordance between predicted group membership and actual group membership in the ‘entire sample’ analysis (Gamma = .43) and 91.9% concordance with the ‘supplemental sample’ analysis (Gamma = .86). However, this latter result is primarily due to the influence of a single variable (# online panel memberships, c2d), which artificially inflates the group differences as everyone in FOPS has a score of 1 or higher, whereas many FGPS people have a score of 0.

⁵ When weighting to the population, the total sum of the population weights equals the current population of Massachusetts. A value was identified that when dividing this total provides the actual sample size (9,331) in the present analysis. All population weights were then divided by this same value. Unfortunately, this procedure did not make much difference, as most p values were still $<.0000000001$.

Table 2. Variables differentiating the FGPS from the FOPS after eliminating gambling-related variables

Entire Sample Analysis				Supplemental Sample Analysis			
Variable	Score Statistic (Step 0)	Variable	Wald Chi-Square (Step 15)	Variable	Score Statistic (Step 0)	Variable	Wald Chi-Square (Step 8)
ctobacco	546	ctobacco	163	c2d	1219	c2d	817
c8a	306	c1	145	ctobacco	247	d12	44
c9	274	employ	127	income	163	ctobacco	34
c11	263	c8a	62	c2c_D	134	employ	26
c1	220	d12	59	employ	114	income	21
employ	208	income	40	c2c_C	109	c27_3	19
c8	187	education	40	education	93	c9	9
income	187	c11	35	c9	87		
depression	165	race_2	39	c11	79		
c10a	164	marital	38	marital	73		
marital	141	c12	21	c3	66		
c12	124	c10a	20	c8a	65		
d12	77	c9	18	c1	60		
d7b	70	d7b	12	d7b	50		
c3	67	age	10	c12	47		
ghealth	41			c26	46		
education	21			d12	43		
age	14			ghealth	40		
d2	10			depression	36		
				c8	35		
				c10a	34		
				c24	33		
				d17_1	31		
				age	23		
				d17_5	20		
				alcohol use	16		
				race_2	15		
				d17_2	15		
				c27_2	14		
				d17_3	13		

Candidate Weighting Variables

Based on the results of Table 2, Table 3 identifies 12 variables likely to have the greatest potential for correcting the behavioral differences between the FOPS and the FGPS, listed roughly in order of their relative strength. Additional columns explain the direction of the effect, identify whether there are available reference sources that could be used for future weighting,⁶ and identify the strength of their relationship to gambling as assessed by bivariate associations between these variables and number of gambling formats engaged in (#GAM_FOR) and PPGM category (PPGM_CAT) (p -values are reported from Pearson correlations, chi-squares and ANOVAs, depending on the variable).

⁶ Recognizing that the question wording in future online panel surveys would have to be altered to match the reference source question.

Table 3. Candidate Weighting Variables

		Direction of Effect	Reference Source for Weighting	Association with #GAM_FOR		Association with PPGM_CAT	
				FOPS	FGPS	FOPS	FGPS
c2d	How many online panels are you a member of? (continuous)	Online panel membership higher in FOPS		0.0007	<0.0001		0.0054
ctobacco	Current tobacco use	Current tobacco use higher in FOPS	BRFSS NSDUH	<0.0001	<0.0001	<0.0001	<0.0001
d12	Were you born in the United States?	More U.S. born individuals in FOPS	ACS	0.5673	<0.0001	0.0881	<0.0001
employ	Employment category	FOPS less likely to be employed or a student	ACS	<0.0001	<0.0001	<0.0001	<0.0001
income	Household Income	Income lower in FOPS	ACS	<0.0001	0.0001	0.0010	<0.0001
c9	Problems with drugs or alcohol in the past 12 months	Problems higher in FOPS	NSDUH	<0.0001	<0.0001	<0.0001	<0.0001
c2c	How often do you tend to post things to online social media	Online posting higher in FOPS		<0.0001	0.0021	<0.0001	0.0016
c1	Gambling identified as person's preferred recreational activity	Gambling a preferred recreational activity higher in FOPS		<0.0001	<0.0001	<0.0001	<0.0001
c8a	How often have you used cannabis in the past 12 months?	Cannabis frequency higher in FOPS	NSDUH	<0.0001	<0.0001	<0.0001	<0.0001
marital	Marital status	FOPS less likely to be married	ACS	<0.0001	<0.0001	<0.0001	<0.0001
c11	Have you had any serious problems with depression, anxiety or other mental health problems in the past 12 months?	Current rate of problems higher in FOPS	NSDUH BRFSS	<0.0001	0.0956	<0.0001	<0.0001
c12	Do you now have any health problem that requires you to use special equipment, such as a cane, a wheelchair, a special bed, or a special telephone?	Health problems higher in FOPS	ACS BRFSS	<0.0001	<0.0001	<0.0001	<0.0001

ADC: American Community Survey (ACS) Public Use Microdata Sample

NSDUH: National Survey on Drug Use and Health

BRFSS: Behavioral Risk Factor Surveillance System

Three variables had no independent reference source and therefore had to be eliminated from consideration: c2d, c2c, c1. In addition, one variable (d12) did not have a strong relationship to #GAM_FOR and PPGM_CAT in the FOPS⁷ and had to be eliminated.

That left eight variables as potential future weighting variables. As all the supplemental variables have been eliminated from consideration, these eight variables are listed in order of importance in Table 4 by virtue of their relationship to FOPS versus FGPS group membership in the 'entire sample' analysis (left columns of Table 2, with particular importance paid to their multivariate relationship). Their descriptive statistics in the FOPS compared to the FGPS (after weighting with the normal demographic variables) is also reported.

Table 4. Eligible Weighting Variables

	FOPS	FGPS
Current tobacco use (ctobacco)	30.4% Yes	11.0% Yes
Employment category (employ)	54.1%: employed 6.2%: unemployed 5.4%: homemaker 6.5%: student 19.0%: retired 8.8%: disabled	63.9%: employed 3.6%: unemployed 2.2%: homemaker 7.6%: student 18.5%: retired 4.1%: disabled
Frequency of cannabis use in the past 12 months (c8a)	16.9%: 4 or more times a week (1) 5.7%: 2-3 times a week (2) 4.5%: Once a week (3) 4.3%: 2-3 times a month (4) 2.4%: Once a month (5) 7.7%: Less than once a month (6) 58.5%: Not at all (7) Mean = 5.27 (SD 2.41)	8.0%: 4 or more times a week (1) 3.2%: 2-3 times a week (2) 1.9%: Once a week (3) 3.3%: 2-3 times a month (4) 1.9%: Once a month (5) 8.4%: Less than once a month (6) 73.4%: Not at all (7) Mean = 6.06 (SD 1.89)
Household income category (income)	8.9%: < \$15,000 12.1%: \$15,000 - \$29,999 16.4%: \$30,000 - \$49,999 29.8%: \$50,000 - \$69,999 16.4%: \$70,000 - \$149,999 9.0%: \$150,000 or more 7.4%: missing Mean = \$74,010 (SD 47.5K)	8.0%: < \$15,000 8.6%: \$15,000 - \$29,999 10.3%: \$30,000 - \$49,999 20.9%: \$50,000 - \$69,999 13.8%: \$70,000 - \$149,999 17.9%: 150,000 or more 20.6%: missing Mean = \$89,450 (SD 52.0K)
Serious problems with depression, anxiety or other mental health problems in the past 12 months (c11)	39.3% Yes	26.2% Yes
Problems with drugs or alcohol in the past 12 months (c9)	11.0% Yes	2.7% Yes
Marital status (marital)	32.5%: never married 12.0%: living with partner 38.6%: married 11.5%: divorced/separated 5.3%: widowed	24.5%: never married 9.9%: living with partner 51.2%: married 9.0%: divorced/separated 5.5%: widowed
Significant physical health limitations (c12)	13.0% Yes	6.2% Yes

⁷ This may be due to the FOPS only being available in English, whereas the FGPS was available in Spanish as well.

Application of Additional Weighting Variables

The final stage of this analysis investigated the ability of the strongest four variables to be individually added as additional weighting variables to reduce or eliminate the differences between the FGPS and the FOPS, with specific attention paid to aggregate measures of gambling involvement. Thus, ctobacco was first added to the existing demographic raking variables to examine the extent to which this new set of variables reduced the differences between the FGPS and the FOPS on three aggregate measures of gambling involvement: #GAM_FOR, GAM_FREQ, and PPGM_TOT. Next, employment category, frequency of cannabis use, and household income were each sequentially added to examine the differences between the three aggregate measures of gambling involvement with these additional variables. (Note that the FGPS was used to determine population estimates for each of these variables, which is why the FGPS figures in Table 5 do not change with the addition of these four variables).

Table 5 presents the descriptive statistics associated with each level of weighting (means and standard deviations) along with a statistical test of the difference between the datasets using a Mann-Whitney U test. As can be seen, while these four additional weighting variables helped in reducing the gambling-related differences between the FOPS and the FGPS, the magnitude of the reduction was inadequate to meaningfully eliminate the differences.⁸

Table 5. Descriptive and Inferential Statistics Associated with Each Level of Weighting

	PPGM Total (PPGM_TOT)		Total # Gambling Formats (#GAM_FOR)		Total Gambling Frequency (GAM_FREQ)	
	FOPS	FGPS	FOPS	FGPS	FOPS	FGPS
Normal demographic weights	1.02 (2.62)	0.12 (.69)	2.97 (2.89)	1.39 (1.63)	56.62 (87.97)	19.90 (50.51)
	U = 3837393	p < .0001	U = 4448828	p < .0001	U = 4414851	p < .0001
Normal demographic weights + ctobacco	0.63 (1.94)	0.12 (0.69)	2.51 (2.47)	1.39 (1.63)	46.18 (80.26)	19.90 (50.51)
	U = 3969632	p < .0001	U = 4513307	p < .0001	U = 4455363	p < .0001
Normal demographic weights + ctobacco + employ	0.65 (1.97)	0.12 (0.69)	2.59 (2.51)	1.39 (1.63)	46.91 (81.02)	19.90 (50.51)
	U = 4522855	p < .0001	U = 5297680	p < .0001	U = 5172335	p < .0001
Normal demographic weights + ctobacco + employ + c8a	0.60 (1.86)	0.12 (0.69)	2.52 (2.45)	1.39 (1.63)	45.13 (79.57)	19.90 (50.51)
	U = 4298237	p < .0001	U = 4973434	p < .0001	U = 4861720	p < .0001
Normal demographic weights + ctobacco + employ + c8a + income	0.55 (1.79)	0.12 (0.69)	2.46 (2.48)	1.39 (1.63)	43.07 (77.76)	19.90 (50.51)
	U = 4527503	p < .0001	U = 5178457	p < .0001	U = 5065582	p < .0001

⁸ It is theoretically possible that these weighting variables may have a stronger influence on eliminating differences on non-gambling variables between the FGPS and the FOPS, but this would have little utility to SEIGMA which is primary concerned with gambling variables.

DISCUSSION AND CONCLUSION

The purpose of this investigation was to determine whether adding additional demographic and/or behavioral weights to opt-in online panels could correct the fairly significant behavioral biases that still occur after normal demographic weighting. This was undertaken by comparing differences in a representative ABS+multimodal sample (FGPS) of 6,293 adult Massachusetts residents compared to an online panel sample of 3,038 adult Massachusetts residents (FOPS) who were administered the same questionnaire in roughly the same time period. A total of 54 variables were compared, which included a range of demographic, substance use, mental health, and gambling-related variables as well as 10 variables specifically created to identify potential differences in online versus non-online panelists.

A large range of variables were found to differentiate the FOPS from the FGPS, with gambling-related variables, substance use variables, and a few demographic variables generally being the strongest. Unfortunately, while adding the four strongest differentiators (tobacco use; employment status; frequency of cannabis use; household income) to the weighting procedure helped in reducing the gambling-related differences between the FOPS and the FGPS, the magnitude of the reduction was modest.

In conclusion, this investigation was unsuccessful in identifying a set of additional weighting variables that would eliminate the fairly significant gambling-related behavioral biases that still occur in online panel data after normal demographic weighting.⁹ This, in turn, precludes online panel data being utilized to establish accurate prevalence rates. That said, the annual SEIGMA online panel surveys still hold considerable value, as their intent has always been to identify *changes* in gambling-related attitudes, motivations, behaviors, and harm from one year to the next, which they still do quite well, and which is arguably more important than actual prevalence rates.

⁹ Even if these behavioral biases cannot be eliminated, reducing them could be helpful. Thus, current tobacco use could be considered as an additional weighting variable in future SEIGMA online panel surveys. In addition, the two demographic variables of employment status and household income could easily be included as additional raking variables despite their limited utility.

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Appendix A: Follow-Up General Population Survey: Supplemental (FGPS-S)

Email Solicitation

Subject: Receive \$5! Complete Follow-Up Massachusetts Survey of Health and Recreation

Hello,

We are reaching out to you because you completed the Massachusetts Survey of Health and Recreation. We are grateful for you completing the survey and we invite you to participate in a brief follow-up. The follow-up survey consists of only 10 questions and we expect you should be able to finish in 3 to 5 minutes.

Please click this link [click this link](#) to complete this brief survey. You will be given a **\$5 Amazon gift code** as a token of our appreciation.

If you would like to learn more, please contact us via email at MAHealth@NORC.org.

Thank you for your help with this important study!

Sincerely,
Rachel Volberg

For more information about the project, please visit: [Social and Economic Impacts of Gambling in Massachusetts](#)
[| UMass Amherst](#)



UMASS
AMHERST

Note: the survey was labelled 1 to 10 in the FGPS-S, but these 10 questions were embedded within different sections of the FOPS. Thus, the FOPS question numbers are displayed.

Survey

C2a. How much time do you spend online most days?

- 11+ hours (5)
- 6-10 hours (4)
- 3-5 hours (3)
- 1-2 hours (2)
- Less than 1 hour (1)

C2b. How often do you use any of the following: Instagram, Twitter, Snapchat, Facebook, Tumblr, LinkedIn, WhatsApp, etc.

- Several times a day (5)
- About once a day (4)
- At least once a week (3)
- A few times a month (2)
- Never, or almost never (1)

C2c. How often do you tend to post things to online social media (i.e., Facebook, Twitter, Instagram, Snapchat, etc.)

- Multiple times most days (7)
- At least once a day (6)
- Several times a week (5)
- Once a week (4)
- Once a month (3)
- Almost never (2)
- Never (1)

C2d. How many online panels are you a member of? (Online panels are groups of individuals who have agreed to take part in online surveys for a particular company (e.g., Ipsos, MassVoice, Qualtrics, etc.) in return for some type of compensation (points, eligibility for draws, digital gift-card/voucher)).

- None (0)
- Just this one (1)
- Two (2)
- Three (3)
- More than three (4)

C24. How often do you vote?

- Every election I am eligible to vote in (4)
- Most elections I am eligible to vote in (3)
- Some elections I am eligible to vote in (2)
- Never or almost never (1)

C25. On a scale from 0 to 10 how 'helpful' a person do you consider yourself to be (0 being very unhelpful; 10 being extremely helpful)? _____

C26. On a scale from 0 to 10 how important is it for you to express your opinion on things? (0 being not at all important; 10 being extremely important)_____

C27. To what extent would you agree or disagree with the following statements? (randomize order of the 3 statements) (NORC Amerispeak questions)

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
c. I like to tell others about new brands or technology.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
a. I usually try new products before other people do.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. When I shop, I look for what is new.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

D17. What kind of internet access do you have? Please select all that apply. (NORC Amerispeak question)

- High-speed, broadband internet at home (such as cable or DSL) (1)
- Dial-up internet at home (2)
- Internet on a cell connection on a mobile phone (3)
- Internet at work, or office, or other location that you can use for taking surveys on a computer or tablet (4)
- No internet access at all (5)

D18. What best describes your telephone service for your household? (NORC Amerispeak question) Cellphone includes smartphones such as iPhones and Android phones. If you have phone service such as through 'Vonage' and other internet phones, it would be considered a landline.

- Landline telephone only
- Have cellphone, but mostly use landline
- Have a landline, but mostly use cellphone
- Cell phone only
- No telephone service

If you are interested in receiving a \$5 Amazon e-gift card, please provide us with your e-mail address. If you are not interested, please click orange arrow to submit the survey.

We are only using your e-mail address so that we will be able to provide you with your payment and will not be used for any additional reasons.

I'd like to thank you on behalf of the University of Massachusetts for the time and effort you've spent answering these questions. If you have any questions about this survey, you may contact Dr. Rachel Volberg at 413-545-6700. Thank you again.

You should be receiving an email from MAHealth@norc.org about your gift code for your participation in the coming days.

Appendix B: Variables in the Analyses

Variable	Description	Reference variable
c1	Which of the following is your preferred recreational activity? (watching TV; walking or hiking; gardening; reading; socializing with friends or family; raveling; gambling; other_____)	1 (watching tv)
c2a	How much time do you spend online most days? (in hours)	Continuous
c2b	How often do you use any of the following: Instagram, Twitter, Snapchat, Facebook, Tumblr, LinkedIn, WhatsApp, etc? (in weeks)	Continuous
c2c_D	How often do you tend to post things to online social media (i.e., Facebook, Twitter, Instagram, Snapchat, etc.)	1 (never)
c2c_C	How often do you tend to post things to online social media (i.e., Facebook, Twitter, Instagram, Snapchat, etc.) (in weeks)	Continuous
c2d	How many online panels are you a member of?	Continuous
c3	Over the past 12 months, would you say that in general your health has been	Continuous (excellent=1, poor=5)
ghealth	General health (2 categories)	2 (Fair to Poor)
c4	In the past 12 months, how would you rate your overall level of stress?	Continuous (very high=1, very low=5)
c5	In the past 12 months, how would you rate your overall level of happiness?	Continuous (very high=1, very low=5)
ctobacco	Current tobacco use (C6b + C6c)	1 (no)
c7c	During the past 30 days, on the days when you drank, about how many drinks did you drink on average?- missing set to mean (2.83)	Continuous; N/A=0
Alcohol_use	Alcohol use (3 categories)	1 (not in past year)
c8	In the past 12 months have you used any marijuana, hallucinogens (such as LSD, mushrooms, or PCP), cocaine, heroin or opium, or any other drugs not intended for medical use?: missing set to MODE	2 (no)
c8a	How often have you used cannabis (e.g., marijuana, hashish, hash oil, CBD oil, etc.) in the past 12 months?	7 (not at all)
c9	problems with drugs or alcohol in the past 12 months	1=no 2=yes
c10a	Have you had problems with other behavior in the past 12 months such as overeating, sex or pornography, shopping, exercise, Internet chat lines, or other things?	2 (no)
c11	Have you had any serious problems with depression, anxiety or other mental health problems?	1 yes, past 30 days 2 yes past year 3 no (reference)
depression	Depression (past 12 months)	1 (no)
c12	Do you now have any health problem that requires you to use special equipment, such as a cane, a wheelchair, a special bed, or a special telephone?	2 (no)
c24	How often do you vote? (in %)	Continuous
c25	On a scale from 0 to 10 how ~helpful a person do you consider yourself to be?	Continuous (0 being very unhelpful; 10 being extremely helpful)
c26	On a scale from 0 to 10 how important is it for you to express your opinion on things?	Continuous (0 being not at all important; 10 being extremely important)

Variable	Description	Reference variable
c27_1	I usually try new products before other people do.	Continuous (1=strongly disagree, 5=strongly agree)
c27_2	When I shop I look for what is new.	Continuous (1=strongly disagree, 5=strongly agree)
ga1	Which best describes your belief about the benefit or harm that gambling has for society?	3 (The benefits are about equal to the harm)
ga3a	Which of the following best describes your opinion about legalized gambling?	2 (Some types of gambling should be legal and some should be illegal)
ga4	Which of the following best describes your opinion about gambling opportunities in Massachusetts?	3 (The current availability of gambling is fine)
ga5	There have been 3 new casinos built in Massachusetts in the past few years. What sort of overall impact do you believe these have had? Would you say...	Continuous (very beneficial=1, very harmful=5)
ga6a	What do you believe will be the single most positive impact for Massachusetts?	5 (no positive impacts)
ga6b	What do you believe will be the single most negative impact for Massachusetts?	5 (no negative impacts)
#GAM_FOR	Number of gambling formats participated in last 12 months(excluding stocks, casino, casino_ma, including egm and table games)	Continuous
Online	In the past 12 months gambled online	1 (no)
GAM_FRE	Detailed frequency of any gambling in last 12 months (excluding stocks, casino, casino_ma, including egm and table game)-Missing 1 set to never- # times/year	Continuous
GAM_\$	Estimated ALL GAMBLING expenditures in past year (excluding stocks, casino, casino_ma, including egm and table game) - Missing 1 set to never	Continuous
gr1	How important is gambling to you as a recreational activity?	Continuous 1=very important, 4=not at all important/NA (combine NA with not at all important)
pa1	In the past 12 months have you seen or heard any media campaigns to prevent problem gambling in Massachusetts?	2 (no)
pa2a	In the past 12 months have you been aware of any programs to prevent problem gambling (other than media campaigns) offered at your school, your place of work, in your community or else	2 (no)
gp01	What portion of your close friends and family members are regular gamblers?	Continuous (none of them=0, all of them=4)
PPGM_TOT	Problem & Pathological gambling measure-TOTAL SCORE - missing set to mean (0.44)	continuous
PPGM_CAT	Problem and pathological gambling measure-Missing set to never (4 categories) (excluding stocks, casino, casino_MA, including egm and table game)	1 (NonGambler)
gp23	Help with gambling problems	0 N/A 1 did not want help (reference) 2 wanted help

Variable	Description	Reference variable
gp23e	Have you excluded yourself from any casino or slots parlor in the past 12 months?	2 (no/NA)
gp24	Have you had problems with gambling in your lifetime prior to the past 12 months?	2 (no/NA)
d2	Are you male, female or other gender?	1 (male) Combined other/prefer not to answer
age	Age (based on 2022-year of birth) - missing set to mean (49.3)	Continuous
employ	Employment 6 categories- missing set to mode (1=employed)	1 (employes)
education	Education 3 categories- missing set to mode (2=some college/BA)	1 (hs or less)
d7b	Have you ever served on active duty in the U.S. Armed Forces, military Reserves, or National Guard?-missing set to mode(2=no)	4 (no, never)
marital	Marital status- missing set to mode(3=married)	3 (married)
income	Income scaled (dollars in thousands)-missing set to mean (84.53)	Continuous
d12	Were you born in the United States??-missing set to mode(1=yes)	1 (yes)
race2	Race/ethnicity- missing set to mode (3=white)	3 (white)
d17	What kind of internet access do you have?	
d18	What best describes your telephone service for your household?	1 (landline only) do not use