Social pressure, altruism, free-riding, and non-compliance in mask wearing by U.S. residents in response to COVID-19 pandemic

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ABSTRACT

Human behavior, such as wearing a mask in public, affects the trajectory of the COVID-19 pandemic. A nationally representative survey of 1198 U.S. residents was used to study demographics, perceptions, and stated beliefs of residents who indicated they believe masks have a role in society in response to COVID-19 but self-reported not wearing masks in at least one public place studied. Individuals who believed wearing masks protected others were more likely to report voluntarily wearing them, providing possible evidence of altruism. Perceiving social pressure negatively impacted the probability of voluntary mask wearing amongst those who believed masks have a role in society, suggesting social shaming may not increase compliance among these individuals. Free-riding is one possible explanation for why an individual respondent may self-report belief that mask wearing has a role in society and simultaneously self-report not voluntarily wearing a mask in public locations. Alternatively, incomplete knowledge, confusion about the role of masks in controlling spread of COVID-19, or fatigue are all possible explanations for why adults who believe masks play a role demonstrate less than optimal compliance themselves with mask wearing. Promotion of altruism, rather than social shaming, is more likely to increase mask wearing based on this analysis. Tactics to improve public health initiative compliance and participation may change throughout the duration of the pandemic and/or may differ between segments of the population. Increased understanding of human behavior as it relates to mask wearing can inform public health communications and construction of incentive-aligned messaging to improve public health-related behaviors and associated outcomes.

1. Introduction

Pandemic-relevant social and behavioral sciences include work related to threat perception, leadership, individual and collective interests, science communication, social context, and stress and coping (Bavel et al., 2020). Individual people's behaviors within communities ultimately influences or determines the spread, and eventual course of the pandemic within a population. Public health outcomes and the spread of disease in the human population is fundamentally an epidemiological question (CDC A, 2012). However, human behavior including the allocation of finite resources like time, money, emotional capacity, or mental attention is a critical component of COVID-19 response and recovery.

A variety of human behavior explanations exist for sub-optimal individual behaviors in response to COVID-19, especially after many months of coping and confusion in response to public health messaging.

Free-riding, altruism, and bandwagoning behaviors have been studied in health-related practices prior to the COVID-19 pandemic, including notably in vaccination decisions (Hershey et al., 1994). Free-riding fundamentally means that an individual is taking advantage of the efforts by others to establish some collective good without actually contributing. Free-riding is often used in the context of economics, psychology, and political science to refer to the negative impacts of this behavioral problem (Van der Hoven, 2012). Altruism, the selfless concern for others or general caregiving for others beyond oneself, is a powerful psychological factor or trait that has been studied in great depth with regard to how it can influence human behavior and decision making (Andreoni, 1990; Cornes & Sandler, 1984; Shim et al., 2012). Framed in the context of game theory and vaccination for influenza, Shim et al. (2012) found that contrary to the assumption that individuals maximize their personal payoffs when making decisions and act according to self-interest, altruism indeed plays a role in vaccination

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decisions (Shim et al., 2012). Altruism has been referenced with respect to mask wearing in response to COVID-19 (Cheng et al., 2020). Although there are undoubtedly a number of frameworks for understanding such behavior, of which altruism is only one. Bandwagoning behavior reflects an activity or action that is currently fashionable or socially supported, often recognized as peer pressure or some amount of societal inertia. Bandwagoning is rooted in conformity and group think in social psychology. Fundamentally bandwagoning suggests that the rate of acceptance of behavior or belief goes up the more that those behaviors or beliefs have already been adopted by others, irrespective of the individual's own views or opinions (Colman, 2003; Cantarelli et al., 2018). Bandwagoning in medicine has been described by Cohen and Rothschild (1979) as "the overwhelming acceptance of unproven but popular ideas" that are often disproved, abandoned, and replaced by another bandwagon (or sometimes proven valid and justified, albeit after the fact) (Cohen & Rothschild, 1979). Indeed, bandwagoning and the want to conform to social pressures was found to impact nursing personnel decisions in an experimental survey conducted in-the-field by Cantarelli et al. (2018). Personal were also impacted by other factors such as denominator neglect, zero-risk effects, halo effects, and anchoring (Cantarelli et al., 2018).

The possibility for free-riding, altruism, peer-pressure (i.e. bandwagoning behavior), and protest/angry resistance to impact mask wearing behaviors by individuals in the U.S. has been recognized. In June 2020 a survey was administered to a nationally representative sample of U.S. residents over the age of 18 to collect data on their beliefs and behaviors with regard to facial masks in response to COVID-19. This analysis seeks to gain insight into the behaviors of a specific segment of the population, namely adults who direct-stated agreement that masks have a role in the U.S. response to the COVID-19 pandemic, but also report not wearing a mask in one or more public locations visited during the pandemic. Stated beliefs by those who wear/do not wear masks in various public locations (including in-person religious services, big box grocery store/supermarket, specialty grocery store, gym, home improvement store, restaurant, workplace, school, clothing store, and retail store other than grocery clothing or home improvement) are summarized to offer insights into what beliefs were prevalent among those wearing masks voluntarily versus those not. It is hypothesized that self-reported mask wearing compliance and non-compliance may be related to self-stated beliefs about the roles of masks in public health, alongside demographics. The potential for externalities in one's behaviors protecting or threatening others, in addition to the possibility of legitimate misunderstandings about masks and/or perceived risks based on geographical location are discussed in order to inform public health communication related to the behaviors of individuals.

2. Materials and methods

The demographics of the survey respondents were targeted to be representative of the U.S. population (U.S. Census) for the demographic categories of gender, age, income, education, and region of residence. Region of residence was as defined by the U.S. census (U.S. Census Bureau, 2016). The survey questions, which were designed to gain a better understanding of the impact of COVID-19 as well as the beliefs surrounding masks and their usage, were developed and distribute using Qulatrics (Qualtrics, 2020). The survey questions employed in this analysis as presented to respondents are available in Supplementary Materials. Data collection took place during the beginning of the relaxation of social distancing in many regions of the U.S., from June 12, 2020 to June 20, 2020. Kantar, a company which hosts an opt-in online panel of potential respondents was used to recruit and contact respondents (Kantar, 2020). Study procedures were approved by the Oklahoma State Institutional Review Board (IRB-20-283). Informed consent was obtained by the respondents. Only respondents over 18 years of age were permitted to participate in the survey. A total of 1198 completed responses were obtained and analyzed.

In addition to traditional demographics, three state-specific classifications of COVID-19 were assigned on the basis of what was deemed high case counts at the time of data collection. States that had over 40,001 cases as of June 17th, 2020 (high case states), the top 9 states with the highest number of per-capita cases of COVID-19 (high number of cases by population states), and 6 states that experienced a high spike in cases after the U.S. holiday Memorial Day 2020 (high increase in cases states). According to the CDC (CDC B, 2020), as of June 17th, 2020, 17 states had over 40,001 cases of COVID-19: California, Texas, Louisiana, Florida, Georgia, North Carolina, Virginia, Maryland, New Jersey, New York, Connecticut, Massachusetts, Pennsylvania, Ohio, Indiana, Michigan and Illinois. To obtain the states with the highest per-capita case load, the number of COVID-19 cases as of June 17, 2020 was divided by the estimated 2019 population (U.S. Census Bureau, 2016). The top 10 states with the highest number of COVID-19 cases per capita were New Jersey, Massachusetts, Rhode Island, District of Colombia, Connecticut, Delaware, Illinois, Maryland, and Louisiana. Six states had record numbers of new cases (high increase in cases states) namely, Florida, Texas, Arizona, Oklahoma, Oregon, and Nevada (CBS News, 2020).

In order to gauge general perceptions of facial coverings in response to the pandemic, respondents were asked *Do you agree that masks (meaning any face covering that covers your nose and mouth) have any role in U.S. society related to the spread of viral disease, especially COVID-19, in the June - December 2020 time frame?* Answer choices provided included *NO - they have absolutely no role whatsoever in U.S. society* or *YES - they have some potential role in U.S. society.* The test of proportions, conducted using STATA/SE16 (StataCorp, 2019), was used to compare the demographics of the respondents who selected yes, and those that selected no. The test of the difference of two proportions $\widehat{p_1}$ and $\widehat{p_2}$, was calculated as:

$$z = \frac{\widehat{p_1} - \widehat{p_2}}{\sqrt{\widehat{p_p}\left(1 - \widehat{p_p}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \tag{1}$$

given:

$$\widehat{P_p} = \frac{x_1 + x_2}{n_1 + n_2} \tag{2}$$

where x_1 and x_2 are the total number of successes in the two populations (Acock, 2018).

Respondents that indicated they believed masks had some potential role in U.S. society were also asked to indicate the locations they visited and their mask wearing status while at that location. Locations included in-person religious services, big box grocery store/supermarket, specialty grocery store, gym, home improvement store, restaurant, workplace, school, clothing store, and retail store other than grocery clothing or home improvement. The percentage of respondents that visited a location and voluntarily wore a mask was statistically compared among locations using the test of proportions (Eqs (1) and (2)). Whether the respondent visited a location and voluntarily wore a mask was further broken down and statistically compared by gender, income, education, child status, and state COVID-19 classification. Income was condensed to higher income (an income of $50,000 or higher) and lower income (an income of $49,999 or lower). Education was condensed to college or more and less than college education. The test of proportions (Eqs (1) and (2)) was used to compare demographics and voluntary mask wearing. For example, the percentage of women versus men who voluntarily wore a mask at an in person religious service. The Bonferroni correction was used to establish the statistical thresholds when multiple tests were conducted, thresholds are reported in the individual tables (Bonferroni, 1936).

Respondents were asked to indicate on a scale from 1(not impacted) to 5(impacted) the level of COVID-19 related impact they experienced for four different activities outside of work/school, specifically re-

spondent's daily activities, ability to buy paper products (e.g. toilet paper, paper towels), ability to find meat, milk, and perishable grocery items, and activities related to work/school. Respondents were also permitted to select *this activity does not apply to me*; those responses were not included in this analysis. Activities included: the respondent's daily activities outside of work/school, ability to buy paper products (e.g. toilet paper, paper towels), ability to find meat, milk, and perishable grocery items, and activities related to the respondent's work/school. The mean score between those who voluntarily wore a mask and did not voluntarily wear a mask were statistically compared using a *t*-test for those locations that pertained to a particular activity. For example, the mean responses to the impact COVID-19 had on the respondent's daily activities outside of work/school were statistically compared between those who went to and voluntarily wore a mask at an in-person religious service and those that did not voluntarily wear a mask. The test for μ_x (sample x) = μ_y (sample y) for unknown σ_x (standard deviation) and σ_y and $\sigma_x \neq \sigma_y$ is (Gosset, 1908):

$$t = \frac{(\overline{x} - \overline{y})}{\left(\frac{S_x^2}{n_x} + \frac{S_y^2}{n_y}\right)^{\frac{1}{2}}} \qquad (3)$$

where $\overline{x}$ is the mean of sample *x*, $\overline{y}$ is the mean for sample *y*, *s* is the standard deviation and *n* is the sample size. The result of Equation (3) has a Student's *t* distribution with *v* degrees of freedom given by (Welch, 1947):

$$-2 + \frac{\left(\frac{S_x^2}{n_x} + \frac{S_y^2}{n_y}\right)^2}{\frac{\left(\frac{S_x^2}{n_x}\right)^2}{n_x+1} + \frac{\left(\frac{S_y^2}{n_y}\right)^2}{n_y+1}} \qquad (4)$$

Respondents were asked to indicate if they agreed with a series of 7 statements regarding mask usage. The statements included: *masks help prevent the spread of COVID-19, masks help prevent me from getting COVID-19, masks help prevent me from spreading COVID-19, masks will help prevent future lock-downs in my community, there is social pressure in my community to wear a mask, masks do not prevent the spread of COVID-19*, and *masks have negative health consequences for the mask wearer*. The percentage of respondents who indicated they visited a location, voluntarily wore a mask there, and agreed with the COVID-19 mask statement was compared using the test of proportions to the percentage of respondents who indicated they visited a location, did not voluntarily wear a mask, and agreed with the COVID-19 mask statement.

A series of logit models of the probability a respondent visited a location and voluntarily wore a mask were estimated. Logit models were chosen because the probability the person visited and voluntarily wore a mask took on the form of either 1 or 0. The latent utility (V_{in}) for location *i* and respondent *n* can be represented by the equation:

$$V_{in} = \beta_1 Income_{in} + \beta_2 HighCase_{in} + \beta_3 HighIncrease_{in} + \beta_4 HighPop_{in}$$
$$+ \beta_5 ActivityImpact_{in} + \beta_6 PaperImpact_{in} + \beta_7 PreventSpread_{in}$$
$$+ \beta_8 PreventMe_{in} + \beta_9 PreventMeSpread_{in} + \beta_{10} LockDown_{in}$$
$$+ \beta_{11} Pressure_{in} + \beta_{12} NoPrevent_{in} + \varepsilon_{in.} \qquad (5)$$

Income$_{jn}$ is a continuous variable ranging from 1 (income of $0-$24,999) to 5 (income of $100,000 or greater), *HighCase$_{in}$* indicates the person is from a state with greater than 401,000 COVID-19 cases, *HighIncrease$_{in}$* indicates the person is from a state with a high increase in COVID-19 cases after Memorial Day 2020, *HighPop$_{in}$* indicates the respondent lives in a state with a high per-capita rate of COVID-19. *ActivityImpact$_{in}$* is the score from 1 (low impact) to 5 (high impact) the impact COVID-19 had on activities outside of work/school and *PaperImpact$_{in}$* is the impact score on ability to buy paper products.

PreventSpread$_{in}$ indicates the respondent agreed with the statement masks help prevent the spread of COVID-19, *PreventMe$_{in}$* indicates the respondent agreed that masks help prevent them from getting COVID-19, *PreventMeSpread$_{in}$* indicates the respondent agreed that masks will prevent them from spreading COVID-19, *LockDown$_{in}$* indicates the respondent agreed that masks will help prevent future lockdowns, *Pressure$_{in}$* indicates the respondents agrees there is social pressure in their community to wear a mask, and *NoPrevent$_{in}$* indicates the respondent agrees that masks do not prevent the spread of COVID-19. The unobserved error term which is assumed independently identically, distributed extreme value is represented by e_{in} (Train & Weeks, 2005). The logit probability (P_{in}) for location *i* and respondent *n* becomes:

$$P_{in} = \frac{e^{\beta_n' x_{in}}}{\sum_n e^{\beta_n' x_{in}}}. \qquad (6)$$

Because coefficients from logit models can be difficult to interpret, marginal effects were estimated.

3. Results

Out of the 1198 respondents obtained, 996 (83%) indicated that masks have a role in U.S. society to prevent the spread of viral disease, including COVID-19, and 202 (17%) did not (Table 1). A lower percentage of respondents who believed masks had a role were 25-34 (17%) and a higher percentage were 65+ when compared to those who did not

Table 1
Demographics for respondents who reported masks have a role in U.S. society to prevent viral spread and those who do not.

Demographic Variable	Do masks have a role in U.S. society to prevent viral spread	
	Yes n=996	No n=202
Gender		
Male	47	51
Female	53	49
Age		
18-24	10	10
25-34	17$^\Psi$	24$^\Psi$
35-44	16	19
45-54	18	21
55-65	17	16
65 +	22$^\Psi$	9$^\Psi$
Income		
$0-$24,999	22$^\Psi$	33$^\Psi$
$25,000-$49,999	25	26
$50,000-$74,999	18	18
$75,000-$99,999	13	13
$100,000 and higher	21$^\Psi$	9$^\Psi$
Education		
Did not graduate from high school	3	3
Graduated from high school, Did not attend college	27$^\Psi$	37$^\Psi$
Attended College, No Degree earned	23	29
Attended College, Associates or Bachelor's Degree earned	33$^\Psi$	22$^\Psi$
Attended College, Graduate or Professional Degree earned	14$^\Psi$	9$^\Psi$
Region of residence		
Northeast	20$^\Psi$	11$^\Psi$
South	38	44
Midwest	21	24
West	21	21
State COVID status		
High number of cases	68	63
High number of cases by population	15	12
High increase in cases	21$^\Psi$	28$^\Psi$

$^\Psi$Indicates the percentage of respondents within a given demographic category differed statistically at the <0.05 level between those who self-stated masks do have a role in society versus those who self stated that they do not have a role in society.

believe 24% and 9%, respectively. A lower percentage who believed masks had a role had an income of $0-24,999 (22%) when compared to those who did not believe (33%). Conversely, a higher percentage of respondents who said yes had an income of $100,000 and higher (21%) when compared to those who said no (9%). Of those who believed masks had a role in society to prevent viral spread, a lower percentage graduated from high school but did not attend college (27%), when compared to those who did not believe (37%). A higher percentage of those who said yes attended college, associates or Bachelor's degree earned (33%) or attended college, graduate or professional degree earned (14%) when compared to those who said no (22% and 9%, respectively). Of those who said they believed masks have a role, a higher percentage were from the northeast (20%) when compared to those who did not believe (11%). Finally, a lower percentage of respondents who said yes, that masks have a role, were from high increase in COVID-19 case states (21%) when compared to those who said no (28%).

Of respondents who visited the locations studied, greater than half reported wearing a mask voluntarily in a big box grocery store/supermarket, a specialty grocery store, a home improvement store, a school, a clothing store, or a retail store other than a grocery, clothing, or home improvement store (Table 2). A higher percentage of females voluntarily wore a mask when compared to men at big box grocery stores (69% vs 57%), specialty grocery stores (66% vs 53%), and school (65% vs 50). A higher percentage of respondents with a lower income voluntarily wore a mask at big box grocery stores, clothing stores, and other retail stores when compared to those with a higher income.

Those who voluntarily wore a mask in a big box grocery store/supermarket indicated a higher mean level of impact of COVID-19 on their daily activities outside of work (3.90) when compared to those who did not voluntarily wear a mask (3.65) (Table 3). A higher mean impact score for their daily activities outside of work/school was found for those who voluntarily wore a mask at a specialty grocery store (4.05) when compared to those who did not (3.71). Those who voluntarily

wore a mask at a clothing store, or other retail store both had higher COVID-19 impact scores for their daily activities outside of work/school. For those who voluntarily wore a mask at their workplace, the COVID-19 impact score for activities related to their work/school (4.07) was higher than those who did not voluntarily wear a mask (3.74).

A higher percentage of those who voluntarily wore a mask at a big box grocery store (85%), a home improvement store (83%) or other retail store (82%) also selected that they agreed with the statement *masks help prevent me from getting COVID-19* when compared to those who did not voluntarily wear a mask (Table 4). A higher percentage of respondents who voluntarily wore a mask at the locations studied with the exception of in person religious services, gym, workplace and school, agreed with the statement *masks help prevent me from getting COVID-19* and *masks help prevent me from spreading COVID-19* when compared to those who did not voluntarily wear a mask. For all locations studied, a higher percentage of respondents who voluntarily wore a mask agreed with the statement *masks will help prevent future lock-down.* For the statement *there is social pressure in my community to wear a mask*, lower percentages of respondents who voluntarily wear a mask at big box grocery store/supermarkets agreed when compared to those not voluntarily wearing a mask. A lower percentage of respondents who voluntarily wore a mask at a big box grocery store/supermarket (5%), or other retailer (6%) agreed with the statement *masks have negative health consequences for the mask wearer* when compared to those who did not 11%, and 12% respectively.

Considering the logit models predicting the probability of voluntary mask wearing, as income increased, the probability of wearing a mask at an in person religious service (-0.060), a big box grocery store/supermarket (-0.035), a specialty grocery store (-0.034), a home improvement store (-0.023), a restaurant (-0.043), a school (-0.057), a clothing store (-0.048), or other retailers (-0.039) all decreased (Table 5). Being from a high increase in cases state increased the probability of voluntarily wearing a mask at an in person religious service (0.125), a big box grocery store/supermarket (0.121), specialty grocery store (0.108),

Table 2

Percent (%) of respondents who reported that masks have a role in U.S. society in response to COVID-19 who can and do visit various public locations and voluntarily wear a mask. N given in table and specific to each location.

	Voluntarily wears a mask	Gender		Income		Education		Child Status	
		Female	Male	Lower[3]	Higher	No college	College or more	No Kids	Kids
In person religious service	52b[1,2]	54	51	58[†]	47	57	46	51	54
	N=325	N=137	N=188	N=151	N=174	N=176	N=149	N=202	N=123
Big box grocery store/supermarket	63c[†]	69[†Ψ]	57[†Ψ]	69[†Ψ]	59[†Ψ]	64[†]	62[†]	64[†]	61[†]
	N=884	N=460	N=424	N=400	N=484	N=459	N=425	N=624	N=260
Specialty grocery store	59bc[†] N=655	66[†Ψ]	53[Ψ]	65[†]	55	62[†]	57[†]	61[†]	57[†]
		N=333	N=322	N=289	N=366	N=335	N=320	N=449	N=206
Gym	49 ab	52	48	54	46	53	44	45	55
	N=236	N=91	N=145	N=100	N=136	N=128	N=108	N=139	N=97
Home improvement store	60c[†] N=729	65[†]	55	65[†]	56[†]	62[†]	58[†]	61[†]	56
		N=363	N=366	N=317	N=412	N=364	N=365	N=520	N=209
Restaurant	51b	54	49	57[†]	47	55	48	52	50
	N=525	N=248	N=277	N=232	N=293	N=273	N=252	N=362	N=163
Workplace	42a[†] N=463	43[†]	41[†]	44	40[†]	43[†]	41[†]	40[†]	45
		N=210	N=253	N=200	N=263	N=248	N=215	N=289	N=174
School	56bc[†] N=199	65[†Ψ]	50[Ψ]	63[†]	50	61[†]	50	59	53
		N=80	N=119	N=89	N=110	N=105	N=94	N=104	N=95
Clothing store	59bc[†] N=578	64[†]	54	66[†Ψ]	53[Ψ]	63[†]	54	59[†]	58[†]
		N=284	N=294	N=172	N=318	N=323	N=255	N=386	N=192
Retail store other than grocery, clothing, or home improvement	62c[†] N=754	67[†]N=374	58[†]	68[†Ψ]	58[†Ψ]	64[†]	60[†]	65[†]	57[†]
			N=380	N=347	N=407	N=400	N=354	N=525	N=229

[1]Percentage of respondents who said no for each category was dropped for brevity.

[†]Indicates the percentage who said yes is statistically different than the percentage that said no at the 0.005 level given the Bonferroni correction.

[2]Matching lowercase letters indicates the percentage is the same down the column. For example the percentage who voluntarily wear a mask in an in person religious service is equal to the percentage who voluntarily wear a mask to the gym, but statistically different from the percentage who wear a mask in a big box grocery store/supermarket at the 0.005 level given the Bonferroni correction.

[Ψ]Indicates the percentage of respondents within the category are statistically different for that location. For example, the percentage of woman who voluntarily wore a mask in a big box grocery store/supermarket is statistically different than the percentage of men at the 0.005 level given the Bonferroni correction.

[3]Lower income is defined as $49,999 or less, higher income is defined as $50,000 or greater.

Table 3

Mean reported level of impact from COVID-19 on activities compared between those who voluntarily wear a mask and do not voluntarily wear a mask at specific locations. Impact scale was from 1(not impacted) to 5(impacted). N given in table.

	Voluntarily wears mask	Your daily activities outside of work/school	Ability to buy paper products (e. g., toilet paper, paper towels)	Ability to find meat, milk, and perishable grocery items	Activities related to your work/school
In person religious service	Yes n=170	3.88 (1.43)			
	No n=155	3.80 (1.33)			
Big box grocery store/supermarket	Yes n=559	3.90$^{\Psi}$ (1.42)	3.66 (1.34)	3.17 (1.39)	
	No n=325	3.65$^{\Psi}$ (1.41)	3.41 (1.33)	2.96 (1.38)	
Specialty grocery store	Yes n=390	4.05$^{\Psi}$ (1.38)	3.69 (1.38)	3.23 (1.44)	
	No n=265	3.71$^{\Psi}$ (1.32)	3.47 (1.30)	3.07 (1.34)	
Gym	Yes n=116	4.01 (1.35)			
	No n=120	3.65 (1.35)			
Home improvement store	Yes n=437	3.88 (1.44)	3.63 (1.36)		
	No n=292	3.68 (1.39)	3.39 (1.35)		
Restaurant	Yes n=270	3.95 (3.95)			
	No n=255	3.62 (1.38)			
Workplace	Yes n=195				4.07$^{\Psi}$ (1.45)
	No n=268				3.74$^{\Psi}$ (1.55)
School	Yes n=111				4.09 (1.40)
	No n=88				3.90 (1.29)
Clothing store	Yes n=341	3.93$^{\Psi}$ (1.43)			
	No n=237	3.59$^{\Psi}$ (1.38)			
Retail store other than grocery, clothing, or home improvement	Yes n=471	3.93$^{\Psi}$ (1.43)			
	No n=283	3.61$^{\Psi}$ (1.34)			

$^{\Psi}$Indicates the mean response for the statement is statistically different between those who voluntarily wear a mask and that location and those who do not. For example the mean response that COVID-19 impacted the respondent's daily activities outside of work/school was greater for those who voluntarily wore a mask at a big box grocery store/supermarket when compared to those who do not voluntarily wear a mask at that location. Measured at <0.005 for daily activities outside of work/school, <0.006 for ability to buy paper products, <0.01 for ability to find meat, and <0.025 for activities related to work/school.

Table 4

Comparison of agreement with mask-related statements between respondents who do and do not voluntarily wear a mask. N given in the table and specific for each specific location.

	Voluntarily wears mask	Masks help prevent the spread of COVID-19	Masks help prevent me from getting COVID-19	Masks help prevent me from spreading of COVID-19	Masks will help prevent future lock-downs	There is social pressure in my community to wear a mask	Masks do not prevent the spread of COVID-19	Masks have negative health consequences for the mask wearer
In person religious service	Yes n=170	74	60	73	58 $^{\Psi}$	28	8	11
	No n=155	71	46	59	39 $^{\Psi}$	36	10	13
Big box grocery store/supermarket	Yes n=559	85 $^{\Psi}$	67 $^{\Psi}$	80 $^{\Psi}$	60 $^{\Psi}$	25 $^{\Psi}$	6	5 $^{\Psi}$
	No n=325	73 $^{\Psi}$	50 $^{\Psi}$	65 $^{\Psi}$	46 $^{\Psi}$	34 $^{\Psi}$	10	11 $^{\Psi}$
Specialty grocery store	Yes n=390	83	66 $^{\Psi}$	79 $^{\Psi}$	62 $^{\Psi}$	27	6	6
	No n=265	75	54 $^{\Psi}$	66 $^{\Psi}$	49 $^{\Psi}$	37	9	10
Gym	Yes n=116	75	58	65	63 $^{\Psi}$	33	7	10
	No n=120	68	48	66	42 $^{\Psi}$	30	12	15
Home improvement store	Yes n=437	83 $^{\Psi}$	66 $^{\Psi}$	79 $^{\Psi}$	61 $^{\Psi}$	26	7	5
	No n=292	74 $^{\Psi}$	51 $^{\Psi}$	67 $^{\Psi}$	48 $^{\Psi}$	35	10	11
Restaurant	Yes n=270	78	66 $^{\Psi}$	77 $^{\Psi}$	61 $^{\Psi}$	26	5	8
	No n=255	74	51 $^{\Psi}$	63 $^{\Psi}$	45 $^{\Psi}$	36	10	12
Workplace	Yes n=195	74	59	73	61 $^{\Psi}$	32	12	11
	No n=268	72	51	64	43 $^{\Psi}$	29	8	10
School	Yes n=111	69	56	64	62 $^{\Psi}$	31	12	14
	No n=88	64	49	48	37 $^{\Psi}$	27	11	9
Clothing store	Yes n=341	79	63	76 $^{\Psi}$	58 $^{\Psi}$	29	7	9
	No n=237	73	52	63 $^{\Psi}$	43 $^{\Psi}$	35	9	10
Retail store other than grocery, clothing, or home improvement	Yes n=471	82 $^{\Psi}$	66 $^{\Psi}$	78 $^{\Psi}$	58 $^{\Psi}$	26	7	6 $^{\Psi}$
	No n=283	72 $^{\Psi}$	49 $^{\Psi}$	64 $^{\Psi}$	44 $^{\Psi}$	36	10	12 $^{\Psi}$

$^{\Psi}$Indicates the percentage of respondents is statistically different between those who voluntarily wear a mask and those who do not voluntarily wear a mask and agree with the stamen regarding mask wearing at the 0.005 level as dictated by the Bonferroni correction. For example a higher percentage of respondents who voluntarily wear a mask at in person religious services believe that masks help prevent me from getting COVID-19 when compared to those who do not voluntarily wear a mask.

home improvement store (0.140), clothing store (0.087), or other retailer (0.101). Being from a high COVID-19 case per population state decreased the probability of wearing a mask at a big box grocery store (-0.197), a specialty grocery store (-0.225), a gym (-0.279), a home improvement store (-0.240), a school (-0.200), a clothing store (-0.213), or other retail stores (-0.221).

As the COVID-19 impact score on activities outside of work/school increased, the probability that the respondent voluntarily wore a mask at a big box grocery store (0.025), a specialty grocery store (0.039), a restaurant (0.042), or other retail store (0.027) increased. As the COVID-19 score for impact on ability to buy paper products increased, the probability that the respondent wore a mask at an in person religious service (0.076), big box grocery store/supermarket (0.024), home improvement store (0.028), school (0.063), or clothing store (0.042) increased.

Agreement that *masks help prevent me from getting COVID-19* increased the probability the respondent wore a mask at a big box grocery store (0.098), home improvement store (0.101), restaurant

Table 5

Estimated marginal effects (from logit models) of respondent demographics, self-reported COVID-19 impacts, and beliefs regarding masks on voluntary mask wearing in 10 public locations. N given in table and specific to each location based on the number of respondents voluntarily wearing masks to that location.

Explanatory Variables	Household income	High case state	High increase in cases state	High case per pop. state	COVID-19 impact on activities outside of work/school	COVID-19 impact on Ability to buy paper products	Masks help prevent the spread of COVID-19	Masks help prevent me from getting COVID-19	Masks help prevent me from spreading of COVID-19	Masks will help prevent future lock-downs	There is social pressure in my community to wear a mask	Masks do not prevent the spread of COVID-19
Public Location	Marginal Effect (SE)											
In person religious service n=325	-0.060** (0.022)	0.007 (0.067)	0.125* (0.072)	-0.078 (0.087)	-0.021 (0.024)	0.076** (0.026)	-0.074 (0.071)	0.060 (0.064)	0.151* (0.067)	0.223*** (0.063)	-0.172** (0.066)	0.136 (0.104)
Big box grocery store/ supermarket n=884	-0.035** (0.012)	-0.021 (0.038)	0.121** (0.040)	-0.197*** (0.051)	0.025* (0.013)	0.024* (0.013)	0.064 (0.047)	0.098** (0.0378)	0.145** (0.043)	0.068* (0.038)	-0.119** (0.040)	-0.066 (0.070)
Specialty grocery store n=655	-0.034** (0.013)	-0.008 (0.047)	0.108** (0.049)	-0.225*** (0.056)	0.039** (0.016)	0.019 (0.016)	0.039 (0.055)	0.056 (0.045)	0.124** (0.050)	0.101** (0.046)	-0.142** (0.046)	-0.068 (0.082)
Gym n=236	-0.033 (0.024)	-0.039 (0.077)	-0.007 (0.082)	-0.279** (0.097)	0.041 (0.029)	0.034 (0.030)	-0.024 (0.083)	0.038 (0.075)	-0.129 (0.078)	0.267*** (0.074)	-0.038 (0.079)	-0.240** (0.104)
Home improvement store n=729	-0.023* (0.013)	-0.002 (0.043)	0.140** (0.054)	-0.240*** (0.056)	0.012 (0.014)	0.028* (0.015)	0.055 (0.052)	0.101** (0.042)	0.118** (0.047)	0.078* (0.043)	-0.127** (0.044)	-0.018 (0.074)
Restaurant n=525	-0.043** (0.016)	0.008 (0.052)	0.075 (0.055)	-0.112 (0.070)	0.042** (0.018)	0.003 (0.018)	-0.062 (0.059)	0.095* (0.050)	0.126** (0.053)	0.158** (0.051)	-0.156** (0.050)	-0.197** (0.084)
Workplace n=463	-0.019 (0.017)	0.070 (0.051)	0.097 (0.059)	-0.074 (0.070)	0.013 (0.020)	0.019 (0.020)	-0.050 (0.059)	0.030 (0.052)	0.048 (0.054)	0.164** (0.051)	-0.000 (0.053)	0.073 (0.083)
School n=199	-0.057** (0.026)	0.026 (0.084)	0.095 (0.089)	-0.200* (0.115)	-0.024 (0.034)	0.063* (0.037)	-0.015 (0.086)	-0.047 (0.083)	0.106 (0.085)	0.225** (0.079)	-0.007 (0.086)	-0.052 (0.125)
Clothing store n=578	-0.048** (0.015)	0.011 (0.048)	0.087* (0.051)	-0.213** (0.064)	0.025 (0.016)	0.042** (0.017)	-0.002 (0.055)	0.046 (0.047)	0.120** (0.051)	0.125** (0.048)	-0.111** (0.048)	-0.056 (0.084)
Retail store other than grocery, clothing, or home improvement n=754	-0.039** (0.013)	0.007 (0.042)	0.101** (0.044)	-0.221*** (0.056)	0.027* (0.014)	0.023 (0.015)	0.037 (0.049)	0.108** (0.041)	0.135** (0.040)	0.100** (0.041)	-0.131** (0.043)	-0.066 (0.073)

Note from top to bottom pseudo R squared is: 0.1037, 0.0952, 0.0883, 0.0967, 0.0871, 0.0823, 0.0446, 0.1008, 0.0885, 0.0959.

(0.095), or other retail store (0.108). Agreeing with the statement *masks help prevent me from spreading COVID-19* increased the probability of wearing a mask at an in person religious service (0.151), big box grocery store (0.145), specialty grocery store (0.124), home improvement store (0.118), restaurant (0.126), clothing store (0.120), or other retail store (0.135). Agreement that masks will prevent future lock-downs increased the probability that the respondent wore a mask at all locations studied. The probability that the respondent voluntarily wore a mask at an in person religious service (-0.172), big box grocery store (-0.119), specialty grocery store (-0.142), home improvement store (-0.127), restaurant (-0.156), clothing store (-0.111), or other retail location (-0.131) decreased if the respondent agreed with the statement *there is social pressure in my community to wear a mask*. Agreeing with the statement *masks do not prevent the spread of COVID-19* decreases the probability the respondent wears a mask to the gym (-0.240), or a restaurant (-0.197).

4. Discussion

Greater levels of self-reported impact on daily activities due to COVID-19 were reported among those who wore masks voluntarily in the public places studied. Limitations surrounding interpretation of findings about mask wearing behavior and/or perceptions about mask wearing or other behaviors are inherent in the self-stated nature of the data. Indeed, this study is reliant on truthfulness of self-reported data, yet there is value in self-reporting compliance along with self-reporting non-compliance, and implications are evident and revealing for development of public health policies and education efforts.

It was to be expected that those who reported more directly experienced negative consequences responded by taking actions themselves. Past studies have identified that one's own experiences influence the probability of taking action to safeguard against illness. For example, experiencing influenza exposure in the past increased the likelihood of vaccination acceptance in an experimental study (Ibuka et al., 2014). Josef Woodman, CEO of Patients Beyond Borders recently stated "It's much harder for Americans to grasp the widespread harm a pandemic can cause, making them less enthusiastic about group sacrifices that can curb the disease." This statement was featured in the recent Politico article in which he pointed out the recent dodging of pandemics by the U.S. or relatively light impacts of those which did arrive on U.S. soil (Kim, 2020). Lack of dire consequences seen first-hand in other nations, in particular Asian countries who now readily embrace mask wearing, may aid in explaining why U.S. residents do not subscribe as readily to taking individual actions to prevent societal harm.

Voluntary mask wearing varied by demographics, the specific location in question, and (necessarily) by whether the respondent had visited the various public locations. Indeed, the potential exists that particularly concerned citizens and/or those with high-risk family members did not visit the public places studied, even after restrictions were lessened or eliminated. Media stories have highlighted the lack of return to dining out, for example, even when restaurants are allowed to legally reopen in different geographical regions (Pinsker, 2020). Individuals who believed wearing masks protected others were more likely to report voluntarily wearing them, providing possible evidence of altruism. Perceiving social pressure negatively impacted the probability of voluntary mask wearing amongst those who self-stated that masks have a role in society, suggesting social shaming doesn't encourage mask wearing.

Masks are not worn for a variety of reasons in the U.S. such as seeing mask mandates as an attack on freedom, believing masks make them look weak, believing (incorrectly) masks cut off oxygen supply, or simply finding masks uncomfortable (Kim, 2020). These viewpoints differ when compared particularly to Asian countries where mask wearing is more commonly believed to be part of civic obligation in public health (Kim, 2020). Arguments about individual rights and unconstitutional restrictions during COVID-19 indeed point to the will of

individuals to continue on with chosen practices or behaviors, unfettered by public health restrictions. The Supreme Court rejected, 5 to 4, a request from a church to block enforcement of restrictions on attendance at religious services by the state (Liptak, 2020). A Pew Research Center study found that 79% of Americans believed that religious houses of worship should be required to follow the same social distancing and gathering rules as other organizations or businesses in the same geography, whereas the other 19% believed that they should be offered more flexibility (Pew Research Center, 2020). While the specific location, such as a church versus a grocery store, may impact views, the conversation about putting one's individual preferences ahead of public health needs remains heated and heavily rooted in cultural expectations. Individualism is cited as one of the reasons that the U.S. is among the few developed countries in the world without a universal health care system, proposed Josef Woodman, CEO of Patients Beyond Borders in a Politico article (Kim, 2020).

Free-riding is one possible explanation for why an individual respondent may self-report belief that mask wearing has a role in society and simultaneously self-report not voluntarily wearing a mask in public locations. Alternatively, incomplete knowledge, confusion about the role of masks in controlling spread of COVID-19, or fatigue are all possible explanations for why adults who believe masks play a role demonstrate less than optimal compliance themselves with mask wearing. Potential evidence of free-riding behavior was observed quite readily in the sense that U.S. residents reported a belief that masks have a role in society in responding to the COVID-19 pandemic crisis, yet those same individuals reported not wearing masks in various public places. Admittedly, free-riding is only one possible explanation for this finding, which applies in the sense that respondents believe that there is a role for masks, but that the role did not extend to them as individuals in all of the public places studied and/or at all times. Alternative explanations include incorrect or incomplete knowledge about suggested mask wearing in public which could lead to a mis-match in reporting that they indeed believe that masks have a role in the public health response but that they legitimately did not understand what that role was suggested to be at the time data was collected. Alternatively, it is possible that individuals viewed specific locations, such as religious gatherings, as exempt in some way and/or that they prefer to avoid mask waring in some locations (i.e. gyms) due to personal comfort or preference, although they still agree that masks have a role in other places.

Mask wearing (or lack thereof) in public is visually observable and easily socially responded to through shaming, ostracizing, or positive recognition. In contrast to the readily observed mask wearing, hand washing after using the restroom is observable only to those present in the restroom for that short period of time, and vaccination decisions are not readily observable to a casual passerby. Even though mask wearing is easily observed we do not find evidence of bandwagoning behavior in the sense that respondents do not seem to respond positively to social pressures in their community to wear masks by an increase in mask wearing. In fact, a decrease in the probability of voluntary wearing was discovered. There are a variety of reasons why social pressure may not yield positive changes in behavior, including fear in the U.S. surrounding such pressure due to violence in response to masks, including physical violence against, and even the killing of, those attempting to apply pressure on others in national news events, who are often retail workers (MacFarquhar, 2020). Some evidence of altruism in mask wearing was found as individuals who self-reported beliefs that mask wearing could help others and their communities reported greater voluntary wearing personally. Shim et al. (2012) incorporated altruism into game-theoretic models of vaccination for influenza and conclude that promoting altruism could be a potential strategy to improve public health outcomes (Shim et al., 2012). Given the negative finding surrounding the use of social pressure and positivity associated with altruism, this analysis lends support to the notion that altruism promotion may be a potential strategy to improve voluntary mask wearing.

Given the finding that the probability of voluntary mask wearing

decreased as respondents reported social pressure around mask wearing suggests similarities to framing and presentation of public health programs as those seen in studying vaccination. Regression analysis has provided evidence, in response to hypothetical scenarios presented to subjects, that altruism, free riding, and bandwagoning were significant motivators in the decision to undergo vaccination (Hershey et al., 1994). Interestingly, that same study found that "Frames stressing the opportunity to free ride increase free riding. Frames stressing altruism do not increase altruism. If generalizable to other settings, these results suggest that public health programs to increase vaccine usage should stress high vaccination rates." (Hershey et al., 1994).

Decision making about personal health actions have been shown to be affected by the choices of others. Vaccination produces the externality of reducing transmission of a disease, and can thus provide incentives for others to free-ride on the benefits while not incurring the costs of vaccination themselves (Ibuka et al., 2014). Evidence has been found that altruism, free riding, and bandwagoning were significant motivators for vaccination acceptance against a contagious disease in a hypothetical research study setting (Hershey et al., 1994). In contrast, empirical evidence of vaccination creating peer-pressure rather than free-riding has been found by other researchers in a discrete choice experiment setting (Verelst et al., 2018). Vaccination is not the only health practice to which free-riding, altruism, and bandwogoning behaviors can be hypothesized; handwashing, wearing of facial coverings (masks), and isolating oneself from others when ill can all be considered through these lenses. Whether one chooses to isolate themselves when ill to prevent spread to others may be too extreme, as the individual has knowledge of the potential consequences, as they are verifiably ill. But not washing one's hands properly or not wearing a mask when one feels well may indeed be subject to interpretation as to why one would seek to avoid such personal costs when the potential for personal and societal consequences are known. Dating back to 1847 with Dr. Ignaz Semmelweis in Vienna (Jarvis, 1994) handwashing is a known essential component of infection control (Drankiewicz & Dundes, 2003; Larson, 1988). Social pressure applied to hand washing behaviors in individuals have demonstrated varying influence, while organizational culture interventions have shown positive results (Larson, 1988). Mah et al. (2006) suggested that hand hygiene non-adherence is better addressed by social marketing than by education or policy. However, in order to craft meaningful social marketing, we must first understand the audience's, or multiple audiences within a population, beliefs, values, and knowledge.

5. Conclusions and implications

Voluntary mask wearing is socially and culturally complicated, and a variety of measurement and reporting issues arise that further complicate analysis of mask wearing behaviors in the U.S. Overarching conceptually to this analysis is the notion that individual behaviors have spillover effects to public health outcomes, in addition to (potentially) influencing an individual's personal health. While personal negative experiences being related to future protective measures is expected, the impacts of social pressure and/or voluntary mask wearing for the protection of others, and not in response to one's own personally incurred costs, is much more complicated. There was a decrease in the probability that a respondent wore a mask to a variety of public places if they agreed that there was social pressure to do so, which could be interpreted as 'pushing back' against social pressures to wear masks, although other possible explanations remain. Regardless of motivation, this rebellion against mask wearing is fodder for debate in media and society.

Social pressure, while having potentially worked in other regions of the world with a more established mask wearing culture, appears counterproductive according to the data analyzed from the U.S. in June 2020. Taken together with past findings about encouraging vaccination, perhaps presentation of high compliance rates in mask wearing would serve public health better than shaming or attempts to convince the

public of altruistic aspects of the practice. While mask wearing compliance and behavior was of primary focus of the analysis, other behaviors such as social distancing, staying home as much as possible, avoiding public places, limiting trips, and other more conservative practices are admittedly 'at odds' with mask wearing in public behavior since in order to wear a mask in public, the individual must have ventured into public.

CRediT authorship contribution statement

Courtney Bir: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – review & editing, Visualization. **Nicole Olynk Widmar:** Conceptualization, Investigation, Writing – original draft, Writing – review & editing.

Declaration of competing interests

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

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssaho.2021.100229.

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