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The role of perceived social norms in college student vaccine hesitancy: Implications for COVID-19 prevention strategies

Anna E. Jaffe [a,*], Scott Graupensperger [b], Jessica A. Blayney [b], Jennifer C. Duckworth [c], Cynthia A. Stappenbeck [d]

[a] Department of Psychology, University of Nebraska-Lincoln, Lincoln, NE, United States
[b] Department of Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, United States
[c] Department of Human Development, Washington State University, Pullman, WA, United States
[d] Department of Psychology, Georgia State University, Atlanta, GA, United States

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ABSTRACT

Among US adults, the highest rates of hesitancy to receive the COVID-19 vaccine are among young adults aged 18 to 25. Vaccine hesitancy is particularly concerning among young adults in college, where social interactions on densely populated campuses can lead to substantial community spread. Given that many colleges have opted not to mandate vaccines, identification of modifiable predictors of vaccine hesitancy – such as perceived social norms – is key to informing interventions to promote vaccine uptake. To address this need, we examined predictors of and explicit reasons for vaccine hesitancy among 989 students aged 18 to 25 recruited from four geographically diverse US universities in the spring of 2021. At the time of the survey, 57.3% had been vaccinated, 13.7% intended to be vaccinated as soon as possible, and 29.0% were vaccine hesitant. Common reasons for hesitancy were wanting to see how it affected others first (75.2%), not believing it was necessary (30.0%), and other reasons (17.4%), which were examined via content analysis and revealed prominent safety concerns. Despite these varied explicit reasons, logistic regressions revealed that, when controlling for demographics and pandemic-related experiences, perceived descriptive and injunctive social norms for vaccine uptake were each significant predictors of vaccine hesitancy (ORs = 0.35 and 0.78, respectively). When both norms were entered into the same model, only perceived descriptive norms uniquely predicted vaccine hesitancy (OR = 0.37; 95% CI: 0.29 – 0.46). Findings suggest perceived social norms are strongly associated with vaccine-related behavior among young adult college students. Correcting normative misperceptions may be a promising approach to increase vaccine uptake and slow the spread of COVID-19 among young adults.

1. Introduction

Beginning in early 2020, and spanning the entirety of 2021, the COVID-19 pandemic associated with the rampant spread of the SARS-CoV-2 virus has been an unmitigated public health crisis [1]. The pandemic has been associated with concerns beyond those directly related to the virus, such as job loss [2] and financial instability [3], increased intimate partner aggression [4], loneliness and other mental health problems [5–10], and changes in substance use behaviors [11–14]. In the US, the Centers for Disease Control and Prevention (CDC) have endorsed empirically-supported prevention strategies to reduce person-to-person spread of the virus (e.g., wearing face masks, social distancing) [15]; and state governments have inconsistently implemented ever-evolving physical distancing measures in response to surges in new cases (e.g., shelter-in-place orders, travel restrictions, curfews). Despite these efforts, new cases in the US rose in the latter half of 2021, approaching daily-case rates similar to the previous peak observed in December of 2020 [16]. Beyond the immediate impact of the virus, continued spread and the prolonging of the pandemic is concerning because the SARS-CoV-2 virus has and will continue to mutate as long as ongoing transmission persists [17].

It has become clear that the most promising strategy for combatting COVID-19 is prophylactic vaccines which can facilitate sufficient herd immunity [18,19]. Experts estimate that approximately 70–90% of people need to be vaccinated to achieve herd immunity [20]. However, slow vaccine uptake rates and subsequent virus mutations have meant a 'moving goalpost' scenario

* Corresponding author at: Department of Psychology, University of Nebraska-Lincoln, 238 Burnett Hall, Lincoln, NE 68588.
E-mail address: ajaffe2@unl.edu (A.E. Jaffe).

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whereby exact estimates of required vaccine coverage are unknown and herd immunity may no longer be feasible [21]. Nevertheless, increasing COVID-19 vaccine uptake rates is the most critical public health priority given that simulation analyses show the current rate of vaccination is insufficient for preventing exacerbation of the pandemic and further mutation of more contagious SARS-CoV-2 variants [22].

1.1. Vaccine hesitancy among young adults

Even prior to the COVID-19 pandemic, the WHO considered vaccine hesitancy – delayed acceptance or refusal of vaccines despite availability – as a top-ten global health threat [23]. The threat currently posed by vaccine hesitancy, specific to COVID-19, positions this hurdle among the most salient issues facing our society [24]. Estimates of vaccine hesitancy have been heterogenous and dynamic, though data consistently show a non-trivial proportion of people who remain hesitant to receiving a COVID-19 vaccine [25]. One group that is of particular concern is young adults, who have the lowest rates of vaccine uptake [26] and the highest levels of vaccine hesitancy [27] relative to other adult age groups in the US.

Although research on recent variants continues to emerge [28], there is evidence suggesting young adults may be at lower risk of developing severe symptoms and complications associated with COVID-19 [29]. Because symptoms are often minor or not present at all, young adults may be less likely to isolate and therefore more likely to unknowingly spread the virus [30], resulting in the poorest adherence to other mitigation strategies relative to other age groups [31]. As such, increasing vaccination rates among young adults may be a key step toward reducing community transmission, including spread to vulnerable and high-risk individuals.

COVID-19 incidence rates have been particularly high on US college campuses [32]. The densely-populated structures on college campuses that require close contact (e.g., lecture halls, classrooms, residence halls, Greek housing) place colleges at heightened risk for community spread [33,34]. College students are also motivated to socialize and drink alcohol, which has also been associated with poorer adherence to social distancing measures [35]. Thus, college students represent a high-risk subgroup for community transmission in which reduced vaccine hesitancy and increased vaccine uptake would be important.

The most common framework for operationalizing vaccine hesitancy is the 5C's model of individual-level determinants of vaccine hesitancy: confidence, complacency, convenience (or constraints), risk calculation, and collective responsibility [36]. Although these individual-level reasons for vaccine hesitancy are critical to address, they may appeal less to young adults, who are largely motivated by social factors [24]. As such, addressing vaccine hesitancy among young adults may require a deeper consideration of social influences beyond the traditional 5C's model [37].

1.2. Social norms approach to reducing COVID-19 vaccine hesitancy

Young adults' health behaviors and attitudes are powerfully influenced by the behaviors and attitudes of their peers (i.e., social norms) [38]. Indeed, social norms are central to several behavioral theories such as Social Norms Theory [38] and Theory of Reasoned Action [39]. Social norms are distinguished into two primary sources of influence: (1) perceived *descriptive norms* that entail perceptions of others' behavior, and (2) perceived *injunctive norms* that entail perceptions of others' attitudes or opinions towards a behavior [40]. Both perceived descriptive and injunctive norms are robust predictors of a wide range of health-related behaviors, such as seatbelt adherence [41], sunscreen use [42], alcohol use [43,44], and risky sexual behavior [45]. Young adults are particularly susceptible to perceived social norms as they have a drive for peer approval [46] and are motivated to adhere to behaviors and attitudes of others as a means of fitting-in and being accepted by peers [47].

Specific to vaccinations, perceptions of social norms are related to college students' intentions to receive vaccines for influenza [48] and Human Papillomavirus [49]. Moreover, there is emerging evidence that perceived social norms may play a key role in COVID-19 vaccination uptake. A recent quasi-experimental study reported a strong positive association between perceptions of the proportion of others who would get a COVID-19 vaccine and one's own intentions to get vaccinated [50]. A 10% increase in perceptions of others' vaccine intentions was associated with a 6.8% increase in one's own propensity to vaccinate, on average. Similarly, US adults who reported greater expectations that friends and family [51] or people in their county [52] would get vaccinated were more likely to express positive vaccine intentions. Specific to college students, a recent study found that perceived norms were a strong predictor of students' own vaccination intentions: those who believed a greater proportion of young adults would get vaccinated were more likely to report intentions to get the COVID-19 vaccine themselves [53].

Given that there may be a range of explicit reasons young adults have for vaccine hesitancy in the specific context of the COVID-19 pandemic, one might question whether perceived social norms would be a meaningful predictor of vaccine hesitancy across individuals with varied rationales. Among college students who did *not* intend to get a COVID-19 vaccine as of November 2020, 85.2% reported they were afraid or nervous of unknown side effects, 68.5% did not trust that the vaccines would be sufficiently tested, 29.6% believed a vaccine would give them COVID-19 or make them sick otherwise, and over a quarter (25.9%) did not think the vaccines would work [53]. These reasons for vaccine hesitancy among college students were highly similar to other studies from the US, UK, and Taiwan, which have highlighted concerns about vaccine safety, side effects, perceptions that others need it more, and distrust of vaccines [54–58]. However, given the importance of peer influences on young adults and college students in particular, perceived norms may be a unifying factor that drives attitudes and behaviors for the COVID-19 vaccine across individuals with a wide range of explicit reasons for hesitancy.

1.3. The current study

Perceived social norms regarding others' vaccination behaviors and attitudes have been indicated as a potentially salient predictor of young adults' vaccine uptake [51,53], which could have important intervention implications. However, several noteworthy limitations should be addressed with additional research. First, existing studies on the role of perceived social norms for *intentions* to receive the COVID-19 vaccine were conducted with data *prior to* public availability of COVID-19 vaccines (i.e., December of 2020), so the associations between perceived norms and behavior must be re-evaluated during a period in which vaccines were more available to young adults. Secondly, Graupensperger, Abdallah, and colleagues' [53] college student sample was collected at one university in a metropolitan area where vaccine uptake has been exceptionally high [59]; thus, research must be extended to a more geographically diverse sample, including more rural populations where vaccine hesitancy has been relatively higher [60]. Third, Graupensperger and colleagues' college study included few covariates. Notably, it has since become evident that COVID-19 attitudes and vaccine hesitancy has been a highly politicized issue in the US, such that those who identify as a Democrat have much more favorable attitudes toward COVID-19 vaccines than those who identify as a Republican [61,62]. Further, there is emerging evidence that

other demographic variables may be related to COVID-19 vaccination uptake. For example, women [63] and sexual minorities [64] report stronger intentions to receive a COVID-19 vaccine than men and heterosexual individuals, respectively. Thus, identifying additional correlates to vaccine hesitancy necessitates re-evaluating the relative influence of perceived social norms while also accounting for key covariates in college students.

To address these gaps, the current study examined associations between college students' vaccine hesitancy and perceived descriptive and injunctive norms within the context of the COVID-19 pandemic. First, we aimed to set the stage by characterizing college students' varied and explicit reasons for their vaccine hesitancy during a time when vaccines were widely available for young adults. Although one study examined reasons for vaccine hesitancy among college students in November 2020 prior to vaccine availability [53] and another study examined reasons for vaccine hesitancy among US young adults in March 2021 during the early months of the public vaccine roll-out [54], we are aware of no studies to date that have examined explicit reasons for vaccine hesitancy among college students in the US since the vaccines were made publicly available.

Second, we aimed to clarify whether perceived social norms are a significant predictor of vaccine hesitancy even in the context of a multitude of explicit reasons for hesitancy. If so, findings would highlight the importance of perceived social norms for young adults, beyond the 5Cs model of vaccine hesitancy, and point to the potential for normative feedback to be an effective intervention strategy across a wide range of vaccine-hesitant young adults. Perceived descriptive norms were operationalized as perceptions of vaccine uptake among people the participant "knows and talks to", similar to Latkin and colleagues' [51] conceptualization of social norms as anticipated vaccine uptake among friends and family. Perceived injunctive norms were operationalized as perceived approval of COVID-19 vaccines among the typical student at the participant's university. In both cases, perceived norms pertain to a referent group that is relatively proximal to the participants, which tend to be more influential than distal referent groups [65]. Given geographic differences in vaccine acceptance [66], this study builds upon existing findings by recruiting students from urban and rural universities in different US regions. Moreover, the extent that perceived norms relate to vaccine hesitancy were examined above-and-beyond the effect of a thorough set of covariates. Specifically, we hypothesized that students who perceived greater vaccine uptake (descriptive norms) and approval (injunctive norms) would be less likely to report vaccine hesitancy, even after controlling for demographic characteristics and other COVID-related experiences (e.g., personal history of COVID-19, perceived risk, fatigue and stress related to the pandemic). In this way, we aimed to make a conceptual contribution to the literature by clarifying that, in light of the diverse reasons for hesitancy during this pandemic, social norms continue to play a prominent role in vaccine uptake.

2. Materials and methods

2.1. Participants and procedures

Participants were college students ages 18 and older who were recruited in the spring of 2021 from either psychology or human development departmental participant pools at four public universities in the US. The research was advertised as "a study on how the COVID-19 pandemic is affecting college students' lives, including mental health, drinking, and sexual experiences." Participants provided informed consent and received class research credit for their time. Individuals were required to pass at least 3 of 4 attention check questions to be included. A total of 1,016 students participated. Given the current focus on young adult ages 18–25 [67], we excluded 26 older individuals (ages 26–61). One participant was excluded for not completing vaccine behavior questions.

The final sample was 989 college students from universities located in a mid-size Midwestern city (n = 444), a large Southern city (n = 229), a large Northwestern city (n = 176), and a rural Northwestern town (n = 140). At the time of survey administration, the COVID-19 vaccine had been made available to some adults, with certain groups (e.g., at-risk adults and healthcare workers) receiving priority, but the roll-out across the US was ongoing. In each of the states where data were collected, approximately 47% of young adults in the general population were estimated to have received a vaccine for COVID-19 when the survey started [68]. At the Midwestern university, students could choose between online and in-person classes; all university staff and students were required to screen for COVID-19 at the beginning of the semester and random mitigation testing was required throughout the semester to gain building access. At the other three universities, the primary modality for classes was online and testing was available on campus for all university staff and students. At all four universities, face coverings and physical distancing were required inside campus buildings. See Supplemental Table 1 for differences among sites.

Participants were, on average, 19.67 years old (SD = 1.35). Across the sample, 71.7% were women, 26.2% men, 1.5% non-binary, 0.2% transgender men, and 0.4% reported another gender identity or declined to state their gender. With regard to race/ethnicity, 16.4% were of Latinx, Hispanic, or Spanish origin, 47.6% were non-Hispanic White, 17.2% were Non-Hispanic Asian, 11.8% were non-Hispanic Black/African American, and 7.0% were multiracial or another race (including 4.7% multiracial, 0.4% Native Hawaiian or Other Pacific Islander, 0.2% American Indian/Alaska Native, and 1.7% Other). Regarding sexual identity, 72.3% identified as exclusively heterosexual/straight, 13.1% as mostly heterosexual/straight, 9.5% as bisexual/pansexual, 1.4% as mostly homosexual/-gay/lesbian, 2.0% as exclusively homosexual/gay/lesbian, and 1.6% as something else/don't know. Over a third of students (35.2%; n = 348) were living with their parents. Regarding COVID-related experiences, over a third (37.3%; n = 369) had tested positive for COVID-19. Nearly one in eight (12.0%; n = 119) reported a close friend or relative had died from COVID-19.

2.2. Measures

2.2.1. Vaccine behaviors and reasons for vaccine hesitancy

Participants were asked whether they have received the vaccine for COVID-19. Response options were 0 = *No,* 1 = *Yes, and I completed all doses recommended,* 2 = *Yes, and I'm in the process of completing all doses recommended,* and 3 = *Yes, but I chose not to get all doses recommended.* Participants who indicated they had not received the vaccine were asked their current plans regarding the COVID-19 vaccine. Response options were 0 = *I intend to get it as soon as possible*, 1 = *I do not intend on getting it right away, but might sometime in the future,* and 2 = *I do not intend to ever get the vaccine.* Participants were coded as vaccine hesitant if they had not received the vaccine and did not intend to get it as soon as possible. Individuals who were vaccine hesitant were asked to select which of four reasons best described why they did not intend to get the vaccine as soon as possible (e.g., "*I have a medical condition for which the vaccine has not yet been tested*", "*I don't think the vaccine is necessary*"); an "other" option was also provided with a text response box to detail their rationale.

2.2.2. Vaccine social norms

Perceived descriptive norms were assessed with the question, "*Of the people you know and talk to regularly, how many have received the COVID-19 vaccine?*" Response options were 0 = *None*, 1 = *Very few*, 2 = *Many*, 3 = *Almost all*, and 4 = *Everyone I know*. Perceived injunctive norms were assessed by asking participants how much they think the typical college student at their university approves of getting the COVID-19 vaccine. Response options ranged from 1 = *Strongly disapprove* to 7 = *Strongly approve.*

2.2.3. Demographic characteristics

Participants were asked about their current gender identity, sexual orientation, and race/ethnicity. Although multiple categories were assessed (as detailed in the participant section above), responses were collapsed into dummy-coded variables for analytic purposes. Specifically, gender identity [69] as a man (i.e., "male" or "transgender man" = 1) was compared to individuals who identified as women, other gender identities, and those who declined to state their gender (=0). Exclusively heterosexual orientation (=1) was compared to any identity as not exclusively heterosexual (=0) [70]. Dummy-coded variables were created to represent the racial/ethnic categories (Hispanic, Non-Hispanic Asian, non-Hispanic Black/African American, Non-Hispanic multiracial/Other) with Non-Hispanic White comprising the reference group. Participants were also asked if their political affiliation was "Democrat", "Republican", "Independent", or "Other"; Democrat was specified as the reference group. Participants' current living situation (response options: "sorority or fraternity house", "residence halls/-dorm room", "off-campus (but not with parents)", "off-campus (with parents)", "other") was recoded to represent whether participants were living with parents off-campus (=1) or not (=0).

2.2.4. COVID-19-related experiences

Participants were asked several questions related to their personal experiences during the COVID-19 pandemic. Participants were coded as having ever tested positive if they indicated they had been tested for COVID-19 and "*tested positive at least once*" [71]. In recognition that not all individuals had access to COVID-19 tests during times when tests were in short supply, we also included individuals who endorsed having "*been presumed to be positive for COVID-19 (for example, I had a known exposure and/or symptoms consistent with COVID-19) or had a positive antibody test*." Participants were also asked if a close friend or relative had passed away from COVID-19 or related complications. Each of these experiences were coded such that 0 = *No* and 1 = *Yes.*

Participants reported what they believed to be their "*personal risk for getting COVID-19 (or getting it again)*" [72] with response options ranging from 1 = *Very low* to 5 = *Very high.* To assess fatigue, participants were also asked how strongly they agreed or disagreed with the statement "*I am tired of taking precautions against COVID-19*". Response options ranged from 1 = *Strongly disagree* to 5 = *Strongly agree*.

COVID-19-related stress was assessed with the COVID Stress Scales [73]. Participants were asked 24 questions about worries they might have experienced over the past 7 days (e.g., "*I am worried about catching the virus*", "*I had trouble concentrating because I kept thinking about the virus*"). Response options ranged from 0 = *Not at all* to 4 = *Extremely*. Total scores were summed and Cronbach's alpha in the current study was 0.95.

2.3. Data analytic plan

To characterize participants' varied and explicit reasons for their vaccine hesitancy, descriptive characteristics were examined for vaccine behaviors and reasons for vaccine hesitancy. Open-ended text responses for vaccine hesitancy reasons were coded using directed content analysis [74]. The first and third author began by independently reading the open-ended responses to familiarize themselves with the data. During data review, preliminary themes were independently created and then the two authors met to discuss what emerged from the data. These themes were defined, refined, and then used to code the data. Few discrepancies emerged, and when they did, these were resolved through discussion.

To examine the role of social norms as predictors of vaccine hesitancy, a series of logistic regressions were conducted. First, unadjusted odds ratios were estimated for perceived descriptive and injunctive norms. Second, adjusted odds ratios were estimated for each norm after controlling for all demographic characteristics and COVID-related experiences. Specifically, because perceived descriptive and injunctive norms may be closely related, we examined one model to evaluate perceived descriptive norms, and a separate model to evaluate perceived injunctive norms as predictors, after controlling for demographic characteristics and other COVID-related experiences. Finally, a combined model was estimated to determine if perceived descriptive and injunctive norms both uniquely predicted vaccine hesitancy when considered as predictors in the same model alongside all other covariates. All analyses were conducted in R version 4.0.3 [75].

3. Results

3.1. Vaccine behaviors

First, we descriptively examined vaccine behaviors. Across participants, 57.3% (n = 567) were fully vaccinated or in the process of completing all doses recommended. Another 13.7% (n = 135) intended to be vaccinated as soon as possible. The remaining 29.0% (n = 287) were vaccine hesitant, including 20.4% (n = 202) who indicated they might get vaccinated but not right away, and 8.6% (n = 85) who did not intend to ever get the vaccine.

3.2. Reasons for vaccine hesitancy

The 287 participants who were vaccine hesitant selected all reasons that applied to their hesitancy. The most common reasons were wanting to see how it affects others in the community first (75.2%; n = 216) and not believing the vaccine was necessary (30.0%; n = 86). Others indicated they had a medical condition for which the vaccine had not yet been tested (7.0%; n = 20) or previously had a severe allergic reaction to vaccines (5.9%; n = 17). Fifty participants (17.4%) indicated there was another reason for their hesitancy; 48 provided a text response.

See Table 1 for results of the content coding of the "other" reason text responses. The most frequently reported other reason was safety concerns (n = 17), including concerns that the vaccine was not yet approved by the U.S. Food and Drug Administration and fear of long-term side effects. Some reported intentions to get the vaccine later (n = 11) such as over summer break. Reasons for delaying included allowing others who need it to get the vaccine first or living in a country outside of the US where they perceived the vaccine supply to be limited or untrustworthy. Others reported ideological concerns (n = 9), including distrust of the government, "religious reasons", or family. Several participants reported general disinterest (n = 8), including not caring to get it, perceptions that the vaccine was not needed, or believing they would not have complications because they had tested positive for COVID-19 already. Finally, a few respondents (n = 3) reported a fear of needles.

3.3. Perceived social norms

Regarding perceived descriptive norms, the modal participant (47.9%; n = 474) perceived that "many" people they knew and

Table 1
Content Coding for "Other" Reasons for Vaccine Hesitancy.

Category and code	Example Quote	*n*
Safety		**17**
Side effects	"The vaccine does not feel safe to me yet because we do not know the long term effects of these. This is why I will not let them put that into my body."	10
Lack of research/approval	"I don't think the vaccine is accurate and safe, I believe a vaccine should take many trial and errors and that could take years."	7
Later		**11**
Wait	"I am waiting to get it over summer break."	4
Let others first	"Give time for people who are more vulnerable to get it first."	4
International	"I'm an international student from a third world country which has already started producing its own vaccines which to me is crazy so I'll get it once I'm in the U.S."	3
Ideology		**9**
Religion	"For religious reasons."	4
Distrust	"I will not take a vaccine the government says to take."	3
Family	"My mother doesn't believe in the vaccine, and I'm trying to make her happy for the time being."	2
Disinterested		**8**
Don't care or want to	"I really just do not care that much."	4
Not needed	"Basically the same as the flu shot–not necessarily required but recommended."	2
Past positive test	"I tested positive & had no complications."	2
Fear of needles	"I am severely and irrationally afraid of needles."	**3**

talked to regularly had received the COVID-19 vaccine (response of 2 on a scale from 0 to 4). Perceived descriptive norms were lower among vaccine hesitant individuals ($M = 1.52$, $SD = 0.75$) than non-hesitant individuals ($M = 2.19$, $SD = 0.77$), $t(549.27) = 12.63$, $p < .001$.

Regarding perceived injunctive norms, 82.7% ($n = 818$) perceived the typical student was at least somewhat approving of the vaccine (i.e., response of 5 or above on a scale from 1 to 7). Perceived injunctive norms were lower among vaccine hesitant individuals ($M = 5.02$, $SD = 1.40$) relative to others who had received or intended to receive the vaccine ($M = 5.62$, $SD = 1.19$), $t(463.54) = 6.32$, $p < .001$.

Associations between perceived social norms and vaccine hesitancy as revealed in logistic regression models can be seen in Table 2 (see Supplemental Table 2 for full model results with covariates). Unadjusted and adjusted estimates were similar, and revealed that even after controlling for demographic characteristics and COVID-related experiences, both perceived descriptive and injunctive vaccine norms were significant predictors of vaccine hesitancy. However, perceived descriptive and injunctive norms were correlated ($r = 0.34$, $p < .001$), and after controlling for descriptive norms, injunctive norms were no longer a significant predictor of vaccine hesitancy (OR = 0.89, $p = .073$). Descriptive norms remained a significant predictor of vaccine hesitancy, even after controlling for all covariates and injunctive norms (OR = 0.37, $p < .001$). Considered in aggregate, Tjur's [76] R^2 indicated all model predictors, including both perceived descriptive and injunctive norms, explained 26.8% of the variance in vaccine hesitancy.

4. Discussion

Building on research suggesting the importance of perceived social norms for vaccine intentions among US adults [51] and college students [53] prior to the COVID-19 vaccine roll-out, the current study was conducted when vaccines had become more widely available and revealed that although there are varied explicit reasons for and predictors of vaccine hesitancy, perceived descriptive and injunctive norms continue to be important drivers of behavior. Thus, findings highlight the robust nature of vaccine-related social norms as a predictor of behavior in a geographically diverse sample of US college students. These perceived norms were each significant predictors after controlling for demographic characteristics (i.e., university, age, gender, sexual identity, race/ethnicity, political affiliation, living situation) and experiences related to COVID-19 (i.e., testing positive, known death, perceived risk, fatigue with precautions, stress). In fact, perceived social norms were the *only* COVID-related variables examined that were uniquely predictive of vaccine hesitancy, highlighting the importance of social influences on young adults' health behaviors [37].

When perceived descriptive and injunctive norms were considered simultaneously in a combined model, descriptive norms emerged as the only unique predictor of vaccine hesitancy. Similarly, in each model, the effect size was larger (i.e., further from an odds ratio of 1) for descriptive norms (ORs = 0.32 to 0.37) than injunctive norms (ORs = 0.71 to 0.89). These findings may highlight the relative importance of perceived peer *behavior* over *attitudes* for vaccine uptake, which is consistent with research examining normative influences on other health behaviors, such as alcohol

Table 2
Social Norms as Predictors of Vaccine Hesitancy.

Model Estimating Vaccine Hesitancy	***Perceived Descriptive Norms***			***Perceived Injunctive Norms***		
	OR	*95% CI*	*p*	*OR*	*95% CI*	*p*
Unadjusted	**0.32**	**0.26 – 0.39**	<.001	**0.71**	**0.63 – 0.79**	<.001
Adjusted for covariates	**0.35**	**0.28 – 0.44**	<.001	**0.78**	**0.69 – 0.88**	<.001
Adjusted for covariates and alternate social norm	**0.37**	**0.29 – 0.46**	<.001	0.89	0.78 – 1.01	.073

Notes. N = 989 for the unadjusted model; N = 985 for the adjusted models (four participants were excluded due to missing data on political affiliation, one of whom also had missing data on predictors for friend/relative dying from COVID-19 and perceived personal risk). OR = Odds Ratio; CI = confidence interval. Bolded estimates are statistically significant at $p < .05$. Covariates for adjusted models included university, age, gender, sexual orientation, racial/ethnic identity, political affiliation, living with parents, history of COVID-19, friend/relative dying from COVID-19, perceived personal risk, tired of taking precautions, and COVID-related stress. Full results for adjusted models including estimates for covariates are shown in Supplemental Table 2.

use [65,77]. However, these findings from the simultaneous model should be interpreted with caution given limitations in the measure and differences in normative referent groups. Specifically, behaviors were evaluated for the people participants knew and talked to regularly; attitudes were evaluated for the typical college student at their university. Although both referent groups are proximal, it is perhaps unsurprising that a stronger effect was found for a potentially closer referent group, consistent with social norms literature in other domains [78,79]. During the pandemic when nearly a third of students in the current sample were living with their parents, individuals that students talk to regularly may not just be a closer subset of a larger college student referent group, but may also include family and friends outside of college. More research is needed to evaluate the role of perceived descriptive and injunctive norms for several referent groups as related to vaccine uptake.

Consistent with research conducted prior to public availability of the vaccine in the US [55,57,58], participants who remained hesitant when the vaccine was publicly available reported a range of explicit reasons for this hesitancy. Several reported reasons involved a social component. Three quarters of hesitant participants indicated they wanted to see how it affected others first, indicating social feedback about the vaccine safety may be important. Several participants also wrote that they were hesitant because their family was strongly disapproving. This sentiment is consistent with the previously discussed importance of a close referent group guiding behavior. Other reasons endorsed ranged far beyond social factors, including medical, religious, and mental health reasons (e.g., phobias). Yet, it is among these same participants that social norms were, on average, important predictors of vaccine hesitancy – highlighting that social influences are an important driver of behavior.

Taken together, findings have important intervention implications. Social norms for health-related behaviors tend to be misperceived – individuals often perceive that others engage in more risky behavior (e.g., alcohol use [80]) and less protective behavior (e.g., adhering to COVID-19 CDC guidelines [81]) than is actually the case. These misperceptions are particularly common for less visible behavior that takes place in private – like vaccinations – and is inferred through partial information (e.g., via media) and projections of one's own beliefs [37]. Indeed, a recent study revealed that college students, on average, underestimated the proportion of peers that were intending to receive a COVID-19 vaccine (i.e., descriptive norms) and underestimated how important their peers felt that getting vaccinated was (i.e., injunctive norms) [53].

Correcting normative misperceptions has been a promising harm-reduction strategy across a broad range of health behaviors [82], and may also be a viable strategy to promote vaccine uptake. For example, personalized normative feedback interventions provide tailored feedback that contrasts individuals' perceived norms to *actual* norms, highlighting discrepancies [83]. Personalized normative feedback interventions have been widely utilized for increasing health behaviors such as sun protection [84], and reducing problematic behaviors such as gambling [85] and alcohol use [86]. It follows that, for young adults in particular, norm-correcting strategies may be a prudent approach for increasing vaccine uptake.

4.1. Strengths and limitations

Strengths of the current study include the multisite data collection across geographically diverse public universities, assessment of vaccine behavior and attitudes during the initial roll-out of the COVID-19 vaccines, comprehensive consideration of covariates, inclusion of both perceived descriptive and injunctive norms, and content analysis of non-standard reasons for vaccine hesitancy. Yet, findings are necessarily limited by the methods and scope of the data collected. Given the site differences observed in the current study, differences among university populations in COVID-related experiences should be expected. It is not clear whether the responses examined here are exactly representative of each respective university, if the universities examined were prototypical of their region and city size, or whether findings would generalize to other universities in or beyond the US. In addition, findings should be interpreted in the context of the historical time of data collection, and there was some variability across sites in administration dates. Further, data were collected during the early phases of the US vaccine roll-out, when the vaccine was not yet available to all college students. Thus, our measure of vaccine hesitancy involved a combination of behavior and intentions. The integration of behavior is an improvement over past research conducted before the roll-out focused solely on intentions. However, given that individuals may not follow-through on vaccine intentions [87], more research should be conducted to determine the role of social norms in vaccine hesitancy now that the vaccine is fully available to all interested adults in the US. Additionally, approximately 73% of the variance in vaccine hesitancy was unexplained in the current study, suggesting there may be unexamined yet important predictors of vaccine hesitancy to consider in future research (e.g., cognitive functioning [88]). Last, the cross-sectional nature of the current study precludes conclusions about temporal ordering or causality. Although past intervention research suggests correcting misperceived social norms can have a causal influence on behavior [89], longitudinal and experimental research is needed to evaluate the causal role of social norms for vaccine uptake.

4.2. Conclusions

Extending research conducted prior to public availability of the COVID-19 vaccine, 29.0% of college students across four universities were not vaccinated and did not intend to be immediately vaccinated in the spring of 2021. Students reported a wide range of reasons for this vaccine hesitancy, from safety and medical concerns, to perceptions that the vaccine was unnecessary, to ideological concerns regarding distrust and religion. However, across these varied reasons, and when controlling for demographic characteristics and COVID-related experiences, perceived descriptive and injunctive social norms for vaccine uptake emerged as important predictors of vaccine hesitancy. Descriptive norms (i.e., perceptions that people whom students talked to regularly were already vaccinated) emerged as having a particularly robust association with vaccine hesitancy. Findings indicate that correcting normative misperceptions (e.g., highlighting that more of one's peers are receiving the vaccine than believed) may be a viable strategy to promote vaccine uptake among young adults.

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Declaration of Competing Interest

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.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2022.01.038.

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