

Murals as Health Communication: A COVID-19 vaccine promotion feasibility study

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Art has been a powerful medium for health communication, capable of engaging audiences, fostering emotional connections, and disseminating information in accessible, culturally resonant ways. This study sought to examine how curated murals focused on COVID-19 could impact peer discussion of COVID-19; perceived social norms of COVID-19 vaccination; perceived availability of accurate information about accurate safety, effectiveness, and availability of COVID-19 vaccines; and confidence in the COVID-19 vaccine amongst university students. Specifically, it examines how murals influence peer discussions, perceived social norms, and the perceived availability of accurate information about COVID-19 vaccination, as well as their role in bolstering vaccine confidence. Using a sequential explanatory mixed methods design, the study integrated quantitative survey data with qualitative focus group data. Findings revealed that murals increased discussion around COVID-19 vaccination, increased perceived availability of accurate information about the COVID-19 vaccine, and that health-focused mural installations resonate with viewers while communicating health information in a less intimidating way. This evidence underscores the utility of art as a tool for health communication, particularly for engaging audiences in peer dialogue. Murals, through their visual and cultural impact, offer a promising avenue for addressing public health challenges and promoting vaccine confidence and uptake among university students.

Key Words: *Murals, Vaccine Confidence, COVID-19 Vaccine Hesitancy, Arts in Public Health, Health Communication*

In practice, health communication thrives on collaborative efforts stemming from diverse perspectives to realize its success (Institute of Medicine US, 2003). Diverse perspectives—ranging from healthcare professionals, creative practitioners, and local leaders—enable the tailoring of messages to resonate with specific audiences. As an interdisciplinary approach, health communication through art offers an innovative form of collaboration that can “attract attention, sustain interest, shape emotions, stimulate memorable responses, and generate shared symbolic systems” (Sonke et al., 2021, p. 107). Additionally, employing captivating visuals or stories can increase access to health information given art’s propensity toward shareable, memorable, and culturally relevant content (Golden, 2022). Frequent exposure to murals strategically placed in high-traffic community spaces enhances public engagement and retention of health messages, especially when the art is culturally relevant and visible over time (Nabirye, 2022; Ramasubramanian & Ramirez, 2023; Trehan & Medhavi, 2023). This repeated interaction fosters health literacy and reinforces positive behaviors within community contexts. Art’s visual appeal, coupled with its shareability, enhances the accessibility of health information, thus playing a pivotal role in reaching a wider and often underserved population (Golden, 2022).

As suggested in a review by Sonke et al. (2021), photography and visual arts are frequently mobilized forms of art for health communication. Murals have addressed prominent public health topics including housing insecurity and health education regarding HIV/AIDS, Ebola, as well as most recently, COVID-19 (Abdullahi et al., 2021; Brinkman, 2007; Cannuscio et al., 2012; Mutembei, 2014; Sonke & Pesata, 2015). Murals are uniquely effective tools for public health communication because they combine storytelling, cultural resonance, and visual impact while leveraging their large scale and integration into public spaces to engage diverse audiences. Unlike digital or gallery-based art, murals offer a semi-permanent presence in communal areas, ensuring sustained visibility and repeated exposure. They serve as powerful storytelling mediums, embedding health messages into collective memory and fostering emotional connections that surpass the transient nature of other media (Gerber et al., 2024). Their accessibility ensures inclusivity, allowing individuals across varying literacy levels and technological access to engage with health messages (Nabirye, 2022). Furthermore, murals evoke cultural pride and resilience, amplifying their dual purpose as enduring educational tools and symbols of solidarity during crises like the COVID-19 pandemic (George, 2024). At the onset of the COVID-19 pandemic, murals were widely used to promote health behaviors such as handwashing and mask wearing (de-Graft Aikins, 2020; Ha et al., 2021; McEwan et al., 2022). However, as the pandemic progressed, the focus of murals shifted to the topic of COVID-19 vaccination (AuYoung et al., 2022; Haryono, 2022). Notable mural centric COVID-19 vaccine confidence partnerships in the United States (US) include “The Signs of Solidarity initiative,” a partnership amongst the CDC, the Georgia Department of Public Health, and the mural-based organization, Living Walls, as well as partnerships between the Boston Metropolitan Area Planning Council’s Arts & Culture

Department and local artists (CDC, 2021a; CDC Foundation, 2023; Harmon, 2021). However, while these initiatives have been widely implemented, few studies have rigorously evaluated their effectiveness in improving health outcomes, particularly vaccine confidence. The literature indicates that most mural-based interventions, though seemingly effective, lacked adequate evaluation metrics, which limit their ability to establish causality between exposure to murals and changes in health behaviors (Martinez-Hollingsworth et al., 2022; Urich et al., 2024).

Teenagers and adolescents are particularly vulnerable to vaccine hesitancy due to factors like misinformation and peer influence (Abdullahi et al., 2021). In the US in 2022, individuals between 18-29 years old were the age group with the lowest rates of COVID-19 vaccination, at an estimated vaccination rate of 75.6%. This group also had the largest percentage of people who report that they “probably will get vaccinated or are unsure” (CDC, 2022a). Notably, research has found that the most common reasons for hesitancy amongst this population include concerns about vaccine side-effects (Adams et al., 2021). Despite the regular employment of murals as a form of health communication, and their potential appeal to this age group, there is limited research on the efficacy of murals as a means for health communication. More specifically, there is a dearth of literature related to murals that address the topic of vaccine confidence, which the CDC defines as the belief that vaccines are safe, work, and are part of a trustworthy medical system (CDC, 2022b). Murals can effectively address this hesitancy by using relatable, culturally resonant imagery to engage teens and promote vaccine confidence. Research has shown that murals can resonate with young people through targeted messaging (Abdullahi et al., 2021), and that murals created with community input can help combat misinformation (Medhavi, 2022). Additionally, murals that incorporate culturally relevant imagery have been found to build trust and encourage vaccine uptake among hesitant youth (Nabirye, 2022).

This study took place during the Spring of 2022 and therefore represented a phase of the pandemic in which COVID-19 vaccines were widely available to the entire US population. The institution did not mandate COVID-19 vaccinations for students, faculty, or staff. The university's health compliance documentation indicated that while COVID-19 vaccination was recommended, it was not a requirement for enrollment or campus activities. Furthermore, the geo-political climate of the state where the university is located was predominately Republican which resulted in less COVID-19 restrictions or policies than states during the same period (Neelon et al., 2021). Given this context, this study aimed to examine a) the role of peer discussion as it relates to confidence in the COVID-19 vaccine; b) the role that murals play in perceived social norms of COVID-19 vaccination; c) the role that murals play in perceived availability of accurate information about accurate safety, effectiveness, and availability of COVID-19 vaccines; and d) how murals, as a communication tool, impacts confidence in the COVID-19 vaccine among university students. It utilized the Theory of Planned Behavior as a theoretical framework to explore the role of attitudes



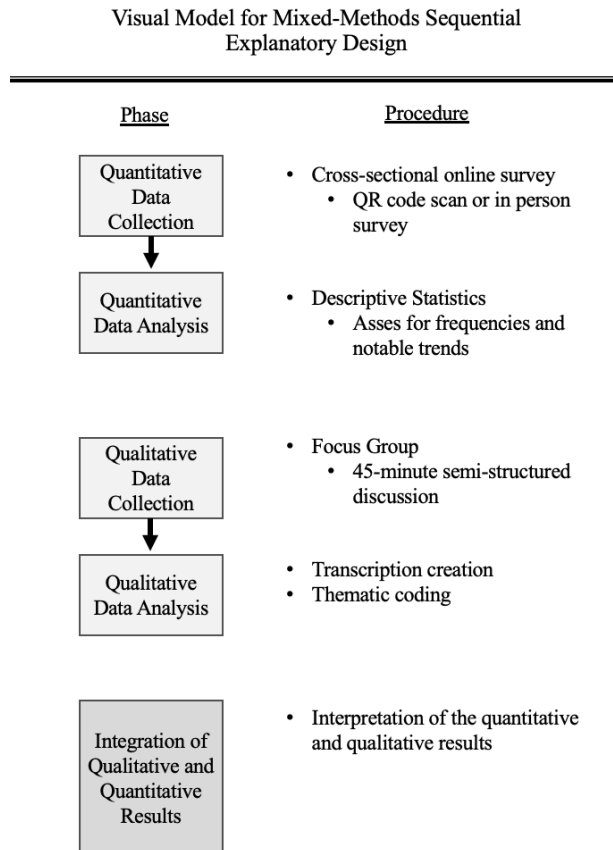
toward a behavior, perceived norm, and perceived behavioral control as it related to intention and action in a population of university students in the southern region of the US (Ajzen, 1991; Simons-Morton et al., 2012).

METHODS

A sequential explanatory mixed methods design allowed for the quantitative data collected to be further informed by qualitative dataset — see Figure 1 (Creswell, 2009; Ivankova et al., 2006). Further, the design employed constructs from the Theory of Planned Behavior (TPB) as its theoretical frame so as to contextualize factors which may precede intention to act on a health behavior such as vaccination (Ajzen, 1991; Badr et al., 2021; Hossain et al., 2021; Shmueli, 2021; Xiao & Wong, 2020). More specifically, this study centered on constructs including attitudes toward the behavior, perceived behavioral control, behavioral beliefs, subjective norms, and intention (Ajzen, 1991). The priority population for the study was college students at a major university in the southern US. To engage this population, the principal investigator collaborated with a professional curator and a hired team of mural artists to create four mural designs that depicted visualizations of vaccine confidence relative to the constructs of TPB which were centered in the study. Please see Appendix A for definitions of each primary construct.

Figure 1.

Visual Model for Mixed-Methods Sequential Explanatory Design



Design

The team created two framed structures, each with an eight-by-eight-foot mural on either side. The first structure was placed directly in front of the entrance to the main on-campus library. This set of murals was intended to reach the general student body and portrayed inclusive, diverse imagery – see Figure 2. The second structure was placed along a “fraternity row” street on campus that houses predominatly white, male students – in a location easily visible to foot and car traffic in the area. Both murals on this structure had an emphasis on school spirit and featured university specific imagery as well as a color scheme that reflected the official school colors.

A one-by-one-foot permanent sticker of a quick response (QR) code was positioned in the bottom right corner of each mural. Each QR-code led to the same landing page with COVID-19 resources and a survey. The murals were exhibited for three months, from February into May of 2022.

Figure 2.

One of the four murals curated for the vaccine confidence study.



Data Collection

In the first phase, quantitative data were collected throughout the period that the murals were up. The QR-code on each mural structure, when scanned on a smartphone, presented a Linktree – a landing page that can share links to multiple websites – with three links: a link to local vaccination sites (CDC, n.d.), a link to accurate vaccination safety and efficacy information (CDC, 2023), and a link to a survey. The QR-code option was available continuously across the three-month period. Analytics of links clicked from the QR-code were tracked during this period. The survey was accessed either by participants scanning the QR-code and navigating to the survey, or through in-person surveys in which students who walked within 400 meters of each mural site were invited to participate. In-person surveys were conducted over seven different sessions for a total of nine hours across the last two months of the mural installations.

The second phase, the qualitative arm, included a focus group that convened 30-days after the murals were removed. Following the mural installation period, the research team conducted a 45-minute focus group discussion to expand on the results of the quantitative data relative to student

perceptions and behaviors. Further, the study received approval from the university's Institutional Review Board (IRB) and complied with university-sanctioned ethical considerations. Additionally, for both the surveys and the focus group, informed consent was obtained prior to participation.

Participants. The study utilized a convenience sampling approach. Inclusion criteria for the survey required the participant to be eighteen years of age or older and a current student at the university. The inclusion criteria for the focus group required each participant to be a current student at the university, eighteen years of age or older, and have attended at least one in-person course on campus during the Spring 2022 semester.

Survey. Convenience sampling was utilized to collect survey data both via QR-code and in-person. To access the survey via QR-code, participants had to be within a scanning range of ten feet from a QR-code sticker on any of the four murals. Further, hosting the survey on Qualtrics allowed for the survey to be taken in a secure manner. For the surveys administered in-person, the principal investigator asked passersby, within 400 meters of each mural, if they would be interested in participating via iPad.

The survey had nineteen questions, five of which were demographic questions – see Appendix B. A reCAPTCHA question was utilized as the first question of the survey to prevent spam responses. There were also four questions which assessed political affiliation, university affiliation, student involvement, and COVID-19 vaccination status. An additional four questions focused on observation and discussion of the curated murals. Two questions focused on knowledge about and perceived availability of information on the COVID-19 vaccine relative to educational resources available digitally through the QR-code visible at each mural. Another two questions assessed perceived social norms concerning COVID-19 vaccination. The last question asked if the participant was interested in knowing more about the focus group, and if they were, to provide an email. All questions, aside from the informed consent and qualifying demographic questions, were optional and therefore did not require a response to continue. Survey responses were captured via a secure Qualtrics survey which only the principal investigator and one of the co-investigators had access to.

Analytics Tracking. The Linktree webpage, which served as the embedded QR-code destination, displayed three distinct links: a link to local vaccination sites, a link to accurate vaccination safety and efficacy information, and a link to a survey. The Linktree platform also tracked the dates, times, and frequency at which the landing page, as well as each link on the landing page, were accessed. These data outputs informed the overall aims and follow-up questions utilized in the focus group.

Focus Group. One month after the mural installation period, a 45-minute semi-structured focus group took place virtually on the videoconferencing application, Zoom. The principal investigator posed open-ended questions to the group based on trends observed in the quantitative survey data and added probing questions as the discussion progressed. To allow for transcription of the dialogue, the Zoom session was recorded with the consent of all participants. To ensure the privacy of participants all data were de-identified before analysis took place. During data processing, all data were stored on a secure university SharePoint Drive.

Data Analysis

The quantitative data collected from the surveys and analytics tracking were analyzed using Qualtrics XM to develop relevant descriptive statistics. Additionally, the recorded qualitative data collected via the focus group were transcribed, using Descript software, and then analyzed by two coders using an iterative thematic coding process. Given the project's sequential explanatory mixed methods design, the qualitative data were analyzed using thematic analysis to explain and further understand the quantitative data collected (Braun & Clarke, 2006).

RESULTS

Survey Data

For the survey data, 231 people were assessed for eligibility, 195 (84.42%) met eligibility requirements, and 191 (82.68%) participants completed the survey. Of those who began the survey, 16.23% were via QR-code and 83.77% were collected in-person. The average respondent age was 20.24 years old (SD = 2.18), while the ages ranged from 18 to 37 years old. Further, 67.19% of respondents identified as female, 26.56% as male, 5.21% as non-binary, and 1.04% as other. Relative to race, 68.34% identified as White, 21.61% as Asian, 8.04% as Black or African American, 1.51% as American Indian or Alaskan Native, and 0.50% as Native Hawaiian or Other Pacific Islander. Further, 26.56% identified as Hispanic or Latinx while 73.44% identified as non-Hispanic or Latinx. Relative to affiliation status with the university, 90.26% were undergraduate students and 9.74% were graduate students. Regarding vaccination status, 94.79% reported having at least one dose of the COVID-19 vaccine, 1.04% responded that they will “definitely get vaccinated,” 1.04% responded that they “probably will get vaccinated or are unsure,” and 3.13% responded they will “probably or definitely will not get vaccinated.”

In the survey, participants estimated the vaccination rates for COVID-19 (≥ 1 dose) amongst students that each participant knew personally. The results showed 76.84% selected greater than 75%, 20.53% selected 51-75%, 2.63% selected 26-50%, and 0% selected less than 25%.

Descriptive statistics relative to personal identifiers are illustrated in Table 1. Additionally, participants estimated the vaccination rates for COVID-19 (≥ 1 dose) amongst the entire student population. In sum, 28.95% selected greater than 75%, 60.53% selected 51-75%, 9.47% selected 26-50%, and 1.05% selected less than 25%. Descriptive statistics relative to personal identifiers are illustrated in Table 2.

Table 1.

Perceived COVID-19 vaccination status amongst university students known personally

Self-Identified Demographic Characteristic	Choice 1: Greater than 75%	Choice 2: 51-75%	Choice 3: 26-50%	Choice 4: Less than 25%
<i>Ethnicity</i>				
Hispanic or Latinx	82.35%	13.73%	3.92%	0.00%
Not Hispanic or Latinx	75.00%	22.86%	2.14%	0.00%
<i>Race</i>				
Black or African American	50.00%	31.25%	18.75%	0.00%
White	82.09%	17.16%	0.75%	0.00%
Asian	69.77%	27.91%	2.33%	0.00%
American Indian, Native Hawaiian, or other Pacific Islander	100%	0.00%	0.00%	0.00%
<i>Political affiliation</i>				
Republican	68.75%	18.75%	12.50%	0.00%
Democrat	78.70%	20.37%	0.93%	0.00%
All university student participants	76.84%	20.53%	2.63%	0.00%

The survey also considered how often participants see any of the murals while on campus and defined the options as very frequently (5 or more times per week), regularly (1-4 times per week), occasionally (once every two weeks), rarely (seen at least one time), and never. In total, 35.79% reported very frequently, 45.79% reported regularly, 10.53% reported occasionally, 5.79% reported rarely, and 2.11% reported never. Therefore, 92.10% reported seeing a mural at least once every two weeks.

Table 2.

Perceived COVID-19 vaccination status amongst all university students

Self-Identified Demographic Characteristic	Choice 1: Greater than 75%	Choice 2: 51-75%	Choice 3: 26-50%	Choice 4: Less than 25%
<i>Ethnicity</i>				
Hispanic or Latinx	29.41%	60.78%	9.80%	0.00%
Not Hispanic or Latinx	29.29%	60.00%	9.29%	1.43%
<i>Political affiliation</i>				
Republican	56.25%	31.25%	12.50%	0.00%
Democrat	29.63%	61.11%	8.33%	0.93%
<i>Race</i>				
Black or African American	12.50%	56.25%	25.00%	6.25%
White	31.34%	60.45%	8.21%	0.00%
Asian	27.91%	62.79%	6.98%	2.33%
American Indian, Native Hawaiian, or other Pacific Islander	29.55%	61.36%	6.82%	2.27%
All university student participants	28.95%	60.53%	9.47%	1.05%

The participants who previously responded that they had seen one of the murals at least one time were then asked how often they had discussed the mural(s) with peers. Overall, 3.76% reported discussion very frequently, 8.60% regularly, 22.04% occasionally, 36.02% rarely, and 29.57% never. More specifically, 70.43% reported that they had discussed the mural(s) at least one time with peers. Table 3 illustrates rates of discussing the mural(s) at least one time across personal identifiers.

Table 3.

Discussion of mural(s) with university student peers

Self-Identified Demographic Characteristic	Discussed mural(s) at least one time with peers
<i>Ethnicity</i>	
Hispanic or Latinx	76.00%
Not Hispanic or Latinx	66.43%
<i>Gender</i>	
Male	62.50%

Female	76.98%
Other	33.33%
<i>Political affiliation</i>	
Republican	53.85%
Democrat	74.07%
<i>Race</i>	
Black or African American	81.25%
White	70.77%
Asian	67.44%
American Indian, Native Hawaiian, or other Pacific Islander	75.00%
All university student participants	70.43%

Of the respondents who previously indicated that they had discussed the mural(s) with peers at least one time, 21.37% agreed or strongly agreed that the mural(s) led to discussion of the COVID-19 vaccine with peers. More specifically, 3.05% strongly agreed, 18.32% agreed, 35.11% were neutral, 31.30% disagreed, and 12.21% strongly disagreed. When considering race, 7.69% of Black or African American student respondents agreed or strongly agreed with the statement. Comparatively, 19.56% of White respondents and 27.59% of Asian respondents agreed or strongly agreed with the statement. Regarding ethnicity, 18.42% of those identifying as Hispanic or Latinx agreed or strongly agreed with the statement. Relative to political affiliation, 14.29% of Republican respondents, 20.00% of Democrat respondents, and 25.00% of other respondents agreed or strongly agreed with the statement.

Finally, participants who responded that they utilized the QR-code were asked to rate on a Likert-type scale of strongly agree to strongly disagree their perception that the links provided on each mural's QR-code improved their awareness of local vaccination sites and/or information on the COVID-19 vaccine. Overall, 12.12% strongly agreed, 36.36% agreed, 30.30% were neutral, 12.12% disagreed, and 9.09% strongly disagreed. Therefore, 48.48% of student respondents either agreed or strongly agreed that the links provided on the mural's QR-code improved awareness of local vaccination sites and/or information on the COVID-19 vaccine.

Analytics Data

The Linktree site, the QR-code's destination, captured the number of QR-code scans and the number of times each of the three available links were clicked. Overall, the QR-code received 229 scans. Of those who used the QR-code, 40.61% clicked on the link to the survey, 1.31% clicked on the link for local vaccination locations, and 1.75% clicked on the link to accurate vaccination safety and efficacy information.

Qualitative Data

The focus group was composed of four undergraduate students, each of whom volunteered at the same research laboratory on campus but were not previously exposed to this study. As such, there were pre-existing relationships amongst the group which aided in the development of the focus group discussion. Additionally, three of the four participants identified as female while one identified as male. Following the semi-structured, focus group discussion a thematic analysis identified codes and themes in an iterative manner (Braun & Clarke, 2006). The first theme related to the question, “Of the murals you engaged with, which features, or aspects did you find captured your attention most and why?” Prominent themes included that a) representing diversity and inclusivity in the murals was an effective way to reach students; b) having the murals at the center of a high foot traffic area made people notice them; and c) the artistic range across the murals was important because people are attracted to different styles.

“I feel like there's just so much diversity in that mural...it feels more inclusive...like the different hair types...and different skin tones...it just felt really welcoming. And it was like... [we are] in it together type of vibe.” (S1)

“It just really showed that there is a sense of community against...COVID.” (S2)

“The location was...instrumental in me noticing it because there was a ton of people that were always walking through there, and they think that if it was in a more like secluded, or maybe like slower area, I don't know that I would have seen it or noticed it as much.” (S4)

The focus group’s discussion elicited several themes as to why university students who saw the mural(s) did not discuss them with peers: a) brief experiences with the mural(s); b) did not understand the meaning of the mural(s); and c) did not engage with peers when near the mural structures.

“I ...did not...bring [it] up...[in] discussion. I think just because I had such a brief experience with it.” (S4)

“Too complex to understand in a way where I was just like, oh, it's pretty, but what is it really about?” (S1)

Based on survey data, there were respondents who identified that the murals led to discussion amongst peers, but that the discussion was not concerning the COVID-19 vaccine. The focus group

considered that this finding may be explained by several themes: a) students did not want to engage in a controversial discussion; b) students acknowledged their close peers already have similar opinions to themselves; c) discussion may have focused on artistic aspects; and d) the intended meaning was not obvious to all students.

“It's so political and controversial, it makes a lot of people uncomfortable.” (S1)

“I guess all the people that I've been around the last year...kind of feel the same as me.” (S3)

“The first thing that they thought to discuss was how pretty it was or the artist.” (S3)

The focus group also discussed the value of a curated, public health mural installation, and considered themes such as how a) art resonates and sticks with people; b) art distributes health information in a less intimidating way; and c) art drives conversations which can begin to change perspectives.

“That's the most important thing — it resonates with someone” (S2)

“I really think that's important because that's the first step into someone changing their mind” (S4)

“It...makes it a lot more digestible for people to understand... It just creates kind of a gateway into a field... that is often very intimidating for others.” (S2)

DISCUSSION

This study aimed to investigate a) the role of peer discussion as it relates to confidence in the COVID-19 vaccine; b) the role that murals play in perceived social norms of COVID-19 vaccination; c) the role that murals play in perceived availability of accurate information about accurate safety, effectiveness, and availability of COVID-19 vaccines; and d) how murals, as a communication tool, impact confidence in the COVID-19 vaccine among university students. Overall, there were four central findings. First, that curated murals increased discussion around COVID-19 vaccination amongst university student participants. Second, that curated murals focused on COVID-19 may not have notably changed perceived social norms of COVID-19 vaccination amongst university students. Third, that murals may increase perceived availability of accurate information about the safety, effectiveness, and availability of COVID-19 vaccines.

Fourth, that as a form of health communication, murals may have the opportunity to resonate with viewers while promoting health conversations in a less intimidating manner.

Curated murals focused on COVID-19 increased discussion around COVID-19 vaccination. A notably larger percentage of respondents who discussed the mural with peers identified as Democratic political affiliation as opposed to Republican. This is consistent with the common political dichotomy that has existed with regard to approval versus disapproval of the COVID-19 vaccine itself as well as the vaccine mandates which were instituted at state and national levels during the height of the pandemic in the US; a majority of Democratic government representatives expressed approval of the vaccine and related mandates whereas a majority of Republican representatives were in disapproval (Bruine de Bruin et al., 2020). Additionally, 81.25% of participants that identified as Black or African American reported that they discussed the mural(s) at least one time with peers; a notably higher percentage than any other racial group. This finding is notable as the literature has shown vaccine hesitancy is typically highest amongst minority populations (Khubchandani & Macias, 2021). With that, this artform provides an opportunity to engage minoritized populations in discussions around COVID-19 vaccination.

The focus group informed the rates of discussion data as they identified which aspects of the mural(s) captured respondents' attention. Themes discussed included a) representing diversity and inclusivity in the murals was an effective way to reach students; b) having the murals at the center of a high foot traffic area made people notice them; and c) the artistic range across the murals was important because people are attracted to different styles. These findings inform the first aim as well as the literature which asserts that art for health communication "attract[s] attention, sustain[s] interest...[and] stimulate[s] memorable responses" (Sonke et al., 2021, p. 107). As it pertains to the 35.11% of respondents who discussed the mural(s) but responded "neutral" to whether the mural(s) led to discussion of the COVID-19 vaccine, the focus group rationalized that this may have occurred due to participants wanting to remain impartial on the topic of the COVID-19 vaccine in general. One focus group participant (S1) noted, "It's so political and controversial, it makes a lot of people uncomfortable to pick a side ... [someone] might perceive me wrong and against them." Further, the focus group discussed how respondents may have disagreed or strongly disagreed due to not understanding the intent of the mural(s).

Curated murals focused on COVID-19 may not have changed the perceived social norm of COVID-19 vaccination amongst university students. The majority of student respondents reported having at least one dose of the COVID-19 vaccine. Relative to this high vaccination rate, the focus group identified how the mural(s) did not conflict with prior perceptions on the vaccine, therefore not affecting the perception of social norms around COVID-19 vaccination. Regarding the survey data, on average, a majority of student participants perceived that greater than 75% of their peer

group was vaccinated. After considering the data, the collection methodology could have more effectively informed the second aim by asking follow-up questions later in the intervention period which would have allowed for change scores to be assessed. Further, change could have been assessed with both pre- and post-assessments.

Murals were seen to increase perceived availability of accurate information about accurate safety, effectiveness, and availability of COVID-19 vaccines. This was evidenced by the survey as nearly half of student respondents either agreed or strongly agreed that the links provided on the mural's QR-code improved awareness of local vaccination sites and/or information on the COVID-19 vaccine. These data also align with research that supports that health communication can increase awareness and knowledge on a given topic (European Centre for Disease Prevention and Control [ECDPC], 2014). Of note, was that the percentage of participants which indicated that the QR-code increased perceived availability of accurate information about accurate safety, effectiveness, and availability of COVID-19 vaccines was notably higher than the percentage that the QR code clicked on the related links. This alludes to the perceived availability of information rather than utilization of resources.

Curated, public health mural installations have the opportunity to resonate with viewers while promoting health conversations in a less intimidating, more approachable manner. This finding was observed through focus group discussion on the value of curated, public health mural installations. Themes included that a) art resonates and sticks with people; b) art distributes health information in a less intimidating way; and c) art drives conversations which can begin to change perspectives. In particular, the theme relating to art distributing health information in a less intimidating way pertained to the concept that the material felt approachable and easy to discuss with peers. These findings align with the literature which supports the ability of arts in health communication as a mechanism to attract attention, facilitate conversation, and sustain interest (Sonke et al., 2020).

Strengths, Limitations, and Recommendations

Several strengths were evident. First, triangulating the quantitative survey data by collecting both in-person and digitally via QR-code strengthened the internal validity of the survey results. Additionally, the use of a sequential explanatory mixed methods design bolstered the methodology given that qualitative data were collected to support and further inform the quantitative data collected. Tailoring the content of the murals to the priority population allowed for the messages to be more relatable and engaging. Finally, utilizing an interdisciplinary approach prioritized collaboration and prevented siloed perspectives.

There are several limitations of the study. The study sample included only 195 respondents while the total university population was about 60,000 students. Given this absence of statistical power, the generalizability of the results was limited. Regarding the focus group, the study utilized a group of four students due to scheduling although typical focus group sizes range from five to eight. Additionally, the use of convenience sampling restricted the generalizability of the results given its inherent sampling bias. This form of convenience sampling also led to the sample for the survey having a majority of participants that were already vaccinated for COVID-19. Moreover, only using a single survey time point limited the ability to observe change across the intervention period. Another limitation was that a focus group was not utilized in the finalization of the mural designs which would have allowed for a more informed, and tailored approach.

Future research on this topic should increase sampling frequency and include locations that would gather a larger, more diverse sample to increase the generalizability of the results. Further, formal pre-post assessment would better assess the impact of the murals by considering its effects. Additionally, adding a focus group from the priority population prior to the murals' installation would allow for more directed tailoring of the potential designs before finalizing the installations. Moreover, having a focus group of participants that were not vaccinated for COVID-19 could also inform trends seen in survey data. Future work could also assess the effectiveness of different mural designs and messaging to explore why some people engaged with the QR-code while others did not. To improve QR-code driven survey engagement, it would be beneficial to incentivize participants. Finally, increasing the number of focus groups after the installation period would increase the diversity of discussion surrounding the quantitative component.

CONCLUSION

This work suggests that murals may be an effective means for health communication for engaging young adults. Overall, the study found that curated murals focused on COVID-19 increased discussion around COVID-19 vaccination amongst university student participants and can increase perceived availability of accurate information about the safety, effectiveness, and availability of COVID-19 vaccines. This increased discussion was also noted amongst minoritized populations in the study which suggests the utility of arts-based methods in vaccine promotion for these populations. Additionally, as a form of health communication, murals may resonate with viewers while promoting health conversations in a less intimidating manner. This study not only provides evidence for driving health conversations surrounding COVID-19, but it has future implications for increasing confidence across other vaccines and health prevention measures in general.



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Appendix A

Conceptualization and Operationalization of Key Terms

Term	Definition	Operationalization
Perceived Social Norms	Beliefs about the behaviors that are considered acceptable or typical within a group (Cialdini & Trost, 1998; Ager & Long, 2015).	Measured through survey items asking participants about their perceptions of how often their peers engage in vaccination-related behaviors (e.g., "Most people I know have been vaccinated.")
Availability of Accurate Vaccine Information	The perception of whether trustworthy and accurate vaccine-related information is readily accessible (Larson et al., 2015; Nutbeam, 2008).	Assessed by asking participants to rate the availability of trustworthy information regarding vaccine safety and effectiveness (e.g., "I feel I have easy access to reliable vaccine information.")
Perceived Vaccine Safety	Beliefs about the safety of the vaccine, including concerns about side effects (Ager & Long, 2015; Larson et al., 2015).	Survey items on perceived vaccine safety (e.g., "I believe the COVID-19 vaccine is safe for most people.")
Perceived Vaccine Effectiveness	Beliefs about how well the vaccine works in preventing COVID-19 infection (Cialdini & Trost, 1998; Larson et al., 2015).	Survey items measuring perceived effectiveness (e.g., "I believe the COVID-19 vaccine is effective in preventing COVID-19.")
Vaccine Confidence	A person's trust in the safety, effectiveness, and reliability of the vaccine and the healthcare system (Ajzen, 1991; Larson et al., 2015).	Measured by self-report on trust in vaccines and healthcare providers, with a focus on belief in the vaccine's ability to protect against COVID-19 (e.g., "I trust the COVID-19 vaccine to protect me from the virus.")



Appendix B

SURVEY

Engage via QR code and in-person; For QR code, discrete link per mural; Both will be through Qualtrics

- **Captcha question**
- **Are you at least 18 years of age?**
 - **Yes**
 - **No**
- **What is your age? _____**
- **What is your affiliation with the University of Florida?**
 - Faculty/Staff
 - Undergraduate Student
 - Graduate Student
 - Other: _____
- **What do you identify as your gender?**
 - Male
 - Female
 - Other:
 - Prefer not to say
- **What do you identify as your race? (select all that apply)**
 - American Indian or Alaska Native
 - Asian
 - Black or African American
 - Native Hawaiian or Other Pacific Islander
 - White
- **What do you identify as your ethnicity?**
 - Hispanic or Latinx
 - Not Hispanic or Latinx
- **Please select all of the following in which you are currently a member?
(select all that apply)**



- Greek Fraternity or Sorority
 - Multi-Cultural Fraternity or Sorority
 - Professional Fraternity or Sorority
 - None
- **What do you consider your political affiliation?**
 - Republican
 - Democrat
 - Independent
 - Other: ____
- **What is your current COVID-19 vaccination status?**
 - Vaccinated (≥ 1 dose)
 - Definitely will get vaccinated
 - Probably will get vaccinated or are unsure
 - Probably or definitely will not get vaccinated
- **Which mural(s) have you seen on campus at the University of Florida?**
(please select all that apply)
 - *Include photos as options*
- **How often do you see any of the murals from the previous question while on campus?**
 - Very Frequently (5 or more times per week)
 - Regularly (1-4 times per week)
 - Occasionally (once every two weeks)
 - Rarely (seen at least one time)
 - Never
- **How often have you discussed the mural(s) with your peers?**
 - Very Frequently (2+ times per week)
 - Regularly (1 time per week)
 - Occasionally (once every two weeks)
 - Rarely (at least one time)
 - Never

- **The murals, referenced above, have led to discussion of the COVID-19 vaccine with my peers at UF.**
 - Strongly agree
 - Agree
 - Neutral
 - Disagree
 - Strongly disagree
- **Did you scan a QR code from one of the mural sites?**
 - Yes
 - No

(If yes – branching logic)

- **The links provided on the mural's QR code improved my awareness of local vaccination sites and/or information on the COVID-19 vaccine.**
 - Strongly agree
 - Agree
 - Neutral
 - Disagree
 - Strongly disagree
- **Among UF students that you know personally, how many would you estimate are vaccinated for COVID-19 (3 1 dose)?**
 - Greater than 75%
 - 51-75%
 - 26-50%
 - Less than 25%
- **Among the entire UF student population, how many would you estimate are vaccinated for COVID-19 (3 1 dose)?**
 - Greater than 75%
 - 51-75%
 - 26-50%
 - Less than 25%
- **Did you speak with a medical professional at the mural site?**
 - Yes



- No
- There was no medical doctor onsite when I was at the mural.

(If yes – branching logic)

- **After speaking with the medical professional(s) onsite, my perception of student vaccination rates changed.**
 - Strongly agree
 - Agree
 - Neutral
 - Disagree
 - Strongly disagree
- **Speaking with the medical professional(s) onsite improved my understanding of the risks and benefits of the COVID-19 vaccine.**
 - Strongly agree
 - Agree
 - Neutral
 - Disagree
 - Strongly disagree

Thank you for completing the survey! If you are interested in learning more about participating in a focus group for this project toward the end of the spring 2022 semester, please enter your email here.

Email: _____