Nowhere to go? A study of marginalization, social connection, and mental health outcomes among young adults experiencing the COVID-19 pandemic

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Background: The COVID-19 pandemic onset necessitated large-scale closures of third places, potentially exacerbating social barriers experienced by young adults in the United States. To better understand the role of urban form in facilitating socialization, we examine the effects of pandemic-based third place closures on mental health outcomes as mediated by changes in social connection. Because identifying as a racial, gender, or sexual minority can compound baseline disadvantages rooted in systemic inequities, we investigate outcome differences for non-white, woman/nonbinary, and LGBTQ+ young adults to disentangle identity-based nuances of the pandemic experience.
Methods: In February 2021, we administered a web-based survey with retrospective name and place generators to 313 18-to-34-year-olds in California, Illinois, and Texas. A structural equation model is estimated showing the direct and indirect effects of physical and virtual mobility constraints on mental health.
Results: Both the closure of third places and dissatisfaction with alternative social spaces are associated with the deterioration of social connections and mental health. The strongest direct predictor of mental health decline is dissatisfaction with virtual socialization (more significant for women and nonbinary respondents). Surprisingly, two distinct categories of third places (i.e., 'civic' and 'commercial') reveal different relationships with social connections and mental health outcomes. Asian, other non-white, and non-heterosexual young adults experienced greater 'civic' visit reduction, while those with intersecting identities of low income and woman/nonbinary or Black experienced greater 'commercial' visit reduction.
Conclusions: Physical and virtual mobility reductions contributed to the inequitable mental health outcomes experienced by young adults during the pandemic. This highlights the potential for a careful redesign of physical and virtual social spaces to support feelings of belonging/safety and spontaneous 'weak tie' interactions, encourages further investigation of social infrastructure's role in facilitating the maintenance of social connections and mental health, and reveals the value of examining differences in mobility-related experiences across social identities.

1. Introduction

The COVID-19 pandemic was declared a national emergency on March 13th, 2020, requiring cities across the United States to

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Table 1

Pandemic context of the 'restricted vaccine access' period in February 2021 for the three U.S. states of interest (Centers for Disease Control and Prevention, 2022; Google, 2022a).

State	Cases		Deaths		Vaccinations		Google Mobility Report U.S. movement reduction in Feb 2021 (percent change from pre-pandemic baseline)[a]					
	New	7-day average	New	7-day average	New	7-day average	Retail & Recreation (visits)	Grocery & Pharmacy (visits)	Parks (visits)	Transit stations (visits)	Workplaces (visits)	Residential (duration)
California	5009	8480	331	353	101,572	221,705	−25.43%	−11.29%	−29.00%	−40.71%	−31.29	+11.71%
Illinois	1355	2.176	45	55	47,067	73,138						
Texas	3630	8044	62	225	15,821	116,884						

[a] The number of visitors to (or time spent in) categorized places on February 15, 2021, compared to the median value from the 5-week period preceding the pandemic lockdown (i.e., January 3 to February 6, 2020) (Mathieu et al., 2020, see further documentation on data-source in Google, 2022b).

partake in a nationwide lockdown. This early pandemic period consisted of a series of temporary and permanent closures of nonessential businesses and academic spaces, reduction in healthcare and social services, travel restrictions and curfews, as well as mandates to stay home, practice social distancing, and obtain access to personal protective equipment. The first vaccines would not be available for another nine months. At the time of data collection, vaccine availability had just begun for select populations in our three U.S. states of interest (Ivory et al., 2022).

Young adulthood describes the period of life between adolescence and adulthood, which ranges in age from 18 to 34 years in this study. This developmental phase is marked by early career development, increasing financial independence, relationship growth, social role transitions, identity formation, differentiation, a deepening sense of community and belonging, and other notable milestones (Arnett, 2007; Graupensperger et al., 2022; Roisman et al., 2004). Pandemic-induced lifestyle changes had distinct impacts on this population. For example, during lockdown students living in dormitories were required to relocate, in many cases moving in with their families of origin (Jones et al., 2021). Recent research has found that young adults are particularly at risk of negative psychological impacts from the pandemic (Cao et al., 2020; Khan et al., 2020), higher levels of worry (Barber and Kim, 2021), and unemployment risks (Moen et al., 2020). Furthermore, pandemic-related loneliness was found to be more common among young adults compared to other age groups (Graupensperger et al., 2021; Lee et al., 2020; Luchetti et al., 2020), supporting the importance of this study's contribution to quantifying the place-based components of this phenomenon.

Using data collected through a web-based survey distributed to young adults in the U.S. (N = 313), this study aims to better understand the extent to which third-place closures and subsequent reduction in socialization opportunities have contributed to social disconnection and mental health decline, in addition to the potential social inequities of these impacts.

1.1. Background

1.1.1. Pandemic-based mental health impacts

Recent studies have found that the experience of quarantining can lead to a wide array of mental health issues (Brooks et al., 2020), stress disorders, and psychological distress (Dam et al., 2020). While pandemic stressors like quarantine mandates affect many domains of life, including professional, financial, and medical, recent research has revealed that changes in the social domain are the strongest predictor of increased depression and anxiety among young adults in the U.S. (Graupensperger et al., 2021). Building upon these findings, this study focuses on access to physical and virtual social environments and associated mental health outcomes for young adults, while controlling for changes in social connection.

1.1.2. Pandemic-based transport impacts

This study examines the effects of reductions in mobility on mental health during the pandemic, which fits within a larger body of pandemic-based research on health-related consequences of transportation suppression during the lockdown. These include some positive outcomes, such as improved air quality (Kim, 2021) and reductions in crash fatalities (Gupta et al., 2021), as well as negative outcomes like reduced access to healthcare (Chen et al., 2021; Oluyede et al., 2022) and declines in well-being (Mars et al., 2022). Table 1 shows the pandemic-based mobility changes that occurred in the three U.S. states of interest (i.e., California, Illinois, and Texas) alongside the general pandemic context at the time of survey deployment (i.e., February 2021), which we refer to herein as the 'restricted vaccine access' period. Although the cause of this immobility is not a lack of transportation, the insights drawn from our findings can contribute to better preparations for future transportation disruptions. This is in line with other pandemic-based studies connecting psychology and travel behavior within the field of transportation, such as Kaplan et al. (2022) which identifies the psychological mechanisms contributing to pandemic-based reductions in transit ridership.

1.1.3. Third places, virtual spaces, and outdoor areas

Existing literature touts the importance of urban mobility for facilitating social cohesion and collective well-being (Anciaes et al., 2016), in addition to the power of mobility to promote feelings of independence and autonomy (Garg et al., 2022). Given pandemic-necessitated reductions in mobility, our study aims to better understand the role that physical and virtual social spaces play in the mental health of young adults.

The term 'third places' refers to social environments that are neither home nor workplace. Traditionally, third places have included libraries, community centers, churches, and parks (Oldenburg, 2007). These places are theoretically valued for their ability to provide opportunities for informal interactions between strangers or casual acquaintances. During the pandemic, the possibility of engaging with local acquaintances and strangers has been severely challenged, amplifying reliance on alternative social infrastructure, such as outdoor facilities and virtual spaces (Liu et al., 2022).

In the initial phases of the pandemic lockdown, a large portion of daily socializing shifted to virtual spaces, including working from home, remote schooling, and accessing healthcare via an array of video conferencing software. Unfortunately, for many individuals, virtual socialization is not a viable or satisfactory alternative. For example, recent research shows that remote mental health services do not meet the needs of many individuals with marginalized identities due to a lack of privacy in unsupportive households (Jones et al., 2021). Alternative social environments that support in-person interactions include outdoor areas, such as shared streets that began to appear and expand in March/April 2020 and national parks that predominantly reopened in May/June 2020 (Scott, 2021).

1.1.4. Strong and weak social ties

From a social network perspective, the primary benefit of third places is the formation of weak ties, such as those between acquaintances or strangers, which serve to bridge separate networks and provide valuable access to new information (Granovetter,

1973). During the pandemic lockdowns, due to risks of viral spread, there has been a notable loss of access to weak tie connections (Borowski and Stathopoulos, 2021; Iranmanesh and Atun, 2021; Long et al., 2022), which recent studies have linked to deteriorated well-being (Pennington, 2021; Tibbetts et al., 2021; Walsh, 2020; Wright et al., 2022). Additionally, beyond the pandemic context, studies have shown a connection between positive social relationships and better physical health outcomes (Holt-Lunstad, 2021; Kemp et al., 2017; Uchino, 2013).

This study also considers the role of social places in maintaining strong social ties, specifically friendships. The focus on friendships in this study is based on the importance of third places for maintaining these relationships (Rosenbaum, 2006), which is likely to shape experiences of early pandemic mandates to remain home. However, while familial relationships are not the focus of this study on third places, it is worth noting that recent research highlights the importance of family-based social support for the mental wellness of transgender and gender-diverse individuals (Hawke et al., 2021).

1.1.5. Marginalized social identities

Research shows that identifying as a racial, gender, or sexual minority has the potential to compound baseline disadvantages rooted in systemic inequities (Gray et al., 2020). In the pandemic context, disparities in outcomes propagate from upstream social determinants of health, including racism, discrimination, poverty, and malignant social policies (Gray et al., 2020). Due to inequitable access to and satisfaction with alternative social spaces, this study compares outcomes for marginalized social identities across dimensions of race, gender, and sexual orientation. Here we use the term 'marginalized' to refer to "individuals who have been discriminated against, ignored, or misrepresented due to inequities within our systems" (Guardia et al., 2021).

Race/ethnicity. In the U.S., prior to the pandemic, marginalized racial and ethnic communities experienced a greater likelihood of economic hardship, poverty, and lower socioeconomic status (American Psychological Association, 2020), as well as healthcare discrimination and distrust (Bergstresser, 2015; Jacobs et al., 2011; Mays et al., 2007). Historically, Black and Latinx workers have faced greater unemployment rates and lower wages compared to white workers (Bureau of Labor Statistics, 2019) and, along with Indigenous Peoples, have been underrepresented in professional occupations (Bureau of Labor Statistics, 2020).

During the pandemic, Black, Latinx, and Indigenous communities in the U.S. have experienced a disproportionate burden of COVID-19 cases and mortality rates (Egbert, 2020; Tai et al., 2021; Webb Hooper et al., 2020). Racism has led to high levels of social disconnection, rejection, and violence during the pandemic (Farquharson and Thornton, 2020). Owing to the origins of the COVID-19 disease in China, Asian Americans have been targets of anti-Asian, xenophobic sentiment, hate crimes, and boycotts (Kang, 2020). Black males have expressed concern about being perceived as suspicious or criminal for wearing a facemask and potentially being harmed or killed (De La Garza, 2020; Taylor, 2020).

Gender. Prior to the pandemic, women worldwide have shouldered a greater load of the 'care economy' labor, which refers to the unpaid work of domestic responsibilities, such as cooking, cleaning, childcare, homeschooling, caring for ill or older adults, and the emotional labor of relationship maintenance (Moreira da Silva, 2019; Power, 2020; Pozzan and Cattaneo, 2020).

During the pandemic, women have experienced higher rates of essential work, job loss, and work disruption due to childcare and domestic duties (Adams-Prassl et al., 2020; Carli, 2020). Women make up a greater percentage of those employed in the healthcare industry (Carli, 2020), and among healthcare staff, young women are at greater risk for negative psychological impacts compared to men (Lai et al., 2020). Additionally, mothers have reported a decline in mental health during the pandemic (Hamel and Salganicoff, 2020). With the closures of schools and daycares during the pandemic, women have taken on a greater portion of domestic labor (De Paz et al., 2020; Kantamneni, 2020; Power, 2020; Sevilla and Smith, 2020). Finally, women have experienced an increased risk of gender-based violence during the pandemic (De Paz et al., 2020).

Sexual identity. Prior to the pandemic, lesbian, gay, bisexual, transgender, queer, and other non-heterosexual (LGBTQ+) individuals were at greater risk for social isolation and lower quality of mental health and well-being compared to non-LGBTQ+ individuals, especially among people of color (Fish et al., 2020; Salerno et al., 2020) and those who are aging and/or living in rural areas (Whittington et al., 2020). One-third of LGBTQ+ youth experience family rejection (Salerno et al., 2020), and they are more likely than non-LGBTQ+ youth to experience homelessness or live in foster care, unstable housing, or unsupportive environments (Morton et al., 2018; Romero et al., 2020; Whittington et al., 2020).

Traditionally, LGBTQ+ individuals have relied on physical leisure spaces for safe social gatherings of community, identity development, and building a sense of self, but during the pandemic, many of these spaces have closed or moved to virtual environments (Anderson and Knee, 2021; Collins and Drinkwater, 2017; Zablotska et al., 2012). Pre-pandemic research on the role of online social spaces in the lives of LGBTQ+ youth has highlighted the benefits of virtual socialization, including information access and the formation of chosen families or alternative support structures, as well as many challenges to consider, including privacy risks and differences in access, knowledge, and skills (Craig and McInroy, 2014; Egner, 2018; Lucero, 2017; McConatha, 2015; Wargo, 2017).

During the pandemic, research has shown that LGBTQ+ youth are more likely than non-LGBTQ+ youth to experience poor mental health and well-being, highlighting the challenges of being severed from pre-pandemic social resources and confined in unsupportive environments (Fish et al., 2020; Kamal et al., 2021). Early pandemic studies recommend examining the success of online interactions in combatting social isolation during lockdowns (Gato et al., 2021).

1.2. Research questions and hypothesized model

This study is designed to investigate three main research questions related to the impacts of third place closures and alternative social spaces on mental health. These research questions are outlined below and depicted in the hypothesized model in Fig. 1.

RQ1. *What is the impact of third places on mental health of young adults during the pandemic?*
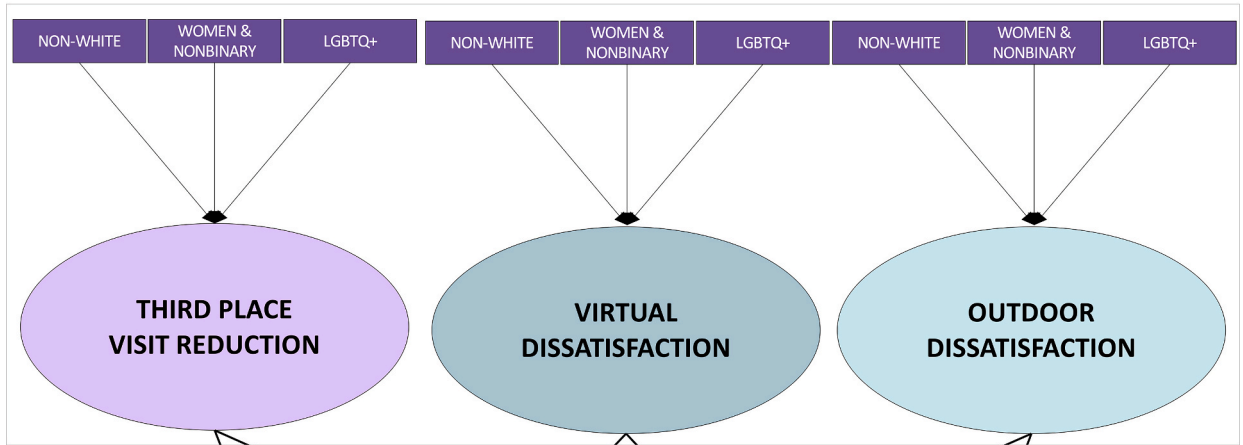
RQ2. *What is the effect of social connections on mental health of young adults during the pandemic?*
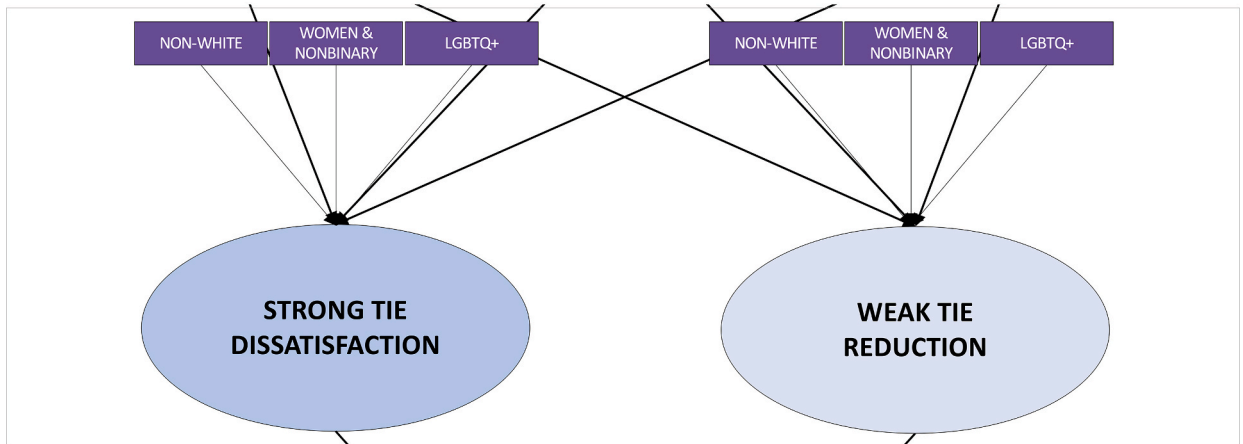
RQ3. *Is there any significant difference in pandemic experiences for young adults with marginalized identities?*
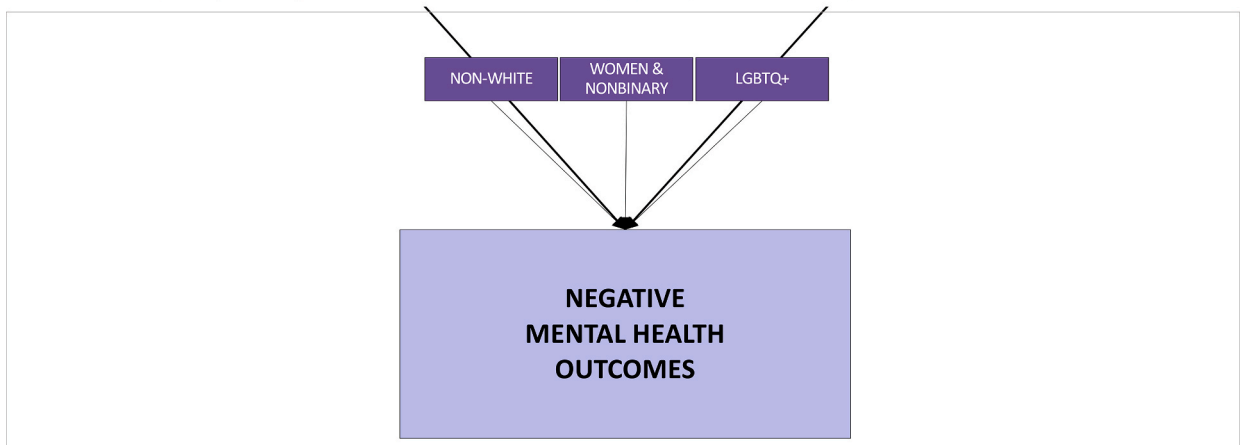
Fig. 1. The associated research questions and hypothesized model.

(1) **What is the impact of third places (i.e., traditional, virtual, and outdoor) on the mental health of young adults during the pandemic?**
   (a) It is expected that access to traditional, virtual, and outdoor third places will be associated with better mental health outcomes.
(2) **What is the effect of different types of social connections (i.e., strong and weak ties) on the mental health of young adults during the pandemic?**
   (a) It is expected that both strong and weak social connections will be associated with better mental health outcomes.
(3) **Is there any significant difference in the pandemic experiences of young adults with marginalized identities along dimensions of race and ethnicity, gender, and sexual orientation?**
   (a) It is expected that marginalized social identity will be correlated with worse mental health outcomes.

1.3. Research contributions

While recent studies have examined the mental health impacts of the COVID-19 pandemic (Brooks et al., 2020; Dam et al., 2020), to the best of our knowledge, this is the first study to quantitatively compare the inequitable impacts of pandemic-based mobility reductions on the mental health of young adults in the U.S. Findings from this work will provide insights into the development of social infrastructure redesign strategies in physical and virtual space and investments that could strengthen social connections, especially among groups identified as having a higher risk of social disconnection.

2. Methodology

2.1. Data collection

A web-based survey with retrospective name and place generators was designed using Qualtrics (Provo, Utah, USA) and administered in February 2021 (i.e., a period of restricted vaccine access) via the Prolific (https://prolific.co/) platform for online subject recruitment of a standard respondent panel (Palan and Chitter, 2018). Data was collected from 330 individuals using the pre-screening criteria of age (i.e., 18–34 years old), state of residence (i.e., California, Illinois, and Texas), and language fluency (i.e., English). Additionally, we required respondents to have approval scores above 95% based on their prior survey participation on the Prolific platform. Seventeen respondents were removed from the dataset for insufficient data or poor-quality answers (such as failing an attention check), resulting in a sample size comprised of 313 individuals. No sampling strategy was employed to oversample, meet specific quotas, or offer different incentives. However, Prolific is known for providing access to a more diverse population of respondents (compared to other platforms like MTurk) along lines of geographical location and ethnicity (Peer et al., 2017), which may have contributed to the diversity achieved in our sample.

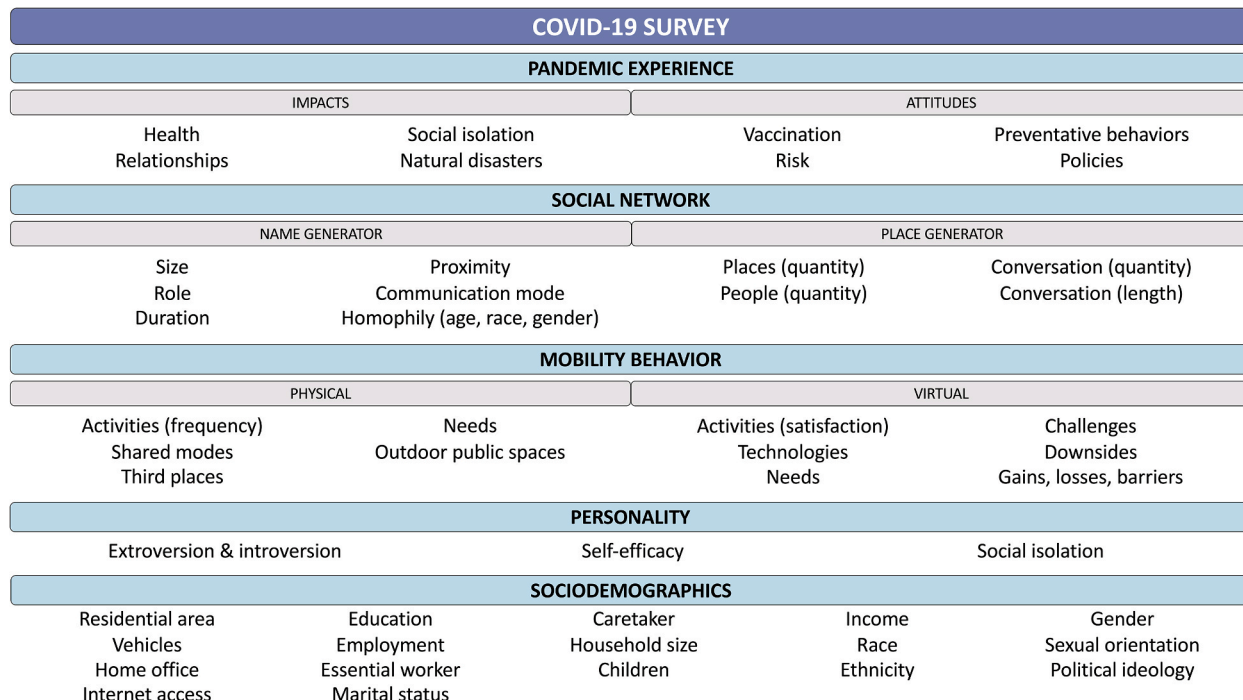| COVID-19 SURVEY				
PANDEMIC EXPERIENCE				
IMPACTS		ATTITUDES		
Health	Social isolation	Vaccination	Preventative behaviors	
Relationships	Natural disasters	Risk	Policies	
SOCIAL NETWORK				
NAME GENERATOR		PLACE GENERATOR		
Size	Proximity	Places (quantity)	Conversation (quantity)	
Role	Communication mode	People (quantity)	Conversation (length)	
Duration	Homophily (age, race, gender)			
MOBILITY BEHAVIOR				
PHYSICAL		VIRTUAL		
Activities (frequency)	Needs	Activities (satisfaction)	Challenges	
Shared modes	Outdoor public spaces	Technologies	Downsides	
Third places		Needs	Gains, losses, barriers	
PERSONALITY				
Extroversion & introversion		Self-efficacy		Social isolation
SOCIODEMOGRAPHICS				
Residential area	Education	Caretaker	Income	Gender
Vehicles	Employment	Household size	Race	Sexual orientation
Home office	Essential worker	Children	Ethnicity	Political ideology
Internet access	Marital status			

Fig. 2. Survey flow chart.

The final survey instrument was approved by the Institutional Review Board (IRB) at Northwestern University and included the following seven sections in accordance with the flow chart provided in Fig. 2.

(1) *Pandemic experience.* Impacts of the pandemic on respondents' well-being and relationships, feelings of social isolation, and satisfaction with social support received from family, friends, colleagues, and intimate partners
(2) Social network.
  (a) The **name generator**, based on work by McCallister and Fisher (1978) and Bidart and Charbonneau (2011), asked respondents to subjectively describe or recreate a depiction of their social network, i.e., networks providing advice,

Table 2
Sociodemographics of the survey sample (N = 313) compared to the three U.S. states of interest for the age range of 18-to-34-year-olds.

	Survey sample (only 18-to-34-year-olds) (%)	California: 18-to-34-year-olds (%)	Illinois: 18-to-34-year-olds (%)	Texas: 18-to-34-year-olds (%)
Residence				
California	56.0%	12.8%	–	–
Texas	29.4%	–	–	8.3%
Illinois	14.6%	–	4.0%	–
Gender				
Man	48.9%	51.5%	51.1%	51.1%
Woman	48.2%	48.5%	48.9%	48.9%
Non-binary	1.9%	–	–	–
Other	1.0%	–	–	–
Race [a,b]				
White or Caucasian	46.3%	60.0%	76.6%	76.1%
Asian	29.8%	19.1%	7.2%	6.5%
Two or more races[a]	11.3%	–	–	–
Black or African American	4.9%	6.7%	12.3%	11.6%
Other	4.2%	19.2%	7.1%	9.8%
Prefer not to answer	1.3%	–	–	–
Indigenous, American Indian, or Alaska Native	1.0%	2.5%	1.1%	1.7%
Middle Eastern[b]	1.0%	–	–	–
Native Hawaiian or Pacific Islander	0.3%	0.9%	0.2%	0.3%
Ethnicity				
Not Hispanic nor Latinx	74.1%	58.6%	83.6%	60.4%
Hispanic or Latinx	23.0%	41.4%	16.4%	39.6%
Prefer not to answer	2.9%	–	–	–
Age				
18–24	49.2%	9.1%	9.1%	9.1%
25–34	50.8%	13.4%	12.2%	12.6%
Income				
$10k or less	5.8%	3.0%	3.8%	4.2%
$10k to $20k	9.4%	3.6%	4.1%	5.0%
$20k to $30k	7.8%	5.0%	5.5%	7.1%
$30k to $40k	9.7%	5.7%	6.1%	7.6%
$40k to $50k	6.5%	5.9%	6.5%	7.6%
$50k to $60k	11.0%	6.0%	6.6%	7.3%
$60k to $80k	11.0%	11.5%	12.6%	13.1%
$80k to $100k	8.1%	10.1%	11.1%	10.5%
$100k to $120k	7.1%	8.5%	8.8%	8.0%
$120k to $150k	5.8%	9.7%	9.3%	7.9%
$150k to $200k	3.6%	9.8%	8.4%	6.3%
$200k or more	4.5%	12.1%	7.5%	5.9%
Prefer not to answer	9.7%	–	–	–
Sexual Orientation				
Straight/Heterosexual	71.5%	–	–	–
Bisexual	16.2%	–	–	–
Lesbian	3.2%	–	–	–
Gay	2.3%	–	–	–
Asexual	2.3%	–	–	–
Pansexual	1.9%	–	–	–
Queer	1.0%	–	–	–
Questioning	1.0%	–	–	–
Prefer not to answer	0.6%	–	–	–

Notes: Based on the U.S. Census Bureau estimates for 2020 accessed using the Microdata Access Tool (MDAT)
[a] Two or more races: The census reports totals for each race as a combination of respondents who identify as that race alone or in combination with one or more other races.
[b] Middle Eastern: In the census, individuals who are white with Middle Eastern or North African roots are counted as white.

Table 3
Exploratory factor analysis (EFA) model output.

Construct	Eigenvalue	Variance Explained	Cronbach's Alpha	Item Name	Loadings	Survey Question(s)	Response Type
Friendship dissatisfaction	3.62	11.6%	0.89	*Confirmation*	0.82	During the pandemic (March 2020 - PRESENT), how satisfied have you felt with the behavioral confirmation you have received from friends? Behavioral confirmation is the feeling that you are useful, doing things well, part of a functional group, and contributing to a common goal.	7-point Likert Scale (1: extremely dissatisfied; 7: extremely satisfied)
				Affection	0.82	During the pandemic (March 2020 - PRESENT), how satisfied have you felt with the affection you have received from friends? Affection is the feeling that you are liked, loved, trusted, accepted, and understood.	7-point Likert Scale (1: extremely dissatisfied; 7: extremely satisfied)
				Status	0.78	During the pandemic (March 2020 - PRESENT), how satisfied have you felt with the status you have received from friends. Status is the feeling that you are independent, treated with respect, taken seriously, and have influence.	7-point Likert Scale (1: extremely dissatisfied; 7: extremely satisfied)
Weak tie reduction	2.57	10.6%	0.87	*People spoken to*	0.86	[During the pandemic (March 2020 to PRESENT) – In the year preceding the pandemic (March 2019 to March 2020)] … typically, how many of those people might you speak with at each of the following places?	Less than 1, 1–3, 4–6, 7–9, 10 or more
				Conversation length	0.82	[During the pandemic (March 2020 to PRESENT) – In the year preceding the pandemic (March 2019 to March 2020)] … on average, how many minutes might those conversations last at each of the following places?	Less than 1, 1–10, 11–20, 21–30, more than 30 min
				People seen	0.63	[During the pandemic (March 2020 to PRESENT) – In the year preceding the pandemic (March 2019 to March 2020)] … how many people do you typically see at each of the following places?	Less than 1, 1–3, 4–6, 7–9, 10 or more
Virtual dissatisfaction	2.10	8.9%	0.79	*Ignored*	0.79	To what extent have you experienced the following potential downsides to virtual socialization during the pandemic (March 2020 - PRESENT)? (Never, rarely, about half the time, most of the time, all of the time) … Feeling ignored or excluded	5-point Likert Scale (1: never; 5: all of the time)
				Social comparison	0.76	To what extent have you experienced the following potential downsides to virtual socialization during the pandemic (March 2020 - PRESENT)? (Never, rarely, about half the time, most of the time, all of the time) … Social comparison	5-point Likert Scale (1: never; 5: all of the time)
				Excessive time	0.46	To what extent have you experienced the following potential downsides to virtual socialization during the pandemic (March 2020 - PRESENT)? (Never, rarely, about half the time, most of the time, all of the time) … Excessive time spent on devices	5-point Likert Scale (1: never; 5: all of the time)
Outdoor dissatisfaction	1.44	8.4%	0.78	*Unwelcome*	0.73	How welcome do you feel in the public outdoor spaces available to you currently?	5-point Likert Scale (1: very welcome; 5: very unwelcome)
				Unsafe	0.72	How safe do you feel in the public outdoor spaces available to you currently?	5-point Likert Scale (1: very safe; 5: very unsafe)
				Lack of parks	0.58	How satisfied do you feel with the parks available to you currently?	5-point Likert Scale (1: very satisfied; 5: very dissatisfied)
'Civic' third place reduction	1.28	6.8%	0.68	*Libraries*	0.87	[During the pandemic (March 2020 to PRESENT) – In the year preceding the pandemic (March 2019 to March 2020)] … considering an average month, how many times per month have you visited libraries in person?	Less than 1, 1–4, 5–8, 9–12, more than 12
				Community centers	0.43	[During the pandemic (March 2020 to PRESENT) – In the year preceding the pandemic (March 2019 to March 2020)] … considering an average month, how many times per month have you visited community centers in person?	Less than 1, 1–4, 5–8, 9–12, more than 12

Table 3 (*continued*)

Construct	Eigenvalue	Variance Explained	Cronbach's Alpha	Item Name	Loadings	Survey Question(s)	Response Type
				Places of worship	0.33	[During the pandemic (March 2020 to PRESENT) – In the year preceding the pandemic (March 2019 to March 2020)] … considering an average month, how many times per month have you visited places of worship in person?	Less than 1, 1–4, 5–8, 9–12, more than 12
'Commercial' third place reduction	1.18	6.8%	0.71	*Coffeeshops*	0.67	[During the pandemic (March 2020 to PRESENT) – In the year preceding the pandemic (March 2019 to March 2020)] … considering an average month, how many times per month have you visited coffee shops in person?	Less than 1, 1–4, 5–8, 9–12, more than 12
				Restaurants	0.61	[During the pandemic (March 2020 to PRESENT) – In the year preceding the pandemic (March 2019 to March 2020)] … considering an average month, how many times per month have you visited restaurants in person?	Less than 1, 1–4, 5–8, 9–12, more than 12
				Bars	0.50	[During the pandemic (March 2020 to PRESENT) – In the year preceding the pandemic (March 2019 to March 2020)] … considering an average month, how many times per month have you visited bars in person?	Less than 1, 1–4, 5–8, 9–12, more than 12

Note: A varimax rotation with a cutoff of 0.3 was used. Cronbach's alpha is reported at the upper boundary of the 95% confidence interval.

assistance, and caring. Specifically, respondents were asked to list up to 10 individuals who provided them with social support at the time of the survey and before the start of the pandemic, as well as the following five relationship characteristics: the role (i.e., family, friend, colleague, partner, or other), duration (i.e., more than 6 years, 5–6 years, 3–4 years, 1–2 years, or less than 1 year), proximity (i.e., same household, same neighborhood, same city, same state, same country, or different countries), communication mode (i.e., more in-person than remote, more remote than in-person, or equally in-person and remote), and homophily (in terms of age, race, gender, sexual orientation, and political affiliation) of each relationship.

(b) This **place generator** was designed specifically for this study. It was inspired by the name generator design and had the goal of recreating the weak ties in a person's social network (e.g., acquaintances and strangers, as described in Section 1.1.4.). Specifically, respondents were asked to describe a typical day by listing up to five places they would go, first at the time of the survey and then prior to the start of the pandemic. Then for each place they listed, they were asked to report how many people there they would see (i.e., 10 or more, 7–9, 4–6, 1–3, or 0), speak with (i.e., 10 or more, 7–9, 4–6, 1–3, or 0), and how long their conversations would last in minutes (i.e., more than 15, 11–15, 6–10, 1–5, or less than 1).

(3) *Physical access to activities.* This section covers the frequency of in-person activities, physical travel to 10 types of indoor third places (namely, art studios and maker spaces, bars, beauty parlors and barbershops, coffee shops, community centers, gyms and fitness centers, libraries, places of worship, restaurants, and shopping centers), intrinsic motivations for physical travel, and satisfaction with seven types of outdoor areas (namely, bicycle paths, community gardens, parks, playgrounds, plazas, shared streets, and sidewalks). The indoor and outdoor places included in the survey were gathered from a consultation of existing literature (e.g., Anttiroiko, 2018; Bullivant, 2019; Fisher et al., 2007; Latham and Layton, 2019) and further refined through pilot testing of the survey.

(4) *Virtual access to activities.* Relative satisfaction with remote activities compared to in-person activities, frequency of technology use, intrinsic motivations for virtual travel, and downsides to socializing virtually

(5) *Pandemic attitudes.* Vaccination intentions, risk prevention behaviors, and preferred policies

(6) *Personality.* Multiple indicator questions to measure three latent variables: extroversion/introversion, self-agency, and social isolation

(7) *Sociodemographics and household factors.* Personal sociodemographics, including marginalized social identities along dimensions of race and ethnicity as described in the U.S. census (Marks and Jones, 2020), gender, and sexual orientation, as well as household constraints related to the pandemic, such as caregiving, having a dedicated home office, and employment as an essential worker

a) *Race and ethnicity:* These questions were designed following best practices as demonstrated by the U.S. census (Marks and Jones, 2020). According to Eisenhower et al. (2014), *race* is defined as "a social categorization imposed on people related to physical appearance for the purpose of making hierarchical power-based distinctions in social relations", while *ethnicity* is defined as "a social categorization based on shared cultural values and meaning such as relational styles, values, language, and customs that is more usually self-claimed or developed in relation to feelings of belonging to a chosen community". It is important to collect data on both constructs due to these distinct differences, especially given that Hispanic identity is an ethnicity but not a race.

Table 4
Descriptive statistics of the variables used as latent construct items.

Construct Name	Item Description	Min	Max	Mean	Stand. Dev.
Friendship dissatisfaction	Confirmation satisfaction	1	7	3.60	1.58
	Affection satisfaction	1	7	3.41	1.69
	Status satisfaction	1	7	3.17	1.50
Weak tie reduction	Change in people spoken to	−12	19	3.53	3.47
	Change in conversation length	−11	20	5.07	5.14
	Change in people seen	−18	20	5.95	5.02
Virtual dissatisfaction	Degree of ignored	0	4	1.68	1.20
	Degree of social comparison	0	4	1.71	1.22
	Degree of excessive time	0	4	2.84	1.12
Outdoor dissatisfaction	Degree of unwelcome	1	5	2.22	1.06
	Degree of unsafe	1	5	2.47	1.19
	Degree of lack of parks	1	5	2.35	1.12
Civic third place reduction	Change in visits to libraries	−1	4	0.80	1.23
	Change in visits to community centers	−3	4	0.31	0.80
	Change in visits to places of worship	−3	4	0.21	0.68
Commercial third place reduction	Change in visits to coffeeshops	−1	4	0.83	1.08
	Change in visits to restaurants	−3	4	1.04	1.02
	Change in visits to bars	−1	4	0.59	0.96

Note: The 'change in' variables were calculated by subtracting the value reported for 'the year preceding the pandemic' from that reported for 'during the pandemic' (i.e., current minus baseline) as described previously in Table 3.
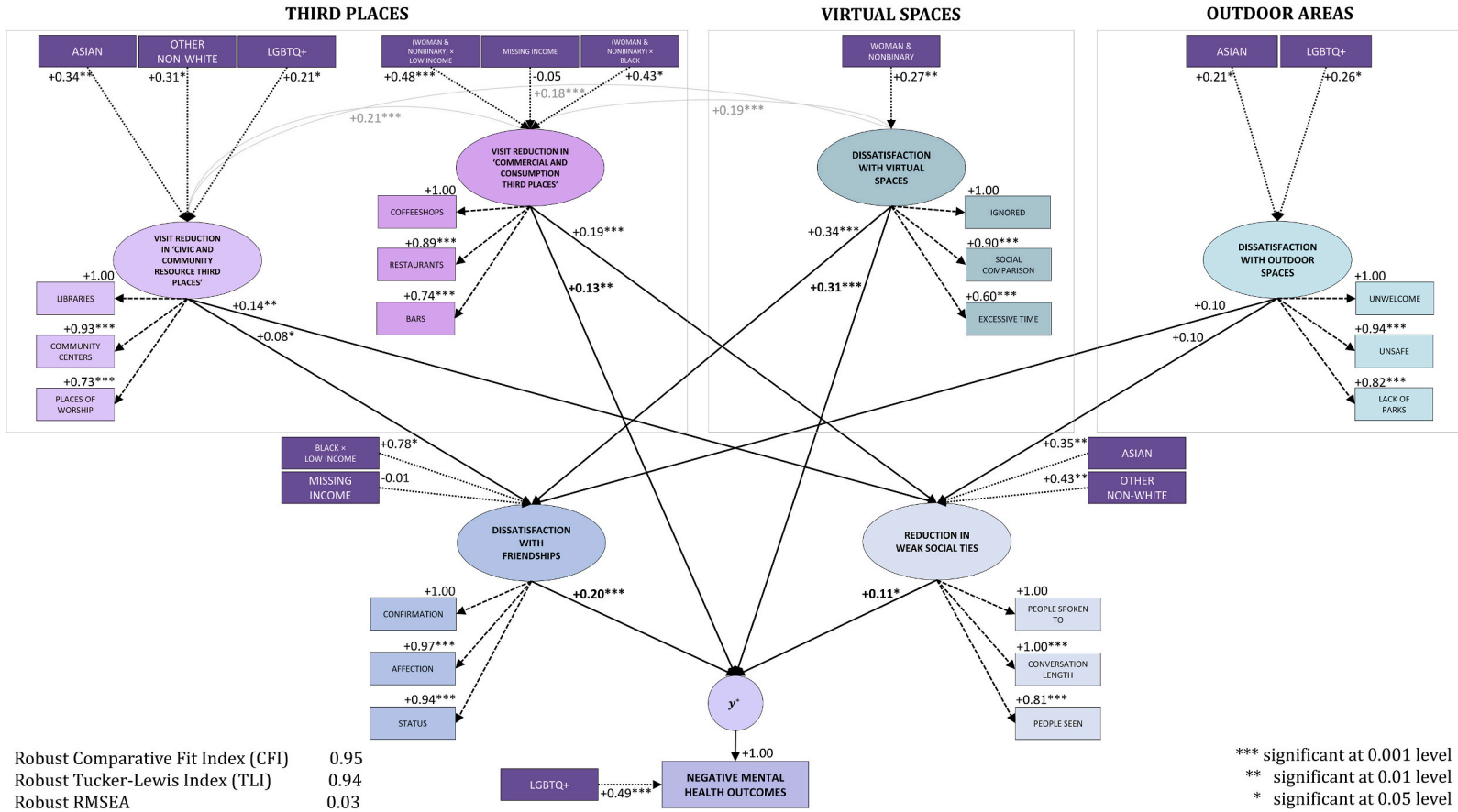
Fig. 3. Final MIMIC model path diagram with standardized coefficients for pandemic-based mental health impacts experienced by young adults in the U.S.

Table 5

MIMIC model results.

Model	Estimate	Std. Err.	P-value
Measurement Model [a]	Estimate	Std. Err.	P-value
Third places (civic):			
Libraries	1.00		
Community centers	0.93	0.17	0.00
Places of worship	0.73	0.19	0.00
Third places (commercial):			
Coffeeshops	1.00		
Restaurants	0.89	0.13	0.00
Bars	0.74	0.13	0.00
Virtual dissatisfaction:			
Ignored	1.00		
Social comparison	0.90	0.06	0.00
Excessive time	0.60	0.08	0.00
Outdoors dissatisfaction:			
Unwelcome	1.00		
Unsafe	0.94	0.13	0.00
Lack of parks	0.82	0.10	0.00
Weak ties:			
People spoken to	1.00		
Conversation length	1.00	0.07	0.00
People seen	0.81	0.09	0.00
Strong ties:			
Confirmation	1.00		
Affection	0.97	0.06	0.00
Status	0.94	0.07	0.00
Mental health:			
Mental health impact	1.00		
Structural Model [b, c]	Estimate	Std. Err.	P-value
Third places (civic):			
Asian	0.34	0.11	0.00
Other non-white	0.31	0.12	0.01
LGBTQ+	0.21	0.10	0.03
Third places (commercial):			
(Woman & nonbinary) × low income	0.48	0.15	0.00
Missing income	-0.05	0.11	0.63
(Woman & nonbinary) × Black	0.43	0.19	0.02
Virtual dissatisfaction			
Woman & nonbinary	0.27	0.09	0.00
Outdoors dissatisfaction:			
Asian	0.21	0.10	0.03
LGBTQ+	0.26	0.11	0.02
Weak ties:			
Asian	0.35	0.11	0.00
Other non-white	0.43	0.15	0.00
Strong ties:			
Black × low income	0.78	0.35	0.03
Missing income	-0.01	0.13	0.93
Mental health:			
LGBTQ+	0.49	0.10	0.00
Covariances – Latent Variables [d]	Estimate	Std. Err.	P-value
Third places (civic):			
Third place (commercial)	0.21	0.06	0.00
Virtual dissatisfaction	0.19	0.05	0.00
Outdoors dissatisfaction	0.02	0.05	0.70
Strong ties	0.08	0.04	0.05
Weak ties	0.14	0.05	0.01
Mental health	0.03	0.05	0.60
Third place (commercial):			
Virtual dissatisfaction	0.18	0.05	0.00
Outdoors dissatisfaction	-0.02	0.04	0.58
Strong ties	0.01	0.05	0.86
Weak ties	0.19	0.05	0.00
Mental health	0.13	0.05	0.00
Virtual dissatisfaction:			

Table 5 (*continued*)

Outdoors dissatisfaction	0.09	0.05	0.09
Strong ties	0.34	0.06	0.00
Weak ties	0.10	0.06	0.06
Mental health	0.31	0.05	0.00
Outdoors dissatisfaction:			
Strong ties	0.10	0.05	0.05
Weak ties	0.10	0.05	0.05
Mental health	0.08	0.05	0.09
Strong ties:			
Weak ties	-0.01	0.05	0.79
Mental health	0.20	0.06	0.00
Weak ties:			
Mental health	0.11	0.05	0.04

Fit Statistics [e]	
Number of observations	308
Robust Comparative Fit Index (CFI)	0.949
Robust Tucker-Lewis Index (TLI)	0.939
Robust RMSEA	0.033

Note: 'Other non-white' refers to respondents who selected Black, African American, Indigenous, American Indian, Alaska Native, Middle Eastern, Native Hawaiian, Pacific Islander, two or more races, or other. 'Low income' refers to respondents who selected a gross annual household income of $50k or less, a reasonable estimate based on data distribution (U.S. Department of Education, January 2022).

[a] The measurement model indicates the relationships between each latent variable (italicized) and its indicators (non-italicized).

[b] The structural model indicates the relationships between latent variables (italicized) and sociodemographic variables (non-italicized).

[c] Missing income data is controlled for in the model by adding a 'missing income' dummy control where relevant.

[d] The covariances between all latent variables are shown in the table regardless of statistical significance.

[e] Missing data: Five respondents were removed due to critical missing data on the dependent identity variables.

    b) *Gender and sexual orientation:* The best practices for measuring gender identity and sexual orientation in surveys are continuously evolving, and the most recently released guidance should be followed (National Academies of Sciences, Engineering, and Medicine, 2022). Please see the Appendix for specific question wording.

2.2. Analytical methodology

To better understand relationships between changes in third-place visits, social connection, and self-reported mental health outcomes for different population segments, we estimate a *multiple-indicators multiple-causes* (MIMIC) structural equation model (SEM) (Diamantopoulos, 2011; Hardin et al., 2011) using the *lavaan* package in the R statistical computing environment (R Core Team, 2020). This methodology allows for the inclusion of latent psychological constructs, like dissatisfaction, in the model. A MIMIC model consists of: (a) a measurement model capturing relationships between a latent variable and its indicators and (b) a structural model capturing the relationships between multiple latent variables, as well as between a latent variable and sociodemographic variables. This methodology will reveal the direct and indirect (or mediated) impacts of third place closures on mental health. Within-group differences will be explored through the regression of latent variables on sociodemographic variables.

The process of estimating a MIMIC model consists of the following steps: (1) correlation analysis to estimate the number of latent factors present in the dataset, (2) principal components analysis (PCA) to statistically confirm the number of factors in the data, (3) exploratory factor analysis (EFA) to extract the latent variables, (4) confirmatory factor analysis (CFA) to test the consistency of the constructs measured, and finally, (5) the estimation of the SEM. In this study, the MIMIC model is estimated using maximum likelihood with robust standard errors and a Satorra-Bentler scaled test statistic. The Satorra-Bentler scaled test statistic is a goodness-of-fit measure that is commonly used in structural equation modeling to better approximate chi-square when the observed variables in the model are not normally distributed. To achieve this, the chi-square statistic is divided by a scaling correction (Satorra, 2000). For the analysis, the data was standardized using each variable's mean and standard deviation to convert all variables to the same scale to reduce error or distortion of findings. All Likert scale items (e.g., dissatisfaction) are treated as pseudo-continuous variables. This ordinal approximation of a continuous variable is a common treatment for Likert variables with five or more categories (Johnson and Creech, 1983). A potential concern with this method is that the measurement errors or residuals that are introduced with this treatment may be correlated rather than random and independent, which would violate the assumptions of classical measurement theory. If this assumption is not met, the data could be skewed and lead to erroneous conclusions. However, analysis of correlation revealed no significant correlations between residuals of Likert variables in our model.

3. Results

3.1. Survey statistics

The sociodemographic distribution of the survey sample compared to the three U.S. states of interest for the age range of 18-to-34-year-olds is provided in Table 2. On average, the sample is representative of state-level distributions in all but three categories: (1) an overrepresentation of Asian respondents with an underrepresentation of white and Black respondents, (2) an underrepresentation of Hispanic or Latino respondents, (3) an underrepresentation of household income over $60k, and (4) an overrepresentation of LGBTQ+ respondents. No perfect census reference exists for sexual orientation given that in this study we include all individuals, not just married and coupled individuals in our statistics. As a general comparison Gallup (N = 12,000) found that in 2021, 7.1% of Americans identified as LGBT, with millennials reaching 10.5% and Gen Z at 20% (Gallup 2022). The higher rate of LGBTQ+ identification compared to these sources may be due in part to our survey questions having more categories and nuance than the comparable questions in Gallup and the U.S. census. Also, the fact that our data was collected using an anonymous online study may have facilitated the reporting of information that may be considered stigmatizing.

3.2. Modeling results

After standardizing the data, a correlation analysis suggests the presence of six distinct factors in the dataset. PCA confirms that the first six factors in the data have eigenvalues over 1, and the Scree plot reveals a break after six factors. EFA using a varimax rotation further confirms the following factors with loadings over the 0.3 cutoff, a commonly used threshold (Hassim et al., 2020; Li et al., 2014). The EFA results are shown in Table 3, and for additional information on these factors, their descriptive statistics are provided in Table 4. These six factors can be interpreted as follows.

- *Reduction in visits to third places (i.e., 'civic' and 'commercial').* Originally, we theorized that all third places explored in the survey would be grouped into a single 'third place' construct, so we were surprised to discover that the construct of third places contained two distinct factors. The first groups coffee shops, restaurants, and bars, which we have labeled 'commercial and consumption third places' (hereafter referred to as 'commercial third places' for brevity), and the second groups libraries, community centers, and places of worship, which we have labeled 'civic and community resource third places' (hereafter referred to as 'civic third places' for brevity). These two groupings have statistically distinct associations with social connection, mental health, and marginalized identities.
- *Virtual dissatisfaction.* This construct consists of experiences described as feeling ignored, social comparison, and excessive time spent on devices.
- *Outdoor dissatisfaction.* Feeling dissatisfied with available outdoor areas consists of feeling unwelcome and unsafe outdoors and dissatisfied with the availability of parks.
- *Reduction in weak social ties.* Weak social ties are measured with three items: the number of people spoken to, the length of conversations, and the number of people seen.
- *Dissatisfaction with social support from friends.* This construct is measured with three items: satisfaction with behavioral confirmation, affection, and status.

CFA confirms that all indicators are significant within a 99% confidence interval. The fit statistics of the CFA are within standard cutoffs of above 0.9 for the comparative fit indicator (CFI) and Tucker-Lewis index (TLI) and below 0.08 for the root mean square error of approximation (RMSEA) with a CFI of 0.97, TLI of 0.96, and an RMSEA of 0.037 (Worthington and Whittaker, 2006).

3.2.1. Results from the multiple-indicators multiple-causes (MIMIC) model

The path diagram of the final MIMIC model containing six factors across three domains is shown in Fig. 3, and the model results are summarized in Table 5. Results from the MIMIC model have goodness-of-fit indicators that demonstrate the model fits the data well. These fit statistics are within standard cutoffs with a robust CFI of 0.95, robust TLI of 0.94, and robust RMSEA of 0.033. All standardized loadings are reported within a 94% confidence interval with exception of the 'missing income' control variables.

3.2.1.1. Results in the place domain.

- *Third places.* Based on previous studies, we originally theorized that all third places would have the same type of impact on social connection and mental health but discovered a significant grouping that separated them into '*commercial*' third places and '*civic*' third places. The effects of these two categories have statistically different impacts on mental health outcomes. In the case of 'commercial' third places, visit reduction is associated with mental health decline, while 'civic' third places are not significantly related to mental health outcomes. In both cases, visit reductions are associated with a decline in weak social ties (i.e., the effect of 'commercial' third places is stronger at 0.19 compared to 0.14), while only 'civic' third places have a significant relationship with change in strong social ties, although the loading is the smallest in the model at 0.08. The two 'third place' categories are positively correlated, suggesting visits to each expand and contract together. Overall, the results suggest that these distinct categories fulfill

different needs, highlighting the potential for tailored solutions to socialization barriers and mental health challenges based on these distinct functions.

- *Virtual places.* Young adults who were less satisfied with virtual tools for socialization during the first year of the pandemic were more likely to experience mental health decline. Virtual dissatisfaction has the largest impact on mental health and reduction in strong social ties. These results suggest the importance of virtual socialization for the maintenance of strong ties and mental health status during the pandemic. Virtual socialization does not appear to be a satisfactory substitute for either 'civic' third places or 'commercial' third places. Based on the positive correlations between the three, the use of these three types of social spaces seems to increase and decrease together.

- *Outdoor areas.* Young adults who were dissatisfied with outdoor areas during the first year of the pandemic were more likely to experience dissatisfaction with friendships and a reduction in weak social ties. However, these outdoor effects are among the smallest in the model, with standardized loadings of 0.10.

- *Summary.* The place domain results suggest the importance of: (1) 'commercial' third places and virtual spaces for mental health, (2) 'civic' third places, virtual spaces, and outdoor areas for friendship maintenance, and (3) 'civic' third places, 'commercial' third places, and outdoor areas for maintaining weak ties.

3.2.1.2. Results in the social domain.

- *Direct effects.* Results in the social domain support the theory that social connections have a positive relationship with the mental health of young adults. Those who were less satisfied with friendships during the pandemic experienced worse mental health outcomes, and those who lost more weak ties also reported worse mental health outcomes. The relationship of mental health with strong ties represented by friendships is greater than with weak ties (standardized loading of 0.20 versus 0.11, respectively).

- *Mediated effects.* Strong social ties (exemplified by friendships) have a stronger relationship with virtual spaces than with outdoor areas (standardized loadings of 0.34 and 0.10, respectively), and consequently, the indirect link between virtual satisfaction and mental health is the largest combined effect in the model. This suggests the importance of virtual maintenance of friendships for the mental health of young adults. The second largest combined effect is the indirect effect of 'commercial' third places on mental health through the maintenance of weak ties. This suggests venues such as coffee shops, restaurants, and bars serve an important function for the mental health of young adults based on their ability to support interactions with casual acquaintances and strangers.

Results in the identity domain. This study focuses on marginalized social identities using a small sample size, so a minimal number of sociodemographic variables is included to simplify the model and reduce the degrees of freedom, a technique followed by other transportation studies using SEM to balance model parsimony with the fit (Biehl and Stathopoulos, 2020). Throughout this paper, we may refer to marginalized social identity groups by the negation of their *non-marginalized* counterpart (e.g., 'non-white' to mean Asian, Black, African American, Indigenous, American Indian, Alaska Native, Middle Eastern, Native Hawaiian, Pacific Islander, two or more races, and other). This strategy is employed for conciseness, and we acknowledge its shortcoming of grouping together many diverse identities which overlooks nuance.

- *Race.* Visit reduction to 'civic' third places is significantly correlated with Asian and other non-white young adults, in addition to the reduction of weak ties. Asian youth are also more likely to experience outdoor dissatisfaction, which has a slight impact on weak tie reduction and friendship dissatisfaction. Furthermore, Asian and other non-white youth are more likely to experience a reduction in weak ties directly. Finally, two significant interactions with Black young adults are observed: first, Black women and nonbinary youth are more likely to experience visit reduction to 'commercial' third places, and second, low-income Black youth are more likely to experience dissatisfaction with friendship-based social support, a finding aligned with other research on racial minorities (McClain et al., 2021).
- *Gender.* Visit reduction to 'commercial' third places is significantly correlated with being a low-income woman or nonbinary young adult, a Black woman or nonbinary young adult, reduction in weak social ties, and mental health decline. Additionally, women and nonbinary youth are more likely to experience virtual dissatisfaction, which is notable considering that virtual dissatisfaction has the strongest association with mental health (0.31). Furthermore, virtual dissatisfaction has a strong impact on strong ties (0.34). The indirect relationships between women and nonbinary gender and worse mental health outcomes are consistent with prior evidence highlighting worse pandemic-based mental health impacts for women and young adults (Banks and Xu, 2020; Pretorius and Padmanabhanunni, 2021).
- *Sexual orientation.* Visit reduction to 'civic' third places is significantly correlated with LGBTQ+ identity and reduction in weak social ties. LGBTQ+ youth are also more likely to experience outdoor dissatisfaction, which has a slight impact on weak tie reduction and friendship dissatisfaction. Finally, LGBTQ+ young adults are the only social group in the model to have a direct relationship with mental health decline, suggesting these youth experienced significant challenges during the first year of the

pandemic beyond the place domains and social domains considered in this model (Fish et al., 2020; Salerno et al., 2020; Whittington et al., 2020).

Nonsignificant variables. The following variables were included in various rounds of model estimation, but they were not found to be statistically significant, so they were excluded from the final model: interactions between multiple marginalized social identities (i.e., race, gender, and sexual orientation), ethnicity, income, household vehicles, internet access, employment, student, essential worker, married, single, caretaker, household size, children over 5 years old, children under 6 years old, rural, urban, and social isolation.

4. Discussion of findings

4.1. Discussion of the place domain: physical, virtual, and outdoors

- *Third place categories.* The presence of two distinct categories of 'third places' was unanticipated but a valuable finding from this study. Possible categorical differences could include that 'commercial' third places (i.e., coffee shops, restaurants, and bars) may be places visited with friends and family for socializing over shorter durations, while 'civic' third places (i.e., libraries, community centers, and places of worship) may be places visited alone for learning, volunteering, and socializing over longer durations.
- *Third places and mental health.* We theorized that those who frequently visited third places prior to the pandemic would experience greater losses in terms of socialization and mental health status. The finding that 'civic' third places are not directly associated with mental health outcomes may suggest that the mental health benefits of these 'civic' destinations could be easier to substitute with remote access compared to those of 'commercial' third places (Bryson et al., 2020).
- *Third places and friendship.* The theory of third places supports the finding that both categories of third places are significantly associated with weak ties. The result that only 'civic' third places are associated with friendship satisfaction may suggest a greater ease of remotely sharing coffee, drinks, or a meal with established friends compared to weak ties. As expected, we find dissatisfaction with both virtual spaces and outdoor areas to be significantly related to friendships, indicating the importance of these alternative social spaces. Additionally, virtual spaces are directly related to mental health, and outdoor spaces are associated with weak ties. These findings align with other research showing a positive association between satisfaction with substitution to virtual interactions during the pandemic and life satisfaction (Waygood et al., 2021).
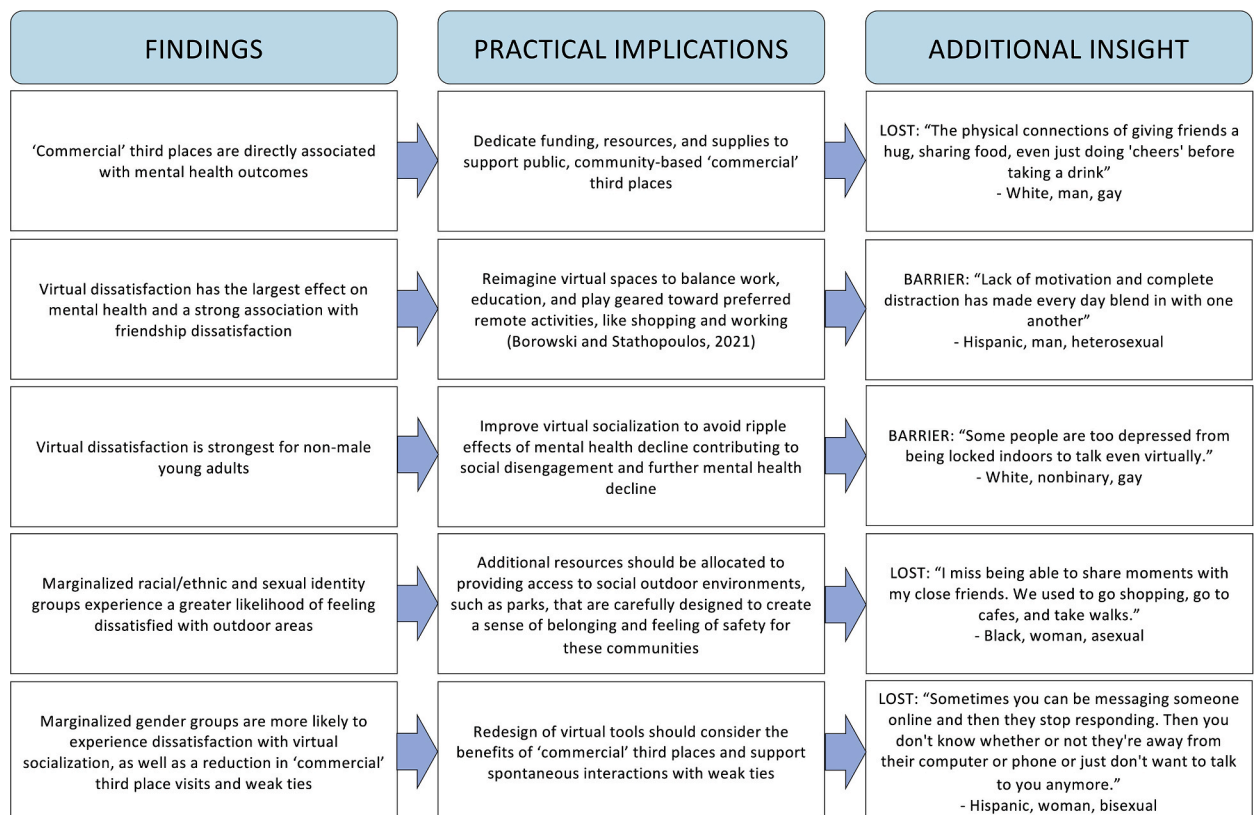
FINDINGS	PRACTICAL IMPLICATIONS	ADDITIONAL INSIGHT
'Commercial' third places are directly associated with mental health outcomes	Dedicate funding, resources, and supplies to support public, community-based 'commercial' third places	LOST: "The physical connections of giving friends a hug, sharing food, even just doing 'cheers' before taking a drink" - White, man, gay
Virtual dissatisfaction has the largest effect on mental health and a strong association with friendship dissatisfaction	Reimagine virtual spaces to balance work, education, and play geared toward preferred remote activities, like shopping and working (Borowski and Stathopoulos, 2021)	BARRIER: "Lack of motivation and complete distraction has made every day blend in with one another" - Hispanic, man, heterosexual
Virtual dissatisfaction is strongest for non-male young adults	Improve virtual socialization to avoid ripple effects of mental health decline contributing to social disengagement and further mental health decline	BARRIER: "Some people are too depressed from being locked indoors to talk even virtually." - White, nonbinary, gay
Marginalized racial/ethnic and sexual identity groups experience a greater likelihood of feeling dissatisfied with outdoor areas	Additional resources should be allocated to providing access to social outdoor environments, such as parks, that are carefully designed to create a sense of belonging and feeling of safety for these communities	LOST: "I miss being able to share moments with my close friends. We used to go shopping, go to cafes, and take walks." - Black, woman, asexual
Marginalized gender groups are more likely to experience dissatisfaction with virtual socialization, as well as a reduction in 'commercial' third place visits and weak ties	Redesign of virtual tools should consider the benefits of 'commercial' third places and support spontaneous interactions with weak ties	LOST: "Sometimes you can be messaging someone online and then they stop responding. Then you don't know whether or not they're away from their computer or phone or just don't want to talk to you anymore." - Hispanic, woman, bisexual

Fig. 4. Summary of practical implications derived from model results.

4.2. Discussion of the social domain: weak and strong ties

- *Social connection and mental health.* Our modeling indicates a positive association between both types of social ties and mental health, of which the magnitude of strong ties is larger (0.20 and 0.11, respectively). While it is well-established that strong social ties like friendships have a positive effect on mental health (Cleary et al., 2018; Sias and Bartoo, 2007), the importance of weak social ties is less understood and an emerging area of study (Amoah et al., 2022). This difference may be due to a lack of standardized measurement for weak ties, unlike strong ties which are commonly studied using egocentric name generators in surveys (Feehan et al., 2021). Our study is among the first to simultaneously compare the roles played by strong and weak social ties in mental health maintenance.
- *Friendship and social spaces.* Friendship satisfaction is significantly associated with 'civic' third places, virtual spaces, and outdoor areas but not 'commercial' third places, which may suggest that, in the pre-pandemic era, friendships were not primarily maintained by 'commercial' third places. As expected, both strong and weak social ties are positively associated with mental health. As predicted, third places have a stronger association with weak social ties (0.14 and 0.19) compared to outdoor areas (0.10) or virtual spaces (not significant).

4.3. Discussion of the identity domain: marginalized experiences

This portion of the analysis was the most open-ended. We expected to find marginalized social identities to be significantly correlated with worse outcomes in each component of our model. While they are not all significantly associated with all factors in our model, twelve significant correlations are identified.

- *Race.* This dimension is significantly associated with 'civic' third places, 'commercial' third places, outdoor areas, strong social ties, and weak social ties. The finding that Asian young adults were more likely to feel unwelcome and unsafe in outdoor areas in the first year of the pandemic may be due to the race-based violence, hate crimes, and xenophobic sentiment that was amplified during this period (Kang, 2020). The significance of 'civic' third places (like libraries, community centers, and places of worship) for Asian and other non-white young adults could be related to the typical geographical centralization and shared local culture that these third places provide (McPherson et al., 2001). The significance of 'commercial' third places for Black women and nonbinary young adults may suggest that these intersectional identities correspond with additional pandemic-based stresses that delayed or prevented the return of this group to these commercial destinations. The finding that Asian and other non-white young adults experienced a greater reduction in weak ties after controlling for third places, virtual spaces, and outdoor areas suggests the existence of additional components of weak tie maintenance not captured in this model that is key for this marginalized group. The finding that low-income Black young adults experienced a greater dissatisfaction with friendship social support after controlling for third places, virtual spaces, and outdoor areas may suggest that this intersectional identity has experienced greater pandemic-based barriers to accessing supportive friendships beyond those captured in this model.
- *Gender.* This dimension is significantly associated with 'commercial' third places and virtual spaces. The finding that women and nonbinary young adults who are also Black or low income experienced a more significant reduction in visits to 'commercial' third places may suggest a greater frequency of pre-pandemic visits, perhaps related to coffee shops and restaurants often being considered safe (Elwood and Martin, 2000), in addition to greater pandemic-based burdens preventing or delaying return to these places. A possible explanation for women and nonbinary respondents being more negatively impacted by feeling ignored, experiencing social comparison, and spending excessive time on devices may relate to gendered socialization in our society, as suggested by the role that hierarchical dominance plays in the social comparison process (Hogg et al., 1999).
- *Sexual orientation.* This dimension shows a positive association between sexual minority identity and both reduction in visits to 'civic' third places and dissatisfaction with outdoor areas, in addition to a direct relationship with mental health decline. The significance of minority sexual identity in 'civic' third places is aligned with the important role that community health centers often play in the lives of sexual minorities (Holmes and Beach, 2020), as well as the significance of gay and lesbian neighborhoods (Smart and Klein, 2013) as places of geographical clustering of traditionally marginalized identities. The finding related to feeling unsafe and unwelcome in outdoor areas may be tied in part to some queer youth expressing an aesthetic that visually conveys their identity to others (Clarke and Smith, 2015), in addition to potential fears among transgender individuals of not 'passing' (Billard, 2019) in unsafe or unwelcoming areas. The direct relationship between LGBTQ+ identity and mental health decline during the year studied suggests additional pandemic-based challenges experienced by this group beyond the place and social domains explored in this analysis.

5. Practical implications

This study focuses on relationships between social spaces and the mental health challenges experienced by young adults during the first year of the pandemic in the U.S. Our findings have important implications for tailored urban redesign, inclusive mobility, and accessibility, as outlined in Fig. 4. Findings from the analysis are associated with practical implications for urban redesign, and each implication is paired with a quote from an open-response question on virtual socialization. These narratives illustrate an identified need through the use of real-world experiences of social losses and barriers experienced during the pandemic. Considering the reduced access to physical third places that has occurred during the pandemic, virtual and outdoor spaces may need to be redesigned to ensure sufficient and satisfactory access to alternative spaces that facilitate social connections and protect the mental health of young adults

during the current and future pandemics. As noted in other studies (Barajas and Braun, 2021), these investments should account for neighborhood inequities and resident consultations.

6. Conclusions

6.1. Summary of findings

The ongoing COVID-19 pandemic is an unprecedented physical and mental health crisis that has significantly disrupted access to resources, social connections, and community safety nets. As we enter a future fraught with anticipated climate, political, and economic crises, we must understand and address the social needs of young adults and the barriers they experience to accessing social connections. In an era marked by a global pandemic, much could be gained from redesigning urban places as foundations for fostering meaningful relationships, supporting collective culture, and maintaining social connectedness. As we begin to tackle the compounding social issues amplified by the COVID-19 pandemic, it is crucial to imagine new possibilities for bolstering community resilience. The three main observations that improve understanding of the role of social environments in maintaining mental health are the following.

(1) *Physical third places* are important for maintaining weak ties for all marginalized identities considered in this study, and 'commercial' third places are important for mental health directly, especially among marginalized intersectional identities related to gender. Therefore, accessibility to 'commercial' third places needs to be prioritized during disruptions.
(2) *Virtual spaces* can be complementary to third places and are important for maintaining strong social ties, as well as mental health directly. Shortcomings in virtual spaces are especially detrimental for marginalized gender identities, while differences along dimensions of race and sexual identity are less notable. Improvements to virtual technology should focus on reducing feelings of being ignored, social comparison, and excessive time commitment.
(3) *Outdoor public spaces* are important for maintaining both strong and weak social ties. Effects are especially consequential for Asian and LGTBQ + young adults. As such, improvements to accessibility, sense of belonging, and safety need to be implemented in these spaces.

In summary, COVID-19 lockdowns and social distancing mandates have led to different mental health outcomes in young adults across social groups during the first year of the pandemic. Social environments are important for maintaining and restoring the mental health of young adults in the U.S. It is crucial to recognize that these pandemic-based disparities are rooted in structural racism, and as such, long-term goals need to achieve large-scale structural changes that reduce systemic inequities.

6.2. Contributions

This study is among the first to investigate relationships between social environments, social connections, and mental health outcomes of young adults during the COVID-19 pandemic. Additionally, differences are examined for marginalized social groups along the dimensions of race, gender, and sexual orientation. While sexual identity has recently been included in public health research, it is still rarely considered in studies related to transportation and urban design (Elliott et al., 2022). Our findings support that it is worthwhile to collect this level of sociodemographic detail in this context.

6.3. Limitations and future work

This study has four primary limitations.

(1) *Sample size.* The sample size is small relative to the complexity of the SEM, and although the size is in line with many other studies examining similar topics (Mehdizadeh et al., 2022), the findings derived from this study should be interpreted with caution.
(2) *Sample representativeness.* Given the convenience of web-based sampling used for data collection, the sample of young adults is not perfectly representative of the three U.S. states of interest, and the analysis does not fully capture the extent of the impacts of the digital divide and inadequate access to technology.
(3) *Identity measurement.* The small sample size may have contributed to nonsignificant intersectional identity effects and the inability to analyze differences among all subgroups of racial, gender, and sexual minorities. To balance respondent burden with insight, the survey question regarding gender did not inquire about sex assigned at birth, and transgender identity was not asked about explicitly. Therefore, it is possible that some transgender respondents opted for a binary gender label instead of a write-in response.
(4) *Weak tie metrics.* There is not currently a standard practice for recreating weak ties in a network. We believe the novel place generator developed for this study is a valuable contribution to the field, and it could benefit from further improvement. Specifically, our place generator asked respondents to list places they visit on a 'typical' day, but future iterations of this data collection method should consider asking about changes to less frequently visited third places, as well.

In parallel, we recommend four main developments for future research.

(1) *Longitudinal surveys.* A larger sample size could be achieved by deploying a second wave of data collection to examine the pandemic recovery process following the reopening of many social spaces and widespread vaccine administration. This would support the estimation of a more complex model that could track the evolution of connections and mental health.

(2) *Qualitative data.* We recommend a larger-scale qualitative study to be conducted before outlining culturally sensitive policy recommendations, and policymakers are encouraged to engage directly with marginalized and vulnerable groups to determine the best strategies to support their needs and concerns as they evolve throughout the remainder of the pandemic. Future research should be guided by ideas and solutions that emerge directly from respondents, such as qualitative findings derived from narrative analyses that demonstrate subjective experiences.

(3) *Identity measurement.* As part of an ongoing movement of shifting attention toward sexual orientation, we acknowledge the need for the inclusion of sensitive social identities in surveys to serve a specific purpose. Here our findings highlight the significance of accounting for sexual identity in a pandemic-based study on mobility and urban design. Best practices for measuring sex, gender identity, and sexual orientation in surveys are continuously evolving, and the most recently released guidance should be followed (National Academies of Sciences, Engineering, and Medicine, 2022).

(4) *Weak tie metrics.* There is a need for a deeper understanding of both the intensity and meaning of places that people engage with in their daily life. There is promise in improving the 'place generator' measurement by providing a more complete description. While traditional third places include libraries, cafes, and community centers, future studies should also consider ways to collect data on 'informal' third places or 'less privileged' spaces, such as street corners, subway stations, buses, public plazas, boardwalks, docks, and back alleys (Sheller and Urry, 2006).

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Declaration of competing interest

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Appendix

What is your **gender**? [Select <u>all</u> that apply]

- Man
- Woman
- Non-binary
- Something else (*optionally write in below*)

What term best describes your **sexual orientation**?

- Straight/Heterosexual
- Bisexual
- Gay
- Lesbian
- Pansexual
- Queer

- Questioning
- My identity is not listed above (*optionally write in below*)
- Prefer not to answer

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