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Development of a coronavirus social distance attitudes scale

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\begin{abstract}
Objective: Our goal was to develop a scale to assess social distance attitudes related to COVID-19.

Methods: We performed an online national survey of US adults (n = 1,074) to assess social distance attitudes, COVID-19 related beliefs and behaviors, and demographics. We assessed scale structure using confirmatory factor analysis and evaluated internal consistency and validity. We assessed association of scale factors with respondent characteristics.

Results: Confirmatory factor analysis supported a hypothesized two-factor solution. Internal consistency was high for both positive (\textit{Alpha} = 0.92) and negative (\textit{Alpha} = 0.91) attitude factors. Analyses supported construct and predictive validity with expected associations between scale factors and perceived norms and behavior (e.g. trips out of the home). We found an interaction suggesting that holding highly negative attitudes reduced the effect of holding positive beliefs. Both attitude factors were related to age, gender, race/ethnicity, and political affiliation. Perceived COVID-19 risk (to others but not for self) and perceived severity were consistently associated with higher positive and lower negative attitudes.

Conclusion: This COVID-19 Social Distance Attitude Scale contains positive and negative factors with high internal consistency and construct and predictive validity.

Practice implication: A greater understanding and ongoing assessment of COVID-19 social distance attitudes could inform policymakers, researchers, and clinicians who seek to promote protective social distance behaviors.

\end{abstract}

1. Introduction

We are experiencing a global pandemic due to COVID-19 [1,2]. In the initial phases of the pandemic, implementation of strict social distance policies helped many countries limit the spread of COVID-19 and potentially saved millions of lives [3–6]. While beneficial, social distance policies have also contributed to major disruptions across multiple dimensions of life. Social distancing can have negative mental and physical health effects and suppress economic activity [7–10]. In many places these disruptions have prompted opposition to social distance orders [11–13]. Unfortunately, many months into the pandemic, the number of COVID-19 cases continues to increase. Many countries and regions have seen increases in the number of cases as social distance policies have been relaxed [14]. Some experts believe that some form of social distancing may be needed for up to several years, in combination with other virus control measures, to manage the pandemic [15,16].

It is crucial to understand public attitudes towards social distancing. A growing body of work has examined knowledge, attitudes, and practices (KAPs) regarding COVID-19 [17–26]. However, this work does not examine attitudes towards social distancing in detail. We therefore performed an online survey of a representative sample of the US adult population to assess these attitudes. Our purpose here is to report on the psychometric properties of a new COVID-19 social distance attitude scale. An understanding of social distance attitudes is vital to help determine and communicate effectively about the role of social distancing in our ongoing struggle against COVID-19.
2. Methods

2.1. Survey development

To create social distance attitude survey items we reviewed communications from prominent public health organizations [27–29]. Key points emphasized the importance of social distancing to reduce transmission of the virus, preserve healthcare capacity, and allow time for development of additional public health infrastructure. We also reviewed media coverage of protests against social distance orders [11–13]. Major opposition themes included the perspective that social distancing policies violated individual rights and that social distancing was not beneficial. A set of potential survey items representing these positive and negative perspectives was reviewed by three health communication specialists yielding a final set of 14 items with eight expressing support and six expressing opposition to social distancing. Items were answered using a 1–5 Likert scale response format from Strongly Disagree to Strongly Agree.

The survey also included items to assess the construct and predictive validity of the social distance attitude scale. This included assessment of perceived norms regarding social distancing, self-reported level of comfort with resuming normal activities, and concern about the timing for lifting of social distance orders. We also assessed social distance behavior by asking respondents to report the number of times they left their homes in the prior week for one of ten common reasons (e.g. to go to work, to go to the grocery store, to go to a restaurant or fast-food location, to seek health care, to go to a drug store or pharmacy, to visit friends families or neighbors, to attend a gathering of 10 or more people) [30,31].

We also assessed demographic characteristics and other perceptions related to COVID-19.

Demographics included age, gender, race/ethnicity, level of education, income, and political party affiliation. Gender was initially assessed with five categories, Male, Female, Transgender (identify as male), Transgender (identify as female), and Other and then collapsed into two categories (identify as male, identify as female). Race/ethnicity was coded as White, Black, Hispanic, Multiracial, and Other (which included American Indian, Asian, and Other). Education was initially assessed with 10 strata which were collapsed into four categories; None through high school/GED, Post-Secondary (Trade school/Some college/Associates), Bachelor’s, and Advanced Degree (Masters, Doctoral/Professional). Income initially assessed with 9 strata which were collapsed into three categories; under $30,000, $30,000 to $74,999, and $75,000 and above. Political party was assessed with four categories, Republican, Democrat, Independent, and something else. We assessed the perceived risk of contracting COVID-19 in the next 30 days for the individual and for others (that the individualized “cared a lot about”) and the perceived severity of COVID-19 (i.e. the perceived likelihood of needing hospitalization if sick with COVID-19).

2.2. Survey administration

Surveys were completed through the Qualtrics online platform using a sample provided by Dynata (https://www.dynata.com). For this study we requested a nationally representative sample of 1000 US adults ages 18 and above. Quotas were used to approximate national rates for age, gender, race, income, and US region. The survey was conducted as open-enrollment, whereby eligible panel members who log into the Dynata website were offered a chance to take this survey. Participants received modest compensation (approximately $1) for completing this survey.

During the last week of May 2020, a total of 2,272 individuals clicked on our survey invitation link, 187 did not complete an age screener item or consent and 609 were ineligible or refused consent. This yielded 1,476 surveys from age-eligible, consented individuals. To ensure data quality, we further excluded 402 surveys based on two criteria. First, we excluded 375 surveys from individuals who completed the full survey in under 10 min (the minimum time we considered needed to complete a valid survey). Second, we excluded 27 surveys from individuals who demonstrated no variance in their response to a block of 16-item assessing attitudes and perceived norms toward the pandemic (i.e. “clicked” down an entire column (e.g. all Strongly Agree or Disagree) for all items). Because some of the 16 items in this section were worded in the positive direction and others in the negative direction, we considered these response patterns contradictory and a sign of poor data quality. After applying these exclusions, 1,074 surveys remained for analyses. The mean time to complete the survey was 25.3 min (range 10.1–117.1).

2.3. Study hypotheses

Our study hypotheses are as follows:

**Hypothesis 1.** We hypothesize that the social distance attitude measure will contain two factors representing positive and negative attitudes toward social distancing. This hypothesis is based upon our observation of apparently separate perspectives in favor of (e.g. public health recommendations) and opposed to (e.g. protests against stay-at-home orders) social distancing as well as report of polarization of COVID-19 related media coverage [32].

**Hypothesis 2.** We hypothesize that both positive and negative social distance attitudes will demonstrate high internal consistency (Hypothesis 2a). We further expect these social distance measures to demonstrate measurement invariance (Hypothesis 2b). Gender differences in prosocial behavior are well described [33]. Recent findings have also identified differences in attitudes regarding COVID-19 related to political affiliation [22,23,34]. We therefore plan invariance testing by gender and political affiliation.

**Hypothesis 3.** We hypothesize that the positive and negative social distance attitude measures will demonstrate construct and predictive validity. In terms of construct validity (Hypothesis 3a), we expect more positive social distance attitudes will be associated with perceived norms more in favor of social distancing, greater concern that social distance orders would be lifted too quickly, and lower comfort with returning to regular routines, while negative social distance attitudes would be associated with the opposite. In terms of predictive validity (Hypothesis 3b), we expect respondents with stronger positive attitudes will make fewer trips outside of the home while respondents with stronger negative attitudes will make more trips. We expect that these associations will hold for mainly trips that can be considered discretionary or non-essential (e.g. attending social gatherings) and not hold for trips for essential activities (e.g. go to the grocery store or work).

2.4. Analysis

We performed the following steps to test our study hypotheses.

2.4.1. Step 1: determination of factor structure

To test Hypothesis 1, the 14 items were entered into a confirmatory factor analysis model testing a two-factor solution. We believe that the strongest psychometric approach is to test theory-based models with confirmatory factor analysis [35]. In the setting of an a priori hypothesis, we believe confirmatory factor
analytic is preferred over exploratory factor analysis (EFA) because results from EFA are more likely to be subject to chance relationships among items [36]. Analyses were performed in Mplus 7 with each item treated as ordinal using WLSMV estimation. Model fit was assessed using the chi-square test, relative fit indices, and by an examination of standardized residuals [37].

2.4.2. Step 2: assessment of consistency

We assessed Hypothesis 2a by calculating a Cronbach’s Alpha for each of the identified factors. For Hypothesis 2b, we assessed invariance of the factor structure by gender and political affiliation using the same model as in Step 1. We first assessed configural invariance, which examines whether the hypothesized two-factor solution was supported for each group. We then compared the configural invariance model to a scalar invariance model which simultaneously assessed invariance of factor loadings and item thresholds (scaling parameters were also constrained to one for both groups). The two models were compared using the scaled chi-square difference test and also examining differences observed in each model parameter from the unconstrained model [38,39].

2.4.3. Step 3: assessment of validity

For Hypothesis 3a, we assessed construct validity of the social distance attitude scale by examining the relationship between scale scores and logically related measures. We created a categorical variable identifying respondents as high and low (median split) on scale factors. We used a chi-square test to compare how having a high vs. low social distance attitude score was related to the pattern of response to potentially related survey items (e.g. perceived norms, concerns about the timing of lifting social distance orders, and comfort with resuming normal activities).

For Hypothesis 3b, we examined predictive validity of the social distance attitude scale by assessing the relationship between scale scores and social distance behavior measured as the total number

Table 1
Sample Description (n = 1074).

| Variable                  | n   | %    |
|---------------------------|-----|------|
| **Gender**                |     |      |
| Male                      | 459 | 44.4%|
| Female                    | 575 | 55.6%|
| **Race/Ethnicity**        |     |      |
| White                     | 723 | 69.9%|
| Black                     | 84  | 8.1% |
| Hispanic                  | 95  | 9.2% |
| Multi-racial              | 65  | 6.3% |
| Other                     | 67  | 6.5% |
| **Age**                   |     |      |
| 18 through 35             | 304 | 29.5%|
| 36 - 50                   | 263 | 25.6%|
| 51–65                     | 277 | 26.9%|
| 65 and above              | 185 | 18%  |
| **Education**             |     |      |
| High school/GED or less   | 225 | 21.8%|
| Some college/Post-secondary | 326 | 31.6%|
| Bachelor’s Degree         | 310 | 30%  |
| Advanced Degree           | 172 | 16.7%|
| **Income**                |     |      |
| Under $30,000             | 291 | 28.1%|
| $30,000 - $74,999         | 397 | 38.4%|
| $75,000 and above         | 346 | 33.5%|
| **Political Party**       |     |      |
| Republican                | 297 | 28.7%|
| Democrat                  | 395 | 38.1%|
| Independent/Other         | 344 | 33.2%|
| **Social Distance Item Means** |     |      |
| Please let us know how much you agree or disagree with the following statements about social distancing and social distance orders? | MEAN (1.0–5.0) | SD |
| Item 1: Social distancing has slowed the spread of coronavirus. | 3.88 | 1.06 |
| Item 2: Social distancing makes me feel more safe. | 3.70 | 1.19 |
| Item 3: It is our duty as good citizens to follow social distance orders. | 3.96 | 1.15 |
| Item 4: For social distancing to be effective, we need everyone to follow the rules. | 4.08 | 1.08 |
| Item 5: Social distancing is not really doing much good. | 2.27 | 1.23 |
| Item 6: Social distancing is doing more harm than good. | 2.24 | 1.26 |
| Item 7: Social distance orders violate my individual rights. | 2.40 | 1.34 |
| Item 8: Social distancing should be a matter of personal choice. | 2.42 | 1.32 |
| Item 9: Stopping social distancing to soon will likely lead to another outbreak of coronavirus. | 3.82 | 1.22 |
| Item 10: Most places in the country can safely stop social distancing. | 2.57 | 1.27 |
| Item 11: We can lift most social distance orders and still keep coronavirus under control. | 2.63 | 1.25 |
| Item 12: We need to have better ways to test and track people with coronavirus before we can safely lift social distance orders. | 3.68 | 1.26 |
| Item 13: We should not lift social distance orders until there is a steady decline in the number of coronavirus cases. | 3.78 | 1.21 |
| Item 14: We should not lift social distance orders if hospitals are full of coronavirus patients. | 3.88 | 1.18 |

SD = Standard Deviation.
* 1=Strongly Disagree, 2=Disagree, 3=Neither Agree or Disagree, 4=Agree, 5=Strongly Agree.
of outside trips (excluding walks) the individual reported in the prior week using linear regression. We included both social distance scale factors (as well as a first-degree interaction terms) in order to assess whether each scale factor is an independent predictor of social distance behavior. To illustrate the effect of interaction terms, we created a four-group (i.e. hi/low, low/low, hi/hi, low/hi) composite variable based upon the median split of component variables and use analysis of variance to assess how the total number of trips varies in relation to this composite variable. These analyses are performed separately for the total number of trips, trips considered to be essential (i.e. to the grocery store/market, to get take-out from a restaurant, to go to work, to seek healthcare, to care for a vulnerable individual or for childcare), and trips considered to be non-essential (i.e. to eat-in at a restaurant, visit friends, family, or neighbors (for reasons other than providing care), attend a gathering of ten or more people).

Finally, we examined the bivariate relationship between the social distance attitude mean scale scores and categorical variables assessing demographic characteristics and other COVID-19 related beliefs using analysis of variance. Responses on the perceived risk (i.e. likelihood of catching coronavirus) and severity of COVID-19 (i.e. likelihood of needing hospitalization) were collapsed from the five-point scale (i.e. 1=“Not at all likely” to 5=“Very likely”) into two categories representing those who reported a lower (i.e. responses 1–3) versus higher (i.e. response 4–5) perceived risk or severity.

2.5. Statistical package
Analyses were performed using SPSS (Version 25) and Mplus (for confirmatory factor analysis).

2.6. Human subjects
This project was reviewed and judged to be exempt (survey without identifying information) by the University of Michigan’s Institutional Review Board.

3. Results
The characteristics of survey respondents are shown in Table 1. The sample was 56% female, 70% White, 8% Black, 9% Hispanic, and 6% multiracial. About 22% had completed a high school education or less while 47% had a college degree. Politically, 29% of respondents identified themselves as Republican, 38% as Democrat, and 33% as Independent or Other. The mean score for social distance attitude items ranged from 2.24 to 4.08.
Respondents reported making an average of 6.6 (SD = 6.7) total trips out of the home in the prior week. This includes an average of 5.3 (SD = 4.9) trips to essential locations and an average of 1.3 (SD = 2.3) trips to non-essential locations. Details on specific responses to social distance norms and the number of trips to specific locations are included in supplementary materials.

For Hypothesis 1, the confirmatory factor analysis of the social distance attitude items supported the hypothesized two-factor solution. Item factor loadings are shown in Fig. 1. While the chi-square test was significant ($X^2 = 467.38$, df = 76), indicating some imperfections in the two-factor solution, the relative fit indices met criteria for good to very good fit (RMSEA = 0.07, CFI = 0.99, TLI = 0.98). An examination of residuals showed that the largest standardized residual was −0.11 (between Items 1 and 6). The remaining residuals were between −0.03 and 0.06. From the factor model there was a significant correlation of −.84 between the positive and negative social distance attitude factors ($p < 0.001$). This indicates that the positive and negative factors still contribute unique information despite sharing 70 % of the variance.

For Hypothesis 2a, results showed high internal consistency for both the positive (Alpha = 0.92) and negative (Alpha = 0.91) social distance attitude factors. Alpha scores did not improve with deletion of any item.

For Hypothesis 2b, the configural invariance fit model fit for female and male respondents was significant ($X^2 = 592.44$, df = 152), showing that the two-factor solution did not perfectly fit the data in either group. However, the relative fit indices met criteria for good to very good fit (RMSEA = 0.08, CFI = 0.98, TLI = 0.98). While the scalar invariance model fit less well (difference in $X^2 = 90.13$, df = 66) the relative fit indices (RMSEA = 0.05, CFI = 0.99, TLI = 0.99) still showed very good fit. The difference in standardized factor loadings between males and females was at most 0.06, indicating minimal group differences. The difference between groups in item thresholds was at most 0.4, indicating small differences in thresholds between groups. Overall, we detect only minimal differences between female and male respondents.

Also for Hypothesis 2b, the fit of the configural invariance model for respondents with different political affiliations (Republican, Independent, Democrat) was significant ($X^2 = 697.91$, df = 228), but the relative fit indices showed good to very good fit (RMSEA = .08, CFI = .98, TLI = .98). The scalar invariance model showed that constraining thresholds, loadings, and residuals variances significantly reduced model fit (difference in $X^2 = 308.73$, df = 132), but the relative fit indices actually suggested an improvement in fit (RMSEA = .06, CFI = .98, TLI = .99). Across the three groups the largest difference observed in standardized factor loadings was .16, indicating small group differences. The largest difference observed in item thresholds was .93, a moderate difference which is to be expected given differences in means between groups, but not so large as to warrant modifying the measure. Across the three groups there are at most moderate measurement differences in the measure with the overall model still fitting quite well.

For Hypothesis 3a, assessment of construct validity showed statistically significant associations between scale factors and perceived norms and related measures. Respondents who had higher ($n = 578$) versus lower ($n = 484$) positive social distance attitudes were more likely to agree that most people they know supported social distance orders (high positive 84 % vs. low positive 44 %, $X^2 p < 0.001$), be worried that social distance orders would be lifted too quickly (high positive 79 % vs. low positive 20 %, $X^2 p < 0.001$), and be less comfortable returning to their regular routines (high positive 12 % vs. low positive 41 %, $X^2 p < 0.001$). Respondents who held higher ($n = 449$) versus lower ($n = 612$) negative social distance attitudes were more likely to agree that they knew lots of people who opposed social distance order (high negative 49 % vs. low negative 27 %, $X^2 p < 0.001$), be worried that social distance orders would be lifted too slowly (high negative 47 % vs. low negative 9 %, $X^2 p < 0.001$), and be more comfortable returning to their regular routines (high negative 45 % vs. low negative 11 %, $X^2 p < 0.001$).

For Hypothesis 3b, assessment of predictive validity showed that the overall regression model was significant (R-square 0.12, $p < 0.001$) and that the positive (standardized Beta=−0.51 $p < 0.001$) and negative (standardized Beta=−0.41, $p = 0.001$) social distance attitude factor scores, as well as the first-degree interaction between the factors (standardized Beta = 0.48, $p < 0.001$), were independently associated with the total number of trips outside the house in the prior week. To illustrate the effect of this interaction, Fig. 2 shows the average number of trips for the composite four-group variable that combines the median split of positive and negative social distance attitude scales. The group with high positive and low negative social distance attitudes took

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**Fig. 2.** Interaction of Positive and Negative Social Distance Attitudes for Trips Out of Home. Bars graph showing the average number of trips out of the home in the prior 7-days for groups defined by high vs. positive and negative social distance attitudes. P-values for comparison of differences between specified groups.
the fewest trips (Mean = 4.5, SD = 4.2). The number of trips was higher for the group having low positive and low negative attitudes (Mean = 7.1, SD = 6.8), and highest for both groups with high negative attitudes. Among individuals who held high negative attitudes, the number of trips in the prior week was similar for those with either high (Mean = 9.5, SD = 9.3) or low (Mean = 8.9, SD = 9.3) positive social distance factor scores. The difference in the number of trips between all the groups is statistically significant except for the difference between the two groups with high negative social distance attitudes (p = 0.45). We found the same relationship between social distance attitude factors and the number of essential or non-essential trips. Please see supplementary materials for details of these findings.

Individual characteristics associated with positive and negative social distance attitudes are shown in Table 2. Both positive and negative social distance attitudes are associated with age, gender, race/ethnicity, and political affiliation.

The associations between positive and negative social distance attitudes, the perceived risk of contracting coronavirus, and the perceived severity of COVID-19 are shown in Table 3. Higher perceived risk-to-self of contracting coronavirus was associated with higher positive social distance attitudes, but not with the strength of negative social distance attitudes. In contrast, the perceived risk-for-others (that the respondent “cared a lot about”) of contracting coronavirus and the perceived severity of COVID-19 infection (i.e. the likelihood of needing hospitalization if sick) were associated with both higher positive and lower negative social distance attitudes.

### 4. Discussion and conclusion

#### 4.1. Discussion

This paper describes the development of a COVID-19 social distance attitude scale. Results support our Hypothesis 1 of a two-factor social distance attitude measure. The first factor represents positive largely health-based attitudes. The second factor captures negative attitudes, including items that question the benefit of social distancing, the consequences of lifting social distance orders, and place emphasis on the importance of individual choice. These findings suggest there exists a distinct set of negative attitudes that are not simply the absence of positive attitudes [40]. A recent study

### Table 2

Association of Social Distance Attitudes and Individual Characteristics.

|                     | Positive Social Distance | Negative Social Distance |
|---------------------|--------------------------|--------------------------|
|                     | Mean | SD   | P    | Mean | SD   | P    |
| **Gender**          |      |      |      |      |      |      |
| Male (n = 459)      | 3.73 | 0.97 | < 0.001 | 2.60 | 1.13 | < 0.001 |
| Female (n = 575)    | 3.94 | 0.91 |      | 2.29 | 1.00 |      |
| **Race/Ethnicity**  |      |      |      |      |      |      |
| White (n = 723)     | 3.92 | 0.92 | < 0.001 | 2.34 | 1.08 |      |
| Black (n = 84)      | 3.55 | 0.92 |      | 2.67 | 0.95 |      |
| Hispanic (n = 95)   | 3.67 | 1.03 |      | 2.64 | 1.00 |      |
| Multi-racial (n = 65) |   | 0.88 |      | 2.76 | 1.06 |      |
| Other (n = 67)      | 3.98 | 0.99 |      | 2.44 | 1.14 |      |
| **Age**             |      |      |      |      |      |      |
| 18 through 35 (n = 304) |   | 0.88 | < 0.001 | 2.68 | 0.98 | < 0.001 |
| 36 – 50 (n = 263)   | 3.81 | 1.01 |      | 2.57 | 1.15 |      |
| 51 – 65 (n = 247)   | 3.99 | 0.92 |      | 2.21 | 1.02 |      |
| 65 and above (n = 215) |   | 0.93 |      | 2.14 | 1.05 |      |
| **Education**       |      |      |      |      |      |      |
| High school/GED or less | 3.73 | 0.95 | P = 0.095 | 2.58 | 1.01 |      |
| Some college/Post-secondary |    | 3.83 | 0.95 | 2.41 | 1.06 |      |
| Bachelor’s Degree   | 3.94 | 0.91 |      | 2.36 | 1.01 |      |
| Advanced Degree     | 3.85 | 0.97 |      | 2.37 | 1.01 |      |
| **Income**          |      |      |      |      |      |      |
| Under $30,000 (n = 291) | 3.84 | 0.92 | P = 0.097 | 2.44 | 1.02 |      |
| $30,000 – $74,999 (n = 397) |   | 0.94 |      | 2.38 | 1.06 |      |
| $75,000 and above (n = 346) | 3.85 | 0.96 |      | 2.47 | 1.13 |      |
| **Political Party** |      |      |      |      |      |      |
| Republican (n = 297) | 3.59 | 0.93 | < 0.001 | 2.47 | 1.03 |      |
| Democrat (n = 395)  | 4.19 | 0.79 |      | 2.06 | 0.97 |      |
| Independent/Other (n = 344) | 3.70 | 0.99 |      | 2.47 | 1.03 |      |

### Table 3

Association of Social Distance Attitudes and Perceived Risk and Severity of COVID-19.

|                     | Positive Social Distance | Negative Social Distance |
|---------------------|--------------------------|--------------------------|
|                     | Mean | SD   | P    | Mean | SD   | P    |
| **Perceived Risk of catching COVID-19: For Self** |      |      |      |      |      |      |
| Not/Less Likely (n = 664) | 3.78 | 0.98 | < 0.001 | 2.44 | 1.06 |      |
| More/Very Likely (n = 362) | 4.00 | 0.83 |      | 2.40 | 1.07 |      |
| **Perceived Risk of catching COVID-19: For Others** |      |      |      |      |      |      |
| Not/Less Likely (n = 604) | 3.69 | 1.00 | < 0.001 | 2.54 | 1.08 |      |
| More/Very Likely (n = 448) | 4.07 | 0.79 |      | 2.26 | 1.02 |      |
| **Perceived Severity of COVID-19: need for hospitalization** |      |      |      |      |      |      |
| Not/Less Likely (n = 431) | 3.56 | 1.01 | < 0.001 | 2.69 | 1.07 |      |
| More/Very Likely (n = 621) | 4.06 | 0.81 |      | 2.24 | 1.02 |      |
describing attitudes toward mask use similarly identified separate factors related to perceived health benefits and personal freedom [41].

Results also support Hypothesis 2 (a and b) with the scale factors demonstrating high internal consistency and good to very good overall fit of a two-factor solution for females and males and for respondents with different political affiliations. Thus the measure appears to be valid across gender and political party allowing for comparison of scores. Our findings of higher positive and lower negative social distance attitudes among female compared to male respondents is consistent with other recent studies reporting gender differences in COVID-19 attitudes and practices [21–23,25,26]. Our finding of an association between political affiliation and both positive and negative social distance attitudes continues a troubling pattern that suggests partisan influence on attitudes and behaviors related to COVID-19 [22,23,34]. Additional demographic associations related to age and ethnicity are similar to patterns in general COVID-19 related KAPs reported by others [19,23,25,26,42].

Results largely support Hypothesis 3. For Hypothesis 3a (construct validity), the associations between positive and negative social distance attitudes and perceived norms and concerns are all in the expected direction. For Hypothesis 3b (predictive validity) we had some unexpected but explainable results. The main effects of positive and negative attitude factors are in the expected directions for the number of overall trips out of the home. The finding of an interaction was unexpected and suggests that holding highly negative social distance attitudes trumps the effect of holding positive beliefs regarding the benefits of social distance measures. The United States experienced relatively modest changes in mobility compared to other countries during the pandemic [43,44]. It is possible that this more limited response is due in part to the effect of this negative social distance attitude factor. Negative social distance attitudes could arise in part from psychological reactance which leads an individual to reject (even beneficial) behaviors that threaten their sense of freedom [45,46]. We originally expected to find an association between social distance attitudes and more discretionary (i.e. non-essential) trips but not for trips for essential activities (e.g. to obtain food, work, seek healthcare). However, we found the same pattern of association for total, essential, and non-essential trips. In retrospect, we believe this still supports validity of the social distance measures. Even though an activity may be considered essential, it is reasonable for the frequency of these trips to be related to our attitude measures.

The finding of different associations between positive and negative social distance attitude factors and other perceptions related to COVID-19 is also potentially important. While a higher perceived risk to self of contracting coronavirus is associated with higher positive attitudes towards social distancing, we found no association between perceived personal risk and the strength of negative beliefs. In contrast, lower negative attitudes were found when respondents perceived coronavirus as a threat to others (who they cared about). It is plausible that holding the belief that coronavirus is a threat to others would lead an individual to be less likely to view social distancing as simply a matter of personal freedom. This pattern is consistent with prior work showing that concern for others is an important influence on health beliefs [47,48]. The perceived severity of COVID-19 was associated with both higher positive and lower negative social distance attitudes. This finding is consistent with the health belief model with regards to the importance of perceived severity as a key driver of behavior [49–51].

4.1.1. Limitations

There are several limitations to our work. Our data are from a single cross-sectional survey which limits our ability to make causal inferences. The survey was performed entirely online which may introduce bias [52]. The data for this study was also collected during a relatively brief period following the initial peak of coronavirus cases in the US. Future survey work will be needed to assess change in social distance attitudes over time. Our primary focus here was to report on the psychometric properties of a social distance attitude scale. Additional likely multivariate analyses will be needed to more fully explore the relationship between attitude factors, other COVID-19 beliefs, and self-reported social distance behavior.

4.2. Conclusions

This COVID-19 social distance attitude scale demonstrates good factor structure with high internal consistency and construct and predictive validity. The scale includes positive and negative attitude factors that have distinct associations with social distance behavior and other COVID-19 related beliefs. Holding highly negative attitudes seems to counter the effects of holding positive beliefs about social distancing. Perceived COVID-19 risk (for others but not for self) and perceived severity were consistently associated with higher positive and lower negative attitudes.

4.3. Practice implications

Recognition of positive and negative attitude factors related to social distancing could help guide government leaders and public health officials in decision-making on social distance policies. It may also inform the design of communications to increase adherence to social distance practices. The observed interaction showing the negative attitude factor canceling or limiting the effects of holding positive beliefs suggests that simple emphasis on the public health benefits of social distancing may have limited effect. Messages that encourage the protection of others, which seems to be associated with both higher positive and lower negative social distance attitudes, may be more promising. Greater perceived severity of COVID-19 is also related to higher positive and lower negative social distance attitudes. Graphic imagery has been used to communicate effectively regarding the severity of health effects in other contexts and might be considered as part of further public education efforts [53]. Ongoing tracking of public attitudes towards social distancing and shifts in attitudes and behaviors in response to public health messaging could be important to guide our collective response to COVID-19 pandemic.

Informed consent and patient details

I confirm all patient/personal identifiers have been removed or disguised so the patient/person(s) described are not identifiable and cannot be identified through the details of the story.

Data statement

Relevant, de-identified study data will be posted in the Mendeley data repository in accordance with University of Michigan policies and procedures, pending discussions with our Office of Research and Sponsored Products.

CRediT authorship contribution statement

Lawrence An: Conceptualization, Methodology, Validation, Investigation, Resources, Writing - original draft, Writing - review & editing, Visualization, Supervision, Project administration, Funding acquisition. Sarah Hawley: Conceptualization, Methodology, Investigation, Writing - review & editing. M. Lee Van Horn: Methodology, Formal analysis, Investigation, Writing - original draft. Elizabeth Bacon: Conceptualization, Methodology.
Declaration of Competing Interest

The authors report no declarations of interest.

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