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Development of a Measure of Physical Distancing: The O'Sickey Distancing Test

Anthony J. O'Sickey
Univeristy of New Mexico

A.J. O'Sickey

Candidate

Psychology

Department

This dissertation is approved, and it is acceptable in quality and form for publication:

Approved by the Dissertation Committee:

Theresa Moyers PhD, Chairperson

Bruce Smith PhD, Committee Member

Brady Horn PhD, Committee Member

Davood Tofighi PhD, Committee Member

DEVELOPMENT OF A BEHAVIORAL MEASURE OF PHYSICAL DISTANCING: THE O'SICKEY DISTANCING TEST

by

A.J. O'SICKEY PHD

B.A. Psychology The University of New Mexico 2012

M.S. Psychology The University of New Mexico 2015

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Development of a Behavioral Measure of Physical Distancing: The O'Sickey Distancing Test

by

A.J. O'Sickey

B.A. Psychology, The University of New Mexico 2012

M.S. Psychology, The University of New Mexico 2018

Ph.D. Psychology, The University of New Mexico 2022

ABSTRACT

Introduction: Covid-19 has swept the globe and has disproportionately affected the United States with over 600,000 deaths in just over one year. The Centers for Disease Control recommendations for reducing the spread of Covid-19 have focused on physical distancing (PD), the practice of maintaining a distance greater than 6 feet from individuals not in the same household. When employed, this health behavior has been found to reduce the incidence of Covid-19. A review of the measurement literature evaluating PD indicates that PD has been measured at the community level via GPS, using proxy measures of the behavior, or as a construct. These methods can be useful in some situations; however, PD is an observable health behavior and can be reported as such. This study sought to address the issues in measuring PD by creating a new measure of self-reported PD that was: 1) appropriate for individual level measurement, 2) based on participant's self-report of the behavior of PD, and 3) presented a less ambiguous representation of the self-reported behavior.

Method: Fifty college students from the University of New Mexico were sampled at a

single time-point to evaluate the convergent and concurrent validity of the O'Sickey Distancing Test (ODT).

Analysis Plan: To establish convergent validity, individual violations of PD as measured by the ODT were correlated with the Social Distancing Measure (SDM) and participant steps per day using Spearman's rank correlations and by comparing the correlations between the ODT and the number of participant self-reported steps per day and a measure of social distancing and participant steps per day using Steiger's t-test of correlated correlations within a sample.

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CHAPTER 1

INTRODUCTION

Covid-19, a respiratory illness that was first reported on November 17th in the Wuhan province of China, has been declared a global pandemic by the World Health Organization and as of June 2021, Covid-19 has claimed over 4 million lives worldwide. The United States has been gravely affected by the global pandemic, with over 7 million Americans testing positive for the virus and over 600,000 deaths (John's Hopkins, 2020). The Centers for Disease Control has released comprehensive guidelines intended to mitigate the spread of Covid-19. The most common recommendation from the CDC for reducing the spread of Covid-19, and associated deaths, is the practice of physical distancing (CDC, 2020).

Physical distancing (PD), maintaining a 6+ foot distance from individuals who are not in the same household, is an effective viral mitigation technique dating back to the early 20th century (McKinsey, McKinsey, & Enriquez, 2018). Mathematical models that have evaluated the spread of Covid-19 transmission with and without PD have shown a clear advantage for PD in reducing Covid-19 spread (Highlander & Singley, 2020; Chandra, Singh, & Bajpai, 2020). Evaluation of regional compliance with PD has confirmed that in areas of higher risk, reduced Covid-19 transmission has been directly related to citizen compliance with suggested PD guidelines (Allcott, et al., 2020). At the level of the individual household, early reports indicated that households that utilized PD prior to infection of a household member, reduced the probability of Covid-19 transmission to other cohabitants by as much as 77% (Wang, et al., 2020). Clear advantages for PD have been evidenced at the global, community, and individual level;

yet, converging lines of evidence have indicated that not all Americans have followed PD guidelines.

Application of PD guidelines by US citizens has been inconsistent at the state community, and individual level. At the local level, GPS monitoring of cell phone movement has indicated that in areas without consistent application of PD guidelines there was a concomitant increase in incidence of cases of Covid-19 (Chu, et. al., 2020). At the community level, organizations such as schools and churches are identified as possible significant sources of Covid-19 spread. Some of these organizations have reduced the spread of Covid-19 by encouraging members to engage in CDC recommended virus mitigation techniques including PD (Center for Disease Control and Prevention; CDC, 2020). Nevertheless, significant evidence indicates that community spread of Covid-19 has been driven not only by these larger organizations but by individual adherence to PD.

Health campaigns at the federal and state levels of government have been enacted to encourage the utilization of PD and other virus mitigation techniques. At the federal level, the CDC has recommended PD, regular handwashing, wearing a cloth face mask in public, and avoiding crowded indoor spaces (CDC, 2020). As of April 2020, almost every state had complimented these recommendations with “stay-at-home” orders encouraging residents to only venture into the public for necessities (Lee, Mervosh, Avila, Harvey, and Matthews, 2020). Despite these interventions, Covid-19 spread has continued at an alarming rate and in some cases has outstripped the medical establishment’s ability to manage patient loads (Hixenbaugh, 2020). These measures have been slow to curb the spread of Covid-19, and scientists have called for behavioral interventions targeting individuals' use of virus mitigation techniques such as PD (Bonell et al., 2020).

Although PD is a fairly straightforward recommendation, measuring its enactment is complex. Interventions such as cognitive behavioral therapy, motivational interviewing, and contingency management have already been effective in modifying harmful health behaviors like smoking, substance misuse, and excessive alcohol consumption (Carrol, et al., 2006). Self-report measures designed by clinical researchers to quantify such discrete health behaviors as clinical outcomes have used a simple frequency count to characterize individual progress. Such frequency counts allowed researchers to represent the health behavior as categorical variables (e.g. did the behavior occur or not), count variables, or aggregate parameter estimates. For example, alcohol treatment studies historically focused on a binary outcome of success, namely complete abstinence or not. Subsequently, alcohol researchers have learned that treatment outcomes are not "all-or-none" and instead occur on a continuum where complete abstinence is not the only meaningful indicator of behavior change (Witkiewitz, et al., 2017). At the variable level, representation of count data as continuous rather than binary allows researchers to model outcomes of clinical trials that are indicative of a broader spectrum of human behavior than encompassed by categorical outcomes. Following this example from the alcohol literature, self-reported PD should therefore be modeled as continuous rather than binary and should be anchored to a specific behavior clearly indicating the presence or absence of PD.

A review of the literature investigating PD indicated over 20 studies where a variable or measure that quantifies aspects of PD was included. Multiple methods of evaluating PD have been utilized in research studies including modeling at the community level and modeling of PD using proxy measures. Five articles located in a literature review estimated PD via GPS modeling, using cellular telephone data recording aggregated individual movement. This method of assessing PD, although uninformative for an individual level intervention, has provided valuable data about the effect of public health interventions at the community level (Allcott, et al., 2020). This indirect method of evaluating PD at the community level has been applied at the individual level by evaluating self-reported step count as a proxy for GPS movement. Recent empirical studies have revealed that a strong positive relationship between participant step-count and self-reported PD exists such that, as indicators of PD increased, self-reported steps per day also increased (Gollwitzer, Martel, Marshall, Hohs, & Bargh, 2020). Indirect measures of PD, called "proxy" measures, have also been included as methods of evaluating PD in seven of the articles reviewed. Notably, behavioral researchers use proxy measures as approximations when the measurement of a behavior is inaccessible to researchers or self-report of a behavior is unreliable. Researchers have not used direct tracking of individuals via their cell phones to approximate social distancing and social contacts. Although this would be the most straightforward measure of movement, it would surreptitiously also collect data from those who come into contact with the index person. Those individuals will almost certainly not have consented to harvesting of their personal movement data."

The remainder of the literature operationalized PD or aspects of it as a construct. Constructs, like proxy measures, are useful when the underlying behavior is inaccessible to measurement. Methodologists have used this strategy to create models of psychological states like depression or anxiety from self-reported behaviors. In the case of unobservable psychological constructs, this type of analytic strategy can be invaluable for tapping a construct that cannot otherwise be observed (Kline, 2015). Constructs have a place in psychological science; however, when observable behaviors are measured in this way it introduces unnecessary ambiguity into the measurement of PD. The Gollwitzer Social Distancing Measure (SDM; Gollwitzer, et al., 2020) is an excellent example of this. Gollwitzer and colleagues used an Amazon Mechanical Turk workforce (N = 258) to develop a single item measure of social distancing. In this single-item measure the authors use a 9-point Likert scale for reporting perceived PD; however, the authors do not provide objective indicators for the levels of the scale and only one item assesses PD. The measure's subjective Likert scale indicates the levels of truthfulness (1-Not very true at all; 9-Very True) of the statement "When I left my house today, I made sure to stay at least 6+ feet away from other people". In this study, the authors connected this scale to self-reported step count behavior and self-reported intentions to socially distance. This item has been intended to represent the construct of "social distancing" but has introduced subjectivity into the measurement of an observable behavior. Although a construct representing behaviors intended to slow the spread of viruses may be useful and scientifically interesting, it confuses the *accurate* assessment of real-world physical distancing, namely that PD is an observable behavior, not a construct, and should be measured as an objective behavior rather than self-report. Utilizing this method allows for the creation of meaningful variables such as contacts per day, contacts with and without masks, and percentage of contacts. These methods allow for more acute estimates of the utility of PD while also providing a count variable for the risk of virus transmission.

Like PD, wearing a mask or cloth face covering has been identified as a possible method of mitigating the spread of Covid-19 (Bai, 2020). Countries with government policies supporting the use of masks by the public had a lower rate of Covid-19 transmission by approximately 46% (Leffler, Ing, Lykins, Hogan, McKeown, & Grzybowski, 2020). Mask mandates in 15 U.S. states and the District of Columbia have been associated with declines in the daily growth rate of Covid-19. These declines in Covid-19 growth have been estimated to have averted more than 200,000 cases of Covid-19 (Lyu & Wehby, 2020). At the individual level, prior to Covid-19 transmission in the household, masks were 79% effective at preventing viral transmission (Wang et al., 2020). Studies evaluating PD have indicated a positive relationship (r=.43) between PD behavior and the wearing of a mask or cloth face covering. This finding indicates that those who are willing to engage in PD are also more likely to wear a mask.

Evidence at the community level has suggested that Covid-19 airborne transmission may be dependent on setting and time. When PD is employed and combined with masks, the transmission of Covid-19 in an enclosed environment has been found to be negligible; on the other hand, when PD is employed without masks Covid-19 can be transmitted rapidly and across surprising distances. Whether an individual is outdoors or indoors, the employment of masks has been found to be associated with the effectiveness of PD (Leonhardt, 2021). While studies have evaluated compliance with stay-at-home orders and recommendations to limit trips to crowded in door situations none have evaluated violations of PD within a specific context at the individual level.

This study sought to rectify the issues within the literature measuring PD by creating a new measure of self-reported PD that is: 1) appropriate for individual level measurement, 2) based on participant's self-report of the behavior of PD, and 3) presents a less ambiguous representation of the self-reported behavior that is not reliant on a construct level measurement of PD.

The aims of the study were to: 1) develop a measure of self-reported violations of PD, representing the time and frequency of violations within a 24-hour period while accounting for environment (indoor/outdoor) and employment of masks, 2) evaluate the convergent validity of the measure by correlating the ODT with self-reported step count, 3) evaluate the convergent validity of the measure by correlating the ODT with an existing construct of social distancing (SDM), 4) estimate the strength of the ODT in predicting participant physical movement against the strength of a construct of social distancing in predicting participant physical movement. This study also explored the relationship between time spent in violation of PD and the two measures evaluating convergent validity, the ODT and the SDM. No study has evaluated the temporal dimension of PD; however it is likely that the time spent in violation of PD guidelines would increase the probability of the transmission of Covid-19.

Following from these study aims it was hypothesized that:

Hypothesis 1: Individual counts of violations of PD measured by the ODT are positively correlated with self-reported daily step-count.

Hypothesis 1a: Total time spent in violation of PD measured by the ODT are positively correlated with participant self-reported daily step count.

Hypothesis 2: Individual counts of violations of PD measured by the ODT are negatively correlated with the SDM.

Hypothesis 2a: Individual counts of violations of PD will be more highly correlated with participant step count than the SDM.

Hypothesis 2b: Total time spent in violation of PD measured by the ODT is negatively correlated with the SDM.

CHAPTER 2

METHODS

Participant Recruitment

To address the study aims, a single-group, single-time point observational study was conducted with University of New Mexico students (N=50). We selected college students because they have been identified as a significant source of community spread and multiple reports have indicated college students are less likely to engage in PD. To increase generalizability this study sought to limit both inclusion and exclusion criteria. The two inclusion criteria were: 1) Student must have been enrolled in courses at the University of New Mexico and 2) owned a smart phone or device that tracked step count. To limit the possibility of cognitive interference with reporting, exclusion criteria included: 1) no lifetime self-reported traumatic brain injury and 2) no evidence of psychoticism in the past year.

Measures/Variables

Physical distancing was evaluated using the O'Sickey Distancing Test (ODT). This brief six-item measure was designed to characterize the quantity and frequency of self-reported counts of violations of PD occurring within a 24-hour period, evaluate time (in minutes) spent in violation of PD, and assess the use of masks when violations of PD did occur. To assess these parameters the measure contained the following two questions: "*In the past 24-hours, how many contacts outside of your immediate household did you have within 6-feet?" How many individuals were within the 6-feet during your contact?" "Were you wearing a mask during this contact?" "How many individuals within 6-feet* *during this contact were wearing a mask?" "Did the contact happen indoors or outdoors?* "*For each contact above please approximate the time spent, in minutes, within the 6-foot distance recommendation."* PD was evaluated as the number of times that an individual violated the 6-foot distancing guidelines. This count of PD violations was correlated with individual participant step count and the single item assessing social distancing from the SDM to test Hypotheses 1 and 2. Time spent in violation of PD guidelines was correlated with participant steps per day and the single item assessing social distancing from the SDM to test Hypotheses 1a and 2b.

Participant physical movement: Participant physical movement was measured via step count collected via participant self-report. Participants with a health tracking device on their smart phone or device were asked to report their total steps for the day when they completed their survey. Participant physical movement was correlated with PD violations and time spent in violation of PD to test hypotheses 1 and 1a. The strength of correlation coefficients predicting participant physical movement was evaluated using Steiger's test of correlated correlations within a sample to test hypothesis 2a.

Social Distancing was evaluated using the Gollwitzer Social Distancing Measure (SDM; Gollwitzer, Martel, Marshall, Hohs, & Bargh, 2020). The single question rated on a Likert-type scale (1-Not very true at all; 9-Very True), "If I have to leave the house, I make sure to stay at least 6 feet away from other people." Participant responses to the SDM were correlated with PD violations and time spent in violation of PD to test hypotheses 2 and 2b. Here violations of physical distancing (PD) were calculated as the total number of self-reported violations of PD from the ODT and the time spent in violation of PD was calculated as the sum of the time spent in violation of PD. The strength of correlation coefficients predicting participant physical movement were evaluated using Steiger's test of correlation coefficients to test hypothesis 2a.

Covariates

Physical Activity was measured using the Physical Activity Scale (PAS: Aadahl & Jorgensen, 2003). This 9-item scale evaluated physical activities by measuring time spent in sedentary, light, moderate, and high activity, in the workplace and during leisure time. The PAS has been validated using structured interviews and has been shown to be positively correlated with participant step count using Spearman rank-order correlations. For this study total time spent engaged in light, moderate, and heavy physical activity across workplace and leisure activities were summed to create a variable of total time spent in physical activity. The study variable was computed by averaging the individual sums of each participant.

Perceived Covid-19 *Risk* was assessed using the six-item Likert-scale Covid-19 Risk Perception Scale (CRPS: Dryhurst, et al., 2021) covering affective and cognitive dimensions to provide a global index of perceived Covid-19 risk. Scaling of the CRPS was modified for this study so that all scales were measured on a 10-point Likert-scale for consistency. A prototypical item from the CRPS is "How worried are you personally about Covid-19 at present? (0 = Not at all worried, 5 = Moderately worried, 10 = Very worried)." The mean score of the six-item scale provided an average of perceived Covid-19 risk and this score was included as a covariate in multivariate analyses. The CRPS has demonstrated good internal consistency in the United States with a Cronbach's alpha of 0.82 (Dryhurst, et al., 2021).

Screening measures

The two screening measures used in this study were chosen from the University of New Mexico Psychology Clinic to screen for psychoticism and possibility of traumatic brain injury (TBI).

Psychoticism: A 3-item binary response choice (0=No-1=Yes) measure was used to screen for potential psychoticism. Participants were excluded for answering in the affirmative to any of the three questions evaluating psychosis. The items included in the psychoticism scale are: "In the past year, have you heard things that others could not hear?", "In the past year, have you felt like people were out to get you or that you were receiving special messages from the television or radio?", and "In the past year, have you seen things that others could not see?"

Traumatic Brain Injury: A 2-item binary response choice (0=No-1=Yes) measure of TBI was used to screen for the possibility of lifetime brain injury. Participants who answered in the affirmative to either of the two items were excluded from study participation. The two items included in the measure are: "Have you ever been hospitalized for a head injury?" and "Have you ever had a head injury resulting in a loss of consciousness for 5+ minutes?"

CHAPTER 3

ANALYSIS

Spearman's rank correlation coefficient is the non-parametric version of the Pearson product moment correlation and is suitable for use when data distribution considerably violates the assumptions required for a Pearson product moment correlation. The Pearson product moment correlation assesses the linear relationship between variables, while Spearman's rank correlation determines the strength and direction of the monotonic relationship between two variables. Spearman's rank correlation is the most appropriate method for evaluating relationships between nominal and ordinal variables (Hypothesis 1 & 1a) and most appropriate method for evaluating relationships between two nominal variables (Hypothesis 2 & 2a). All variables used in the data analysis are included in Table 3 with information regarding computation and references used for variable construction. Significance of each tested hypothesis was determined by observing the direction of the correlation coefficient ρ, designation of a significance level of $p < 0.01$ for all hypotheses, and for hypotheses 1, 1a, and 2a, 99% confidence intervals not containing zero.

Steiger's test for correlated correlations was used to determine the strength of the ODT and the SDM in predicting participant self-reported step count. Steiger's test for correlated correlations within a population is the most appropriate small sample size method for evaluating the relationships between two correlations from a single group when both are predicting the same dependent variable (May & Hittner, 1997). This test provides a *t*-value that can be evaluated against critical values of *t* to determine if there is a statistically significant difference between the strength of the two correlations in predicting time spent in violation of PD.

CHAPTER 4

RESULTS

All data was cleaned, and descriptive statistics were analyzed using SPSS v. 21, Spearman's rank correlations were conducted using the Jamovi software extension for R (Jamovi, 2021), and Steiger's t-test of correlated correlations was conducted using software from quantpsy.org (Lee & Preacher, 2013). The distribution of data points for violations of PD, participant self-reported step count, the single item from the SDM, and time spent in violation of PD met the assumptions required for a Spearman's rank correlation. The assumptions of the Spearman correlation are that the data must be at least ordinal and values of one variable must be monotonically related to the other variable in the equation. Figures 1-5 display the scatterplots for the data distributions. Violations of PD as measured by the ODT were significantly skewed (3.302) and kurtotic (16.899) and time spent in violation was also skewed and kurtotic (11.419). Table 2 displays skewness and kurtosis statistics for all variables used in hypothesis testing.

Inspection of the data revealed five participants who completed the demographic portion of the survey but opted to not respond to the items querying PD, self-reported steps, or measures of social distancing and these participants were dropped from the analysis. Two participants were observed to have reported values outside of the range of the scales for exercise with one participant reporting exercising 420 hours in a 24-hour period and another participant reporting seven hours of heavy physical activity and reported less than 100 steps in the 24-hour period measured, these participants were also not included in the final analysis. All other participants were retained. Participants in this sample (N=43) were majority Female (74%) minority Male (22%). Racial composition was mostly Caucasian (72%) with the next greatest reporting African American (8%). The majority of the participants reported having some college (60%) and the next greatest level of education reporting having attained bachelor's degrees (14%). Much of the sample reported having never been married (78%) with a single participant reporting having been divorced. Household income was non-normally distributed with the largest proportion of the sample (26%) reporting less than $10,000 per year in income (Table 1 contains full demographic descriptions of the sample). The average number of violations of PD as measured by the ODT were ($M = 4.55$, SD 7.79), with total time spent in contact in minutes ($M = 186.111$, $SD = 302.913$), and average steps in the 24-hours measured was ($M = 5351$, $SD = 4{,}464$). The mean reported truthfulness of adherence to PD guidelines measured via the SDM was ($M = 6.17$, $SD = 1.505$). Table 1 contains the means, standard deviations, and frequency counts for the variables included in the data analysis.

Correlations and Regressions

Hypothesis 1, that individual counts of violations of PD as measured by the ODT would be positively correlated with self-reported step count was tested using the Spearman's rank correlation. The hypothesis that violations of PD would be positively related to step count was not supported, $r(41) = 0.186$, $p = 0.122$, 99% CI [-0.225, 0.541].

Hypothesis 1a, that individual counts of violations of PD as measured by the ODT would be correlated with self-reported time spent in violation of PD was tested via the Spearman's rank correlation. The hypothesis that violations of PD would be significantly positively correlated with time spent in violation of PD was supported $r(43) = 0.721$, $p < .001$, 99% CI [0.465, 0.866].

Hypothesis 2 was proposed to establish the convergent validity of the ODT with the SDM. The hypothesis was supported, r(41) = -0.554., p < .001, 99% CI [-0.778, -0.204] indicating that the self-report of violations of PD were significantly negatively correlated with participant self-report on the SDM.

Hypothesis 2a that violations of PD, when compared to the SDM, would be more highly correlated with self-reported step count was not supported z (39) = 1.544, p = 0.0612. This result was trending at the p < 0.05, indicating that violations of PD may be a stronger predictor of participant self-reported step count.

Hypothesis 2b that the total time spent in violation of PD measured by the ODT will be negatively correlated with the SDM was not supported by the result of the Spearman's rank correlation r(41) = -0.296, p = 0.030, 99% CI [-0.618, 0.112]. Notably, this result was significant at a level of p < 0.05, however, the confidence interval, 99% CI [-0.553, 0.012] included zero indicating a non-significant result.

Exploratory Analysis

Upon observation of the data presented it was noted that violations of PD were non-normally distributed with a significant number of reports of zero or one contact. Two models were considered to evaluate this result. Poisson regression, a discrete probability distribution that indicates the likelihood of a given number of events, like violations of PD, in a fixed interval was considered. Although the Poisson distribution is optimal for determining the relationship with count variables, inspection of the data indicated that the variance of violations of PD exceeded the mean. In count dependent variables when the variance exceeds the mean there is an indication that the data is overdispersed and a

Poisson regression is inappropriate. Negative binomial regression, an extension of Poisson regression where the conditional variance exceeds the conditional mean in the observed data was a more appropriate method of modeling the data.

Violations of PD were included as a dependent variable with total time spent exercising and perceived Covid-19 risk included as covariates. The model converged; however, the result returned was non-significant $p = .969$ and fit indicators, Akaike's information criterion (AIC; AIC= 188.564) and the Bayesian information criterion (BIC; BIC=199.131) indicated that the fitted model was a poor fit for the data.

CHAPTER 5

DISCUSSION

The aims of this study were to 1) develop a measure of self-reported violations of PD representing the time and frequency of these violations within a 24-hour period, 2) evaluate the convergent validity of the measure by correlating the ODT with participant self-reported step count, 3) evaluate the convergent validity of the measure by correlating the ODT with a different but similar construct, the SDM 4) estimate the strength of the ODT in predicting participant physical movement against the strength of the SDM in predicting participant physical movement and 5) evaluate the relationship between time spent in violation of PD guidelines and the two measures included to evaluate convergent validity.

Violations of PD and participant endorsement of the SDM did not predict participant self-reported step count. Although this relationship has been observed in previous studies (Gollwitzer, Martel, Marshall, Hohs, & Bargh, 2020) it is likely that the variability in the current study sample was different from the that of Golwitzer and colleagues. One candidate for explaining this difference was the low number of self-reported violations of PD in the current study. This explanation is unlikely, given that the SDM was slightly less related to participant self-reported step count and this result was also non-significant. It is possible that the results of the Golwitzer study were not generalizable to a sample of college students. Notably, the Golwitzer study utilized a sample collected from Amazon Mechanical Turk (M'Turk), a crowdsourcing website for businesses that provides "workers" the opportunity to answer surveys for remuneration. Recent research (Paolacci & Chandler, 2014; Buhrmester, Kwang, & Gosling, 2011) has questioned the validity of data collected from the platform from M'Turk workers, noting that workers are generally older, more highly educated, and more likely to be underemployed compared to the general population.

Another possible reason for the lack of observed relationship between violations of PD as measured by the ODT and participant self-reported step count was the time between the Golwitzer study and the current study. The Golwitzer study was published in April of 2020 and the data for the current study was collected in the Fall of 2020 and Spring of 2021. Between April, 2020 and May, 2021 there was significant variability in the application of stay-at-home orders between states. New Mexico, where the current study data was collected, was noted to have rescinded and renewed requirements for stay-at-home orders 16 times between March 2020 and May 2021 (NMDOH, 2021). Other states have experienced similar variability in stay-at-home requirements. Notably, M'Turk workers are primarily located in India and the United States, two countries that have differed significantly in their response to the global pandemic.

Although the proposed relationship between violations of PD and participant self-reported step count was not supported, two other tests of convergent validity were supported. Notably, time spent in violation of PD and a significant negative relationship with the SDM were both observed in the current sample suggesting that the ODT is a valid method of assessing violations of PD.

Limitations

This study has significant strengths and limitations. Based in a recent empirical literature base, the ODT was developed with a priori hypotheses and adequately powered statistical tests to appropriately assess findings. Despite these strengths, there are some confusing findings. Foremost among these is the lack of relationship between the SDM and variables expected to be related to social distancing. This was perhaps the most difficult relationship to reconcile within this data set and multiple different methods of analyzing these relationships were attempted. Despite these attempts to understand the association between these variables, the relationships examined did not yield levels of significance determined a priori.

An important limitation in this study is the lack of racial diversity in this sample. Although this sample was collected in a majority minority demographic area, most of the sample identified as Caucasian females, an occurrence which is common in college student samples. The lack of diversity in the sample presented a population that was too homogenous to conduct independent analyses evaluating differences in PD by race or ethnicity. A final limitation of this project is that traditional measure validation is conducted in between subjects designs, as was this study; yet, the ODT is optimally designed for within-subject administration. Thus, a primary goal of future projects should be to evaluate the reliability of this measure in a within-subjects design.

From the time this project was proposed and the writing of this discussion, deaths in the United States related to Covid 19 have increased by 47%, an additional 262,000 deaths (John's Hopkins, 2021). In the past few months over 76.6 million Americans have been vaccinated against Covid 19 (Carlsen, Huang, Levitt, & Wood, 2021) and hope has begun to return to the US. Despite these generally promising statistics there are significant differences in vaccine administration between states. Notably, New Mexico has currently fully vaccinated (two doses) 64.5% of the population whereas Michigan has fully vaccinated 53% of the population. In states where vaccination rates are higher, new cases of Covid-19 have slowed whereas those states where vaccination has lagged behind, cases have begun to rise again and hospitals are again nearing capacity (Michigan.gov/coronavirus). This increase in cases has continued despite reintroduction of statewide regulations encouraging citizens to stay-at-home except for essential activities (e.g. grocery shopping). These trends indicate the increasing importance of behavioral measures of mitigation efforts on the part of individuals in empirical studies of virus spread.

Although the future of the United States and its response to Covid-19 seems clearer than one year prior, the ODT can provide some clarity in the area of measurement of PD. Perhaps ominously, public health officials have opined that as we grow closer to the natural world, the next pandemic is a matter of "when" and not "if". With this thought in mind, there is hope that this measure, although perhaps too late for study in the current global pandemic, will be useful for the next.

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APPENDIX A FIGURES

Figure 1. Scatterplot of Steps by Violations of PD

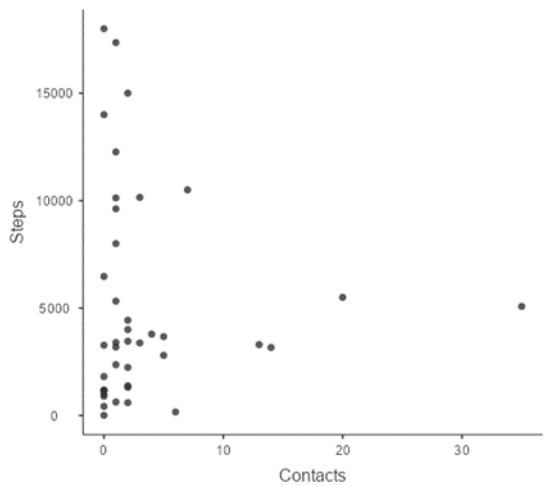


Figure 2. Scatterplot of Social Distancing by Steps

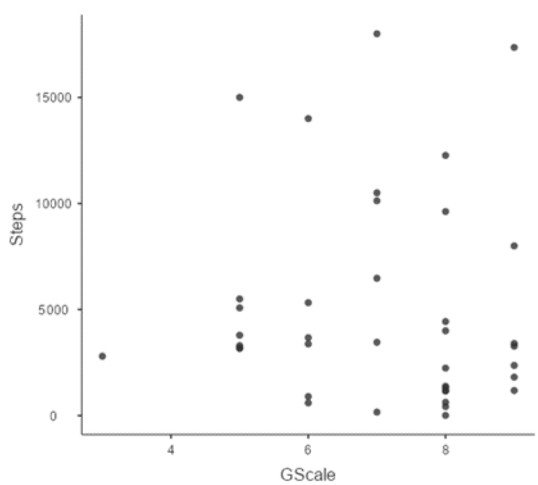


Figure 3. Scatterplot of Contacts by Minutes in Contact

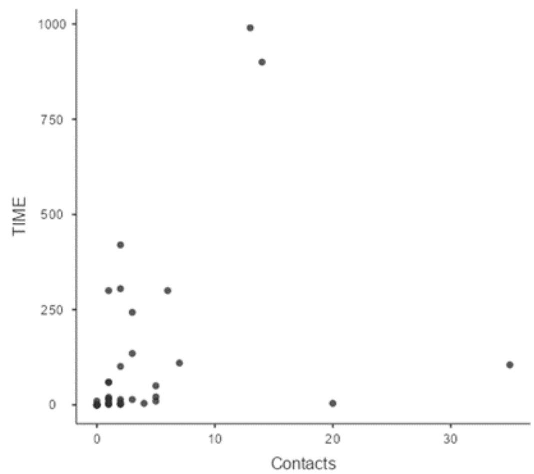


Figure 4. Scatterplot of Social Distancing by Minutes in Contact

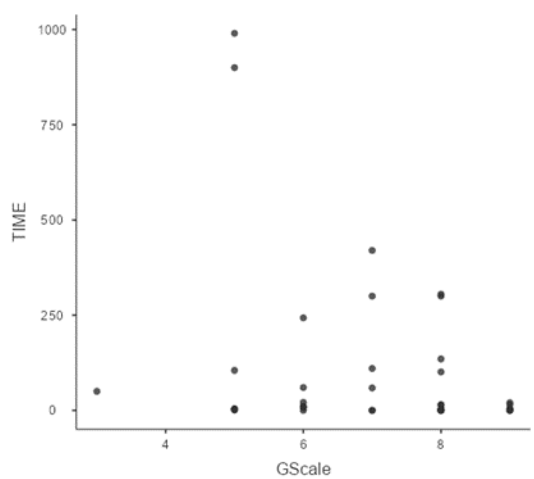
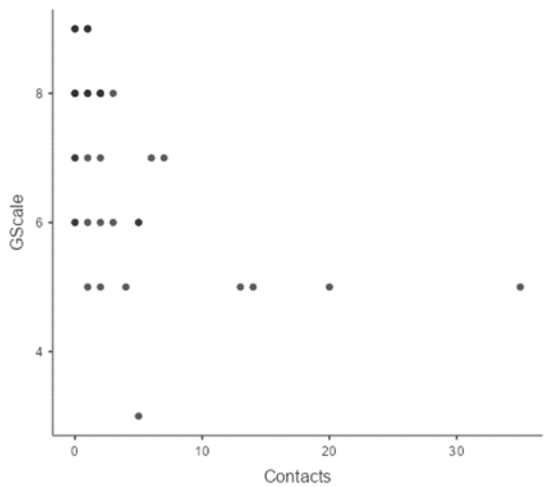


Figure 5. Scatterplot of Social Distancing by Contacts



APPENDIX B TABLES

Tables

Table 1. Descriptive Statistics

	N	%	Mean	SD
Violations of PD	43		3.47	6.40
Steps	41		5015	4839
Minutes of contact	43		98.4	215
Social distancing	41		7.05	1.52
Gender				
Female	29	67.4		
Male	14	32.6		
Education				
High School/GED	4	9.3		
Some College	24	55.8		
AA/AS	4	9.3		
Bachelors	7	16.3		
Masters	4	44.2		
Race				
AI/AN	1	2.3		
Asian	2	4.7		
White	34	79.1		
Biracial	2	9.3		
Other	4	9.3		
Hispanic/Latino	11	25.6		
Marital Status				
Divorced	1	2.3		
Married	8	18.6		
Never Married	34	79.1		

PD= Physical Distancing, AA/AS= Associates of Arts/Associates of Science, AI/AN=American Indian/Alaska Native

Table 2 Skewness & Kurtosis Indices

	Contacts	Steps	TIME	SDM
N	43	41	43	41
Missing	0	2	0	2
Mean	3.47	5015	98.4	7.05
Standard deviation	6.40	4839	215	1.52
Variance	40.9	2.34e+7	46320	2.30
Minimum	0.00	11.0	0.00	3
Maximum	35.0	18000	990	9
Skewness	3.56	1.32	3.16	-0.539
Std. error skewness	0.361	0.369	0.361	0.369
Kurtosis	14.6	0.888	10.4	-0.418
Std. error kurtosis	0.709	0.724	0.709	0.724

Contacts= Number of self-reported violations of physical distancing, , Time= Time spent in violation of physical distancing guidelines, Steps= Participant self-reported step count SDM=Social distancing measure.

Table 3. Correlation Matrix of Primary Study Variables

	Contacts	Steps	TIME
Spearman's rho	—		
p-value	—		
N	—		
Spearman's rho	0.186	—	
p-value	0.122	—	
N	41	—	
Spearman's rho	0.721**	0.199	—
p-value	< .001	0.211	—
N	43	41	—
Spearman's rho	-0.554**	-0.162	-0.296
p-value	< .001	0.162	0.030*
N	41	39	41

Note. ** p < .001, * p < .05, Contacts= Number of self-reported violations of physical distancing, Time= Time spent in violation of physical distancing guidelines, Steps= Participant self-reported step count, SDM=Social distancing measure.