Identifying as Someone who Avoids Virus Transmission Strengthens Physical Distancing Habit-Behaviour Relationships: A Longitudinal Multi-National Study During the COVID-19 Pandemic

Abstract

Physical distancing remains an important initiative to curb COVID-19, and virus transmission more broadly. This exploratory study investigated how physical distancing behaviour changed during the COVID-19 pandemic and whether it was associated with identity with virus transmission avoidance and physical distancing habit strength. In a longitudinal, multinational study with fortnightly repeated-assessments, associations and moderation effects were considered for both overall (person-level means) and occasion-specific deviations in habit and identity. Participants (N=586, M age = 42, 79% female) self-reported physical distancing behavioural frequency, physical distancing habit strength, and identity with avoiding virus transmission. Physical distancing followed a cubic trajectory, with initial high engagement decreasing rapidly before increasing again near study end. Physical distancing was associated with both overall and occasion-specific virus transmission avoidant identity and physical distancing habit strength. People with strong virus transmission avoidant identity engaged in physical distancing frequently regardless of fluctuations in habit strength. However, for those with weaker virus transmission avoidant identity, physical distancing was strongly aligned with fluctuations in habit strength. To enhance engagement in physical distancing, public health messaging might fruitfully target greater or more salient virus-transmission avoidance identity, and stronger physical distancing habit.

Keywords: behaviour change; maintenance; disease outbreaks, COVID-19 health practices; social distancing

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Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first identified in December 2019, and as of October 2021, the global death toll was near five million people (World Health Organisation [WHO], 2021). SARS-CoV-2 spreads through aerosols from respiratory droplets among people in close proximity, causing COVID-19 (Greenhalgh et al., 2021). Although many individuals succumb to severe pneumonia-like symptoms (Coroiu et al., 2020), the virus is transmitted both by symptomatic and asymptomatic individuals (Bai et al., 2020). Despite the international rollout of vaccination programs, evidence suggests achieving immunity from COVID-19 will be difficult (Forni & Mantovani, 2021). Some emergent variants have shown greater resistance to vaccines (Abu-Raddad et al., 2021).

A common strategy that many government bodies recommended to break the chain of person-to-person transmission and reduce the rate of infection and death was physical distancing (also referred to as 'social distancing') — standing one-to-two metres apart from others when in public (Chu et al., 2020; Lewnard & Lo, 2020; WHO, 2020). Prediction modelling simulations estimated that physical distancing practices may be required for the foreseeable future to limit overloading of health systems and prevent a possible resurgence in contagion (Kissler et al., 2020). Physical distancing is also likely to be recommended for virus transmission reduction in future pandemics.

There has been some evidence on psycho-social factors that influence physical distancing behaviour. For example, some evidence suggested that physical distancing is motivated partially to fulfil people’s needs to minimise virus transmission or desires to comply with government directives (Chung & Chan, 2021). Additionally, research has shown that physical distancing is predicted by fear of virus contagion and self-efficacy to sustain

mitigation practices (Bogg & Milad, 2020; Trifiletti et al., 2021). Other research suggested intention to engage in physical distancing behaviours is enhanced via behavioural self-efficacy, moral obligation (toward those at greater risk), perception of significant others' expectations, and action planning (Hagger et al., 2020).

Most evidence of psycho-social predictors of physical distancing has focussed on values and beliefs, but this does not provide a comprehensive perspective on psychological influences of physical distancing behaviour. To translate into behaviour, values and beliefs need to be reflected on and actioned through intention and self-regulation (Friese et al., 2011; Strack & Deutsch, 2004). Although these factors are indeed important in predicting future behaviour, it is also important to consider influences on behaviour that are not so reliant on conscious reflection. Dual process models put forth that there are two forms of psychological influences on behaviour – reflective influences such as values and expectancies, and automatic influences such as biases and habits that influence behaviour non-consciously, spontaneously and without intent (Evans, 2003, 2009). Compared to reflective influences, automatic influences are theorised to be less prone to wane over time because of shifts in priorities or erosion of motivation. Evidence has suggested that complacency may set in for virus transmission avoidant behaviours (Backer et al., 2021; Reicher & Drury, 2021). For example, contact surveys using cross-sectional data of mobility patterns showed physical distancing behaviours significantly waned in Denmark in June 2020, consistent with a relaxing of virus mitigation practices although physical distancing measures remained (Backer et al., 2021). Backer et al. (2021) found irrespective of the government directive to physically distance, younger cohorts showed a significant increase in community contacts that steadily declined as age increased. Other research highlights adherence to social distancing measures for those infected by the virus was low (e.g., 18%) and likely reflected a deprivation in resources for necessities such as food, money, and safe accommodation

(Reicher & Drury, 2021). It is therefore necessary to explore how automatic processes, such as habit and identity, might influence physical distancing behaviour.

Physical Distancing Habits

Habits are recurring behavioural influences that are automatically evoked when responding to a situation, in which the behaviour has previously been consistently and repeatedly performed (Gardner, 2015). Repeating an action regularly in the presence of the cue serves to reinforce mental cue-action associations that are stored in memory. As habit forms, the reliance on conscious cognitive control to initiate action is alleviated, and the action becomes a more automatic response to associated cues (Lally et al., 2011). Habit increases the likelihood of future behavioural frequency such that encountering the cue prompts the action non-consciously, even amidst competing goals or lapses in motivation and concentration (Hagger & Rebar, 2020). In the context of the COVID-19 pandemic, repeated physical distancing within the relevant stable context, such as whenever near another person when outside of the home, might be expected to have led to the formation of habits for physical distancing behaviour, which in turn motivate future physical distancing behavioural frequency. Indeed, Hagger et al. (2020) found strong relationships between habit strength and physical distancing behaviour in the United States (r = 0.64) and Australia (r = 0.69), and Hagger et al. (2021) found that, along with intention, habit strength predicted physical distancing across one week and four months.

Past studies of the impact of habit on behaviour have tended to focus on between-person effects, but it is also important to consider whether within-person fluctuations in habit strength have an influence on physical distancing behaviour. Habit strength has shown to change over time through transformative processes such as formation or degradation (Kwasnicka et al., 2016; Orbell & Verplanken, 2015; Rebar et al., 2016). Although habit theory postulates that habits are slow-to-change memory traces of cue-action associations, it

is also reasonable to expect people's reported automaticity of their behaviour to fluctuate from one occasion to another, given that self-reported habit indices capture symptoms of habit manifestation on behaviour – how automatic the behaviour feels. Over any given time, a person will have an overall tendency of a strength of habit, but on some occasions, they may report habit strength scores that deviate from this general tendency, either owing to true change in habit strength or as a result of shifts in the manifestation of the symptoms of habit on behaviour at that time. Notably, amidst a burgeoning field of research on habit-behaviour associations, possible fluctuations in reported habit strength over time have largely been neglected. It could be expected that fluctuations in physical distancing habit strength and behavioural frequency may co-occur, such that when the manifestation of habit strength is particularly strong for a person, they will engage in more physical distancing behaviour.

Identifying as Someone who Avoids Virus Transmission

Beyond acting out of habit, people may engage in frequent physical distancing behaviour because it aligns with their identity. Theorised as an automatic influence on behaviour, identities provide people with an intrinsic reference for future role-appropriate behaviours (Sparks & Shepherd, 1992; Stryker & Burke, 2000). A person forms a set of standards that conform to the meaning and expectations of an identity and are motivated to act accordingly (Burke, 2006), such as a health-conscious and/or altruistic identity that is consistent with physical distancing behaviour. Discordance between behaviour and identity has shown to create an uncomfortable affective state that can elicit motivational urges to act in line with identity to avoid these negative feelings (Stets & Serpe, 2013; Stracham & Brawley, 2008). The impulse to repeat identity-congruent behaviours has been theorised to reinforce one's self-belief as being that "type of person" because the behaviour is perceived as an important part of oneself (Charng et al., 1988; Ogden & Hills, 2008; Stryker, 1987).

A person's identity has been theorised to be tightly aligned with behavioural frequency in that it is both shaped through past behaviour and influences future behaviour through motivating behavioural choices consistent with the identity (Stryker & Burke, 2000). Studies support this notion, for example, identity has been found to increase the likelihood of engagement in pro-environmental actions (Cafora et al., 2017), binge-drinking (Gardner, de Bruijn, et al., 2012), physical activity (Rhodes et al., 2016), organic food purchasing (Carfora et al., 2019), and blood donation (Charng et al., 1988). In the context of COVID-19, a person may adopt an identity as being 'the kind of person who' tries to avoid transmission of the virus, which would be expected to consistently generate engagement in physical distancing. Those who identify with moral aspects of reducing virus contagion have been found to be more likely to adhere to mitigation strategies in order to protect vulnerable community members from COVID-19 contagion (Christner et al., 2020; Prosser et al., 2020).

People will have an overall tendency of the degree to which they identify as someone who avoids virus transmission, and this will likely deviate from one occasion to the next, either through change in the degree of identity strength or in the experienced manifestation of identity on behaviour at that time. It is therefore reasonable to expect physical distancing behavioural frequency to align with virus transmission avoidant identity, both overall (between-person) and with occasion-specific fluctuations (within-person).

Virus Transmission Avoidant Identity may Impact the Influence of Habit Strength on Physical Distancing Behavioural Frequency

Both identity and habit strength have been found to enhance behavioural maintenance (Rhodes & Sui, 2021; Rhodes et al., 2021; Verplanken & Sui, 2019), but it has not yet been tested whether there is synergy at play in these effects. Both identity and habit strength influence behaviour through reward mechanisms; habits form through reward (de Wit & Dickinson, 2009) and achieving identity standards can be rewarding (Spruijt-Metz et al.,

2015). It could be that the reward experienced from engaging in identity-congruent behaviour acts as a catalyst for the habitual influence on behaviour, making behaviour more likely to be habitually influenced if identity is strong. However, the potential moderating impact of identity on habit strength – behavioural frequency associations has not yet been considered.

The Present Study

This study aimed to provide a more comprehensive understanding of change in physical distancing behavioural frequency and the role of habit and identity in behavioural frequency of physical distancing. Given the lack of empirical evidence on trajectory of change in physical distancing over time, no hypotheses were formed, and investigation of the trajectory of change in physical distancing behavioural frequency was exploratory.

Psycho-social constructs can change and their behavioural manifestation may fluctuate from one occasion to another, so it is important to consider whether the processes are a function of individual differences or between-person processes (Shiffman et al., 2008). Therefore, the present study considered both between- and within-person influences of virus transmission avoidant identity and physical distancing habit strength on physical distancing behavioural frequency. Specifically, the study sought to investigate whether physical distancing behavioural frequency was associated with people's overall (i.e., person-level mean) identity as someone who avoids virus transmission, overall habit strength for physical distancing, or occasion-specific fluctuations (i.e., occasion score – person-level mean) in habit and identity strength. Finally, the study aimed to determine whether virus transmission avoidant identity moderated the association between physical distancing habit strength and physical distancing behavioural frequency. Given there was not a strong evidence base on the issue, no hypotheses were formed, and the investigation was exploratory.

Methods

Design and Procedure

Data from the present study were collected as part of a larger international longitudinal study investigating a number of hygiene behaviours and people's motivation and wellbeing during the COVID-19 pandemic in 2020. The present study used data relating to physical distancing behaviour frequency, physical distancing habit strength, and transmission-reduction identity. The study was open to any person aged 18 years or older. Recruitment was through social media and email lists across the UK, Germany, Denmark, Italy, and Australia, with participants directed to either an English, German or Italian language survey. The survey (Qualtrics, Provo, UT) was open to participants from April 1 to October 9, 2020, although start dates were staggered across countries. Participants could enter the study at any point until July and were sent automated email invitations for follow-up surveys every two weeks from point of study entry until study completion. Depending upon entry date, the maximum number of surveys participants could have completed were 14 English surveys, and 12 German and Italian surveys. People from other countries were also invited to complete the English version of the survey. Ethics Committees of host site institutions granted approval for all study procedures. Given the aim of the study was to consider change over time, only data from participants who contributed three or more surveys were eligible for the present study. Of 962 participants who completed the baseline survey, data were used from the 586 (61.5%) participants who completed three or more surveys. Of the sample used for this study, 9 or more surveys were completed by 50% of the present study sample (Number of surveys completed: M = 8.37, SD = 3.43; 25% IQR = 5, 75% IQR = 12; Figure 1).

[INSERT FIGURE 1 HERE]

Study Timeline

The United Kingdom was in national lockdown at the start of data collection on 1st April 2020, wherein people were prohibited to leave their residence except for essential

services, until restrictions gradually eased from May 2020. Public health containment measures, such as physical distancing, were in place across the UK for the entirety of the study however, the requisite distance shifted from 2 meters to 1 meter in late June 2020.

The Italian survey opened on 18th April 2020, five weeks into national lockdown that concluded on 3rd June 2020, with a minimum of 2-meter physical distancing containment measures active throughout the study. The German survey opened on 28th April 2020, two weeks after restrictions were relaxed, though schools, nursing homes, and borders remained closed and were accompanied by public health directives that included physical distancing of at least 1.5 meters. Similarly, physical distancing measures implemented in Denmark and Australia across the study's timeline entailed a minimum distance of 1.5 meters.

Measures

All measures were self-reported. Demographic information was collected at baseline only and included age (in years), gender (woman/man/non-binary/prefer not to say/other), education (I am still in full-time education/[*open response for year*]/over 65), and country of residence (open response).

Physical distancing behaviour frequency, habit strength, and identity with reducing virus transmission were assessed at every timepoint. To reduce participant burden, brief (one- or two-item) measures were used. Although not appropriate for capturing the breadth of complex, multifaceted constructs, such brief measures have been shown to have as much validity and reliability as more extensive, multi-item scales measuring the same constructs, while reducing response fatigue and participant burden in repeated measures studies such as ours (Allen et al., 2022).

Physical distancing behaviour frequency was assessed using one item with a five-point Likert response scale: "When I was around other people yesterday, I stayed at least 2m away from them."(1), "None of the time" (2), "Almost none of the time", (3), "Some of the time"

(4), “Most of the time” (5), “Every time” –with a sixth option (“Not applicable”) treated as missing. Immediately before this question was presented to participants, text appeared clarifying that: “In the next question, ‘other people’ means people OTHER THAN THOSE IN YOUR HOUSEHOLD.”

Habit strength was assessed using two automaticity items from the Self-Report Habit Index (Verplanken & Orbell, 2003), which are also used in the Self-Report Behavioural Automaticity Index (SRBAI; Gardner, Abraham, et al., 2012): (“[When I am around other people, staying at least 2m away from them is something] …I do automatically”; "I do without thinking”; 1 [“Strongly disagree”] to 7 [“Strongly agree”]). These two items were selected because they strongly load on automaticity factors in structural analyses of the scales (e.g., Morean et al., 2018), while showing good face and discriminant content validity (Gardner, Abraham et al., 2012). A scale score was calculated as the average of the two automaticity responses. Spearman Brown interitem reliability was 0.94 (Willse, 2018).

Following Sparks and Shepherd (1992), identity as someone who avoids virus transmission was measured using one item: “I see myself as a person who takes all steps necessary to avoid spreading viruses…” (1) “Strongly disagree” to (7) “Strongly agree”.

Data Management and Analyses

Assumption testing was conducted for the models with no violations found. Specifically, visual distributions and plots were inspected as well as descriptive statistics and bivariate correlations to test for univariate and multivariate normality prior to model fitting. Throughout model fitting visual inspection was used to confirm model assumptions of linearity (prediction plots), homogeneity of variance (fitted vs residual plots), and normality of residuals (QQ plots). There was 2.4% of missingness in the data of which 9.8% of all missingness was from ‘not applicable’ responses to the physical distancing behavioural measure. Inspection of patterns of missingness showed that missingness was not at random,

indicating that imputing was not appropriate. Complete case analysis was therefore applied within the models.

Intraclass correlations (ICCs) were calculated to establish the ratio of between- vs within-person variability for the study variables, with values nearer to 0.00 indicative of more variability attributable to change within-person over time rather than between-person differences, and values nearer to 1.00 indicative of more variability due to between-person differences than change over time within-person. Multilevel modelling via *lme4* package (Bates et al., 2014) of *R* (R Core Team, 2019), which accounts for nesting of data within-person over time, was estimated to test the hypotheses.

The habit strength and identity variables were parsed into between- and within-person variables. Between-person variables were calculated as each individual's average value across occasions; within-person variables were calculated as the deviation from each individual's average per occasion (Shiffman et al., 2008). To account for change in physical distancing behaviour over time, a series of natural polynomial growth curves were estimated. Model fit comparisons were conducted to determine which curve modelling best fit the data. To test both the between- and within-person associations of physical distancing behaviour with physical distancing habit strength and virus transmission avoidant identity, physical distancing behavioural frequency was predicted by overall physical distancing habit strength, overall virus transmission avoidant identity, occasion-specific fluctuations in habit strength, and virus transmission avoidant identity. In an extension of this model, to test the moderating effect of identity on habit strength – behavioural frequency associations, physical distancing behavioural frequency was predicted by sample mean-centred overall physical distancing habit strength, overall virus transmission avoidant identity, fluctuations in physical distancing habit strength and virus transmission avoidant identity, as well as their interaction terms. All variables in the model were interval or ratio and therefore treated as continuous. After

random effect structure testing to find the best fit for the data, random effects were set so that slopes and intercepts were allowed to vary between individuals. To provide effect size estimates, **pseudo-R^2** values were calculated as suggested by Byrnes (2008) using the *sjstats* package (Lüdecke, 2021). All data and script for this study are available on https://osf.io/xdfe3/?view_only=ac928da808b74985858524c4197629eb.

Results

Sample Characteristics

The 586 participants resided in Germany (39.0%), the United Kingdom (32.6%), Australia (8.3%), Denmark (6.8%), Italy (5.7%), or one of 22 other countries (e.g., Belgium, Canada, Spain, Netherlands, Singapore, Switzerland, USA). Most surveys were completed in English (54.7%), with 39% completing the German and 6.3% the Italian translations. Participants identified as female (78.5%), male (19.9%), non-binary (<0.01%), other (<0.01%), or prefer not to say (0.7%). Participants' average age was 42 years (SD = 16.11). Most participants had completed some form of higher education (68.1%), though some were in current full-time tertiary education (19.1%).

INSERT TABLE 1 HERE

ICCs revealed that variability of physical distancing behaviour frequency, habit strength, and identity with reducing virus transmission was mostly at the between- vs. within-person level, with identity most stable over time and physical distancing behaviour frequency the most variable over time. However, one-third and one-half of the variability of these variables was present at the within-person level, which indicates that physical distancing behaviour, physical distancing habit strength, and virus transmission avoiding identity changed over time. Physical distancing habit strength was positively associated with physical distancing behaviour frequency and with identity with virus transmission avoidance (r = .39,

.38, respectively). Physical distancing behavioural frequency was also positively associated with identity with virus transmission reduction (r = .45).

Physical Distancing Behavioural Frequency

The growth curve modelling revealed that including the first (linear), second (quadrating), and third (cubic) polynomial curves resulted in the best fitting model with the increase from quadratic to cubic increasing model fit (χ^2 difference = 9.04, $p < .01$) and addition of the fourth curve not statistically significantly improving model fit (χ^2 difference = 2.70, p = .10). Change trajectory in physical distancing behavioural frequency is depicted in Figure 2, with the thick, black line depicting the group-level trend in change over time, shaded by the 95% confidence interval, overlaid on individual data with more solid lines indicative of more data at that coordinate point.

INSERT FIGURE 2 HERE

Physical Distancing Behavioural Frequency, Physical Distancing Habit Strength and Virus Transmission Avoidant Identity

Multilevel model results shown in Table 2 revealed that physical distancing behavioural frequency was positively associated with physical distancing habit strength and virus transmission avoidant identity at both between- and within-person levels. Overall habit strength explained 5.8% of variability in physical distancing behavioural frequency, and overall virus transmission avoidant identity explained 5.6% of variability in physical distancing behavioural frequency. Occasion-specific fluctuations in both habit strength and identity each explained 1.0% variability in physical distancing behavioural frequency. Including change over time, the model was estimated to explain 28.2% of variability in physical distancing behavioural frequency.

INSERT TABLE 2 HERE

Multilevel model results shown in Table 3 revealed that including the moderation effects increased the explained variability to 29.0%, and there was a significant moderation effect of overall virus transmission avoidant identity on the association between physical distancing behavioural frequency and occasion-specific physical distancing habit strength. Probing results revealed that the association between fluctuations in occasion-specific physical distancing habit strength and behavioural frequency was strongest for people with weak overall virus transmission avoidant identity. The moderation is depicted in Figure 3, in which the association between physical distancing behavioural frequency and occasion-specific physical distancing habit strength is depicted for people with low (1 *SD* < sample *M*), mean (*M*), and high (1 *SD* > sample *M*) overall virus avoidant identity. For all predicted values, the association was statistically significantly positive but the strength of the association was stronger for those with weak virus transmission avoidant identity: $\omega = 0.11$ [95% CI: 0.08 to 0.13] compared to those with strong identity: $\omega = 0.04$ [95% CI: 0.01 to 0.07]. Those with strong virus transmission avoidant identity tended to engage in high frequency of physical distancing, regardless of how they rated their habit strength for that two-week time period. Those with weak virus transmission avoidant identity, however, tended to not engage in physical distancing behaviour frequently, unless they felt they had particularly strong habits for physical distancing that two-week time period. No other moderation effect was found to be statistically significant.

INSERT TABLE 3 AND FIGURE 3 HERE

Discussion

The present study investigated change in physical distancing behavioural frequency across April to October 2020 and whether people's virus transmission avoidant identity and physical distancing habit strength influenced their physical distancing behavioural frequency. Notably, these associations were tested at between- and within-person levels, allowing us to

establish whether certain people tended to act differently than others, depending on overall habit strength or identity values, as well as whether fluctuations within a person's reported habit strength or identity values over time were also influential on physical distancing behavioural frequency.

Study variables were found to be relatively stable over time. Both virus transmission avoidant identity and physical distancing habit strength were mostly attributable to between-person differences across the six-month study timeline, supporting the theoretical notion that identity and habit strength are slow to change (Orbell & Verplanken, 2015; Serpe, 1987; Stets & Burke, 2000). Although notably, there was within-person variation in identity and habit strength, such that about 40% of the variability was attributable to within-person change and fluctuations. We speculate that these are shifts in how much a person is experiencing the manifestation of identity and habit strength on behaviour; but this is the first evidence that self-reported habit strength and identity fluctuate to this extent and there is undoubtedly some measurement artefact underlying some of the changes, so much more work is needed to determine the meaning of these changes and their impact on behaviour.

Physical Distancing Behavioural Frequency Trajectory

Our findings revealed that the group-level trajectory of physical distancing behavioural frequency was cubic, in that it decreased rapidly over the first few occasions, then bottomed out and began increasing again nearing the end of the study time. This initial decline may reflect the onset of complacency (Backer et al., 2021; Reicher & Drury, 2021), although it is important to not extrapolate these group level findings to individual's experiences. The likely large between-person variability in physical distancing frequency may have arisen either because of personal circumstances, opportunities, or environmental factors (such as the lifting of social restrictions in some study countries), or individual

changes in psycho-social factors such as habit strength or the degree to which they identified as someone who avoids virus transmission.

Physical Distancing Habit Strength and Virus Transmission Avoidant Identity

The present study found that physical distancing habit strength and virus transmission avoidant identity were significantly related to physical distancing behavioural frequency. These findings extend on a building body of evidence that considered the impact of habit and identity on behaviour at a between-person level (e.g., Carfora et al., 2017; Charng et al., 1988; Gardner, de Bruijn, et al., 2012; Lally et al., 2010), and theoretical notions that identity and habit play roles in behavioural change and maintenance (Rhodes & Sui 2021; Rhodes et al., 2021; Verplanken & Sui, 2019). Additionally, the study extends on a building body of evidence revealing that habit strength is an important predictor of physical distancing behaviour (Hagger et al., 2020, 2021). The significant relationships observed at both within-person and between-person levels is important because it demonstrates that physical distancing corresponds with both people's overall tendencies, as well as occasion-specific deviations in identity and habit strength. Applied to the circumstances investigated in this study, the findings may indicate that during time periods where there were more decisional opportunities to engage in physical distancing behaviour, habit strength for physical distancing and virus transmission avoidance identity might have manifested more strongly compared to when there was less opportunity to engage in physical distancing behaviour.

Transmission-avoidance identity was found to moderate the link between physical distancing habit strength and behavioural frequency, in that people who strongly identified as virus transmission avoidant tended to engage in frequent physical distancing behaviour regardless of fluctuations in physical distancing habit strength. Physical distancing behaviour was impacted by occasion-specific fluctuations in habit strength only for people who did not strongly identify as virus transmission avoidant. This finding extends on previous research

showing stronger identity is related to stronger habit (e.g., Gardner & Lally, 2013; Kaushal et al., 2018; Luyckx et al., 2008; Tilden et al., 2005). Although the roles of identity and habit have been theorised and evidenced as essential for maintained behaviour change (Rhodes & Sui, 2021; Rhodes et al., 2021; Verplanken & Sui, 2019), this is the first study to demonstrate there is synergy at play between habit and identity in influence on behaviour. Our findings suggest that habit strength comes into play most for people without strong identities relevant to that behaviour. Taken together, these results highlight the need for consideration of both habit and identity in physical distancing interventions going forward.

Practical Implications

Identifying as 'the kind of person who' engages in a behaviour is thought to provide an important mechanism for behaviour change, because from such identities flow rules regarding the appropriateness of behaviour (West & Brown, 2013). Importantly, engaging in a behaviour that violates such rules (e.g., seeking physical proximity to others), or failing to engage in a behaviour integral to adherence to such rules (e.g., not maintaining distance from others), undermines the sense of affiliation with such identity, which in turn can threaten the coherence and continuity of perceptions of oneself (e.g., Vignoles, 2011). Identity may offer a beneficial addition to behaviour change interventions based on its capacity to motivate and self-regulate behaviour in the longer-term (Husband et al., 2019; Stryker & Burke, 2000). While identity has to our knowledge not been studied extensively in most behavioural domains, studies from the smoking literature demonstrate that ex-smokers who develop an identity as a 'non-smoker' tend to sustain cessation attempts for longer (see Tombor et al, 2015). Our findings suggest that, for example, public health campaigns could portray people as ‘the sort of person who’ avoids spreading viruses, to build identity among those already doing the behaviour. Alternatively, physical distancing could be marketed in a way that

associates the behaviour with existing valued identities such as being someone who protects others.

Our within-person findings suggest priming people's identity values at the crucial point of action may be worthwhile considering as public health initiatives to enhance physical distancing behaviours. The field of marketing has largely promoted the idea that consumer behaviour is driven by priming brand salience (Guido, 2001). Advertisements aim to prime people so that their most salient values are the ones that are concordant with purchasing a product. There is evidence demonstrating priming salience of specific types of values (e.g., collectivism vs individualism) within COVID-19-based communication can impact motivation for physical distancing (Courtney et al, 2021). It may be that simple priming messages about virus transmission avoidant identity (e.g., "Be proud that you are someone helping to avoid virus transmission") could enhance physical distancing behavioural frequency if positioned at the relevant time and place where physical distancing behaviour is required. Consideration would be needed, however, to ensure priming identity does not have the unwanted effects of reducing physical distancing behaviours of those who do not have a strong virus transmission avoidant identity.

Study Strengths, Limitations, & Future Directions

A fundamental study strength was the consideration of both within- and between-person levels of analyses. This highlights the importance of capturing both overall between-person tendencies as well as occasion-specific deviations from those tendences to fully untangle the psycho-social drives of physical distancing behaviour. An additional study strength is the large, multi-national sample assuring wider generalisability of study findings, particularly as similar studies tend to rely upon smaller samples leading to limited applicability (Christner et al., 2020; Prosser et al., 2020). Finally, online administration of

study measures allowed for rapid responding to the COVID-19 pandemic from across the globe.

This present study is not without limitations. Caution needs to be applied when considering the one-item identity scale that may be insufficient to capture the multifaceted nature of the construct (Sparks & Shepherd, 1992), given that including additional identity items may have captured more comprehensive evaluations of one's identity believed to comprise moral and affective components. It may also be that investigating identity at more fine-grained levels of analysis, such as that specific to transmission of the SARS-CoV-2 virus rather than to virus transmission more generally, might have led to differences in the strength of affiliation, and so relationships between identity, habit and behaviour. Additional study limitations include self-report assessment tools of physical distancing behavioural frequency, as respondents could favour socially desirable answers or prefer consistency in responses, rather than providing accurate reflections of their experiences. It may be that participants are unable or unwilling to accurately report their physical distancing behavioural engagement. Future research might include data collection that comprises behavioural measures less prone to response bias such as observational monitoring or technology-based measures such as face-to-face proximity estimation using Bluetooth on smartphones (Liu et al., 2013). Additionally, self-report measures of habit strength assume people can accurately record processes theorised to be outside of conscious awareness therefore, some have questioned the utility of this measure (Sniehotta et al., 2012). However, the measure used in the current study does not assume respondents have direct access to these processes but rather probe people to reflect on 'symptoms' of habit (Orbell & Verplanken, 2015). As with all measures, change in values are likely a combination of true change and measurement artefact, so more research is needed to determine the true fluctuation of habit over time and the meaningfulness of the change in terms of behavioural regulation.

Other study limitations include assumptions of the analytic approach applied as well as limitations of the study design. Although the multilevel modelling applied in the study is appropriate for accounting for the nesting of the data, it applied assumptions that relationships were linear. Additionally, the parsing of between- and within-person effects based on individual means may not represent the bulk of their behavioural engagement scores if their distributions are not normal. There is reason to consider behaviour change a more idiosyncratic, non-linear process than was modelled within, so future research may consider approaches such as complex adaptive systems (Heino, et al., 2021). Furthermore, the present study is observational and correlational; hence, we cannot establish causality of these effects. So, although our findings provide preliminary evidence of the interplay of habit strength and virus transmission avoidant identity on physical distancing behavioural frequency, longer or more intensive time series data collection periods, prospective and experimental studies are needed to disentangle the directionality and coupling dynamics of these effects. Finally, the current study did not include data on participants' emotional wellbeing, mood, and health status, which may have influenced their capacity to engage in physical distancing behaviours (Galea et al., 2020).

Conclusion

This study revealed that physical distancing behavioural frequency fluctuating in a non-linear trajectory amidst early in the COVID-19 pandemic, with a relatively rapid decrease followed by a bottoming out and then gradual increase. Additionally, the study findings revealed that people who identified strongly as someone who avoids virus transmission tended to engage in more physical distancing behaviour than people with weaker virus transmission avoidant identity, and that as identity values fluctuated in behavioural manifestation, so too did physical distancing behaviour, such that when identity was particularly strong for a person, they tended to engage in more physical distancing

behaviour than they usually did. The same pattern was revealed for the impact on physical distancing habit strength and behaviour, such that people who had stronger habits tended to engage in more behaviour than those with weaker habits, and when behavioural manifestations of habits were particularly strong, people tended to engage in more physical distancing behaviour than was typical for them. Moderation analyses revealed there is also an interplay between the influence of virus transmission avoidant identity and physical distancing habit strength, such that a strong virus transmission avoidant identity may buffer from lapses in physical distancing behavioural frequency resulting from lapses in behavioural manifestation of habit strength. Consideration for utilising marketing approaches to enhance salience of branding (e.g., Guido, 2001) to revamp physical distancing public awareness messaging to enhance physical distancing habit and virus transmission avoidant identity may help lead to greater engagement of essential physical distancing hygiene behaviours during the COVID-19 pandemic and beyond.

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Table 1.

Descriptive Statistics and Bivariate Correlations of Behaviour Frequency, Habit, and Self-Identity

Variable	Possible range^	*M*	*SD*	ICC	1	2
1.Physical distancing behaviour frequency	1-5	2.92	0.92	0.55 [0.52, 0.58]		
2. Physical distancing habit	1-7	4.74	1.59	0.57 [0.54, 0.60]	0.39	
3. Transmission-limiting self-identity	1-7	5.68	1.14	0.63 [0.60, 0.66]	0.45	0.38

Note. M and *SD* represent mean and standard deviation, respectively. ICC represents Intraclass correlation. Values in brackets indicates 95% confidence intervals for ICC and each correlation. No significance indications were included in the correlations because they do not account for within-person nesting so statistical significance should not be interpreted.

Table 2

Multilevel Linear Model Estimates of Associations of Physical Distancing Behavioural Frequency with Between- and Within-Person Physical Distancing Habit Strength and Identity as Someone who Avoids Virus Transmission

	Estimate	*t-value*	95% CI
			LL to UL
Intercept	0.40	3.18	0.16 to 0.65
Linear change	-6.71	-8.39	-8.28 to -5.14
Quadratic change	6.25	8.41	4.79 to 7.70
Cubic change	-2.42	-3.31	-3.86 to -0.99
Overall physical distancing habit strength (person-level mean)	0.20	9.97	0.16 to 0.24
Overall virus transmission avoidant identity (person-level mean)	0.28	10.52	0.23 to 0.33
Occasion-specific fluctuations in physical distancing habit strength (difference from person-level mean)	0.07	0.01	0.05 to 0.09
Occasion-specific fluctuations in virus transmission avoidant identity (difference from person-level mean)	0.17	0.02	0.14 to 0.29

Note. N = 586; CI = confidence interval; *LL* = lower limit; *UL* = upper limit.

Table 3

Multilevel Linear Model Estimates of Moderation Effects of Between- and Within-Person Physical Distancing Habit Strength and Identity as Someone who Avoids Virus Transmission on Physical Distancing Behavioural Frequency

	Estimate	*t-value*	95% CI
			LL to UL
Intercept	2.94	125.46	2.89 to 2.98
Linear change	-6.60	-826	-8.17 to -5.04
Quadratic change	6.60	8.25	4.67 to 7.59
Cubic change	-2.38	-3.24	-3.81 to -0.94
Overall physical distancing habit strength (person-level mean)	0.20	9.92	0.16 to 0.24
Overall virus transmission avoidant identity (person-level mean)	0.27	9.81	0.22 to 0.32
Occasion-specific fluctuations in physical distancing habit strength (difference from person-level mean)	0.07	6.82	0.05 to 0.09
Occasion-specific fluctuations in virus transmission avoidant identity (difference from person-level mean)	0.16	9.74	0.13 to 0.20
Overall physical distancing habit strength × Overall virus transmission avoidant identity	-0.01	-0.90	-0.04 to 0.02
Occasion-specific fluctuations in physical distancing habit strength × Occasion-specific fluctuations in virus transmission avoidant identity	-0.00	-0.10	-0.03 to 0.03
Overall physical distancing habit strength × Occasion-specific fluctuations in virus transmission avoidant identity	-0.00	-0.20	-0.03 to 0.02
Overall virus transmission avoidant identity × Occasion-specific fluctuations in physical distancing habit strength	-0.03	3.13	-0.06 to -0.01

Note. N = 586; predictor variables were mean-centred; CI = confidence interval; *LL* = lower limit; *UL* = upper limit.

Figure Legends

Figure 1.

Number of fortnightly assessments completed by participants with 4,901 assessments from 586 individuals.

Figure 2.

Change in physical distancing behavioural frequency over time by survey number, with the thick black line depicting the group-level trend in change over time, shaded by the 95% confidence interval, overlaid on individual data with more solid lines indicative of more data at that coordinate point.

Figure 3.

Simple slopes probing analyses of the moderation effect of virus transmission avoidant identity on physical distancing behavioural frequency and habit strength. High (strong) identity is indicative of one standard deviation above the mean, low (weak) identity is indicative of one standard deviation below the mean.