

# **Systematic review of interventions to promote the performance of physical distancing behaviours during infectious disease pandemics/epidemics**

## **Authors**

Tracy Epton\* – Lecturer in Health Psychology, Manchester Centre for Health Psychology, University of Manchester

Daniela Ghio – Lecturer in Psychology, School of Health & Society, University of Salford

Lisa M. Ballard – Senior Research Fellow, Faculty of Medicine, University of Southampton

Sarah F. Allen – Lecturer in Psychology, School of Social Sciences, Humanities and Law, Teesside University

Angelos P. Kassianos – Senior Research Fellow, Department of Applied Health Research, University College London

Rachael Hewitt - PhD Candidate, School of Healthcare Sciences, Cardiff University

Katherine Swainston – Senior Lecturer in Psychology, Centre for Applied Psychological Science, Teesside University

Wendy Irene Fynn -IEHC, University College London

Vickie Rowland - Public Health Practitioner, London Borough of Havering

Juliette Westbrook - Department of Psychology, University of Bath, Bath, UK

Elizabeth Jenkinson - Senior Lecturer, Faculty of Health and Applied Sciences, University of the West of England, Bristol

Alison Morrow - Trainee Health Psychologist, NHS Fife

Grant J. McGeechan – Senior Lecturer in Health Psychology, Centre for Applied Psychological Science, Teesside University.

Sabina Stanescu - School of Psychology, University of Southampton, Southampton, UK

Aysha A Yousuf – Lead Research Assistant, Lancashire and South Cumbria NHS Foundation

Nisha Sharma - Chartered Health Psychologist, Department of Clinical Health Psychology, Royal National Orthopaedic Hospital

Suhana Begum - Visiting lecturer, Department of Psychology, City University of London and Public Health Lead, Surrey County Council. ORCID: 0000-0003-1168-2660

Eleni Karasouli – Senior Research Fellow, Warwick Clinical Trials Unit, University of Warwick

Daniel Scanlan - Research and Communication, Education Support, London, UK, N5 1EW

Gillian W Shorter – Lecturer in Clinical Psychology, Centre for Improving Health Related Quality of Life, Queen’s University Belfast

Madelynne A. Arden - Professor of Health Psychology, Centre for Behavioural Science and Applied Psychology, Sheffield Hallam University

Christopher J. Armitage - Professor of Health Psychology, Manchester Centre for Health Psychology, University of Manchester; Manchester University NHS Foundation Trust, Manchester Academic Health Science Centre; NIHR Greater Manchester Patient Safety Translational Research Centre.

Daryl B O’Connor - Professor of Psychology, School of Psychology, University of Leeds.

Atiya Kamal - Senior Lecturer in Health Psychology, Department of Psychology, Birmingham City University

Emily McBride - Senior Research Fellow, Department of Behavioural Science and Health, University College London  
Vivien Swanson - Reader in Health Psychology, University of Stirling  
Jo Hart - Professor of Health Professional Education, Division of Medical Education, University of Manchester  
Lucie Byrne-Davis - Professor of Health Psychology, Division of Medical Education, University of Manchester  
Angel Chater - Professor of Health Psychology and Behaviour Change, University of Bedfordshire  
John Drury - School of Psychology, University of Sussex

\*Corresponding author: Tracy Epton, Manchester Centre for Health Psychology, University of Manchester, Oxford Road, Manchester, M13 9PT; epton.tracy@gmail.com

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### **Conflicts of interest**

AK and JD participate in the UK's Scientific Advisory Group for Emergencies sub-groups SPI-B but are writing in a personal capacity.

## Abstract

### Objectives

Physical distancing, defined as keeping 1-2m apart when co-located, can prevent cases of droplet or aerosol transmitted infectious diseases such as SARS-CoV2. During the COVID-19 pandemic, distancing was a recommendation or a requirement in many countries. This systematic review aimed to determine which interventions and behavior change techniques (BCTs) are effective in promoting adherence to distancing and through which potential mechanisms of action (MOAs).

### Methods

Six databases were searched. The review included studies that were (a) conducted on humans, (b) reported physical distancing interventions, (c) included any comparator (e.g., pre-intervention versus post-intervention; randomized controlled trial) and (d) reported actual distancing or predictors of distancing behavior. Risk of bias was assessed using the Mixed Methods Appraisal Tool. BCTs and potential MoAs were identified in each intervention.

### Results

Six papers indicated that distancing interventions could successfully change MoAs and behavior. Successful BCTs (MoAs) included feedback on behavior (e.g., motivation); information about health consequences, salience of health consequences (e.g., beliefs about consequences), demonstration (e.g., beliefs about capabilities) and restructuring the physical environment (e.g., environmental context and resources). The most promising interventions were proximity buzzers, directional systems and posters with loss-framed messages that demonstrated the behaviors.

### Conclusions

The evidence indicates several BCTs and potential MoAs that should be targeted in interventions and highlights the gaps that should be focused on in future research.

**KEYWORDS:** *Systematic review; physical distancing; COVID-19; social distancing*

### Highlights

- Evaluates the effectiveness of interventions to promote distancing in pandemics
- Six studies show that interventions can increase distancing
- Key techniques: feedback, information about consequences, restructuring
- Key delivery modes are posters and proximity buzzers
- Further research is required to test more techniques and modes of delivery



## **Systematic review of interventions to promote physical distancing behavior during infectious disease pandemics/epidemics**

The COVID-19 pandemic has caused over 5.9 million deaths globally at the time of writing (February, 2022; John Hopkins University, 2021). SARS-CoV-2 (the virus that causes COVID-19) is higher in transmissibility than other epidemic viruses (e.g., SARS-CoV, MERS-CoV) with a reproductive number (i.e., the average number of people an infected person infects) of 2 to 3.58 (this is higher than the 1.7 to 1.9 and  $<1$ , for SARS-CoV and MERS-CoV respectively; Zhu et al., 2020). For eleven months in 2020 there was no vaccine for the SARS-CoV-2 virus. This meant that the highly transmissible virus needed to be solely controlled through non-pharmaceutical methods (e.g., wearing face-coverings, avoiding crowded places, staying at home, physically distancing from others, cleaning hands, testing, self-isolation if infected) that involved individuals changing their behavior. Even with a good uptake of vaccines these behaviors are important to keep transmission rates low (Vilches et al., 2019).

The risk of spreading SARS-CoV-2 is particularly high when people are in the same location (CDC, 2020). Physical distancing (i.e., staying at least 1-2 metres (m) apart from people when co-located), reduces the risk of infection from aerosols and droplets entering the eyes, nose or mouth when an infected person talks, coughs or sneezes (CDC, 2020). Indeed, one review found that SARS-CoV-2 transmission is reduced with physical distancing of 1m or more compared with closer than 1m (Chu et al., 2020).

Many governments and health agencies have recommended people adhere to a physical distance of between 1m (WHO, 2020) and 2m (NHS, 2021) from people who are not in their household. Desirable spatial distance varies considerably across social and environmental contexts (e.g., familiarity of person, standing vs. seated, indoors vs. outdoors, occupation)

despite the desirability of personal space (Sommer, 1969). For example, typical social interaction happens at an average of 135.1 centimetres (cm) for formal interaction and 91.7cm for interaction with friends (Sorokowska et al., 2017).

Policy makers and researchers often use the terms social distancing or physical distancing to describe several behaviors: staying at least 1-2m apart from others when co-located and crowd avoidance (which is made up of several behaviors such as avoiding crowded places, working from home, only leaving the house for essential purposes and exercise, ordering groceries online). These behaviors have the same goal of limiting contact to reduce transmission of the virus and may have some of the same predictors (e.g., fear of contracting COVID-19). However, the suite of behaviors linked to crowd avoidance differ from staying at least 1-2m apart from others. Crowd avoidance is likely to be impeded by structural barriers, such as type of occupation and not having internet access, that do not affect the ability to stay at least 1-2m apart. Likewise, staying at least 1-2m apart is likely to be impeded by the actions of the others in the vicinity (Hoeben et al., 2021) that will not affect adherence to crowd avoidance. As such, interventions designed to promote crowd avoidance and physical distancing are likely to have different antecedents and require different approaches. Moreover, staying at least 1-2m apart when co-located is a more pressing public health concern – a survey found that adherence to crowd avoidance was 90% but adherence to staying 1-2 apart was only around 66% (Coroiu et al., 2020). We have thus focused on one physical distancing behavior that is staying at least 1-2m apart from others when co-located (we refer to this as physical distancing throughout).

Levels of adherence to physical distancing regulations during the COVID-19 pandemic have been varied; between 30.4% and 94.6% of people surveyed reported keeping a physical distance from others (Coroiu et al., 2020; Dohle et al., 2020; Nivette et al. 2021;

Norman et al., 2020; ONS, 2021). There were differences in adherence between countries (Dohle et al., 2020; Nivette et al. 2021; Norman et al., 2020; ONS, 2021) and contexts (e.g., indoors vs. outdoors; Norman et al., 2020). Predictors of physical distancing were: beliefs (e.g., higher trust in politics and science was positively correlated with adherence; Dohle et al., 2020); quality of messages (e.g., the clarity of rules predicted distancing early in the pandemic; Reinders Folmer et al., 2020a) and level of infection in society (i.e., high infection levels were related to increased distancing; Reinders Folmer et al., 2020b). It is therefore important to understand what influences and how to influence distancing behaviors to design effective behavior change interventions (see O'Connor et al., 2020).

To design effective behavior change interventions, it is essential to identify exactly what behavior needs to change and the influences on said behavior (i.e., constructs from the Theoretical Domains Framework (TDF); Cane et al., 2012; and Behavior Change Wheel COM-B model, Michie et al., 2014). The strategies to change these constructs must then be determined (i.e., the intervention functions and policy categories), alongside the behavior change techniques (BCT: Michie et al., 2013), and how to deliver that BCT. For the target behavior of physical distancing a relevant domain to target could be *social influences* (i.e., the social environment, support, norms and culture). Within the domain of social influences, a relevant theoretical construct is *social norm*, which can be changed by targeting the intervention function of *modelling* (i.e., providing examples for people to emulate). Modelling can be achieved by using the BCT of *demonstration of the behavior* that can be delivered by a poster showing two people distancing using the length of a car to ensure they are 2m apart.

Longitudinal survey studies (Hagger et al., 2020; Hamilton et al., 2020; Norman et al., 2020; Rozendaal et al., 2020; Van Bavel et al., 2020; Vignoles et al., 2021), guidance

documents and recommendation papers (e.g., Bonell et al., 2020; Drury et al., 2021a; SPI-B, 2020; Templeton et al., 2020) have identified several predictors that influenced physical distancing behavior. These predictors are associated with the theoretical domains of social influences, beliefs about capabilities, beliefs about consequences, behavioral regulation, and knowledge. The survey studies proposed BCTs (e.g., *information about others' approval, framing/reframing, feedback on behavior, restructuring the physical environment; information about health consequences, salience of health consequences, habit formation, prompts and cues*) that could be used in interventions (Hagger et al., 2020; Hamilton et al., 2020; Norman et al., 2020; Rozendaal et al., 2020). However, interventions that allow comparisons between the presence and absence of intervention components are needed to identify relevant theoretical domains, intervention functions, and determine which BCTs are effective.

It is also important, during intervention development, to identify the potential Mechanisms of Action (MoAs) that BCTs might influence (Moore & Evans, 2017; Carey et al., 2019) to create a logic model for how the intervention works. The Theory and Techniques Tool (Carey et al., 2019; Connell et al., 2018; Johnston et al., 2020) was developed from a synthesis of the literature, consensus and triangulation studies to determine which potential MoA each BCT influences and the strength of that evidence.

### **The present study**

Although the survey evidence identifies potential theoretical domains and BCTs to target, we do not know (a) if interventions are effective at promoting the performance of physical distancing during a pandemic, (b) what the most effective components of interventions are (e.g., behavior change techniques; modes of delivery), (c) what are the likely theoretical domains, intervention functions and MoAs, (d) who the interventions are



effective for and (e) in which circumstances the interventions work best (e.g., phase of pandemic; other restrictions e.g., lockdown; infection rate; case fatality ratio). This review aimed to systematically review the evidence to determine the effectiveness and methodological quality of interventions to promote physical distancing and to explore moderators of effects on behavior.

## **Methods**

The review was pre-registered on PROSPERO ([CRD42021230821](#)). The PRISMA guidelines (Page et al., 2021) were followed and the checklist is included in the Supplementary Materials Table S1.

### **Search strategy and selection criteria**

Searches for published and unpublished studies were performed on six databases between January to February 2021 using PubMed, PsycInfo, Web of Science (see Supplementary materials for the full list of Web of Science databases), PsyArXiv, MedRXiv and the Open Science Framework with no restriction on date. Search filters used were for behavior (e.g., physical distancing, social distancing), study type (e.g., intervention, trial or experiment) and virus related (e.g., COVID, coronavirus, SARS, MERS, H1N1, Ebola, influenza or swine flu pandemic, epidemic) based on search terms used in previous reviews (Lawes-Wickwar et al., 2021). MeSH terms were used where available. See Supplementary Materials for full search terms for each database. Additional studies were located using ascendancy (using google scholar) and descendancy approaches.

Using PICO (population, intervention, comparator, outcome), studies were included if they (a) included any human population, (b), reported interventions to promote physical-distancing (i.e., those that focus on distancing when people are co-located in the same physical space e.g., keeping at least 1-2m apart) in any setting (c) included any comparator

(e.g., pre-intervention behavior, alternative intervention, a control group, a measurement only group), and (d), the outcomes reported were performance of physical-distancing behavior (e.g., observational measures of number of people distancing vs not distancing; self-reported frequency or quality of distancing behavior), a predictor of behavior (i.e., a MoA or theoretical construct or variable that may influence behavior: e.g., self-efficacy, intentions, willingness, attitudes, norms) or outcomes of behavior (e.g., number of infections). The included studies could be for any date and of any study design (e.g., randomized controlled trials; pre-post studies; nonrandomized controlled trials; natural experiments).

### **Screening**

Each reference was screened by two authors using Rayyan referencing software - screening was conducted by 18 authors (all with a PhD and/or MSc in psychology; author initials removed for blinding). At the title/abstract screening stage any that were marked as 'include' by at least one screener were reviewed at the full text stage. Any that were marked 'maybe' by at least one screener were further assessed by the first author who decided whether to include for the full text stage. Full texts were screened by two additional authors (XX, YY) and disagreements were resolved through discussion with the two authors (there was 17% disagreement in the full texts).

### **Data extraction**

Data were extracted by the first author using a coding frame (see Supplementary Table S2 for coding frame and full details of study characteristics) developed by two authors (XX, YY – both had PhDs in Psychology and expertise in reviewing). For each study, the following were recorded: study type (e.g. randomized controlled trials; pre-post studies; non randomized trials; natural experiments); context (e.g., country of data collection, date of

data collection, public health restrictions in place at the time, phase of the pandemic); sample (e.g.,  $N$ , population, gender, age); intervention description (e.g., setting, description of delivery); comparison (e.g., type of control or alternative intervention, description of delivery, BCTs and a summary of the findings (including effect sizes and whether measure of distancing was indoors or outdoors). Two methods of measuring effectiveness were used (a) Cohen's  $d$  was calculated where possible to report the size of the intervention's effect and (b)  $p$  values were used to determine the significance of differences between the intervention and comparison.

To aid readers interested in intervention design we identified BCTs (i.e. the active ingredient in interventions) included in the intervention (e.g., feedback on behavior), the potential MoAs (i.e. a construct that the BCT influences that may subsequently influence behavior; e.g., feedback processes) through which the BCTs might work, the theoretical domains (i.e. what needs to change; e.g., knowledge) and the intervention functions (i.e. the means by which to change the behavior; e.g., education).

BCTs were identified using the BCTTv1 (Michie et al., 2013) which is a 93-item taxonomy of behavior change techniques that is widely used in describing interventions. The theoretical domains were identified using the results of an expert consensus study that identified domains related to BCTs (Cane et al., 2015). Intervention functions related to each BCT were identified by using a review of interventions and an expert consensus exercise (Michie et al., 2014). The MoAs related to each BCT were identified using the Theory and Technique Tool (Carey et al., 2019; Connell et al., 2018; Johnston et al., 2020) which is an atheoretical list of MoAs that are linked to BCTs. Policy categories were identified using the Behavior Change Wheel definitions (Michie et al., 2014).

Risk of bias was assessed using the MMAT<sup>1</sup> (Hong et al., 2018). This tool was chosen as it allows for the assessment of the varied study designs that were potentially included in this review. The tool uses two screening questions on the research question and suitability of data collection with five follow up questions depending on design (see Table 2) – all manuscripts, supporting materials and pre-registrations were checked for details. For RCTs, appropriate randomization was assessed for details of how this was managed (e.g., via computer algorithm). Comparable groups at baseline were assessed by examining randomization checks and tables of baseline information, if provided, to determine if there were any large differences that were likely not due to chance. Complete outcome data of at least 80% was assessed by reported drop-outs, exclusions and comparing baseline Ns with those reported in the results for the outcome variables (i.e., ns, dfs). Whether the outcome assessor was blinded (i.e., participants if self-report measures used, intervention provider if they were involved in measurement) was evaluated by looking for information about blinding. Participants' adherence to the assigned intervention (i.e., exposed to and continued with intervention to follow up, no crossover to comparator or another intervention) was assessed by looking at the methods section to assess if they had been exposed to the intervention or they could have avoided the intervention.

For non-randomized trials, the extent to which the sample was representative of the target population was assessed by scrutinizing descriptions of the sample, the target population, and descriptions of attempts to achieve representativeness. The appropriateness of the measurements included having a clear definition of the measure, accurately measured and with validated and reliable instruments. Complete outcome data

was assessed as described above. Controlling for confounding variables was assessed by identifying potential confounding variables and seeing if these were controlled for in the study. Assessment of if the intervention was administered as intended was from the descriptions of the intervention and reports of deviations from this procedure.

For quantitative descriptive studies, the quality of the sampling strategy was gauged by assessing how closely the method of selection was associated with the research question. The sample's representativeness of the target population was assessed as described above. The appropriateness of the measurements was assessed as described above. The non-response bias was judged by evaluating non-responders against responders. The appropriateness of the statistical analysis was assessed through the stated details of the analysis, the justification, and any limitations recognized.

Risk of bias was assessed independently by two of the authors (WW, XX) and disagreements were discussed until agreement was reached (initial agreement was between 65 and 100%).

The summary of findings, effect sizes, and BCTs, were extracted/ calculated by the first author and by a second data-extractor (YY or ZZ). Study authors were contacted for missing information.

A narrative description of studies and a meta-analysis was planned ([PROSPERO CRD42021230821](#)); however due to the small number of effect sizes identified for each outcome, and problems with the independence of these effect sizes, a narrative synthesis only was undertaken. The key purpose of the review was to assess the evidence for each type of intervention to aid governments, policy makers and organisations to evaluate the options. We therefore reported the results by type of intervention (legislation, environmental / social planning, regulation, communications and marketing). To inform

intervention design, we also included a section on BCTs, the potential MoAs through which these operate, theoretical domains and intervention functions.

## **Results**

The flow of papers is shown in Figure 1 (Page et al., 2021). Potentially relevant articles ( $N = 1146$ ) were identified from the database search and 1 article was obtained from other sources. Titles and abstracts ( $N = 1014$ ) were screened for eligibility after removing 133 duplicates; Studies that did not meet the inclusion criteria ( $n = 956$ ) were excluded, leaving 59 articles for which full texts were obtained and read. A further 53 articles were excluded after the full text was examined; the principal reason for exclusion at this stage were that no physical distancing intervention occurred ( $n = 47$ ). The remaining articles ( $n = 6$ ) met the inclusion criteria for the review, reporting tests of the impact of physical distancing interventions on behavior or predictors of behavior.

### **Study characteristics**

The 6 papers that met the inclusion criteria reported the effect of 14 interventions (and 3 other control interventions) and included over 5531 participants (One study, Hoebe et al., 2021, did not report the  $N$  due to the nature of the observational study design). The studies included randomized controlled trials ( $n = 4344$ ; Bos et al., 2020; Khoa et al., 2021; Lunn et al., 2020); non-randomized trials ( $n = 1187$ ; Blanken et al., 2020; Chutipimon et al., 2020); and a natural experiment ( $n = \text{unknown}$ ; Hoebe et al., 2021).

Studies were based in Europe (Bos et al., 2020; Blanken et al., 2020; Hoebe et al., 2021; Lunn et al., 2020), Asia (Chutipimon et al., 2020); and North America (Khoa et al., 2021). Data were collected between January and August 2020 (See Table S2). Study samples were from the general population (Bos et al., 2020; Hoebe et al., 2021; Khoa et al., 2021; Lunn et al., 2020); university staff, students, graduates and visitors (Blanken et al., 2020;

Chutipimon et al., 2020) and data was collected between January 2020 (pre pandemic comparison) and August 2020 (see Table S3 in Supplementary Materials)

The interventions varied in delivery methods and BCTs used – (see Table 1 for a description of studies and see Table S2 in Supplementary Materials for a full description of studies including context, behaviour change techniques).

### **Risk of bias**

The randomized controlled trials varied in risk of bias. All studies had a clear research question and the data was appropriate to answer the research question. Only one study (25%) included details of how randomization was managed (Bos et al., 2020); the others were unclear (due to the online nature of the studies, randomization was likely to have been undertaken by computer algorithm although this was not reported). Two studies (50%) reported randomization checks to evaluate if the groups were comparable at baseline; one of those studies found slight differences in age between conditions that was likely to be due to chance (Bos et al., 2020; this was controlled for in subsequent analysis) and the other found no differences between conditions (Lunn et al., 2020). All studies had complete outcome data (of at least 80% of those who had been randomized completed the study). All the studies (100%) had outcome assessments that were conducted without the involvement of the person delivering the intervention. All used self-report data; for 3 of the studies the participants were blinded to condition as each received some form of intervention; however, control participants in two of the comparisons in the Bos et al. study had participants who were potentially not blinded to condition as they were in a ‘no message’ control. All of the studies had participants who were exposed to the intervention; although only one (Bos et al., 2020) performed a treatment check to ensure the intervention was attended to.

For the non-randomized trials, one of the study samples (50%) was representative of the target population (i.e., Chutipimon et al., 2020, targeted university canteen customers and their sample reflected this); the other study was not clear who their target population was but pointed out it was not representative of the general population (Blanken et al., 2020). For appropriate measurement, Chutipimon et al. (2020) trained observers in a pilot study to improve reliability of their observations and Blanken et al. (2020) used a device that was accurate to within 10cm (Tanis et al., 2021). Regarding complete outcome data, both studies do not report drop-out data – although, with observational studies this criteria may not be applicable. Regarding confounding variables, both studies did not control for all possible confounds (e.g., Blanken et al. (2020) may have had people who stayed at the art fair beyond their allotted time slot so were in more than one condition; Chutipimon et al. (2020) did not control for crowd size). Regarding the delivery of the intervention as intended, both studies delivered the interventions as intended; although, Blanken et al. (2020) adjusted their protocol to allow participants to test the proximity buzzers after an initial session. There was a low non-response rate as all people in the area at the selected times were included in the study so there was no opportunity for “non-response”.

For the quantitative descriptive study, the sampling strategy was relevant as the research question was to find the extent to which the general population complies with physical distancing directives in public places and their sample was people captured on CCTV in multiple public places over 10 weeks, which was collected on a weekday and a weekend day at a 5 minute interval during a busy period (Hoeben et al., 2021). The sample was representative of their target population of people who used public places. The measurement was appropriate and had adhered to a codebook. The analysis was explained, justified and limitations were recognised.



See Table 2 for the breakdown of risk of bias for each study.

## **Main results**

The results are broken down by the policy category that each intervention fits into (Michie et al., 2011). The policy categories included are: legislation, environmental / social planning, regulation and communication / marketing (Michie et al., 2011).

### **Legislation**

Legislation is “making or changing laws” (p. 7; Michie et al., 2011); one intervention measured the effect of legislation through government fines (Hoeben et al., 2021) to explore the effect on distancing behavior.

#### ***Government fines***

Hoeben et al. (2021) measured distancing behavior in a natural experiment. They compared CCTV footage taken pre and post the government fines (after 23 March 2020) that were introduced to punish non-compliance of breaching a 1.5m physical distancing mandate and meeting in groups of 3 or more). After the government fines were introduced, there was a steady increase in distancing violations from early April 2020 to early May 2020 (especially on weekends) – this was correlated with an increased number of people on the street (as shown on the CCTV footage) and an increased number of people in non-residential locations (taken from cell phone data) (Hoeben et al., 2021). There is therefore no evidence that government fines influenced distancing behavior.

### **Environmental/ Social Planning**

Environmental or social planning is “designing and/or controlling the physical environment” (p. 7; Michie et al., 2011); two studies explored the effect of environmental changes using directional systems (Blanken et al., 2020) and distancing markers (Chutipimon et al., 2020) to explore the effect on distancing behavior.

### ***Directional Systems***

A non-randomized trial tested the implementation of one-way systems on distancing behavior (Blanken et al., 2020). One-way floor decal arrows were used to indicate walking directions at an art fair and behavior was measured using proximity sensors worn by visitors. One set of comparisons included comparing one-way arrows versus no arrows (both conditions also included a buzzer that sounded when within 1.5m proximity of another person). The addition of one-way arrows decreased the number of distancing violations ( $d = .40$ ). However, a further comparison of one-way arrows versus bi-directional arrows (two lanes – clockwise and anti-clockwise) found that there was no difference between the two conditions with slightly fewer violations in the bi-directional arrow condition ( $d = -.13$ ).

### ***Distancing Markers***

A four-day observational study of distancing behavior in a university canteen explored the effectiveness of floor decal stickers that marked out 2m distances (2 side by side at the canteen counter and 3 adjacent to the counter) (Chutiphimon et al., 2020). There were 4 different kinds of floor decal stickers: (1) a red arrow between footprint stickers at 2m distances to show the direction to queue, (2) an image of an aggressive red “scary” coronavirus with glowing eyes and “Stop COVID-19” printed under it with cut-outs for feet at 2m distances, (3) a written message between footprint settings of (e.g., “Physical distancing and Win COVID-19” [sic], “Please maintain a distance from other customers” and “Please queue here”) and (4) the footprint stickers alone (Chutiphimon et al., 2020). The red arrow ( $d = .10$ ), the “scary” coronavirus ( $d = .22$ ) or written message ( $d = -.11$ ) were not significantly more effective overall than the footprint stickers alone (Chutiphimon et al., 2020). The written message was significantly more effective than the footprint stickers alone at one of the marking points near the counter ( $d = .52$ ) but not at the other

(Chutipimon et al., 2020). With all groups there were fewer violations of distancing at markings further away from the counter (Chutipimon et al., 2020).

## **Regulation**

Regulation is “establishing rules or principles of behavior or practice” (p. 7; Michie et al., 2011); two studies used this method through government recommendations (Hoeben et al., 2021) and proximity indicators (Blanken et al., 2020) to measure the effect on distancing behavior.

### ***Government recommendations***

One study, from the Netherlands, explored physical distancing prior to and post government distancing recommendations (Hoeben et al., 2021). This natural experiment used CCTV footage of open public spaces and compared footage from dates that were prior to government recommendations about physical distancing (29 February to 12 March 2020) and post government recommendations (after 15 March 2020). The behavior measured was a count of distancing violations. These started to decline from 12 March 2020 even though no explicit distancing recommendation was in place and continued to decline after the government recommendation on the 15 March 2020 until the 19 March 2020. There was no strong evidence that the explicit government recommendations influenced distancing behavior as this was already occurring prior to the government recommendation to physically distance (Hoeben et al., 2021).

### ***Proximity indicators***

A non-randomized trial tested the use of buzzers (i.e., a device that buzzed when within 1.5m of another person) on distancing behavior (Blanken et al., 2020). Participants in all conditions had their behavior monitored electronically using a proximity device. In some conditions the proximity devices additionally included a buzzer that provided feedback

when proximity was breached. There were 3 conditions: (1) the buzzer sounded immediately when within the 1.5m range (and users received a demonstration of how the buzzer worked) (2) the buzzer had a 2-second delay in buzzing after being within the 1.5m range and (3) a no buzzer control condition. The buzzer was effective in reducing distancing violations when the buzzer sounded immediately when within the 1.5m range ( $d = .42$ ) compared to a condition without buzzers. The buzzers were ineffective when there was a 2-second delay in buzzing after being within the 1.5m range ( $d = -.22$ ).

### **Communication/ Marketing**

Communication and marketing is defined as “using print, electronic, telephonic or broadcast media” (p. 7; Michie et al., 2011). Three studies used communication and marketing through written messages (Bos et al., 2020), and posters (Khoa et al., 2021; Lunn et al., 2020). These studies measured intentions to distance (Bos et al., 2020; Khoa et al., 2021), support for government regulations (Bos et al., 2020), self-efficacy (Khoa et al., 2021), fear (Khoa et al., 2021), perceived effectiveness (Lunn et al., 2020) and memorability (Lunn et al., 2020).

#### ***Written messages***

A large scale randomized controlled trial ( $N = 3616$ ) explored the effect of three conditions (Bos et al., 2020): (1) a brief written message delivered online, from a credible source (i.e., medical professional), about the health consequences of not physically distancing, (2) a brief written message, from a credible source, focusing on the moral duty to physically distance and (3) a no message control. The health consequences message was not effective in increasing intentions to physically distance ( $d = .06$ ) but did increase support for government regulations ( $d = .10$ ) compared to a no message control (Bos et al., 2020) with a very small effect size. The moral duty message was effective in increasing intentions

to physical distance ( $d = .10$ ) and for support for government regulations ( $d = .13$ ) compared to a no message control (Bos et al., 2020) with a very small effect size. However, there were no differences between the health consequences and the moral duty message on intentions and no data about the impact of the intervention on subsequent behavior.

### **Posters**

Two randomized controlled experiments compared various interventions (Khoa et al., Studies 2 & 3, 2021): (1) a poster with an image of 2 featureless figure cartoons standing a distance apart with a 2-way arrow between that included a message focused on showing how the behavior steers away from negative outcomes (i.e., a loss framed message - “Failing to maintain physical distance risks yourself of [sic] being infected with the coronavirus and endangers your personal life”), (2) the same picture with a message focused on positive outcomes (i.e., a gain framed message - “Maintaining physical distance protects yourself from being infected with the coronavirus and secures your personal life”), (3) a control poster - the same picture with a message to “Please maintain physical distance”, (4) the loss framed poster with the addition of an anthropomorphic image of a coronavirus and (5) the gain framed poster with the addition of an anthropomorphic image of a coronavirus.

The loss framed poster was more effective at increasing intentions to physically distance than the control poster (Khoa et al. – study 2, 2021), and the gain framed poster (Khoa et al. – study 2, 2021; Khoa et al., - study 3;  $d = .59$ ). There were no differences in self-efficacy between the loss framed and the gain framed posters. The loss framed poster also increased fear more than the gain framed poster and fear mediated the effect of the intervention on intentions (Khoa et al. – study 2, 2021).

The addition of an anthropomorphic image of a coronavirus to the gain framed and loss framed message also resulted in increased intentions with a loss framed message compared

to the gain framed message (Khoa et al., - study 3, 2021;  $d = 1.76$ ). None of the studies measured impacts on behavior.

An online randomized experiment compared three posters (Lunn et al., 2020) on ratings of perceived effectiveness and memorability. One poster (that acted as the control) was an instructional poster that included four panels with images of two featureless figure cartoons at a 2m distance apart in four situations (i.e., walking in the street, sitting at a table, when shopping, on a football field). The second poster (referred to as the individual person poster) referred to transmission of the virus to an individual by showing four panels of groups of people not physically distancing and included comments referring to one person who “Has COVID-19 but doesn’t know it yet” and the implied consequences of this “Has an undiagnosed heart condition. If they had sat further apart, she’d have been ok”. The third poster (referred to as the transmission rate poster) was similar to the second poster but referred to transmission to others but not to an individual person; it showed four panels of groups of people not physically distancing with comments referring to a person who “Has COVID-19 but doesn’t know it yet” and the implied consequences of this “Will now pass the virus onto 6 others. If they had sat further apart, she’d have been ok”). The featureless figure poster was perceived as more effective ( $d = -.32$ ) and memorable ( $d = -.37$ ) than the individual people transmission poster (Lunn et al., 2020) but not the transmission rate only poster ( $d = -.15$  for effectiveness;  $d = -.23$  for memorability); there were also no significant differences between the transmission rate and the individual person posters ( $d = .17$  for effectiveness;  $d = .14$  for memorability; Lunn et al., 2020). However, behavior was not measured and the perceived effectiveness and memorability of posters are not necessarily predictors of behavior change.

### **Behavior Change Techniques, Mechanisms of Action, and Intervention Functions**

## ***Behavior change techniques***

For each intervention we identified the BCTs that were included, the theoretical domains and potential MoAs for change and the intervention functions that were the means to change behavior. We report below the effect of these BCTs (a summary is included in Table 3 and Tables S4-S6 in Supplementary Materials). However, it's important to note that the BCTs were not tested in isolation and may have interacted with each other.

*Monitoring of behavior by others without feedback (2.1)* was detrimental to behavior change when compared to the same electronic monitoring system but including *feedback on behavior (2.2)* using proximity buzzers (Blanken et al., 2021).

*Feedback on behavior (2.2)* was effective, although the unique effect of this was not tested (Blanken et al., 2020).

*Information about health consequences (5.1)* was effective when using a brief loss framed message on a poster *demonstrating the behavior (6.1)* (Khoa et al., 2021) and when a moral duty poster was compared with a measurement only control (Bos et al., 2020).

*Information about health consequences (5.1)* was ineffective when delivered via a message focused on avoiding consequences from a credible source (health consequences - Bos et al., 2020), a gain framed message focused on gaining positive outcomes (Khoa et al., 2021) and posters showing transmission routes (Lunn et al., 2020). *Salience of consequences (5.2)* were effective when using a coronavirus image on a loss framed poster that demonstrated the behavior (6.1) (Khoa et al., 2021) but not when they were used to separate 2m floor decals (Chutipimon et al., 2020).

*Demonstration of the behavior (6.1)* worked with a brief loss framed message to increase intentions (Khoa et al., 2021). *Demonstration of the behavior (6.1)* and *instructions*

*to perform the behavior (4.1)* increased perceived effectiveness and memorability of the message (Lunn et al., 2020).

There were inconclusive results for *credible source (9.1)* as there was no difference between a health consequences message and a control but a moral duty message was effective in influencing intentions (Bos et al., 2020). Guidelines from the government, which may be regarded by some as a credible source, did not influence actual behavior (Hoeben et al., 2021).

*Comparative imagining of future outcomes (9.3)* was not effective in changing perceived effectiveness and memorability (Lunn et al., 2020). *Future punishment (10.11)* with a government fine was not effective in changing behavior (Hoeben et al., 2021)

*Restructuring the physical environment (12.1)* with direction walking systems was effective at increasing physical distancing (Blanken et al., 2020).

*Framing / reframing (13.2)* as a moral duty was effective at changing intentions when compared to a control but not to a health consequences message (Bos et al., 2020).

Two BCTs were identified that were used in several interventions but were only compared with alternative interventions that also included that BCT: these were *prompts and cues (7.1)* (Blanken et al., 2020; Chutipimon et al., 2020; Khoa et al., 2021; Lunn et al., 2020) and *habit formation (8.3)* (Chutipimon et al., 2020). This means that the effect of these two BCTs was not assessed in these studies.

### ***Mechanisms of actions***

The MOAs that are potentially influenced by the BCTs are summarised in Table S4. The potential MoAs that were most common were intentions and behavioral cueing. Intentions were potentially influenced (or even actually influenced as this was measured in



some studies) by BCTs such as *information about health consequences (5.1)*, *salience of health consequences (5.2)*, *demonstration of behavior (6.1)* and *framing/reframing (13.2)*.

Behavioral cueing was potentially influenced by BCTs such as *prompts/cues (7.1)*, *habit formation (8.3)*, *restructuring the physical environment (12.1)* and *adding objects to the environment (12.5)*.

Other common potentially influenced MoAs were beliefs about consequences, attitude towards the behavior and environmental context and resources. Beliefs about consequences were potentially influenced by BCTs such as *information about health consequences (5.1)*, *salience of health consequences (5.2)*, and *comparative imagining of future outcomes (9.3)*.

Attitude towards the behavior were potentially influenced by BCTs such as *information about health consequences (5.1)*, *credible source (9.1)* and *framing/reframing (13.2)*.

Environmental context and resources were potentially influenced by the BCTs that were delivered through *prompts/ cues (7.1)*, *restructuring the physical environment (12.1)* and *adding objects to the environment (12.5)*.

Fewer interventions used BCTs that were related to other potential MoAs (i.e., knowledge, beliefs about capabilities, perceived susceptibility/vulnerability, physical skills, social learning/imitation, memory, attention and decision-making processes, feedback processes, motivation and general attitudes and beliefs). These MoAs, related BCTs and their effectiveness are cross-referenced in Table S4.

The interventions of directional walking systems and proximity buzzers that used *restructuring the physical environment (12.1)* and/or *adding objects to the environment (12.5)* that are related to the MoAs of environmental context and resources, behavioral

cueing, feedback processes and motivation were particularly effective at increasing distancing behavior (Blanken et al., 2021).

### **Theoretical domains**

Six theoretical domains (that identify what needs to change in order for behavior change to occur) were related to the BCTs. The most common domain was environmental context and resources that was related to 3 BCTs which were: *restructuring the physical environment (12.1)*, *objects added to the environment (12.5)* and *prompts/ cues (7.1)*. Changing the environmental context and resources seemed particularly effective through introducing directional systems and proximity buzzers (without a delay; Blanken et al., 2020).

Knowledge was related to *feedback on behavior (2.2)* and *information about health consequences (5.1)*. Beliefs about consequences was related to the BCTs of *salience of consequences (5.2)* and *comparative imagining of future outcomes (9.3)*.

Physical skills and social influence were related to one BCT each. Physical skills were related to *habit formation (8.3)*. Social influence was related to *demonstration of behavior (6.1)*. These theoretical domains, BCTs and their effectiveness are cross referenced in Table S5.

### **Intervention functions**

There were 8 intervention functions that the BCTs were potentially related to that were the potential means to change behavior. These were persuasion, enablement, training, education, coercion, environmental restructuring, incentivisation and modelling.

The most commonly used intervention function was persuasion related to 5 BCTs (2.2, 5.1, 5.2, 9.1, 13.2). Training (2.2, 4.1, 6.1, 8.3) and enablement (9.3, 12.1, 12.5, 13.2) were related to 4 BCTs. Coercion (2.1, 2.2, 10.11), education (2.2, 5.1, 7.1), and

environmental restructuring (7.1, 12.1, 12.5) were related to 3 BCTs each. Incentivisation (2.1, 2.2) and modelling (6.1) were related to 2 and 1 BCT, respectively. Environmental restructuring seemed the most effective means of changing distancing behavior as directional systems and proximity buzzers were effective (Blanken et al., 2020). The intervention functions, BCTs and their effectiveness are cross referenced in Table S6.

## **Discussion**

The current systematic review identified six papers reporting the effects of fourteen interventions. This review has identified which intervention components have been tested and the strength of this evidence. This focused mainly on effective policy categories (i.e., the means by which to deliver an intervention function), behavior change techniques (i.e., how to change the behavior), the delivery mode (i.e., how to deliver the BCTs) and the potential mechanisms of action (i.e., how the BCTs work). It provides important guidance for policy makers on possible interventions to promote this key health protective behavior (BPS, 2021; Chater et al., 2021).

### **Policy Categories**

The review assessed evidence for interventions that were in four of the policy categories: legislation, environmental and social planning, regulation and communications and marketing. Legislation was shown (through government fines; Hoeben et al., 2021) to be an ineffective policy for encouraging physical distancing. Although the other three policy categories have the potential to produce change there is mixed evidence of effectiveness that depends upon the specific intervention type. Environmental and social planning policies changed physical distancing behavior when directional systems were used (Blanken et al., 2020) but there was no clear evidence that footprint decals were effective (Chutipimon et al., 2020). Regulation changed behavior when proximity indicators, without a delay, were

used (Blanken et al., 2020) but not when delivered as government recommendations (Hoeben et al., 2021). Communications/ marketing was effective when delivered via some posters (Khoa et al., 2021) but not for other posters (Lunn et al., 2020) and written messages (Bos et al., 2020). The policy categories of guidelines, fiscal measures and service provision were not used as a means to change behavior in the included interventions. Although not tested in the included studies, guidelines that detail how to manage physical distancing practices within public areas may be particularly useful in encouraging distancing behavior.

### **Behavior Change Techniques**

The review found support for several BCTs involved in physical distancing behavior. These included BCTs that were identified in survey studies including: *providing feedback on the behavior (2.2)* (e.g. via proximity buzzers; Blanken et al., 2020); *information about health consequences (5.1)* (e.g., via posters with loss framed messages; Khoa et al., 2021) and *restructuring the physical environment (12.1)* (e.g., via directional systems; Blanken et al., 2020).

There were two techniques that may have been effective, that were highlighted by previous survey studies, but were not compared to a condition without those techniques. *Prompts/ cues (7.1)* and *habit formation (8.3)* could be particularly effective enablers for physical distancing in distracting situations, as people would be reminded or have formed the habit.

Two other BCTs highlighted by survey studies had inconclusive evidence, (*framing/ reframing (13.2)*, Bos et al., 2020) or were not tested (*information about others' approval (6.3)*).

Other BCTs that were not mentioned in the literature and had some supportive evidence for changing intentions or behavior were *salience of consequences* (5.2) such as delivered via posters with loss framed messages, with an image of a coronavirus standing between two figures (Khoa et al., 2021); *demonstration of the behavior* (6.1) such as delivered via posters with loss framed messages (Khoa et al., 2021); and *adding objects to the environment* (12.5) through proximity buzzers (Blanken et al., 2020).

The review also identified BCTs that were ineffective. There was no support for using the BCT of *future punishment* (10.11) as government fines (Hoeben et al., 2021) were ineffective; this is supported by recent reviews suggesting that punitive approaches to public health are often ineffective or counterproductive (Independent SAGE, 2021; Mills, Symons, & Carter, 2021).

There are other BCTs that were not tested but are potentially useful in changing distancing behavior. These are listed in the future research section. It is also worth noting that the included BCTs were not tested in isolation so their effectiveness may be due to their interaction with other BCTs in that intervention.

### **Mechanisms of Action**

Several MoAs were related to BCTs that were tested in the interventions included in this review. The most effective BCTs were related to environmental context and resources, behavioral cueing, feedback processes and motivation but these were related to two interventions of directional walking systems and proximity buzzers (Blanken et al., 2020).

BCTs that were related to other potential MoAs had inconclusive results. However, interventions that used loss framed prevention posters (Khoa et al., 2021) were effective at changing intentions that are also related to the MoAs: attitudes towards the behavior, beliefs about consequences, knowledge, perceived susceptibility/ vulnerability and social

learning and imitation. Prospect theory (Kahneman & Tversky, 1979) could explain why the loss framed posters were successful as it suggests that when trying to change behaviors linked to health risk (e.g., physical distancing), loss frames (e.g., making negative consequences of not doing behavior salient) are more effective than gain frames (e.g., making the benefits of doing the behavior salient) as we are motivated to reduce the loss (cf., Abhyankar, O'Connor, & Lawton, 2008).

### **Theoretical Domains**

The review found that BCTs from six of the fourteen theoretical domains were used. Changing the environmental context and resources seemed particularly effective with mixed evidence for BCTs that can influence knowledge, beliefs about consequences and social influence. A theoretical domain that could be particularly relevant to encouraging physical distancing behavior is cognitive and interpersonal skills as distancing is influenced by the behavior of other people; therefore having the skills to enable negotiation of space would be valuable.

### **Intervention Functions**

The review identified that eight of the nine intervention functions were related to the BCTs used in physical distancing interventions: education, persuasion, modelling, environmental restructuring, enablement, training, incentivisation and coercion. Restriction (using rules to increase distancing by reducing the opportunity to engage in opposing behaviors; Michie et al., 2014) was not used. Application of this intervention function could be through managing crowds e.g., restricting the number of people in shared spaces rather than encouraging distancing as per the included interventions. Environmental restructuring was particularly effective as a means to change behavior (Blanken et al., 2020).

### **Other Considerations**

Physical distancing is influenced by the context in which it is performed such as restrictions on the opportunity to distance, distractions, and beliefs (e.g., around risk and trust). For example, distancing is affected by the number of other people in the vicinity (Hoeben et al., 2021; Liebst et al., 2020); stay at home orders facilitated distancing in Hoeben et al.'s study as there were fewer people in public spaces, which consequently made physical distancing easier. Distraction may also affect the ability to distance; for example, distancing behavior decreased when ordering food at the counter (Chutipimon et al., 2020). Beliefs such as risk can affect distancing behavior. For example, those who lived in low risk areas had decreased physical distancing in an avatar study (Cartaud et al., 2020). There is mixed evidence that when risk is perceived to be lower, through wearing face-coverings, distancing behavior may change. An avatar study found that when avatars wore masks, people indicated they would stand closer (Cartaud et al., 2020; Luckman et al., 2020); however, 1.5m distancing was not related to mask wearing in a CCTV observational study (Liebst et al., 2020). Belief such as trust are also related to distancing behavior: higher levels of trust in science and politics increased adoption of behaviors such as physical distancing (Dohle et al., 2020). Therefore, these contextual factors should be considered when designing physical distancing interventions.

### **Areas for Future Research**

This review identified several limitations in the extant literature, which could be addressed in future research. First, measures in many studies conflated physical distancing when co-located (e.g., keep 1-2m apart; avoid hugging, kissing, hand shaking) with crowd avoidance (e.g., avoid crowded places, work from home, limit time spent away from home) – these studies were thus excluded from our review. Second, studies did not always report intentions or behavior; for example, Lunn et al. (2020) reported perceived effectiveness and

memorability of the intervention posters but not intentions to distance or actual behavior. Although measuring these variables is useful when deciding between different posters addressing the same MoA and using the same BCTs it is less useful at early stages of research when identifying effective MoAs and BCTs is needed. An agreed core outcome set could be used to improve reporting standards (Shorter et al., 2019; Williamson et al., 2021). Third, as can be seen in Table S4 only fourteen out of twenty-six MoAs were coded as included in the interventions in this review and only fourteen out of ninety-three behavior change techniques were coded by this review's authors (moreover, none of the studies identified behavior change techniques using a taxonomy). Additionally, these have not always focused on MoAs that have been identified as potentially important, e.g., behavioral regulation was identified as an important target but was not tested in the included interventions (Hagger et al., 2020). Fourth, the interventions did not always compare interventions that differed in BCTs – for example, Chutipimon et al. (2020) compared two interventions that both used *prompts and cues* (7.1). Although this is useful when deciding the best way to deliver BCTs we know are effective, it is less useful when we need to identify effective BCTs. Behavioral regulation, perceived susceptibility/vulnerability and social norms were not addressed in the interventions included in this review. Fifth, the samples in the studies were largely unrepresentative of the general population (i.e., the sampling strategies were convenience sampling rather than aiming for a representative sample; however, two of the three studies assessed for this in the MMAT were representative of their target population) although the review itself included studies from several countries over three continents. Sixth, with the exception of one study the data were collected in *Western, Educated, Industrialised, Rich and Democratic* countries (WEIRD – Henrich et al., 2010) so these results may not generalise to other contexts.



Further research into interventions to promote physical distancing behavior is needed.

This review has identified which intervention components are promising, which are inconclusive and which have not been tested. These intervention components are constructs that need to change (theoretical domains), the means to change the behavior (policy categories, intervention functions), strategies to change behavior (the BCTs), how to deliver the interventions and the mechanisms through which BCTs work (the MoAs). Future interventions could systematically test these intervention components. For example, *social comparison* (6.2) and *information about others approval* (6.3) could be effective in changing social norms around physical distancing as social influences were promising domains identified in survey studies. BCTs such as *problem solving* (1.2) (e.g., finding solutions to address situations when distancing is difficult), *instructions on how to perform the behavior* (4.1), *demonstration of the behavior* (6.1) and *behavioral rehearsal* (8.1) could be effective in increasing capabilities. Those BCTs could also be coupled with *information about health consequences* (5.1) as there is evidence that behavior is more likely when both perceptions of risk and self-efficacy are influenced by an intervention (Sheeran et al., 2014). The BCTs *information about social and environmental consequences* (5.2), *anticipated regret* (5.5), and *information about emotional consequences* (5.6) could influence beliefs about consequences; *goal setting (outcome)* (1.1) and *incentive (outcome)* (10.8) (e.g., information about the positive consequences of distancing on allowing opening up of restrictions) could influence intentions and motivation.

Studies that explore the barriers and facilitators of physical distancing are also required to ensure the interventions are optimised; for example, a barrier may be that physical distancing involves the co-operation of others so an intervention component that focuses on being able to communicate your distancing needs with others may be necessary.

## **Limitations of the Review**

We have identified three limitations of this review. First, there was only one high quality study (Hoebe et al., 2021 had a low risk of bias on all elements) in the review; although a higher risk of bias in the other studies was most often due to a lack of information rather than certainty of a high risk of bias. Second, we were not able to meta-analyse the data due to the small number of effect sizes for each outcome and problems with the independence of these effect sizes. Third, the small number of studies and the unrepresentative samples meant we were unable to explore who the interventions worked for.

## **Conclusion**

This review is the first review to summarise the state of the literature regarding physical distancing interventions. Although the review contains only a small number of studies, there is a need to evaluate emerging evidence in order to promote physical distancing during the ongoing COVID-19 pandemic. Research on physical distancing is still important even though some governments have relaxed restrictions to do this with the COVID-19 pandemic as some members of the public still wish to physically distance to keep themselves safe (Drury et al., 2021b); although these people may be motivated to physically distance, interventions may still be necessary to increase capabilities and opportunities. Furthermore, physical distancing may be necessary in the future as restrictions may be reimplemented with new strains of COVID-19 or for future pandemics. The review has extended our knowledge to show that physical distancing intentions and behavior can be increased but the size of the effect cannot be determined. Although there are BCTs that show influences on intentions and behavior this is based on only a few studies so strong conclusions cannot be drawn. However, this review has provided recommendations for interventions to be tested in

future research and has been used to develop recommendations (Hart et al., 2021) as a starting point for public health campaigns.

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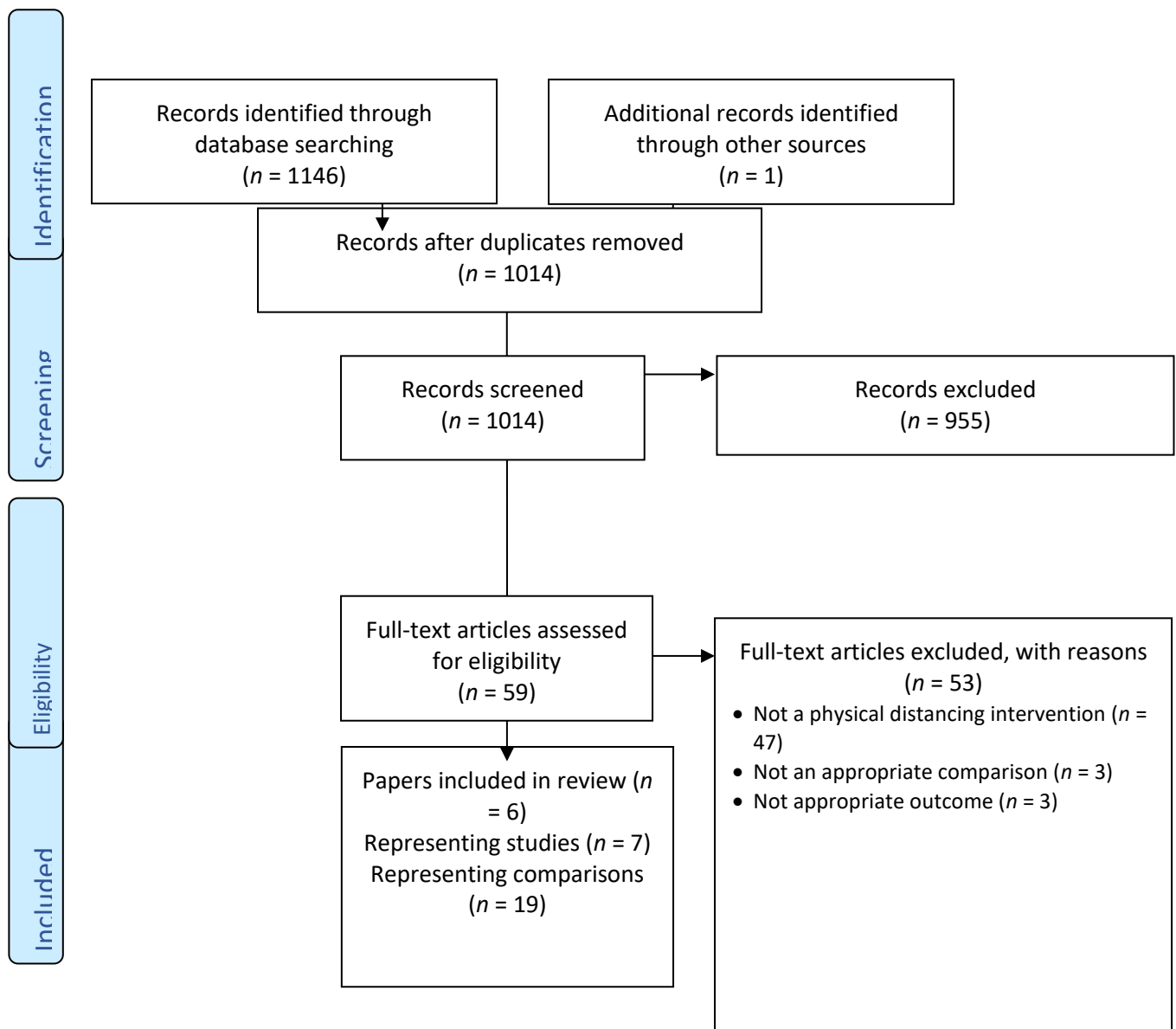


Figure 1. Flow diagram of papers included in the review

**Table 1: Study Characteristics**

Authors	Location and Sample	Conditions	Results
Bos et al. (2020)	German Online setting General population ( $N = 3616$ ) No demographics reported	Intentions/plans and support for government regulations were measured after receiving one of two message types or a no message control in this study  1. A consequentialist message (i.e., focused on consequences and included a photo of a credible source) 2. A Deontological message (i.e. focused on moral duty and included photo of credible source) 3. No message control	1. consequentialist message vs no message control <ul style="list-style-type: none"> <li>No effects on intentions/plans to physically distance <math>d = .06</math></li> <li>Significant difference in support for government regulations particularly in under 60 year olds and women <math>d = .10</math></li> </ul> 2. deontological message vs consequentialist message <ul style="list-style-type: none"> <li>No effects on intentions/plans to physically distance <math>d = .04</math></li> <li>No difference in support for government regulations <math>d = .03</math></li> </ul> 3. deontological message vs no message control <ul style="list-style-type: none"> <li>Significant difference in intentions/plans to physically distance <math>d = .10</math> (This message is particularly effective for those under 60 and males)</li> <li>Significant difference in support for government regulations particularly in under 60 year olds and women <math>d = .13</math></li> </ul>
Blanken et al. (2020)	Netherlands Art Fair setting Graduates of Dutch art academies and others ( $N = 787$ ) Demographics not reported	Behaviour (a count of distance violations was recorded electronically using a proximity device) was measured in four conditions that varied in walking directions and buzzers.  1. Unidirectional walking directions (with arrows on floor decals - one lane only) 2. Bidirectional walking directions (clockwise and anti-clockwise with arrows on floor decals) 3. Immediate buzzer (that immediately sounded when within 1.5m of another person from outside of your household. A demonstration of how it worked was included) 4. Delayed buzzer (sounded 3 seconds after being within 1.5m of another person from outside of your household)	1. unidirectional walking directions + immediate buzzer vs immediate buzzer <ul style="list-style-type: none"> <li>The addition of unidirectional arrows indicating a one-way system decreased the number of distancing violations compared to immediate buzzer alone <math>d = .40</math></li> </ul> 2. unidirectional walking directions vs bidirectional walking directions <ul style="list-style-type: none"> <li>There were no differences between the one way and two-way systems <math>d = -.13</math></li> </ul> 3. bidirectional walking directions + delayed buzzer vs bidirectional walking directions <ul style="list-style-type: none"> <li>A delayed buzzer had no effect or had a negative effect. <math>d = -.22</math></li> </ul> 4. unidirectional walking directions + immediate buzzer vs unidirectional walking directions <ul style="list-style-type: none"> <li>Buzzers were effective in reducing distancing violations when the feedback from them was immediate and when visitors received a demonstration of the buzzer. <math>d = .42</math></li> </ul>
Chutipimon et al. (2020)	Thailand University canteen setting University staff, students and others ( $N = 400$ ) 83% were aged 19-64 years	Behaviour (from CCTV recordings were used to note success and failure to distance) was measured after exposure to three types of floor decal marker that were used to mark out 2m gaps (there were 5 markings (1-2 were side by side at the counter; 3-5 were queued adjacent)  1. Red arrow floor decal (red arrow between footprint stickers at 2m distance) 2. Coronavirus floor decal (an aggressive coronavirus with glowing eyes and "stop Covid-19" with cut out circle for feet) 3. Footprint floor decal (footprint stickers at 2m distance) - control	1. red arrow floor decal vs footprint floor decal <ul style="list-style-type: none"> <li>No difference in distancing at any marking between floor decals</li> <li>Fewer failings in both groups at markings further away from counter  Marking point 1: <math>d = -.41</math>  Marking point 2: <math>d = .11</math>  Marking point 3: <math>d = .04</math>  Marking point 4: <math>d = -.08</math>  Marking point 5: <math>d = .85</math>  Mean = <math>.10</math></li> </ul> 2. coronavirus floor decal vs footprint floor decal <ul style="list-style-type: none"> <li>No difference in distancing at any marking between floor decals</li> <li>Fewer failings in both groups at markings further away from counter  Marking point 1: <math>d = .29</math></li> </ul>

Authors	Location and Sample	Conditions	Results
			<p>Marking point 2: <math>d = -.08</math>  Marking point 3: <math>d = -.01</math>  Marking point 4: <math>d = .52</math>  Marking point 5: <math>d = .40</math>  Mean = .22</p> <p>3. text floor decal vs footprint floor decal</p> <ul style="list-style-type: none"> <li>Difference in marking point 1 (at the counter) between intervention and control but no differences at any other marking.</li> <li>Fewer failings in both groups at markings further away from counter</li> </ul> <p>Marking point 1: <math>d = .52</math>  Marking point 2: <math>d = -.21</math>  Marking point 3: <math>d = -.25</math>  Marking point 4: <math>d = -.48</math>  Marking point 5: <math>d = -.11</math>  Mean = -.11</p>
Heoben et al. (2021)	Netherlands Outdoor public space setting General population ( $N =$ unknown) Demographics not reported	<p>Behaviour was measured at four time points. CCTV recordings used to note failure of 1.5m distancing or when in groups of &gt;3 people (not from your household). Cell phone data was also collected to measure change in time spent at non-residential places.</p> <ol style="list-style-type: none"> <li>Pre-outbreak measures (Jan 2020 – Feb 2020)</li> <li>Outbreak but pre government recommendations (29 Feb to 12 Mar 2020)</li> <li>Government recommendations (to keep 1.5m apart) (19 Mar 2020 to 21 Mar 2020)</li> <li>Government recommendations (to keep 1.5m apart) and fines (for not complying with 1.5m distancing) (26 Mar to 2 May 2020)</li> </ol>	<p>Not possible to calculate <math>d</math> as did not count non violations</p> <ol style="list-style-type: none"> <li>government recommendations vs pre outbreak <ul style="list-style-type: none"> <li>Decline in failures to distance from 12 March (no explicit distancing rule) and continues to decline after 1.5m recommendation (after 15 March) with lowest number of 19 March (before explicit rules and announcement of fine).</li> <li>12 – 19 March there is a decline in number of people on street from CCTV data (compared to Jan - Feb 2020). Number of people on street positively correlated with number of violations.</li> <li>Up to 12 March number of people in non-residential places was same as pre-COVID. 12 – 19 March there is sharp decline in time spent at non-residential locations</li> </ul> </li> <li>government recommendations + fines vs government recommendations pre fines <ul style="list-style-type: none"> <li>After explicit rule and fines for physical distancing there is a steady increase in violations (especially on weekends) from early April to early May. Increase in violations related to increase in number of new cases.</li> <li>Number of people on street positively correlated with number of violations. Time spent at non-residential locations relatively low until 4 April when started to increase. Correlation between time spent at non-residential locations and distancing violations remains even after people on street controlled for.</li> </ul> </li> </ol>
Khoa et al – study 2 (2021)	USA Online setting General population ( $N = 104$ ) 71.2% female ; mean age 42.18 years	<p>Intentions, fear and self-efficacy were measured after exposure to one of three message types</p> <ol style="list-style-type: none"> <li>Gain framed “promotion” message (Image of two figures standing apart and text “maintaining physical distance protects yourself from being infected with the coronavirus and secures your personal life”)</li> <li>Loss framed “prevention” message (Image of two figures standing apart (with arrow) and text “failing to maintain physical distance risks yourself of being infected with the coronavirus and endangers your personal life”)</li> <li>Minimal message (Image of two figures standing apart with “please maintain physical distance”) - control</li> </ol>	<ol style="list-style-type: none"> <li>gain framed message vs minimal message <ul style="list-style-type: none"> <li>Intentions were not reported but assume no significant differences between control and gain framed (“promotion”). Cannot calculate <math>d</math></li> </ul> </li> <li>loss framed message vs minimal message <ul style="list-style-type: none"> <li>Greater intentions to distance between loss framed (“prevention”) and control. Cannot calculate <math>d</math></li> </ul> </li> <li>loss framed message vs gain framed message <ul style="list-style-type: none"> <li>Greater intentions to distance between loss framed (“prevention”) and gain framed (“promotion”). Chronic prevention focus (i.e., a tendency to avoid losses) does not moderate this effect.</li> <li>Cannot calculate <math>d</math></li> <li>Loss framed (“prevention”) reported higher fear than gain framed (“promotion”). Fear was shown as a mediator of the effect of the physical distancing intervention (comparing loss and gain framed) on intentions</li> <li>Cannot calculate <math>d</math></li> <li>There was no difference loss framed (“prevention”) and gain framed (“promotion”) on self-efficacy and this was not a mediator</li> </ul> </li> </ol>

Authors	Location and Sample	Conditions	Results
			<ul style="list-style-type: none"> <li><math>d = .27</math></li> </ul>
Khoa et al - study 3 (2021)	USA Online setting General population ( $N = 124$ ) 43.5% female; mean age 41.77 years	<p>Intentions were measured after exposure to one of four message type</p> <ol style="list-style-type: none"> <li>Loss framed “prevention” message (Image of two figures standing apart (with arrow) and text “failing to maintain physical distance risks yourself of being infected with the coronavirus and endangers your personal life”)</li> <li>Gain framed “promotion” message (Image of two figures standing apart (with arrow) and text “maintaining physical distance protects yourself from being infected with the coronavirus and secures your personal life”)</li> <li>Loss framed message with anthropomorphic scary cartoon coronavirus between the figures</li> <li>Gain framed message with anthropomorphic scary cartoon coronavirus between the figures</li> </ol>	<ol style="list-style-type: none"> <li>Main effects of message type <ul style="list-style-type: none"> <li>Higher intentions in loss framed (“prevention”) than gain framed (“promotion”) conditions. Cannot calculate <math>d</math></li> </ul> </li> <li>Main effects of anthropomorphic image <ul style="list-style-type: none"> <li>Higher intentions in anthropomorphic than non-anthropomorphic conditions. Cannot calculate <math>d</math></li> </ul> </li> <li>Interaction between message type and anthropomorphic image <ul style="list-style-type: none"> <li>anthropomorphic image is absent loss framed (“prevention”) have greater intentions than gain framed (“promotion”) <math>d = .59</math></li> <li>anthropomorphic image increased intentions in loss framed (“prevention”) compared to anthropomorphic gain framed (“promotion”) <math>d = 1.76</math></li> <li>anthropomorphic image in loss framed (“prevention”) condition increased intentions compared to non-anthropomorphic loss framed (“prevention”) condition <math>d = .70</math></li> </ul> </li> </ol>
Lunn et al. (2020)	Ireland Online setting General population ( $N = 500$ ) 49% female; 33% <40 years / 31% 40-59 years / 36% >60 years	<p>Perceived effectiveness and perceived memorability were measured after exposure to one of three posters</p> <ol style="list-style-type: none"> <li>Individual person poster ( 4 panels, each with an image of people not maintaining social distance, with text-bubbles that foretold stories of chains of infection. Showed individuals who don’t realize they have the virus, spreading it to an identifiable vulnerable person. Including counterfactuals “if they had sat further away she’d have been ok” and open-ended implications “he has asthma”)</li> <li>Transmission rate poster (4 panels, each with an image of people not maintaining social distance, with text-bubbles that foretold stories of chains of infection. Showed individuals unwittingly spreading the virus to multiple others. Including counterfactuals “Had they sat further apart those people would have been ok” and open-ended implications “will now give COVID-19 to her colleagues, they’ll give it to their families”)</li> <li>Control poster (Featureless figurative cartoons in 4 panels depicting distancing in 4 social situations (i.e., walking in the street, sitting at a table, when shopping, on a football field))</li> </ol>	<ol style="list-style-type: none"> <li>individual person poster vs control poster <ul style="list-style-type: none"> <li>Control poster was significantly seen as more effective and memorable than intervention poster (calculated by number of people who selected maximum score as data highly skewed) <math>d = -.32</math> effectiveness <math>d = -.37</math> memorability</li> </ul> </li> <li>transmission rate poster vs control poster <ul style="list-style-type: none"> <li>No significant differences between the control poster and the transmission rate poster (calculated by number of people who selected maximum score as data highly skewed) <math>d = -.15</math> effectiveness <math>d = -.23</math> memorability</li> </ul> </li> <li>transmission rate poster vs individual person poster <ul style="list-style-type: none"> <li>No differences between the transmission rate poster and the individual person poster (calculated by number of people who selected maximum score as data highly skewed) <math>d = .17</math> effectiveness <math>d = .14</math> memorability</li> </ul> </li> </ol>

**Table 2: Quality of studies**

Study	Screening		Randomized Controlled Trials					Non Randomized Trials					Quantitative Descriptive Study				
	Clear Research Question	Data addresses Research Question	Randomisation appropriately performed	Comparable groups at baseline	Complete outcome data ( $\geq 80\%$ )	Outcome assessor blinded	Participants adhere to assigned Intervention	Participants representative	Appropriate measurement	Complete outcome data ( $\geq 80\%$ )	Confounders accounted for	Intervention delivered as intended	Relevant sampling strategy	Representative sample	Appropriate measurement	Low non response bias	Appropriate analysis
Bos et al. (2020)	Yes	Yes	Yes	Yes*	Yes	No	Yes										
Khoa et al. (2021) – study 2	Yes	Yes	Can't tell	Can't tell	Yes	Yes	Yes										
Khoa et al. (2021) – study 3	Yes	Yes	Can't tell	Can't tell	Yes	Yes	Yes										
Lunn et al. (2020)	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes										
Blanken et al. (2020)	Yes	Yes						Can't Tell***	Yes	Can't tell	No	Yes +					
Chutipthimon et al. (2020)	Yes	Yes						Yes	Yes	Can't tell	No	Yes					
Hoeben et al. (2021)	Yes	Yes											Yes	Yes	Yes	Yes	Yes

**Notes:**

\* there was a slight but significant difference in age, that was likely due to chance, and that was controlled for in subsequent analysis

\*\* for two of the three comparisons the participants were likely not blinded to condition as they were in a no message control and the measure was self-report

\*\*\* target population was not mentioned, the sample was recruited from an art fair so was not representative of the general population

+ intervention was delivered as intended but after an initial session where participants tested their proximity buzzers during the study time they changed the protocol to allow give them a demonstration of this prior to entering the study



**Table 3: Behavior change techniques, their delivery and effectiveness**

2.1 Monitoring of behavior by others without feedback	<p><b>Distance monitoring without a buzzer</b> (Blanken et al., 2020)  <b>Ineffective</b> – the no buzzer control condition (where behavior was monitored with a proximity device without feedback) coupled with unidirectional walking directions only was less effective than the unidirectional walking directions with a buzzer  <u>Other BCTs:</u> 7.1; 12.1</p>
2.2 Feedback on behavior	<p><b>Proximity Buzzer</b> (Blanken et al., 2020)  <b>Effective</b> – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring  <u>Other BCTs:</u> 7.1; 12.1; 12.5</p>
4.1 Instruction on how to perform the behavior	<p><b>Poster demonstrating behavior</b> (Lunn et al., 2020)  <b>Inconclusive</b>  Poster demonstrating behavior was significantly seen as more effective and memorable than other posters but did not measure intentions/behavior  <u>Other BCTs:</u> 6.1; 7.1; 9.1</p> <p><b>Health consequences message</b> (Bos et al., 2020)  <b>Ineffective</b> no difference in intentions between this and a measurement only control or moral duty message  <u>Other BCTs:</u> 9.1</p> <p><b>Moral duty message</b> (Bos et al., 2020)  <b>Inconclusive</b> message focusing on moral duty influenced intentions compared to message only control but no difference compared to health consequences message.  <u>Other BCTs:</u> 9.1; 13.2</p>
5.1 Information about Health Consequences	<p><b>Gain framed “promotion” poster</b> † (Khoa et al, 2021)  <b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions  <u>Other BCTs:</u> 6.1; 7.1</p> <p><b>Loss framed “prevention” poster</b> (Khoa et al, 2021)  <b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study)  <u>Other BCTs:</u> 6.1; 7.1</p> <p><b>Poster with consequences to individual people or about transmission rate</b> (Lunn et al., 2020)  <b>Inconclusive</b> ind person and transmission rate not effective in increasing effectiveness and memorability (and did not measure intentions or behavior)  <u>Other BCTs:</u> 7.1; 9.1; 9.3</p>

5.2 Salience of Consequences	<p><b>Floor decal markers with scary coronavirus†</b>  <i>(Chutipimon et al., 2020)</i>  <b>Inconclusive</b> – floor decal 2m markers with scary coronavirus don’t increase behavior when compared to other 2m floor decal markers  <u>Other BCTs:</u> 7.1; 8.3</p> <p><b>Loss framed “prevention” poster with scary coronavirus†</b> <i>(Khoa et al, 2021)</i>  <b>Effective</b> – Loss framed “prevention” focused posters were effective in increasing intention when compared the same posters w/o the scary coronavirus and Gain framed “promotion” posters  <u>Other BCTs:</u> 5.1; 6.1; 7.1</p>
6.1 demonstration of behavior	<p><b>Gain framed “promotion” poster</b> <i>(Khoa et al, 2021)</i>  <b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions  <u>Other BCTs:</u> 5.1; 7.1</p> <p><b>Loss framed “prevention” poster</b> <i>(Khoa et al, 2021)</i>  <b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study)  <u>Other BCTs:</u> 5.1; 7.1</p> <p><b>Poster demonstrating behavior</b> <i>(Lunn et al., 2020)</i>  <b>Inconclusive</b>  Poster demonstrating behavior was significantly seen as more effective and memorable than other posters but did not measure intentions/behavior  <u>Other BCTs:</u> 4.1; 7.1; 9.1</p>
7.1 prompts / cues	Note – no studies compared a condition with prompts/ cues and one without any prompts and cues
8.3 Habit formation	Note: no studies compared conditions with habit formation strategies and one without habit formation strategies
9.1 credible source	<p><b>Health consequences / moral duty message</b> <i>(Bos et al., 2020)</i>  <b>Inconclusive</b> as no difference between a control and a health consequences message from a credible source but difference with a moral duty message from a credible source  <u>Other BCTs:</u> 5.1; 13.2</p> <p><b>Government Guidelines†</b>  <i>(Hoeben et al., 2021)</i>  <b>Inconclusive</b> – behavior occurred before explicit government recommendations. May require other measures in place (e.g., stay at home orders) to facilitate change  <u>Other BCTs:</u> N/A</p>
9.3 comparative imagining of future outcomes	<p><b>Poster with consequences to individual people or about transmission rate</b> <i>(Lunn et al., 2020)</i>  <b>Inconclusive</b> ind person and transmission rate not effective in increasing effectiveness and memorability (and did not measure intentions or behavior)  <u>Other BCTs:</u> 5.1; 7.1; 9.1</p>

10.11 future punishment

**Government Fines†**

*(Hoeben et al., 2021)*

**Ineffective** – no evidence that fines influenced behavior

Other BCTs: 9.1

12.1 restructuring physical environment

**Directional walking system**

*(Blanken et al., 2020)*

**Effective** one-way walking system increased behavior but no difference with bi-directional system

Other BCTs: 2.2; 7.1

12.5 Adding objects to environment

**Proximity Buzzer**

*(Blanken et al., 2020)*

**Effective** – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring

Other BCTs: 2.2; 7.1; 12.1

13.2 framing / reframing

**Moral duty message †**

*(Bos et al., 2020)*

**Inconclusive** message focusing on moral duty influenced intentions compared to message only control, but no difference compared to health consequences message.

Other BCTs: 5.1; 9.1

## Supplementary materials

Table S1 – PRISMA checklist

Section and Topic	Item #	Checklist item	Reported (Yes/No)
<b>TITLE</b>			
Title	1	Identify the report as a systematic review.	Yes
<b>BACKGROUND</b>			
Objectives	2	Provide an explicit statement of the main objective(s) or question(s) the review addresses.	Yes
<b>METHODS</b>			
Eligibility criteria	3	Specify the inclusion and exclusion criteria for the review.	Yes
Information sources	4	Specify the information sources ( <u>e.g.</u> databases, registers) used to identify studies and the date when each was last searched.	Yes
Risk of bias	5	Specify the methods used to assess risk of bias in the included studies.	Yes
Synthesis of results	6	Specify the methods used to present and synthesise results.	Yes
<b>RESULTS</b>			
Included studies	7	Give the total number of included studies and participants and summarise relevant characteristics of studies.	Yes
Synthesis of results	8	Present results for main outcomes, preferably indicating the number of included studies and participants for each. If meta-analysis was done, report the summary estimate and confidence/credible interval. If comparing groups, indicate the direction of the effect ( <u>i.e.</u> which group is favoured).	Yes
<b>DISCUSSION</b>			
Limitations of evidence	9	Provide a brief summary of the limitations of the evidence included in the review ( <u>e.g.</u> study risk of bias, inconsistency and imprecision).	Yes
Interpretation	10	Provide a general interpretation of the results and important implications.	Yes
<b>OTHER</b>			
Funding	11	Specify the primary source of funding for the review.	Yes
Registration	12	Provide the register name and registration number.	Yes

## Web of Science database includes

This includes: Science Citation Index Expanded (1900-present) -- Social Sciences Citation Index (1900-present) -- Arts & Humanities Citation Index (1975-present) -- Conference Proceedings Citation Index- Science (1990-present) -- Conference Proceedings Citation Index- Social Science & Humanities (1990-present) -- Book Citation Index– Science (2005-present) -- Book Citation Index– Social Sciences & Humanities (2005-present) -- Emerging Sources Citation Index (2015-present) -- Current Chemical Reactions (1993-present) (Includes Institut National de la Propriete Industrielle structure data back to 1840) -- Index Chemicus (1993-present)

## Search terms for each database

### PubMed

("physical distancing"[MeSH Terms] AND (("methods"[MeSH Terms] OR "methods"[All Fields] OR "intervention"[All Fields]) OR ("clinical trials as topic"[MeSH Terms] OR ("clinical"[All Fields] AND "trials"[All Fields] AND "topic"[All Fields]) OR "clinical trials as topic"[All Fields] OR "trial"[All Fields]) OR experiment[All Fields])) AND ("pandemics"[MeSH Terms] OR "epidemics"[MeSH Terms] OR "influenza, human"[MeSH Terms]))

PsycInfo (search 25.01.21 = 0)

physical distancing.mh. and (intervention or trial or experiment).af. and (pandemics or epidemics or influenza, human).mh.

Web of science (search 25.01.21 = 826)

ALL FIELDS: (physical-distance OR social-distance OR physically-distanced OR socially-distanced OR physical-distancing OR social-distancing OR physical-proximity OR social-proximity OR social-contact OR physical-contact) AND ALL

FIELDS: (intervention OR trial OR experiment) AND ALL

FIELDS: (pandemic OR epidemic OR Covid OR coronavirus OR SARS OR MERS OR H1N1 OR ebola OR influenza OR swine flu)

Refined by: DOCUMENT TYPES: ( ARTICLE OR DATA PAPER OR PROCEEDINGS PAPER OR EARLY ACCESS )

Timespan: All years. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC.

Includes these databases:

Science Citation Index Expanded (1900-present) -- Social Sciences Citation Index (1900-present) -- Arts & Humanities Citation Index (1975-present) -  
- Conference Proceedings Citation Index- Science (1990-present) -- Conference Proceedings Citation Index- Social Science & Humanities (1990-present) -- Book Citation Index– Science (2005-present) -- Book Citation Index– Social Sciences & Humanities (2005-present) -- Emerging Sources Citation Index (2015-present) -- Current Chemical Reactions (1993-present) (Includes Institut National de la Propriete Industrielle structure data back to 1840) -- Index Chemicus (1993-present)

PsyArXiv (search 25.01.21 = 61)

(physical-distance OR social-distance OR physically-distanced OR socially-distanced OR physical-distancing OR social-distancing OR physical-proximity OR social-proximity OR social-contact OR physical-contact) AND (intervention OR trial OR experiment) AND (pandemic OR epidemic OR Covid OR coronavirus OR SARS OR MERS OR H1N1 OR ebola OR influenza OR swine flu)

MedRXiv (search 11.02.21 = 105)

This does not allow complex searches so Physical distance and Social distance in title or abstract were used as separate searches (these also covered physical distancing and social distancing)

Osf (search on preprints 11.02.21 = 145)

(physical-distance OR social-distance OR physically-distanced OR socially-distanced OR physical-distancing OR social-distancing OR physical-proximity OR social-proximity OR social-contact OR physical-contact) AND (intervention OR trial OR experiment) AND (pandemic OR epidemic OR Covid OR coronavirus OR SARS OR MERS OR H1N1 OR ebola OR influenza OR swine flu)

**Table S2: Study Characteristics**

Authors / Study type/ Comparisons	Context	Sample description	Intervention description	Comparison	Results
Bos et al. (2020)	<b>Country:</b> Germany	N: 3616	<b>Setting:</b> online	<b>Setting:</b> online	<b>Intentions</b> (indoors or outdoors not specified)
RCT	<b>Data collection:</b> 20-27 March 2020	<b>Population:</b> General population	<b>Delivery:</b> Consequentialist message – focus on consequences; included photo of credible source	<b>Delivery:</b> No message control	No effects on plans to physically distance (defined as “situations in which the respondent comes closer than two meters to others”)
<b>Comparisons :</b> 1. consequentialist message vs no message control 2. deontological message vs consequentialist message 3. deontological message vs no message control	<b>Public health measures:</b> Nationwide contact ban announced on 22 March that prohibited meeting more than one person at a time outside of HH  Does not mention government physical distancing recommendation  <b>Phase of pandemic:</b> 19,848 - 50,871 cases 68 – 351 deaths	<b>Gender:</b> not reported  <b>Age:</b> not reported	<i>“Dr Med Kellner, who is an infectiologist is treating corona patients in Leipzig, appeals to consider the consequences of personal actions: 'In times of the corona pandemic, the actions of every person can have considerable consequences for the health of other people. Through their personal actions they can break the chain of infection and thus protect especially the weakest in society from illness and death. Think about the consequences of your actions and the suffering of others, which you can prevent by keeping a physical distance from people, paying careful attention to hygiene, and encouraging your fellow humans to do the same.'”</i>  <b>BCTs:</b> <b>Potentially active</b> 5.1 health consequences* 9.1 credible source	<b>BCTs:</b> None	“Compared to the same week last year, by what percentage will you reduce or increase your physical, social contacts in the coming week?”  $d = .06$  <b>Support for Government regulations</b>  Significant difference in support for government regulations particularly in under 60 year olds and women  $d = .10$
			<b>Setting:</b> online  <b>Delivery:</b> Deontological message – focus on moral duty; included photo of credible source  <i>“Dr Med Kellner, who is an infectiologist is treating corona patients in Leipzig, appeals to the moral duty to stop the pandemic: 'In times of the corona pandemic, every person has a moral duty to stop the spread of the virus. You fulfil your moral duty by keeping a physical distance from people,</i>	<b>Setting:</b> online  <b>Delivery:</b> Consequentialist message – focus on consequences; included photo of credible source  <i>“Dr Med Kellner, who is an infectiologist is treating corona patients in Leipzig, appeals to consider the consequences of personal actions: 'In times of the corona pandemic, the actions of every person can have considerable consequences for the health</i>	<b>Intentions</b> (indoors or outdoors not specified)  No effects on plans to physically distance (defined as “situations in which the respondent comes closer than two meters to others”)  “Compared to the same week last year, by what percentage will you reduce or increase your physical, social contacts in the coming week?”  $d = .04$

Authors / Study type/ Comparisons	Context	Sample description	Intervention description	Comparison	Results
Blanken et al. (2020)	Country: Netherlands	N: 787	<p><i>paying careful attention to hygiene, and encouraging your fellow humans to do the same. Consider to what extent your personal actions are suited to break the chains of infection and whether the pandemic would be contained if everyone acts like you. ’’</i></p> <p><b>BCTs:</b> <b>Potentially active</b> 13.2 framing/reframing*† <b>Also in comparison group</b> 5.1 health consequences 9.1 credible source</p> <p><b>Setting:</b> online</p> <p><b>Delivery:</b> Deontological message – focus on moral duty; included photo of credible source</p> <p><i>“Dr Med Kellner, who is an infectiologist is treating corona patients in Leipzig, appeals to the moral duty to stop the pandemic: ‘In times of the corona pandemic, every person has a moral duty to stop the spread of the virus. You fulfil your moral duty by keeping a physical distance from people, paying careful attention to hygiene, and encouraging your fellow humans to do the same. Consider to what extent your personal actions are suited to break the chains of infection and whether the pandemic would be contained if everyone acts like you. ’’</i></p> <p><b>BCTs:</b> <b>Potentially active</b> 13.2 framing/reframing* 5.1 health consequences 9.1 credible source</p> <p><b>Setting:</b> Art fair</p> <p>One way system:</p>	<p><i>of other people. Through their personal actions they can break the chain of infection and thus protect especially the weakest in society from illness and death. Think about the consequences of your actions and the suffering of others, which you can prevent by keeping a physical distance from people, paying careful attention to hygiene, and encouraging your fellow humans to do the same. ’’</i></p> <p><b>BCTs:</b> <b>Potentially active</b> None <b>Also in intervention</b> 5.1 health consequences 9.1 credible source</p> <p><b>Setting:</b> online</p> <p><b>Delivery:</b> No message control</p> <p><b>BCTs:</b> None</p> <p><b>Setting:</b> Art fair</p>	<p><b>Support for Government regulations</b></p> <p>No difference in support for government regulations</p> <p><math>d = .03</math></p> <p><b>Intentions</b> (indoors or outdoors not specified)</p> <p>Significant difference in plans to physically distance (defined as “situations in which the respondent comes closer than two meters to others”)</p> <p><math>d = .10</math></p> <p>This message is particularly effective for those under 60 and males “Compared to the same week last year, by what percentage will you reduce or increase your physical, social contacts in the coming week?”</p> <p><b>Support for Government regulations</b></p> <p>Significant difference in support for government regulations particularly in under 60 year olds and women</p> <p><math>d = .13</math></p>



Authors / Study type/ Comparisons	Context	Sample description	Intervention description	Comparison	Results
Non randomized trial  <b>Comparisons :</b> 1. unidirectional walking directions + immediate buzzer vs immediate buzzer 2. unidirectional walking directions vs bidirectional walking directions 3. bidirectional walking directions + delayed buzzer vs bidirectional walking directions 4. unidirectional walking directions + immediate buzzer vs unidirectional walking directions	<b>Data collection:</b> Data collected 28-30 August 2020 at an Art Fair between first and second wave of COVID-19 (about 500 cases per day)  <b>Public health measures:</b> 9 March & 12 March directives (e.g., avoiding hand shaking, working from home) 15 March 1.5m recommended  23 March fines for not adhering to 1.5m rule  <b>Phase of pandemic:</b> 69,131 – 70,140 cases 6,224 deaths	<b>Population:</b> Graduates of Dutch art academies and others  <b>Gender:</b> not reported  <b>Age:</b> not reported	<b>Delivery:</b> Walking directions unidirectional with arrows on floor decals (one lane only)  Buzzer when within 1.5m of another person (not from your HH) – immediate buzzing after contact was made (and demonstration of how it worked)  <b>BCTs:</b> <b>Potentially active</b> 12.1 restructure physical environment*† <b>Also in comparison group</b> 2.2 Feedback on behavior 7.1 prompts and cues 12.5 Adding objects to the environment	<b>Delivery:</b> Buzzer when within 1.5m of another person (not from your HH) – immediate buzzing after contact was made (and demonstration of how it worked)  <b>BCTs:</b> <b>Also in intervention</b> 2.2 Feedback on behavior 7.1 prompts and cues 12.5 Adding objects to the environment	<b>Behavior (indoors)</b>  A count of distance violations recorded electronically using a proximity device  The addition of unidirectional arrows indicating a one-way system decreased the number of distancing violations  $d = .40$
			<b>Setting:</b> Art fair  One way system <b>Delivery:</b> Walking directions unidirectional with arrows on floor decals (one lane only)  <b>BCTs:</b> <b>Potentially active</b> None <b>Also in comparison group</b> 2.1 monitoring of behavior by others without feedback 7.1 prompts and cues 12.1 restructure physical environment*	<b>Setting:</b> Art fair  <b>Delivery:</b> Walking directions bidirectional (clockwise and anti-clockwise) with arrows on floor decals  <b>BCTs:</b> <b>Also in intervention group</b> 2.1 monitoring of behavior by others without feedback 7.1 prompts and cues 12.1 restructure physical environment*	<b>Behavior (indoors)</b>  A count of distance violations recorded electronically using a proximity device  There were no differences between the one way and two-way systems when both were restructured  $d = -.13$
			<b>Setting:</b> Art fair  Buzzer: <b>Delivery:</b> Buzzer when within 1.5m of another person (not from your HH) – buzzing 2 seconds after contact was made  Walking directions bidirectional (clockwise and anti-clockwise) with arrows on floor decals  <b>BCTs:</b>	<b>Setting:</b> Art fair  <b>Delivery:</b> Walking directions bidirectional (clockwise and anti-clockwise) with arrows on floor decals  <b>BCTs:</b> <b>Potentially active</b> 2.1 monitoring of behavior by others without feedback <b>Also in intervention</b>	<b>Behavior (indoors)</b>  A count of distance violations recorded electronically using a proximity device  A delayed buzzer had no effect or had a negative effect.  $d = -.22$

Authors / Study type/ Comparisons	Context	Sample description	Intervention description	Comparison	Results
Chutipimon et al. (2020)  Non randomized controlled trial  <b>Comparisons :</b> 1. red arrow floor decal vs footprint floor decal 2. coronavirus floor decal vs footprint floor decal 3. text floor decal vs footprint floor decal	<b>Country:</b> Thailand  <b>Data collection:</b> Data collected 7, 8 or 9 August 2020 (control collected 6 August 2020)  <b>Public health measures:</b> Since March 2020 there were government mandated measures including stay-at-home orders and the closure of schools, restaurants, and other public places, in addition to restricting the number of people allowed to socially gather  Does not mention government physical distancing recommendation	N: 400  <b>Population:</b> university staff, students and others  <b>Gender:</b> 58.5% female  <b>Age:</b> 83% 19-64	<p><b>Potentially active</b> 2.2 Feedback on behavior*</p> <p><b>Also in comparison group</b> 7.1 prompts and cues 12.1 restructure physical environment 12.5 Adding objects to the environment</p> <hr/> <p><b>Setting:</b> Art fair</p>	<p>7.1 prompts and cues 12.1 restructure physical environment</p> <hr/> <p><b>Setting:</b> Art fair</p>	
			<p>Buzzer: <b>Delivery:</b> Buzzer when within 1.5m of another person (not from your HH) – immediate buzzing after contact was made (and demonstration of how it worked)</p> <p>Walking directions unidirectional with arrows on floor decals (one lane only)</p> <p><b>BCTs:</b> <b>Potentially active</b> 2.2 Feedback on behavior* <b>Also in comparison group</b> 7.1 prompts and cues 12.1 restructure physical environment 12.5 Adding objects to the environment</p>	<p><b>Delivery:</b> Walking directions unidirectional with arrows on floor decals (one lane only)</p> <p><b>Potentially active</b> 2.1 monitoring of behavior by others without feedback <b>Also in intervention</b> 7.1 prompts and cues 12.1 restructure physical environment</p>	<p><b>Behavior</b> (indoors)</p> <p>A count of distance violations recorded electronically using a proximity device</p> <p>Buzzers were effective in reducing distancing violations when the feedback from them was immediate and when visitors received a demonstration of the buzzer.</p> <p><math>d = .42</math></p>
			<b>Setting:</b> university canteen	<b>Setting:</b> university canteen	<b>Behavior</b> (indoors)
			<p><b>Delivery:</b> Floor decal sticker – red arrow between footprint stickers at 2m distance</p> <p><b>BCTs:</b> <b>Potentially active</b> None <b>Also in comparison group</b> 7.1 prompts/cues* 8.3 habit formation</p>	<p><b>Delivery:</b> Floor decal sticker –footprint stickers at 2m distance</p> <p><b>BCTs:</b> <b>Also in intervention</b> 7.1 prompts/cues* 8.3 habit formation</p>	<p>CCTV recordings used to note success and failure to distance at each of 5 markings (1-2 were side by side at the counter; 3-5 were queued adjacent)</p> <p>No difference in distancing at any marking between intervention and control</p> <p>Fewer failings in both groups at markings further away from counter</p> <p>Marking point 1: <math>d = -.41</math> Marking point 2: <math>d = .11</math> Marking point 3: <math>d = .04</math> Marking point 4: <math>d = -.08</math> Marking point 5: <math>d = .85</math></p> <p>Mean = .10</p>
			<b>Setting:</b> university canteen	<b>Setting:</b> university canteen	<b>Behavior</b> (indoors)
			<b>Delivery:</b>	<b>Delivery:</b>	

Authors / Study type/ Comparisons	Context	Sample description	Intervention description	Comparison	Results
	<b>Phase of pandemic:</b> 3,345 – 3351 cases 58 deaths		Floor decal sticker – an aggressive coronavirus with glowing eyes and “stop Covid-19” with cut out circle for feet	Floor decal sticker –footprint stickers at 2m distance	CCTV recordings used to note success and failure to distance at each of 5 markings (1-2 were side by side at the counter; 3-5 were queued adjacent)
			<b>BCTs:</b> <b>Potentially active</b> 5.2 Salience of consequences*† <b>Also in comparison group</b> 7.1 prompts/cues* 8.3 habit formation	<b>BCTs:</b> <b>Also in intervention</b> 7.1 prompts/cues 8.3 habit formation	No difference in distancing at any marking between intervention and control  Fewer failings in both groups at markings further away from counter  Marking point 1: $d = .29$ Marking point 2: $d = -.08$ Marking point 3: $d = -.01$ Marking point 4: $d = .52$ Marking point 5: $d = .40$  Mean = .22
			<b>Setting:</b> university canteen  <b>Delivery:</b> Floor decal sticker – text “Please maintain a distance from other customers”, “Physical distancing and Win COVID-19”, “Please maintain a distance from other customers” and “Please queue here”  <b>BCTs:</b> <b>Potentially active</b> None <b>Also in comparison group</b> 7.1 prompts/cues* 8.3 habit formation	<b>Setting:</b> university canteen  <b>Delivery:</b> Floor decal sticker –footprint stickers at 2m distance  <b>BCTs:</b> <b>Also in intervention</b> 7.1 prompts/cues 8.3 habit formation	<b>Behavior (indoors)</b>  CCTV recordings used to note success and failure to distance at each of 5 markings (1-2 were side by side at the counter; 3-5 were queued adjacent)  Difference in marking point 1 (at the counter) between intervention and control but no differences at any other marking  Fewer failings in both groups at markings further away from counter  Marking point 1: $d = .52$ Marking point 2: $d = -.21$ Marking point 3: $d = -.25$ Marking point 4: $d = -.48$ Marking point 5: $d = -.11$  Mean = -.11
Heoben et al. (2021)  Natural experiment  <b>Comparisons :</b>	<b>Country:</b> Netherlands  <b>Data collection:</b> pre outbreak data Jan 2020 – Feb 2020  pre instruction data 29 Feb, 5, 7, 12 March	N: unknown  <b>Population:</b> General population  <b>Gender:</b> not reported  <b>Age:</b> not reported	<b>Setting:</b> public spaces  <b>Delivery:</b> Government recommendation to keep 1.5m apart  <b>BCTs:</b> <b>Potentially active</b>	<b>Setting:</b> public spaces  <b>Delivery:</b> Pre-outbreak measures  <b>BCTs:</b> None	<b>Behavior (outdoors)</b>  CCTV recordings used to note failure of 1.5m distancing or when in groups of >3 people (not from your HH). Cell phone data was also collected to measure change in time spent at non-residential places



Authors / Study type/ Comparisons	Context	Sample description	Intervention description	Comparison	Results
Khoa et al – study 2 (2021)  RCT  <b>Comparisons :</b> 1. gain framed message vs minimal message 2. loss framed message vs minimal message 3. loss framed message vs gain framed message	<b>Country:</b> USA  <b>Data collection:</b> Data collected during Covid and before submission date of 11 Aug 2020  <b>Public health measures:</b> Does not mention government physical distancing recommendation  <b>Phase of pandemic:</b> unknown	<b>Study 2</b> N: 104  <b>Population:</b> General population  <b>Gender:</b> 71.2% female  <b>Age:</b> 42.18	<b>Setting:</b> online  <b>Delivery:</b> Gain framed (“promotion”) message  Image of two figures standing apart and text “maintaining physical distance protects yourself from being infected with the coronavirus and secures your personal life”  <b>BCTs:</b> <b>Potentially active</b> 5.1 info about health consequences* †  <b>In comparison</b> 6.1 demonstration of behavior 7.1 Prompts/cues	<b>Setting:</b> online  <b>Delivery:</b> Image of two figures standing apart with “please maintain physical distance”  <b>BCTs:</b> <b>In intervention</b> 6.1 demonstration of behavior 7.1 Prompts/cues	Not possible to calculate $d$ as did not count non violations <b>Intentions</b> (indoors)  4 item scale (likelihood of avoiding crowded areas in supermarket; keeping myself physically distant from others while shopping; maintaining a safe distance from people in supermarket; keep myself apart from engaging in touching of others whilst shopping)  Not reported but assume no significant differences between control and gain framed (“promotion”)  Cannot calculate $d$
			<b>Setting:</b> online  <b>Delivery:</b> Loss framed (“prevention”) message  Image of two figures standing apart (with arrow) and text “failing to maintain physical distance risks yourself of being infected with the coronavirus and endangers your personal life”  <b>BCTs:</b> <b>Potentially active</b> 5.1 info about health consequences*† <b>In comparison group</b> 6.1 demonstration of behavior 7.1 Prompts/cues	<b>Setting:</b> online  <b>Delivery:</b> Image of two figures standing apart (with arrow) with “please maintain physical distance”  <b>BCTs:</b> <b>In intervention</b> 6.1 demonstration of behavior 7.1 Prompts/cues	<b>Intentions</b> (indoors)  4 item scale (likelihood of avoiding crowded areas in supermarket; keeping myself physically distant from others while shopping; maintaining a safe distance from people in supermarket; keep myself apart from engaging in touching of others whilst shopping).  Greater intentions to distance between loss framed (“prevention”) and control  Cannot calculate $d$
			<b>Setting:</b> online  <b>Delivery:</b> Loss framed (“prevention”) message	<b>Delivery:</b> Gain framed (“promotion”) message  Image of two figures standing apart (with arrow) and text “maintaining physical distance protects yourself from being	<b>Intentions</b> (indoors)  4 item scale (likelihood of avoiding crowded areas in supermarket; keeping myself physically distant from others while shopping; maintaining a safe

Authors / Study type/ Comparisons	Context	Sample description	Intervention description	Comparison	Results
			Image of two figures standing apart (with arrow) and text “failing to maintain physical distance risks yourself of being infected with the coronavirus and endangers your personal life”  <b>BCTs:</b> <b>Potentially active</b> None <b>In comparison group</b> 5.1 info about health consequences* 6.1 demonstration of behavior 7.1 Prompts/cues	infected with the coronavirus and secures your personal life”  <b>BCTs:</b> <b>In intervention</b> 5.1 info about health consequences 6.1 demonstration of behavior 7.1 Prompts/cues	distance from people in supermarket; keep myself apart from engaging in touching of others whilst shopping).  Greater intentions to distance between loss framed (“prevention”) and gain framed (“promotion”). Chronic prevention focus (i.e., a tendency to avoid losses) does not moderate this effect.  Cannot calculate <i>d</i>  <b>Fear</b>  Loss framed (“prevention”) reported higher fear than gain framed (“promotion”). Fear was shown as a mediator of the effect of the physical distancing intervention (comparing loss and gain framed) on intentions  Cannot calculate <i>d</i>  <b>Self-efficacy</b>  There was no difference loss framed (“prevention”) and gain framed (“promotion”) on self-efficacy and this was not a mediator  <i>d</i> = .27
Khoa et al - study 3 (2021)  RCT  <b>Comparisons :</b> 1. Loss framed message vs gain framed message	<b>Country:</b> USA  <b>Data collection:</b> Data collected during Covid and before submission date of 11 Aug 2020  <b>Public health measures:</b>  Does not mention government physical distancing recommendation  <b>Phase of pandemic:</b> unknown	<b>Study 3</b> N: 124  <b>Population:</b> General population  <b>Gender:</b> 43.5% female  <b>Age:</b> 41.77	<b>Setting:</b> online  <b>Delivery:</b> Loss framed (“prevention”) message  Image of two figures standing apart (with arrow) and text “failing to maintain physical distance risks yourself of being infected with the coronavirus and endangers your personal life”  Also, anthropomorphic condition with a scary cartoon coronavirus between the figures  <b>BCTs:</b>	<b>Setting:</b> online  <b>Delivery:</b> Gain framed (“promotion”) message  Image of two figures standing apart (with arrow) and text “maintaining physical distance protects yourself from being infected with the coronavirus and secures your personal life”  Also, anthropomorphic condition with a scary cartoon coronavirus between the figures  <b>BCTs:</b>	<b>Intentions</b> (indoors)  4 item scale (likelihood of avoiding crowded areas in supermarket; keeping myself physically distant from others while shopping; maintaining a safe distance from people in supermarket; keep myself apart from engaging in touching of others whilst shopping).  Higher in loss framed (“prevention”) than gain framed (“promotion”) conditions  <i>Can't calculate d</i>

Authors / Study type/ Comparisons	Context	Sample description	Intervention description	Comparison	Results
			<b>Potentially active</b> None <b>In comparison group</b> 5.1 info about health consequences* 5.2 salience of health consequences*† (in anthro vs non anthro) 6.1 demonstration of behavior 7.1 Prompts/cues	<b>Potentially active</b> None <b>In comparison group</b> 5.1 info about health consequences* 5.2 salience of health consequences*† (in anthro vs non anthro) 6.1 demonstration of behavior 7.1 Prompts/cues	Higher in anthropomorphic than non-anthropomorphic conditions  <i>Can't calculate d</i>  Interaction between above showed that when:  anthropomorphic image is absent loss framed ("prevention") have greater intentions than gain framed ("promotion") $d = .59$  anthropomorphic image increased intentions in loss framed ("prevention") compared to anthropomorphic gain framed ("promotion")  $d = 1.76$  anthropomorphic image in loss framed ("prevention") condition increased intentions compared to non-anthropomorphic loss framed ("prevention") condition  $d = .70$
Lunn et al. (2020)  RCT  <b>Comparisons :</b> 1.individual person poster vs control poster 2. transmission rate poster vs control poster 3.transmission rate poster vs individual person poster	<b>Country:</b> Ireland  <b>Data collection:</b> Data collected final week of March 2020  <b>Public health measures:</b> Recommendations to maintain 2m distance and limit social interaction but before rules to limit mixing of different HHs  <b>Phase of pandemic:</b> 1564 – 3235 cases 9 – 71 deaths	N: 500  <b>Population:</b> General population  <b>Gender:</b> 49% female  <b>Age:</b> 33% < 40 31% 40-59 36% > 60	<b>Setting:</b> online  <b>Delivery:</b> Poster Individual person poster – 4 panels, each with an image of people not maintaining social distance, with text-bubbles that foretold stories of chains of infection. Showed individuals who don't realize they have the virus, spreading it to an identifiable vulnerable person. Including counterfactuals "if they had sat further away she'd have been ok" and open-ended implications "he has asthma"  <b>BCTs:</b> <b>Potentially active</b> 5.1 information about health* consequences	<b>Setting:</b> online <b>Delivery:</b> Poster Featureless figurative cartoons in 4 panels depicting distancing in 4 social situations (i.e., walking in the street, sitting at a table, when shopping, on a football field)  <b>BCTs:</b> <b>Potentially active</b> 6.1 demonstration of behavior* 4.1 instructions on how to perform the behavior <b>In intervention</b> 7.1 Prompts/cues 9.1 Credible source	<b>Evaluation – perceived effectiveness &amp; perceived memorability</b> (not specified but posters showed outdoors)  Control poster was significantly seen as more effective and memorable than intervention poster (calculated by number of people who selected maximum score as data highly skewed)  $d = -.32$ effectiveness $d = -.37$ memorability

Authors / Study type/ Comparisons	Context	Sample description	Intervention description	Comparison	Results
			9.3 comparative imagining of future outcomes* <b>In comparison group</b> 7.1 Prompts/cues 9.1 Credible source		
			<b>Setting:</b> online  <b>Delivery:</b> Poster Transmission rate poster - 4 panels, each with an image of people not maintaining social distance, with text-bubbles that foretold stories of chains of infection. Showed individuals unwittingly spreading the virus to multiple others. Including counterfactuals “Had they sat further apart those people would have been ok” and open-ended implications “will now give COVID-19 to her colleagues, they’ll give it to their families”  <b>BCTs:</b> <b>Potentially active</b> 5.1 information about health consequences* 9.3 comparative imagining of future outcomes* <b>In comparison group</b> 7.1 Prompts/cues 9.1 Credible source	<b>Setting:</b> online  <b>Delivery:</b> Poster Featureless figurative cartoons in 4 panels depicting distancing in 4 social situations (i.e., walking in the street, sitting at a table, when shopping, on a football field)  <b>BCTs:</b> <b>BCTs:</b> <b>Potentially active</b> 6.1 demonstration of behavior* <b>In intervention</b> 7.1 Prompts/cues 9.1 Credible source	<b>Evaluation – perceived effectiveness &amp; perceived memorability</b> (not specified but posters showed outdoors)  No significant differences between the control poster and the transmission rate poster (calculated by number of people who selected maximum score as data highly skewed)  $d = -.15$ effectiveness $d = -.23$ memorability
			<b>Setting:</b> online  <b>Delivery:</b> Poster Transmission rate poster - 4 panels, each with an image of people not maintaining social distance, with text-bubbles that foretold stories of chains of infection. Showed individuals unwittingly spreading the virus to multiple others. Including counterfactuals “Had they sat further apart those people would have been ok” and open-ended implications “will now give COVID-19 to her colleagues, they’ll give it to their families”	<b>Setting:</b> online  <b>Delivery:</b> Poster Individual person poster – 4 panels, each with an image of people not maintaining social distance, with text-bubbles that foretold stories of chains of infection. Showed individuals who don’t realize they have the virus, spreading it to an identifiable vulnerable person. Including counterfactuals “if they had sat further away she’d have been ok” and open-ended implications “he has asthma”	<b>Evaluation – perceived effectiveness &amp; perceived memorability</b> (not specified but posters showed outdoors)  No differences between the transmission rate poster and the individual person poster (calculated by number of people who selected maximum score as data highly skewed)  $d = .17$ effectiveness $d = .14$ memorability



Authors / Study type/ Comparisons	Context	Sample description	Intervention description	Comparison	Results
			<b>BCTs:</b> <b>Potentially active</b> 9.3 comparative imagining of future outcomes <b>In comparison group</b> 7.1 Prompts/cues 9.1 Credible source	<b>BCTs:</b> <b>Potentially active</b> 9.3 comparative imagining of future outcomes <b>In comparison group</b> 7.1 Prompts/cues 9.1 Credible source	

Notes: BCT = behavior change technique (taken from Michie et al., 2013); \* = proposed primary BCT; †unique test of BCT

**Table S3 Dates of data collection**

	Jan 20	Feb 20	Mar 20	Apr 20	May 20	Jun 20	Jul 20	Aug 20
Bos et al. 2020								
Blanken et al. 2020								
Chutipimon et al. 2020								
Hoeben et al. 2021								
Lunn et al. 2020								
Khoa et al. 2021								

**Table S4 – Potential Mechanisms of Action and the corresponding BCTs**

Potential mechanisms of Action	Related BCTs	Related Interventions

Intentions	5.1 Information about Health Consequences	<p><b>Gain framed “promotion” poster</b> (<i>Khoa et al., 2021</i>)  <b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions  <u>Other BCTs:</u> 6.1; 7.1</p> <p><b>Loss framed “prevention” poster*</b> (<i>Khoa et al., 2021</i>)  <b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study)  <u>Other BCTs:</u> 6.1; 7.1</p>
	5.2 Salience of Consequences	<p><b>Poster with consequences to individual people or about transmission rate</b> (<i>Lunn et al., 2020</i>)  <b>Inconclusive</b> ind person and transmission rate not effective in increasing effectiveness and memorability (and did not measure intentions or behavior)  <u>Other BCTs:</u> 7.1; 9.1; 9.3</p> <p><b>Floor decal markers with scary coronavirus</b> (<i>Chutipimon et al., 2020</i>)  <b>Inconclusive</b> – floor decal 2m markers with scary coronavirus don’t increase behavior when compared to other 2m floor decal markers  <u>Other BCTs:</u> 7.1; 8.3</p> <p><b>Loss framed “prevention” poster with scary coronavirus*</b> (<i>Khoa et al., 2021</i>)  <b>Effective</b> – Loss framed “prevention” focused posters were effective in increasing intention when compared the same posters w/o the scary coronavirus and Gain framed “promotion” posters  <u>Other BCTs:</u> 5.1; 6.1; 7.1</p>
	6.1 demonstration of behavior	<p><b>Gain framed “promotion” poster</b> (<i>Khoa et al., 2021</i>)  <b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions  <u>Other BCTs:</u> 5.1; 7.1</p> <p><b>Loss framed “prevention” poster*</b> (<i>Khoa et al., 2021</i>)  <b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study)  <u>Other BCTs:</u> 5.1; 7.1</p> <p><b>Poster demonstrating behavior</b> (<i>Lunn et al., 2020</i>)  <b>Inconclusive</b>  Poster demonstrating behavior was significantly seen as more effective and memorable than other posters but did not measure intentions/behavior  <u>Other BCTs:</u> 4.1; 7.1; 9.1</p>
	13.2 framing / reframing	<p><b>Moral duty message</b> (<i>Bos et al., 2020</i>)  <b>Inconclusive</b> message focusing on moral duty influenced intentions compared to message only control, but no difference compared to health consequences message.  <u>Other BCTs:</u> 5.1; 9.1</p>
Behavioral Cueing	7.1 prompts / cues	Note – no studies compared a condition with prompts and cues and one without any prompts and cues

8.3 Habit formation	Note: no studies compared conditions with habit formation strategies and one without habit formation strategies
12.1 restructuring physical environment	<b>Directional walking system</b> <i>(Blanken et al, 2020)</i> <b>Effective</b> one-way walking system increased behavior but no difference with bi-directional system <u>Other BCTs: 2.2; 7.1</u>
12.5 Adding objects to environment	<b>Proximity Buzzer</b> <i>(Blanken et al, 2020)</i> <b>Effective</b> – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring <u>Other BCTs: 2.2; 7.1; 12.1</u>
Beliefs about consequences	<hr/> 5.1 Information about Health Consequences <b>Gain framed “promotion” poster</b> <i>(Khoa et al, 2021)</i> <b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions <u>Other BCTs: 6.1; 7.1</u>  <b>Loss framed “prevention” poster</b> <i>(Khoa et al, 2021)</i> <b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study) <u>Other BCTs: 6.1; 7.1</u>  <b>Poster with consequences to individual people or about transmission rate</b> <i>(Lunn et al., 2020)</i> <b>Inconclusive</b> ind person and transmission rate not effective in increasing effectiveness and memorability (and did not measure intentions or behavior) <u>Other BCTs: 7.1; 9.1; 9.3</u>  5.2 Salience of Consequences <b>Floor decal markers with scary coronavirus</b> <i>(Chutipimon et al., 2020)</i> <b>Inconclusive</b> – floor decal 2m markers with scary coronavirus don’t increase behavior when compared to other 2m floor decal markers <u>Other BCTs: 7.1; 8.3</u>  <b>Loss framed “prevention” poster with scary coronavirus</b> <i>(Khoa et al, 2021)</i> <b>Effective</b> – Loss framed “prevention” focused posters were effective in increasing intention when compared the same posters w/o the scary coronavirus and Gain framed “promotion” posters <u>Other BCTs: 5.1; 6.1; 7.1</u>  9.3 comparative imagining of future outcomes <b>Poster with consequences to individual people or about transmission rate</b> <i>(Lunn et al., 2020)</i> <b>Inconclusive</b> ind person and transmission rate not effective in increasing effectiveness and memorability (and did not measure intentions or behavior) <u>Other BCTs: 5.1; 7.1; 9.1</u> <hr/>

Attitudes towards the behavior	5.1 Information about Health Consequences	<p><b>Gain framed “promotion” poster</b> (<i>Khoa et al, 2021</i>)  <b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions  <u>Other BCTs:</u> 6.1; 7.1</p> <p><b>Loss framed “prevention” poster</b> (<i>Khoa et al, 2021</i>)  <b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study)  <u>Other BCTs:</u> 6.1; 7.1</p> <p><b>Poster with consequences to individual people or about transmission rate</b> (<i>Lunn et al., 2020</i>)  <b>Inconclusive</b> ind person and transmission rate not effective in increasing effectiveness and memorability (and did not measure intentions or behavior)  <u>Other BCTs:</u> 7.1; 9.1; 9.3</p>
	9.1 credible source	<p><b>Health consequences / moral duty message</b> (<i>Bos et al., 2020</i>)  <b>Inconclusive</b> as no difference between a control and a health consequences message from a credible source but difference with a moral duty message from a credible source  <u>Other BCTs:</u> 5.1; 13.2</p>
		<p><b>Government Guidelines</b>  (<i>Hoeben et al., 2021</i>)  <b>Inconclusive</b> – behavior occurred before explicit government recommendations. May require other measures in place (e.g., stay at home orders) to facilitate change  <u>Other BCTs:</u> N/A</p>
	13.2 framing / reframing	<p><b>Moral duty message</b>  (<i>Bos et al, 2020</i>)  <b>Inconclusive</b> message focusing on moral duty influenced intentions compared to message only control, but no difference compared to health consequences message.  <u>Other BCTs:</u> 5.1; 9.1</p>
Environmental context and resources	7.1 prompts / cues	Note – no studies compared a condition with prompts and cues and one without any prompts and cues
	12.1 restructuring physical environment	<p><b>Directional walking system</b>  (<i>Blanken et al, 2020</i>)  <b>Effective</b> one-way walking system increased behavior but no difference with bi-directional system  <u>Other BCTs:</u> 2.2; 7.1</p>
	12.5 Adding objects to environment	<p><b>Proximity Buzzer</b>  (<i>Blanken et al, 2020</i>)  <b>Effective</b> – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring  <u>Other BCTs:</u> 2.2; 7.1; 12.1</p>

Knowledge	4.1 Instruction on how to perform the behavior	<p><b>Poster demonstrating behavior</b> (<i>Lunn et al., 2020</i>)</p> <p><b>Inconclusive</b></p> <p>Poster demonstrating behavior was significantly seen as more effective and memorable than other posters but did not measure intentions/behavior</p> <p><u>Other BCTs:</u> 6.1; 7.1; 9.1</p> <p><b>Health consequences message</b></p> <p>(<i>Bos et al., 2020</i>)</p> <p><b>Ineffective</b> no difference in intentions between this and a measurement only control or moral duty message</p> <p><u>Other BCTs:</u> 9.1</p> <p><b>Moral duty message</b> (<i>Bos et al., 2020</i>)</p> <p><b>Inconclusive</b> message focusing on moral duty influenced intentions compared to message only control but no difference compared to health consequences message.</p> <p><u>Other BCTs:</u> 9.1; 13.2</p>
	5.1 Information about Health Consequences	<p><b>Gain framed “promotion” poster</b> (<i>Khoa et al., 2021</i>)</p> <p><b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions</p> <p><u>Other BCTs:</u> 6.1; 7.1</p> <p><b>Loss framed “prevention” poster</b> (<i>Khoa et al., 2021</i>)</p> <p><b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study)</p> <p><u>Other BCTs:</u> 6.1; 7.1</p> <p><b>Poster with consequences to individual people or about transmission rate</b> (<i>Lunn et al., 2020</i>)</p> <p><b>Inconclusive</b> ind person and transmission rate not effective in increasing effectiveness and memorability (and did not measure intentions or behavior)</p> <p><u>Other BCTs:</u> 7.1; 9.1; 9.3</p>
Beliefs about capabilities	4.1 Instruction on how to perform the behavior	<p><b>Poster demonstrating behavior</b> (<i>Lunn et al., 2020</i>)</p> <p><b>Inconclusive</b></p> <p>Poster demonstrating behavior was significantly seen as more effective and memorable than other posters but did not measure intentions/behavior</p> <p><u>Other BCTs:</u> 6.1; 7.1; 9.1</p> <p><b>Health consequences message</b></p> <p>(<i>Bos et al., 2020</i>)</p> <p><b>Ineffective</b> no difference in intentions between this and a measurement only control or moral duty message</p> <p><u>Other BCTs:</u> 9.1</p> <p><b>Moral duty message</b> (<i>Bos et al., 2020</i>)</p> <p><b>Inconclusive</b> message focusing on moral duty influenced intentions compared to message only control but no difference compared to health consequences message.</p> <p><u>Other BCTs:</u> 9.1; 13.2</p>

	6.1 demonstration of behavior	<p><b>Gain framed “promotion” poster</b> (<i>Khoa et al, 2021</i>)  <b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions  <u>Other BCTs:</u> 5.1; 7.1</p> <p><b>Loss framed “prevention” poster</b> (<i>Khoa et al, 2021</i>)  <b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study)  <u>Other BCTs:</u> 5.1; 7.1</p> <p><b>Poster demonstrating behavior</b> (<i>Lunn et al., 2020</i>)  <b>Inconclusive</b>  Poster demonstrating behavior was significantly seen as more effective and memorable than other posters but did not measure intentions/behavior  <u>Other BCTs:</u> 4.1; 7.1; 9.1</p>
Perceived susceptibility/ vulnerability	5.1 Information about Health Consequences	<p><b>Gain framed “promotion” poster</b> (<i>Khoa et al, 2021</i>)  <b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions  <u>Other BCTs:</u> 6.1; 7.1</p> <p><b>Loss framed “prevention” poster</b> (<i>Khoa et al, 2021</i>)  <b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study)  <u>Other BCTs:</u> 6.1; 7.1</p> <p><b>Poster with consequences to individual people or about transmission rate</b> (<i>Lunn et al., 2020</i>)  <b>Inconclusive</b> ind person and transmission rate not effective in increasing effectiveness and memorability (and did not measure intentions or behavior)  <u>Other BCTs:</u> 7.1; 9.1; 9.3</p>
	5.2 Salience of Consequences	<p><b>Floor decal markers with scary coronavirus</b> (<i>Chutipimon et al., 2020</i>)  <b>Inconclusive</b> – floor decal 2m markers with scary coronavirus don’t increase behavior when compared to other 2m floor decal markers  <u>Other BCTs:</u> 7.1; 8.3</p> <p><b>Loss framed “prevention” poster with scary coronavirus</b> (<i>Khoa et al, 2021</i>)  <b>Effective</b> – Loss framed “prevention” focused posters were effective in increasing intention when compared the same posters w/o the scary coronavirus and Gain framed “promotion” posters  <u>Other BCTs:</u> 5.1; 6.1; 7.1</p>

Skills	4.1 Instruction on how to perform the behavior	<p><b>Poster demonstrating behavior</b> (<i>Lunn et al., 2020</i>)</p> <p><b>Inconclusive</b></p> <p>Poster demonstrating behavior was significantly seen as more effective and memorable than other posters but did not measure intentions/behavior</p> <p><u>Other BCTs:</u> 6.1; 7.1; 9.1</p> <p><b>Health consequences message</b></p> <p>(<i>Bos et al., 2020</i>)</p> <p><b>Ineffective</b> no difference in intentions between this and a measurement only control or moral duty message</p> <p><u>Other BCTs:</u> 9.1</p> <p><b>Moral duty message</b> (<i>Bos et al., 2020</i>)</p> <p><b>Inconclusive</b> message focusing on moral duty influenced intentions compared to message only control but no difference compared to health consequences message.</p> <p><u>Other BCTs:</u> 9.1; 13.2</p>
	6.1 demonstration of behavior	<p><b>Gain framed “promotion” poster</b> (<i>Khoa et al, 2021</i>)</p> <p><b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions</p> <p><u>Other BCTs:</u> 5.1; 7.1</p> <p><b>Loss framed “prevention” poster</b> (<i>Khoa et al, 2021</i>)</p> <p><b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study)</p> <p><u>Other BCTs:</u> 5.1; 7.1</p> <p><b>Poster demonstrating behavior</b> (<i>Lunn et al., 2020</i>)</p> <p><b>Inconclusive</b></p> <p>Poster demonstrating behavior was significantly seen as more effective and memorable than other posters but did not measure intentions/behavior</p> <p><u>Other BCTs:</u> 4.1; 7.1; 9.1</p>
Memory, attention and decision making processes	7.1 prompts / cues	Note – no studies compared a condition with prompts and cues and one without any prompts and cues
Feedback processes	2.2 Feedback on behavior	<p><b>Proximity Buzzer</b></p> <p>(<i>Blanken et al, 2020</i>)</p> <p><b>Effective</b> – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring</p> <p><u>Other BCTs:</u> 7.1; 12.1; 12.5</p>

General attitudes and beliefs	9.1 credible source	<b>Health consequences / moral duty message</b> ( <i>Bos et al., 2020</i> ) <b>Inconclusive</b> as no difference between a control and a health consequences message from a credible source but difference with a moral duty message from a credible source <u>Other BCTs: 5.1; 13.2</u>  <b>Government Guidelines</b> ( <i>Hoeben et al., 2021</i> ) <b>Inconclusive</b> – behavior occurred before explicit government recommendations. May require other measures in place (e.g., stay at home orders) to facilitate change <u>Other BCTs: N/A</u>
	2.2 Feedback on behavior	<b>Proximity Buzzer</b> ( <i>Blanken et al., 2020</i> ) <b>Effective</b> – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring <u>Other BCTs: 7.1; 12.1; 12.5</u>
None identified	2.1 Monitoring of behavior by others without feedback	<b>Distance monitoring without a buzzer</b> ( <i>Blanken et al., 2020</i> ) <b>Ineffective</b> – the no buzzer control condition (where behavior was monitored with a proximity device without feedback) coupled with unidirectional walking directions only was less effective than the unidirectional walking directions with a buzzer <u>Other BCTs: 7.1; 12.1</u>
	10.11 future punishment	<b>Government Fines</b> ( <i>Hoeben et al., 2021</i> ) <b>Ineffective</b> – no evidence that fines influenced behavior <u>Other BCTs: 9.1</u>

\* actual intention measured and change occurred

**Table S5 – theoretical domains and related BCTs**



Theoretical domain	BCTs	Related interventions
Environmental context and resources	7.1 prompts / cues	Note – no studies compared a condition with prompts and cues and one without any prompts and cues
	12.1 restructuring physical environment	<b>Directional walking system</b> <i>(Blanken et al, 2020)</i> <b>Effective</b> one-way walking system increased behavior but no difference with bi-directional system <u>Other BCTs:</u> 2.2; 7.1
	12.5 Adding objects to environment	<b>Proximity Buzzer</b> <i>(Blanken et al, 2020)</i> <b>Effective</b> – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring <u>Other BCTs:</u> 2.2; 7.1; 12.1
Knowledge	2.2 Feedback on behavior	<b>Proximity Buzzer</b> <i>(Blanken et al, 2020)</i> <b>Effective</b> – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring <u>Other BCTs:</u> 7.1; 12.1; 12.5
	5.1 Information about Health Consequences	<b>Gain framed “promotion” poster</b> <i>(Khoa et al, 2021)</i> <b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions <u>Other BCTs:</u> 6.1; 7.1  <b>Loss framed “prevention” poster</b> <i>(Khoa et al, 2021)</i> <b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study) <u>Other BCTs:</u> 6.1; 7.1  <b>Poster with consequences to individual people or about transmission rate</b> <i>(Lunn et al., 2020)</i> <b>Inconclusive</b> ind person and transmission rate not effective in increasing effectiveness and memorability (and did not measure intentions or behavior) <u>Other BCTs:</u> 7.1; 9.1; 9.3

Beliefs about consequences	5.2 Salience of Consequences	<p><b>Floor decal markers with scary coronavirus</b> (<i>Chutipimon et al., 2020</i>)</p> <p><b>Inconclusive</b> – floor decal 2m markers with scary coronavirus don't increase behavior when compared to other 2m floor decal markers</p> <p><u>Other BCTs:</u> 7.1; 8.3</p>
	9.3 comparative imagining of future outcomes	<p><b>Loss framed “prevention” poster with scary coronavirus</b> (<i>Khoa et al, 2021</i>)</p> <p><b>Effective</b> – Loss framed “prevention” focused posters were effective in increasing intention when compared the same posters w/o the scary coronavirus and Gain framed “promotion” posters</p> <p><u>Other BCTs:</u> 5.1; 6.1; 7.1</p>
Social influence	6.1 demonstration of behavior	<p><b>Gain framed “promotion” poster</b> (<i>Khoa et al, 2021</i>)</p> <p><b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions</p> <p><u>Other BCTs:</u> 5.1; 7.1</p>
		<p><b>Loss framed “prevention” poster</b> (<i>Khoa et al, 2021</i>)</p> <p><b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study)</p> <p><u>Other BCTs:</u> 5.1; 7.1</p>
		<p><b>Poster demonstrating behavior</b> (<i>Lunn et al., 2020</i>)</p> <p><b>Inconclusive</b></p> <p>Poster demonstrating behavior was significantly seen as more effective and memorable than other posters but did not measure intentions/behavior</p> <p><u>Other BCTs:</u> 4.1; 7.1; 9.1</p>
Physical skills	8.3 Habit formation	Note: no studies compared conditions with habit formation strategies and one without habit formation strategies
None identified	2.1 Monitoring of behavior by others without feedback	<p><b>Distance monitoring without a buzzer</b> (<i>Blanken et al, 2020</i>)</p> <p><b>Ineffective</b> – the no buzzer control condition (where behavior was monitored with a proximity device without feedback) coupled with unidirectional walking directions only was less effective than the unidirectional walking directions with a buzzer</p> <p><u>Other BCTs:</u> 7.1; 12.1</p>

4.1 Instruction on how to perform the behavior

**Poster demonstrating behavior** (*Lunn et al., 2020*)

**Inconclusive**

Poster demonstrating behavior was significantly seen as more effective and memorable than other posters but did not measure intentions/behavior

Other BCTs: 6.1; 7.1; 9.1

**Health consequences message**

(*Bos et al., 2020*)

**Ineffective** no difference in intentions between this and a measurement only control or moral duty message

Other BCTs: 9.1

**Moral duty message** (*Bos et al., 2020*)

**Inconclusive** message focusing on moral duty influenced intentions compared to message only control but no difference compared to health consequences message.

Other BCTs: 9.1; 13.2

**Health consequences / moral duty message** (*Bos et al., 2020*)

**Inconclusive** as no difference between a control and a health consequences message from a credible source but difference with a moral duty message from a credible source

Other BCTs: 5.1; 13.2

9.1 credible source

**Government Guidelines**

(*Hoeben et al., 2021*)

**Inconclusive** – behavior occurred before explicit government recommendations. May require other measures in place (e.g., stay at home orders) to facilitate change

Other BCTs: N/A

10.11 future  
punishment

**Government Fines**

(*Hoeben et al., 2021*)

**Ineffective** – no evidence that fines influenced behavior

Other BCTs: 9.1

13.2 framing / reframing

**Moral duty message**

(*Bos et al., 2020*)

**Inconclusive** message focusing on moral duty influenced intentions compared to message only control, but no difference compared to health consequences message.

Other BCTs: 5.1; 9.1

**Table S6 – Intervention functions and related BCTs**

Intervention function	Related BCTs	Related Interventions
Persuasion	2.2 Feedback on behavior*	<p><b>Proximity Buzzer</b> (<i>Blanken et al., 2020</i>)  <b>Effective</b> – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring  <u>Other BCTs:</u> 7.1; 12.1; 12.5</p>
	5.1 Information about Health Consequences*	<p><b>Gain framed “promotion” poster</b> (<i>Khoa et al., 2021</i>)  <b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions  <u>Other BCTs:</u> 6.1; 7.1</p> <p><b>Loss framed “prevention” poster</b> (<i>Khoa et al., 2021</i>)  <b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study)  <u>Other BCTs:</u> 6.1; 7.1</p> <p><b>Poster with consequences to individual people or about transmission rate</b> (<i>Lunn et al., 2020</i>)  <b>Inconclusive</b> ind person and transmission rate not effective in increasing effectiveness and memorability (and did not measure intentions or behavior)  <u>Other BCTs:</u> 7.1; 9.1; 9.3</p>
	5.2 Salience of Consequences**	<p><b>Floor decal markers with scary coronavirus</b> (<i>Chutipimon et al., 2020</i>)  <b>Inconclusive</b> – floor decal 2m markers with scary coronavirus don’t increase behavior when compared to other 2m floor decal markers  <u>Other BCTs:</u> 7.1; 8.3</p> <p><b>Loss framed “prevention” poster with scary coronavirus</b> (<i>Khoa et al., 2021</i>)  <b>Effective</b> – Loss framed “prevention” focused posters were effective in increasing intention when compared the same posters w/o the scary coronavirus and Gain framed “promotion” posters  <u>Other BCTs:</u> 5.1; 6.1; 7.1</p>
	9.1 credible source*	<p><b>Health consequences / moral duty message</b> (<i>Bos et al., 2020</i>)  <b>Inconclusive</b> as no difference between a control and a health consequences message from a credible source but difference with a moral duty message from a credible source  <u>Other BCTs:</u> 5.1; 13.2</p> <p><b>Government Guidelines</b> (<i>Hoeben et al., 2021</i>)  <b>Inconclusive</b> – behavior occurred before explicit government recommendations. May require other measures in place (e.g., stay at home orders) to facilitate change  <u>Other BCTs:</u> N/A</p>

	13.2 framing / reframing **	<p><b>Moral duty message</b> (Bos et al, 2020) Inconclusive message focusing on moral duty influenced intentions compared to message only control, but no difference compared to health consequences message. <u>Other BCTs:</u> 5.1; 9.1</p>
Enablement	5.2 Salience of Consequences**	<p><b>Floor decal markers with scary coronavirus</b> (Chutipimon et al., 2020) Inconclusive – floor decal 2m markers with scary coronavirus don't increase behavior when compared to other 2m floor decal markers <u>Other BCTs:</u> 7.1; 8.3</p> <p><b>Loss framed “prevention” poster with scary coronavirus</b> (Khoa et al, 2021) Effective – Loss framed “prevention” focused posters were effective in increasing intention when compared the same posters w/o the scary coronavirus and Gain framed “promotion” posters <u>Other BCTs:</u> 5.1; 6.1; 7.1</p>
	9.3 comparative imagining of future outcomes**	<p><b>Poster with consequences to individual people or about transmission rate</b> (Lunn et al., 2020) Inconclusive ind person and transmission rate not effective in increasing effectiveness and memorability (and did not measure intentions or behavior) <u>Other BCTs:</u> 5.1; 7.1; 9.1</p>
	12.1 restructuring physical environment*	<p><b>Directional walking system</b> (Blanken et al, 2020) Effective one-way walking system increased behavior but no difference with bi-directional system <u>Other BCTs:</u> 2.2; 7.1</p>
	13.2 framing / reframing **	<p><b>Moral duty message</b> (Bos et al, 2020) Inconclusive message focusing on moral duty influenced intentions compared to message only control, but no difference compared to health consequences message. <u>Other BCTs:</u> 5.1; 9.1</p>
Training	2.2 Feedback on behavior *	<p><b>Proximity Buzzer</b> (Blanken et al, 2020) Effective – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring <u>Other BCTs:</u> 7.1; 12.1; 12.5</p>

Education	4.1 Instruction on how to perform the behavior*	<p><b>Poster demonstrating behavior</b> (<i>Lunn et al., 2020</i>)</p> <p><b>Inconclusive</b>  Poster demonstrating behavior was significantly seen as more effective and memorable than other posters but did not measure intentions/behavior  <u>Other BCTs:</u> 6.1; 7.1; 9.1</p> <p><b>Health consequences message</b>  (<i>Bos et al., 2020</i>)  <b>Ineffective</b> no difference in intentions between this and a measurement only control or moral duty message  <u>Other BCTs:</u> 9.1</p> <p><b>Moral duty message</b> (<i>Bos et al., 2020</i>)  <b>Inconclusive</b> message focusing on moral duty influenced intentions compared to message only control but no difference compared to health consequences message.  <u>Other BCTs:</u> 9.1; 13.2</p>
	6.1 demonstration of behavior*	<p><b>Gain framed “promotion” poster</b> (<i>Khoa et al, 2021</i>)  <b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions  <u>Other BCTs:</u> 5.1; 7.1</p> <p><b>Loss framed “prevention” poster</b> (<i>Khoa et al, 2021</i>)  <b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study)  <u>Other BCTs:</u> 5.1; 7.1</p> <p><b>Poster demonstrating behavior</b> (<i>Lunn et al., 2020</i>)  <b>Inconclusive</b>  Poster demonstrating behavior was significantly seen as more effective and memorable than other posters but did not measure intentions/behavior  <u>Other BCTs:</u> 4.1; 7.1; 9.1</p>
	8.3 Habit formation*	Note: no studies compared conditions with habit formation strategies and one without habit formation strategies
	2.2 Feedback on behavior *	<p><b>Proximity Buzzer</b>  (<i>Blanken et al, 2020</i>)  <b>Effective</b> – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring  <u>Other BCTs:</u> 7.1; 12.1; 12.5</p> <p><b>Gain framed “promotion” poster</b> (<i>Khoa et al, 2021</i>)  <b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions  <u>Other BCTs:</u> 6.1; 7.1</p> <p><b>Loss framed “prevention” poster</b> (<i>Khoa et al, 2021</i>)  <b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study)  <u>Other BCTs:</u> 6.1; 7.1</p> <p><b>Poster with consequences to individual people or about transmission rate</b> (<i>Lunn et al., 2020</i>)  <b>Inconclusive</b> ind person and transmission rate not effective in increasing effectiveness and memorability (and did not measure intentions or behavior)  <u>Other BCTs:</u> 7.1; 9.1; 9.3</p>
	5.1 Information about Health Consequences*	

	7.1 prompts / cues*	Note – no studies compared a condition with prompts and cues and one without any prompts and cues
Environmental restructuring	7.1 prompts / cues*	Note – no studies compared a condition with prompts and cues and one without any prompts and cues
	12.1 restructuring physical environment*	<b>Directional walking system</b> <i>(Blanken et al, 2020)</i> Effective one-way walking system increased behavior but no difference with bi-directional system <u>Other BCTs:</u> 2.2; 7.1
	12.5 Adding objects to environment*	<b>Proximity Buzzer</b> <i>(Blanken et al, 2020)</i> Effective – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring <u>Other BCTs:</u> 2.2; 7.1; 12.1
Coercion	2.1 Monitoring of behavior by others without feedback*	<b>Distance monitoring without a buzzer</b> <i>(Blanken et al, 2020)</i> Ineffective – the no buzzer control condition (where behavior was monitored with a proximity device without feedback) coupled with unidirectional walking directions only was less effective than the unidirectional walking directions with a buzzer <u>Other BCTs:</u> 7.1; 12.1
	2.2 Feedback on behavior *	<b>Proximity Buzzer</b> <i>(Blanken et al, 2020)</i> Effective – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring <u>Other BCTs:</u> 7.1; 12.1; 12.5
	10.11 future Punishment**	<b>Government Fines</b> <i>(Hoeben et al., 2021)</i> Ineffective – no evidence that fines influenced behavior <u>Other BCTs:</u> 9.1
Incentivisation	2.1 Monitoring of behavior by others without feedback*	<b>Distance monitoring without a buzzer</b> <i>(Blanken et al, 2020)</i> Ineffective – the no buzzer control condition (where behavior was monitored with a proximity device without feedback) coupled with unidirectional walking directions only was less effective than the unidirectional walking directions with a buzzer <u>Other BCTs:</u> 7.1; 12.1

	2.2 Feedback on behavior *	<b>Proximity Buzzer</b> <i>(Blanken et al, 2020)</i> <b>Effective</b> – buzzer increased behavior when feedback is immediate (2 sec delay ineffective) when coupled with physical restructuring <u>Other BCTs:</u> 7.1; 12.1; 12.5
Modelling	6.1 demonstration of behavior*	<hr/> <b>Gain framed “promotion” poster</b> <i>(Khoa et al, 2021)</i> <b>Ineffective</b> no difference between Gain framed “promotion” and control poster on intentions <u>Other BCTs:</u> 5.1; 7.1  <b>Loss framed “prevention” poster</b> <i>(Khoa et al, 2021)</i> <b>Effective</b> – increased intention when compared to Gain framed “promotion” focused poster (2 studies) and control (1 study) <u>Other BCTs:</u> 5.1; 7.1  <b>Poster demonstrating behavior</b> <i>(Lunn et al., 2020)</i> <b>Inconclusive</b> Poster demonstrating behavior was significantly seen as more effective and memorable than other posters but did not measure intentions/behavior <u>Other BCTs:</u> 4.1; 7.1; 9.1

Intervention Functions were determined from a consensus exercise and review of interventions to determine which interventions were related to which BCTs (p. 151-155, Michie et al., 2014).

\* shows frequently used BCTs \*\* shows less frequently used BCTS