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Fostering compliance with physical distancing by interactive feedback in the context of the COVID-19 pandemic: A web-based randomized controlled trial

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ABSTRACT

Background: To slow down the spread of COVID-19, the observance of basic hygiene measures, and physical distancing is recommended. Initial findings suggest that physical distancing in particular can prevent the spread of COVID-19.

Objectives: To investigate how information to prevent the spread of infectious diseases should be presented to increase willingness to comply with preventive measures.

Methods: In a preregistered online experiment, 817 subjects were presented with either interactively controllable graphics on the spread of COVID-19 and information that enable them to recognize how much the spread of COVID-19 is reduced by physical distancing (experimental group) or text-based information about quantitative evidence (control group). It was hypothesized that participants receiving interactive information on the prevention of COVID-19 infections show a significantly higher willingness to comply with future containment measures than participants reading the text-based information. Explorative analyses were conducted to examine whether other factors influence compliance.

Results: As predicted, we found a small effect (d = 0.22, 95% CI: 0.11; 0.23, $p < .001$) for the tested intervention. The exploratory analysis suggests a decline in compliance later in the study ($r = -0.10$, 95% CI: −0.15; −0.07). Another significant predictor of change in compliance was health-related anxiety, but the effect was trivial.

Conclusions: When presented interactively, information on how the own behavior can help prevent infectious diseases can lead to slightly stronger changes in attitude towards behavioral prevention measures than just text-based information. Given the scalability of this simple internet-based intervention, it could play a role in fostering compliance during a pandemic within universal prevention strategies. Future work on the predictive validity of self-reported compliance and the real-world effects on the intervention is needed.

1. Introduction

1.1. Scientific background

On social media, the hashtag *#stayhome* went viral during the first phase of the COVID-19 pandemic (March/April 2020), reminding people to comply with the social respectively physical distancing regulations for slowing the COVID-19 spread. Physical distancing and pronounced hygiene measures were announced to be the most important strategies to slow the spreading of the disease (World Health Organisation, 2020). Following the suggestion of the WHO, in this paper, we favor the term “physical distancing” as opposed to “social distancing”, since it is a physical separation that prevents transmission. However, people can still remain socially connected, e.g. via technology. Initial findings from Italy suggest that physical distancing in particular can prevent or slow down the spread of COVID-19 (Dowd et al., 2020). Thus, it is crucial to effectively communicate the urgency and meaningfulness of these measures to the population so that people are motivated to comply with these regulations. However, there is a lack of research on how exactly such information should look like to convince and motivate people to stick to them as effectively as possible. Thus, this randomized, controlled online study aimed to investigate how information should be designed for the general population to increase the acceptance of and compliance with these measures.

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According to the theory of planned behavior (TPB; Ajzen, 1991), intentions are modulated by three important factors: personal attitude (including all positive and negative outcome beliefs and evaluations), subjective norms (the perception of social norms and the willingness to comply), as well as perceived behavioral control. The TPB has been applied to a wide range of studies on health behaviors (Hagger et al., 2016; McEachan et al., 2011; C.Q. Zhang et al., 2020). The three included constructs were found to successfully predict intentions and behavior [see Armitage and Conner (2000) for a review]. In the context of health-related behavior, the TPB has been successfully applied to increase motivation, for example in smoking cessation (Norman et al., 1999). It can be concluded that compliant behavior that results in fewer infections emerges, at least in part, from intentions towards future behavior. The current study testing whether compliance in engaging in and maintaining physical distancing in the context of the COVID-19 pandemic can be fostered using an online exercise that is based on visual feedback.

Arguing with statistical risks is a predominant technique trying to convince people to comply with measures regarding health-related behavior and protection. During the current COVID-19 pandemic, all justifications for fostering behavioral changes and shutdowns were based on prevalence and incidence of infection, and mortality rates in one's own country or other countries (not more than a few weeks old). Based on these current extrapolated observations, predictions were made as to which measures can best contribute to slowing down the spread and flatten the curve. The resulting information for the public was therefore mainly of probabilistic and statistical nature (e.g., getting the R-factor below 1). Statistical evidence, in particular, was found to effectively alter peoples ́ judgments and attitudes (Boster et al., 2000; Campo et al., 2004) – stronger than anecdotal evidence (Hoeken and Hustinx, 2009). However, one major constraint of using statistical information is that humans' estimations of probabilities are biased in several ways (Sanborn and Chater, 2016). Humans have substantial difficulties estimating the course of variables that follow exponential growth functions (Levy and Tasoff, 2016). Nevertheless, statistical information is mainly presented in the media as purely text-based information (i.e., numbers), which might not be the optimal form of how information is presented. We used this popular form of communication in our control group as a test of how the information would change compliance in a "treatment as usual" fashion. Thus, individuals receiving this "usual" information were treated as the control group in our study.

1.2. Objectives

In the current online experiment, we wanted to investigate how media representations can be modified to increase the intention of individuals to follow disease prevention guidelines. Therefore, we provided optimized communication strategies that were hypothesized to increase compliance with the safety measures. In the first step, we tried to increase the comprehension of growth functions by stating the results as discrete case numbers of infections (Hoffrage and Gigerenzer, 1998; Munnich et al., 2007). Furthermore, we added graphical visualizations as they have been shown to offer several benefits: First, infographics attract attention (Geidner et al., 2015). Secondly, visualizations support learning when combined with text and information (Kim et al., 2018), and thirdly, they do require less cognitive effort in processing leaving unoccupied capacity that can be used to integrate the new information and adapt the attitude accordingly (Stenning, 1995). In the context of the current COVID-19 pandemic, visually supported information about behavior measures was repeatedly advocated by the research team of the COVID-19 Snapshot Monitoring (COSMO) from the University Konstanz (Betsch et al., 2020). However, visualization alone is sometimes not impelling enough to yield a benefit in the context of reasoning (Boster et al., 2000; Micallef et al., 2012). People have to engage more with the materials and activate their prior knowledge (Kim et al., 2017). Thus the information is processed more elaborately which contributes to learning (Marraffino et al., 2015), reduced misperception (Geidner et al., 2015), and lesser counterarguing so that even incongruent information might be integrated and prior beliefs changed accordingly.

Based on these findings in this randomized online study, participants in the experimental group are presented with interactively controllable exponential curves and information using concrete examples that enable them to recognize, how much the spread of COVID-19 has reduced by physical distancing [sources: Dowd et al., 2020; Signer and Warshaw, 2020]. In more detail, as part of the online experiment, participants in the experimental group created visualizations showing the hypothetical spread of COVID-10 depending on the degree of behavioral compliance to social distancing (for complete description, see Multimedia Appendix 1). Participants in the control group are presented with simple text-based information provided by German institutions (Bundeszentrale für Gesundheitliche Aufklärung, 2020; Robert Koch Institut, 2020). We predict that participants who receive interactive information on the prevention of COVID-19 infections show a significantly higher willingness to adhere to containment measures afterward than participants who only read the text-based information.

Explorative analyses are conducted to examine whether other possible factors influence compliance. Our choice of variables was guided by similar investigations into compliance with COVID-19 preventive measures (Clark et al., 2020). In addition to socio-demographic variables like age and gender, the general health status will be included to explore whether subjects who perceive themselves as less healthy show higher compliance. Knowing infected persons or even having friends or family members with a COVID-19 infection could influence compliance as well, so we included the number of infected acquaintances, friends, and family members as exploratory predictors. Finally, psychometric variables were included. Symptoms of anxiety and depression could reflect a behavioral tendency towards withdrawal, possibly making it less difficult to maintain physical distancing. Self-reported health-related anxiety is also included as a possible predictor, as generally more cautious health behavior makes compliance more likely. The Big Five personality factors might interact with compliance in various ways. While we suspect persons higher in neuroticism and conscientiousness to show higher compliance, extroverted persons and persons more open to experience could find prolonged reductions in social interaction more difficult to maintain. According to the TPB, perceived control about future actions is a predictor of future behavior. Confidence that one can control future behavior oneself is best captured by the well-established concept of self-efficacy (Bandura, 1977). Thus, we included a self-efficacy scale to measure this specific component of the TPB.

2. Methods

The study was reviewed and approved by the Institutional Review Board of the Department of Psychology, University of Marburg (Ref. 2020-27k). It was preregistered at AsPredicted (ID #37823) and implemented with the online survey platform "SoSciSurvey" (Leiner, 2019). The survey was available to users via https://www.soscisurvey.de/CorDis from March 27th to May 14th, 2020. Code and data used in the analyses are available at https://osf.io/fnvmy/.

2.1. Interventions

This is an experimental randomized-controlled study with two groups: interactive information (experimental group) and text-based information (control group). The randomization was implemented using a random number generator which created an equally distributed number of participants for both conditions, control and experimental group. For this, participation was only counted if the survey was completed, otherwise, the next participant entered the same condition as one of the previously aborted trials (label of draw option: Equal distribution of completed questionnaires (drawing without putting back)).

2.1.1. Control group

The ‘text-based information’ group received an informational text based on recommendations (quantitative evidence) from the Robert Koch Institute and the Federal Centre for Health Education (Bundeszentrale für Gesundheitliche Aufklärung). To make sure that participants had read and understood the information, they had to answer three comprehension questions afterward. Participants were instructed to indicate whether the following statements were true or false: “Quarantine and social distancing only serve your protection from COVID-19.”, “If possible, sneeze and cough into a disposable handkerchief or the crook of your arm and turn away from other people”, and “Social distancing means, among other things, staying at home as much as possible”. While the first statement should be rated “false”, the remaining two questions were “true”. Subjects that failed to provide correct answers to any of these questions were excluded.

2.1.2. Experimental group

The ‘interactive information’ group included individual feedback and visualizations of the latest findings in COVID-19 research. In the first part, the effect of physical distancing on the overall number of cases was addressed: A graph showed the development of COVID-19 infections in two cities in Italy (Bergamo and Lodi), with only one of them enforcing contact restrictions (Dowd et al., 2020). The second focused on the impact of the individual comparing three intensities of compliance with physical distancing behavior (either none, 50% less contact, or 75% less contact). The projections were based on the virus spread on the cruise ship Princess Diamond (Signer and Warshaw, 2020; S. Zhang et al., 2020). A step-by-step graphical depiction of the experimental condition is given in Multimedia Appendix 1.

Possible participants following the study's URL were greeted with an introduction page containing general information. Participation was only possible when subjects had confirmed that they were at least 18 years old and had read the informed consent page. Next, subjects answered the psychometric scales, followed by the experimental or control tasks. After completing the tasks, subjects filled out the post-trial compliance scale. Optionally, they could provide free-text comments on the study. It was also possible to optionally enter the e-mail address to participate in the raffle of a 30€ Amazon voucher.

2.2. Questionnaires

2.2.1. Socio-demographic data

Socio-demographic variables were collected on the first survey page. This included age, sex, education, profession and the current residence. Additional questions on the occupational situation were also raised as to whether the person is in a systemically important occupation, whether he or she can work from home and whether the person can keep at least 1.5 m distance from other people at work. Systemically important occupations include police, fire brigade, medical and nursing staff, food production and distribution, infrastructure (electricity, gas, water, telecommunications), refuse collection, agriculture, funerals, radio and press.

2.2.2. Health information

The subjects' health status was assessed. The overall subjective health was rated on a 1 to 5 Likert scale ranging from “very bad” to “very good”. Current symptoms that could indicate a COVID-19 infection were assessed. Also, subjects could indicate whether they know persons infected with COVID-19 among friends, family or acquaintances.

2.2.3. Symptoms of anxiety and depression

Depressive symptoms were measured using the Patient Health Questionnaire-9 (PHQ-9, Kroenke and Spitzer, 2002). The PHQ-9 is a brief self-report scale measuring the DSM-5 criteria of major depressive disorder. Symptoms of anxiety were measured with the Generalized Anxiety Disorder-7 (GAD-7, Spitzer et al., 2006), which consists of seven items. The GAD-7 was originally constructed to screen for generalized anxiety disorder, but has since been shown to be a reliable and valid measure for anxiety in the general population (Plummer et al., 2016). Additionally, the Penn State Worry Questionnaire (Meyer et al., 1990) was used to capture excessive worry.

2.2.4. Personality

The ten-item personality inventory (TIPI, Gosling, Gosling et al., 2003) was used as a brief measure of the Big Five personality traits (Openness to Experience, Conscientiousness, Extraversion, Agreeableness, Neuroticism). Despite its brevity TIPI converges well with longer, widely used Big-Five measures. The ten items are rated on a seven-point Likert scale ranging from 1 (“Disagree strongly”) to 7 (“Agree strongly”). Scale values are obtained by averaging the two items for each dimension.

2.2.5. Self-efficacy

The general self-efficacy scale (GSE, Schwarzer and Jerusalem, 1995) was used to measure general perceived self-efficacy. The GSE was validated and standardized for usage in 33 different languages. The items are formulated in such a way that they assess the subjective conviction to achieve goals and solve problems if only enough effort is made. The ten items of the GSE are rated on a four-point Likert scale ranging from 1 (“Not at all true”) to 4 (“Exactly true”).

2.2.6. Health concerns

We used the “health concerns” scale from the Freiburg personality inventory (FPI, Fahrenberg et al., 1994). The FPI is a common personality inventory in German-speaking countries. It is mainly used in clinical and health-related settings. The scale surveys various aspects of very cautious health behavior, such as hygiene behavior, nutrition or frequent consultations with a physician. The scale has twelve items that are scored using a binary scale (“true” or “not true”).

2.2.7. Pre- and post-trial compliance: the social distancing compliance scale

The primary outcome was measured using a self-constructed scale that captures the intention to show a range of behaviors for disease prevention. Before the two different experimentally varied pieces of information were shown, the subjects were asked about their current (pre-trial) compliance with these behaviors by means of the following question text: “To what extent do you comply with the following measures of the Federal Government to contain COVID-19?”. After the experimental information was presented, the following question text was used to assess post-trial compliance: “Will you follow the following measures to contain COVID-19 in the future?”. These questions were each followed by nine behaviors that are related to preventing the spread of COVID-19:

- Keep a distance of least 1.5 m to people
- Keep a distance of at least 2 m to other people
- Stay at home
- No more meetings with friends and family
- Do not meet persons over 50 years of age in person (except those living in the household)
- Do not meet older people aged 65 and over in person (except those living in the household)
- No longer meet persons with chronic disease in person (except those living in the household)
- Comply with the hygiene rules
- Do not touch your face

The items were rated using a seven-point Likert scale ranging from 1 (“never”) to 7 (“always”).

2.3. Participants

2.3.1. Recruiting procedure

The subjects were recruited through media distribution of the questionnaire link and accompanying information. The study was advertised in reports in German newspapers and social media. As an incentive, there was an opportunity to participate in a raffle of Amazon vouchers. This opportunity was used by 600 subjects. As this was an online survey without personal contact with the participants, several criteria were established to ensure the quality of the data. These included control questions on the content of the information provided, as well as the processing time of the questionnaire. Subjects who completed the study in an implausibly short time (i.e. more than two times faster than the average respondent, as proposed (Leiner, 2013)) were excluded.

2.3.2. Sample size planning

A simulation was conducted to determine the sample size. In the simulation, we assumed that pre-trial compliance was influenced by self-efficacy, health concerns, anxiety, and depression symptoms, as well as personality variables. We also predicted a small effect for the experimental condition: subjects in the experimental group were expected to score 0.2 standard deviations higher on the post-trial compliance scale. To detect this effect, the simulation showed that a sample size of $N = 800$ was needed to detect a small effect with 80% power. Details on the simulation procedure, including code to reproduce the results, are provided in the Supplementary material. The survey was opened 4069 times and 1367 persons started the survey. 908 subjects completed the study. After removing subjects who met the predefined exclusion criteria, the data of 817 subjects were analyzed.

2.4. Statistical analysis

For the main hypothesis, we used linear regression to predict the compliance scale value after completing the trial from the compliance score before the trial (pre-trial compliance) and a binary-coded variable indicating group membership. For the exploratory analysis, we included additional predictors to determine their influence on intent to comply. The variables included were the sum scores of the PHQ-9, GAD-7, PSWQ, FPI-R, GSE as well as the factor scores of the TIPI, age in years, gender, subjective general health status, number of infected persons in the family, in close relationships and distant relationships. Additionally, a variable counting the days since the start of the trial was included. This was done to explore if a change in compliance can be observed as the pandemic progressed. Finally, a bootstrapped backwards-stepwise regression was conducted to determine the most influential additional variables. In this procedure, predictors are removed from the initial full model until the Akaike Information Criterion (AIC) is minimized. Variability in predictor selection is investigated by bootstrapping. We performed 10,000 bootstrap runs and retained only predictors that were selected in at least 95% of runs.

All statistical analyses were conducted using the R statistical programming language (R Core Team, 2020). The bootStepAIC package was used to perform the stepwise regression (Rizopoulos, 2022).

3. Results

3.1. Descriptive statistics

817 subjects (612 female, 201 male, four third gender) were included in the analysis (Fig. 1). The mean age was 34.47 (SD = 13.99). 107 (13.1%) of subjects stated that they had at least a secondary school

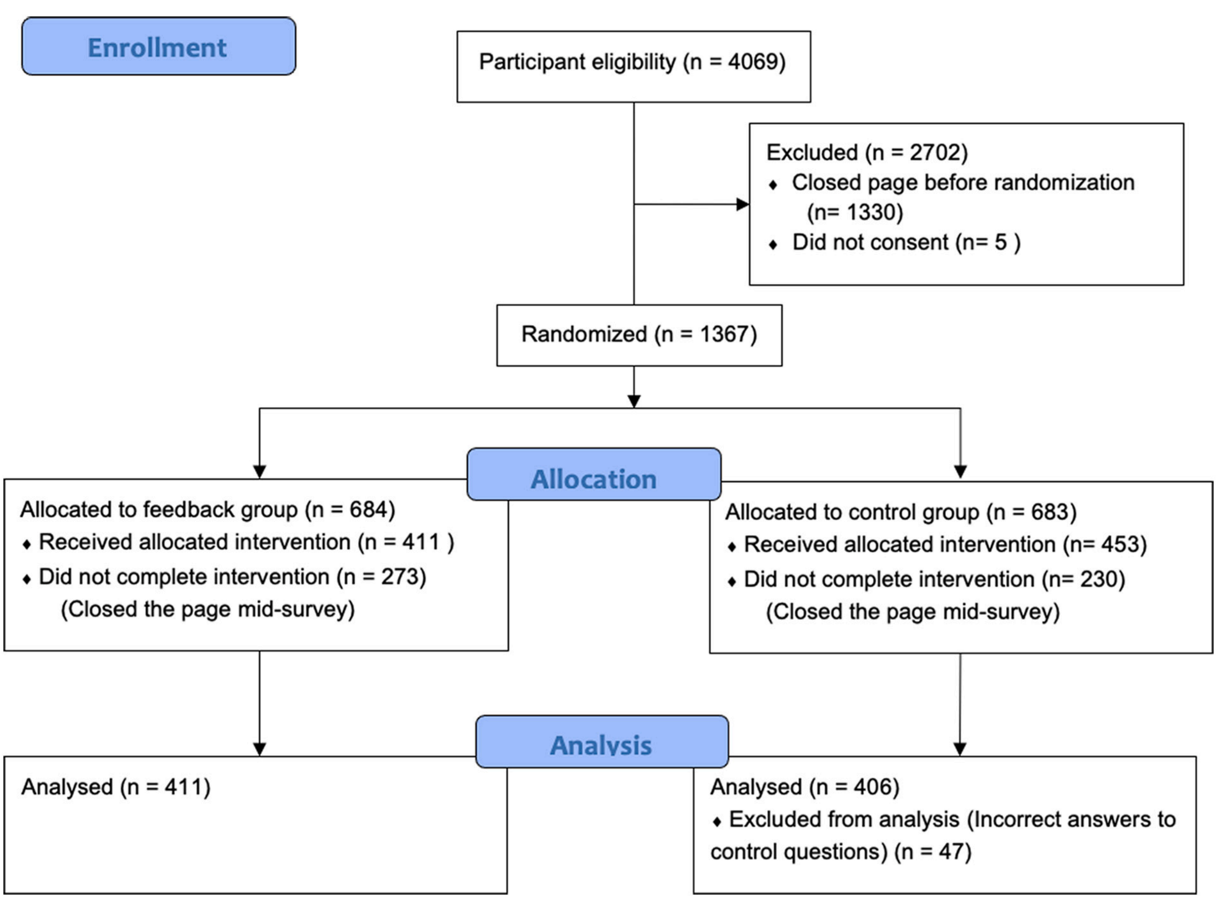

Fig. 1. CONSORT diagram for the CorDis trial.

leaving certificate, 318 (38.92%) had a high school diploma, and 302 (36.96%) had a university or college degree. 47 (5.75%) of subjects had a doctorate. The "other" category included 89 (10.1%) subjects with no formal education, with completed apprenticeship or vocational baccalaureate diploma.

37.21% of subjects were still in training or studying while 50.80% were either employed or civil servants. The remaining participants were either self-employed (4.28%), unemployed (2.10%), retired (4.28%), or exclusively housewives/househusbands (1.35%). As shown in Table 1, significant differences in these variables were observed between the experimental and the control group.

In the control group, the median time to complete the task (i.e., reading the information) was 69 s (MAD = 47.44). In the experimental group, it took subjects 302.50 s to read the text and perform the interactive procedures (MAD = 151.97).

3.2. Health-related and data and psychometrics

The majority of subjects rated their health as good. The mean of the five-point item was 4.22 (SD = 0.77, Median = 4). Only 14.44% of subjects chose "3" or lower. A summary of all psychometric scale values can be found in Table 2. The average score on the depression scale (PHQ-9) was higher than the value observed in a representative sample of the German population (Hinz et al., 2016). This corresponds to a standardized mean difference (Cohen's *d*) of 0.68 (95% confidence interval: 0.6; 0.76). Similarly, the GAD-7 in this sample was higher than the mean score in the German normative sample (Löwe et al., 2008), corresponding to $d = 0.61$ (95% CI: 0.56; 0.66).

3.3. Post-trial compliance

The results are summarized in Table 3. A large part of the outcome variance (65.85%) was explained by pre-trial compliance. As predicted, we also found evidence for a small effect of the interactive information condition. On average, subjects in the interactive information condition scored 0.17 points higher on the post-trial compliance scale. The group variable explained 1.17% of outcome variance, corresponding to a small effect ($r = 0.11$, d = 0.22).

3.3.1. Exploratory analyses

The number of days since trial onset explained an additional 1.06% of variance, which corresponds to a small effect ($r = -0.10$, d = −0.21), indicating a slight drop in compliance for participants who joined the study later. The effect of the FPI health concerns scale on post-trial compliance was significant but small. It explained an additional 0.16% of variance, which corresponds to a trivial effect ($r = 0.04$, d = 0.08). The effect of the interactive information group remained stable after including the additional variables. The results of the model are summarized in the second column of Table 4.

The bootstrapped stepwise regression procedure selected three predictors: pre-trial compliance (in 100% of runs), the group variable (99.99%), and the number of days since trial onset (99.93%). The remaining predictors were selected only in 82.08% of runs (FPI Health Concerns) or less.

3.4. Reliable change of compliance values

To illustrate the effects, we estimated a reliable change index for all subjects based on the pre- and post-trial compliance scores. We used the

Table 1
Demographic characteristics and tests for differences of the experimental and control group.

	Experimental	Control	Test for difference
N	411	406	
Age in years, mean (SD)	34.5 (14.1)	34.4 (13.9)	$t(814.98) = -0.16$, $p = .88$
Gender, female, n (%)	311 (75.7%)	301 (74.1%)	χ^2 (1) = 0.30, $p = .58$
Education, n (%)			
Secondary	62 (15.1%)	45 (11.1%)	χ^2 (1) = 2.53, $p = .11$
High school	142 (34.5%)	145 (35.7%)	χ^2 (1) = 0.25, $p = .62$
University degree	148 (36.0%)	154 (37.9%)	χ^2 (1) = 0.25, p = .62
Doctorate	5 (1.2%)	6 (1.5%)	χ^2 (1) = 0.74, $p = .39$
Other	41 (10%)	48 (11.8%)	χ^2 (1) = 0.54, $p = .46$
Profession, n (%)			
In training/studying	151 (36.7%)	153 (37.7%)	χ^2 (1) = 0.04, $p = .84$
Employed	209 (50.9%)	206 (50.7%)	χ^2 (1) = 0, $p = 1$
Unemployed	10 (2.4%)	7 (1.7%)	χ^2 (1) = 0.22, $p = .64$
Self-employed	12 (2.9%)	16 (3.9%)	χ^2 (1) = 0.10, $p = .76$
Retired	17 (4.1%)	18 (4.4%)	χ^2 (1) = 0.00, $p = .97$
Housewife/husband	5 (1.2%)	6 (1.5%)	χ^2 (1) = 0.00, $p = .98$

Table 2
Descriptive statistics of all psychometric scales used in the study.

	Mean	SD	Median	Min	Max
PHQ-9	6.35	5.13	5.00	0.00	27.00
GAD-7	5.27	4.47	4.00	0.00	21.00
PSWQ	45.49	12.33	44.00	19.00	80.00
TIPI Openness	5.22	1.10	5.50	1.00	7.00
TIPI Conscientiousness	5.50	1.09	5.50	2.00	7.00
TIPI Extraversion	4.32	1.38	4.50	1.00	7.00
TIPI Agreeableness	5.19	1.00	5.50	2.00	7.00
TIPI Neuroticism	3.16	1.40	3.00	1.00	7.00
GSE Self-efficacy	29.55	4.48	30.00	12.00	40.00
FPI-R Health concerns	5.70	2.39	6.00	0.00	12.00

Note. SD: standard deviation, Min: observed minimum, Max: observed maximum. TIPI scales are mean scores, all other scores are sum scores.

Table 3
Results of the linear regression model testing the main hypothesis.

Predictor	*b*	95% CI	*t*(814)	*P*
Intercept	1.54	[1.32, 1.77]	13.39	<0.001
Pre-trial compliance	0.77	[0.74, 0.81]	40.18	<0.001
Experimental group	0.17	[0.11, 0.23]	5.36	<0.001

Note. All estimates are unstandardized. The 95% confidence interval was calculated analytically.

Table 4
Results of the linear regression model testing additional explanatory variables.

Predictor	*b*	95% CI	*t*(794)	*P*
Intercept	1.16	[0.82, 1.88]	4.30	<0.001
Pre-trial compliance	0.76	[0.70, 0.78]	38.01	<0.001
Experimental group	0.17	[0.11, 0.23]	5.34	<0.001
PHQ-9	−0.01	[− 0.01, 0.01]	−1.17	0.242
GAD-7	0.00	[− 0.01, 0.01]	0.36	0.716
PSWQ	0.00	[0.00, 0.01]	0.78	0.436
FPI Health Concerns	0.01	[0.00, 0.03]	1.99	0.047
Openness	0.01	[− 0.01 0.02]	0.87	0.386
Conscientiousness	0.00	[− 0.01, 0.02]	0.14	0.885
Extraversion	0.02	[− 0.01, 0.02]	1.15	0.251
Agreeableness	0.00	[− 0.02, 0.02]	−0.15	0.883
Neuroticism	0.01	[− 0.01, 0.02]	0.63	0.531
Self-efficacy	0.01	[− 0.04, 0.15]	1.20	0.231
Age (years)	0.00	[0.00, 0.00]	−0.94	0.346
Gender: male	−0.02	[− 0.11, 0.05]	−0.58	0.561
General health	0.01	[− 0.03, 0.05]	0.25	0.800
Infected, family members	0.14	[− 0.03, 0.39]	1.28	0.201
Infected, close relationship	−0.03	[− 0.14, 0.10]	−0.46	0.645
Infected, distant relationship	−0.03	[− 0.08, 0.07]	−0.67	0.505
Days since start of trial	−0.01	[−0.01, −0.00]	−5.18	<0.001

Note. All estimates are unstandardized.

correlation between pre- and post-scores in the control group ($r = 0.78$) as a reliability measure. According to the formula proposed by Jacobson and Truax (1992), a change of 1.05 points can be considered “reliable”. In the interactive information group, reliable improvements concerning the compliance were observed in 26 subjects (6.33%), while one subject had reliably lower scores after the experiment. 384 subjects showed no reliable change. In the control group, 15 subjects (3.69%) improved while seven subjects deteriorated and 384 showed no reliable change. Overall, the chance of achieving a significant improvement in compliance was thus increased by 2.63% in the experimental group. In other words, 38 persons would have to pass the experimental condition for one person to show an improvement in compliance.

4. Discussion

During a pandemic, the individual behavior of a person can potentially prevent or cause new infections (Islam et al., 2020). An important determinant of this behavior is the behavioral intent. This intent in turn is influenced by available information on the consequences of the behavior. In this study, we have shown that the way this information is presented can play a role in this. As predicted, we found a small intervention effect. Reliable change analysis suggested that a small proportion of participants significantly changed their attitude. However, given the high scalability of the information presentation method we used in the experimental condition, a small effect is not necessarily trivial. If tasks like the one used in this study are placed on highly frequented Internet sites, tens of thousands of people may go through such an intervention, possibly leading to higher rates of compliance. Thus, interactive information with feedback is a flexible, cost-effective, and quickly applicable way to build compliance with preventive measures.

In our exploratory analysis, we included time since the start of the trial as a predictor. This was done to include possible population-level shifts in compliance as the pandemic progresses. Patients who participated later reported to be less compliant. We have two possible explanations for this. First, compliance could be declining because it is generally difficult to maintain protective measures over longer periods of time. A certain “fatigue” with regard to the measures may have set in among the population. Second, loosening of contact restrictions in Germany could have been responsible for this effect. Schools were gradually opened from May 3, 2020, and stores, clinics and nursing homes from May 6. This would be in line with evidence from a smartphone surveillance study (Jang et al., 2021). Here, increased physical distancing was found from the beginning of March until late April, which slowly and gradually decreased later. Similarly, wearable tracking studies found a steep drop in steps recorded by activity tracking, that reversed later (Pépin et al., 2020).

The statistically significant effect of the FPI scale for health-related anxiety scale was extremely small, making it difficult to interpret. Also, it was included only in 82% of bootstrap model selection runs, suggesting limited replicability. An obvious explanation is that people who reach high scores on the scale show more “health motivation” and are thus more likely to adapt their behavior more quickly in response to new health-related information (Moorman and Matulich, 1993). However, mere similarities in item content may also have led to the effect, as both our outcome measure and the FPI scale ask about health behavior. It is worth noting that, even after conditioning on many other variables, the effect of the intervention remained stable.

Some limitations of this study need to be acknowledged. First, the intensity of the experimental and control condition differed substantially. Subjects in the experimental condition spent five times more time on their task. Thus, we cannot rule out that the effect was based purely on increased exposure to information related to the spread of COVID-19. Second, our sample was biased towards relatively young, healthy, and highly educated subjects. Pre-trial compliance was already fairly high and subjects with low compliance were underrepresented. Thus, it remains unclear whether the intervention works equally well for all levels of compliance. Third, the intervention was only based on the early regulations taken against COVID-19, i.e., social distancing behavior (thanks to an anonymous reviewer for this comment). We did not look at whether other measures such as wearing a mask would also benefit from the inactive intervention. We expect that the positive commitment shift induced by the interactive intervention should also apply to other measures, though, because this study focused on the presentation form of health information to induce according health behavior. But, of course, this needs to be looked at in future studies. This paper, therefore, reflects a piece of the puzzle, showing that interactive information could be an effective way to present health related information. Finally, it is unclear whether a change on the compliance scale is associated with changes in disease prevention behavior. This would only be the case if the effect of the intervention was stable over time and the scale used correlated with the corresponding behavior.

Future studies could pursue this type of low-threshold, Internet-based feedback intervention to test its potential in other areas of health behavior. In the field of disease prevention, further studies could answer the open questions of this study. In particular, the predictive value of the proposed compliance scale would be of great interest. Another important aspect would be including compliance with additional prevention measures, which have not been included here. For example, wearing a face mask was not recommended by the WHO for a long time, so the focus of this study was on physical distancing. At present, however, face masks are considered in many countries to be an important part of a gradual relaxation of lockdowns and contact bans (Chu et al., 2020). Experts argued that a second wave of COVID-19 infections was imminent (Xu and Li, 2020), after we conducted this study. Now, even a third wave of COVID-19 spread and vaccines are available for the general population but the measures of social distancing and wearing face masks are still the very important measures to reduce the infections. In addition, future outbreaks of previously unknown pathogens could necessitate renewed social distancing. Since studies show that motivation to adhere to safety measures decreases over time, it is important to explore ways to promote motivation to adhere.

In conclusion, interactive information and feedback have the potential to make a small contribution to reducing the spread of infectious diseases within the framework of broad-based, content- and methodologically diverse packages of measures.

Compliance with ethical standards

All experiments were approved by the Institutional Review Board of the Department of Psychology, University of Marburg (Ref. 2020-27k) and were performed in accordance with the ethical standards described in the 1964 Declaration of Helsinki.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.invent.2022.100545.

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