Personality and Individual Differences 181 (2021) 111016

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Dark- and bright-side reactions to government advice about Covid-19, and a test of a method to moderate such reactions

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ARTICLE INFO

Keywords:
COVID-19 pandemic
Health behaviour
Personality disorders
Five-factor model
Behaviour change

ABSTRACT

The aim of this paper was to study how individual differences in personality shape reactions to authorities' health advice during the COVID-19 pandemic and how such reactions can be modified. Three studies, with between 249 and 407 participants, investigated this. Study 1 used a longitudinal design, and included measures of personality (NEO-FFI3, SCATI), political orientation, age and gender as predictors of reactions toward COVID-19 advice and regulations. Studies 2 and 3 were randomised experiments testing effects of principles for behaviour modification on such reactions. In study 1, we found that being female, older, or having liberal political views, as well as neuroticism, agreeableness and conscientiousness in the higher ranges, were associated with constructive reactions. Externalising personality disorders were related to opposite reactions. In study 2, we found that the experimental instructions had a significant positive impact on such reactions. These results were replicated in study 3. Implications and limitations are discussed.

1. Introduction

The COVID-19 crisis has generated many hundreds of scientific papers about the pandemic. The core issue has been how to avoid transmission of the virus until treatment becomes available. When the virus is transmitted by air or through touching contaminated surfaces, distancing from others and personal hygiene become important. This has been the basis for governments' advice and recommendations to reduce transmission during the current pandemic. The major concerns in this respect are the extent to which people follow medical and government advice, accept vaccinations and, through the social media, attempt to convince others to agree with their outlook. Differential psychologists have been interested in the demographic, ideological and personality correlates of these behaviours.

The COVID-19 crisis has already prompted a great deal of research salient to such issues (de Medeiros Carvalho et al., 2020; Grover et al., 2020; Haakonsen & Furnham, 2021; Huang & Zhao, 2020; Lai et al., 2020; Lee, 2020; Lima et al., 2020; Qian & Jiang, 2020; Shanafelt et al., 2020; Xiang et al., 2020). Yet, it is important to further understand how personality can influence COVID-19-related reactions, beliefs and behaviours, and also, most importantly, how such health-related behaviours can be changed. In three studies below, we shed light on these questions.

2. Study 1

There is a vast literature on the relationship between both personality traits and personality disorders and mental and physical health. The processes and mechanisms that explain the relationship are disputed, but it remains the case that there is considerable evidence that traits account for a wide variety of health-related behaviours, including following the advice of professionals.

Individual differences in personality can be classified into normal personality traits and traits associated with personality disorders (PDs), or alternatively *bright-* and *dark-side* traits. As regards the bright-side traits, previous research has suggested that four of the five factors are related to attitudes toward, and behaviours concerning, COVID-19 (A.M. Bacon, Corr, 2020a; A. Furnham, 2018). Extraverts take more risks, obey rules less rigorously and interact more than introverts; thus, they are likely to socialise more with others despite recommendations. Neurotic individuals are, by definition, worriers and prone to anxiety: thus, they would be expected to follow medical and governmental advice. Those high in agreeableness are more community- and relationship-oriented and would therefore be expected to follow rules and be concerned about others. Similarly, those high in conscientiousness, who are typified as reliable and orderly, would be expected to follow rules.

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https://doi.org/10.1016/j.paid.2021.111016
Received 13 December 2020; Received in revised form 15 May 2021; Accepted 18 May 2021
Available online 24 May 2021

Inevitably, there may be interactions between these variables, an eventuality that we will explore.

Many studies have also found relationships between PDs and health- or risk-related behaviours (Crysel et al., 2013). However, there are many different conceptualisations of such *dark-side traits* (A. Furnham, 2020; A. Furnham & Grover, 2020). *The Diagnostic and Statistical Manual of Mental Disorders* (4th edition; *DSM-IV*) groups PDs into three clusters: 'A' – odd; 'B' – dramatic/emotional; and 'C' – anxious (American Psychiatric Association [APA], 2000), and describes disorders as being 'enduring, inflexible, and long-term' (p. 686). The DSM-5 did not include fundamental changes in the classification of PDs (APA, 2013). Many studies have analysed various PDs and their higher-order factors of *externalising-internalising* PDs (Caspi & Moffitt, 2018), where externalising PDs have been associated with more anti-social behaviours. The literature on the relationship between the PDs and mental and physical health, however, is limited, and we believe we are among the first to examine it with respect to COVID-19 pandemic behaviours.

There have been a few personality trait studies on the COVID-19 pandemic (A.M. Bacon, Corr, 2020a, 2020b). Aschwanden et al. (2020) found that neuroticism and extraversion related differently to duration estimates of the pandemic, while conscientiousness related to precautions. Blagov (2020) examined bright- and dark-side personality correlates of the endorsement of social distancing and hygiene. He found conscientiousness and neuroticism had a predictable interaction with endorsement. Dark-side traits (psychopathy, meanness and disinhibition) predicted low endorsement of health behaviours and the intent to knowingly expose others to risk. Zajenkowski et al. (2020) found that low scores on agreeableness and high scores on dark triad traits were associated with low compliance with government regulations. Personality explained only 10% of the variance in compliance. However, compliance was measured with a single item, and the study was cross-sectional.

In our first study, we extended the abovementioned research by including data from a longitudinal study. We assumed that some people would follow government advice carefully, while others would essentially ignore it or even oppose it. Predictions of such reactions based on personality are given below. Moreover, we include predictions for *gender*, *age* and *political convictions* as well, since these are part of a broader picture of individual differences that have implications for risk perceptions and health-related behaviour.

Gender is important when risk is involved in the situation. Research has shown that, on average, women tend to be more risk-averse than men (Byrnes et al., 1999). We therefore predicted that women would be more likely to be compliant (H1a) and less likely to be deviant/oppositional (H1b).

Moreover, among the high-risk factors for serious illness in the current pandemic, *age* has been frequently emphasised. Severity and mortality have been much higher among older people (Wang et al., 2020). This phenomenon has become well known through media, and research has indicated that the public understands this danger, even if the personal risk is regularly underestimated (Niepel et al., 2020). We therefore posited (H2) that age would be positively related to risk-avoiding attitudes and behaviours (compliance).

In addition to this, the COVID-19 pandemic has been strongly politicised across the world (Brown & Wang, 2020), and *political convictions* have repeatedly been found to influence self-preserving behaviours, with consequences for health and longevity (Bertoldo et al., 2017; Chan, 2019; Levant et al., 2019). Politically and socially liberal people have been shown to be less individualist and more community oriented. Hence, we hypothesised that liberalism would be associated with compliance (H3).

Based on the theory and findings briefly discussed above, we predicted that extraversion would be positively correlated with opposition to restrictions (H4a) and negatively correlated with compliance with restrictions (H4b), while for neuroticism (H4c), agreeableness (H4d) and conscientiousness (H4d), the opposite would be true. These three hypotheses were based on trait-activation theory (Roberts et al., 2006).

Finally, we predicted that overall, PDs would be more closely associated with oppositional than with compliant attitudes and behaviours. Furthermore, we posited that PDs that are primarily associated with moving against people, as well as cluster B, externalising PDs (H5a) – and more specifically anti-social (H5b), histrionic (H5c), schizotypal (H5d) and narcissistic (H5e) PDs – would be positively correlated with oppositional beliefs and behaviours.

2.1. Method

2.1.1. Participants

In our first wave of surveys in November 2019, before the pandemic was known or anticipated, 600 subjects participated. Three hundred men and 300 women above 18 years were recruited through Prolific. They volunteered and were paid 4£ for each hour of participation. In our second wave in May 2020, 407 of those individuals completed a new survey. Of these, 205 were men and 202 were women, with a mean age of 31 years ($SD = 11$). In our third survey in June 2020, 362 participated again. Of these, 177 were men and 185 were women. The mean age was still the same. The sample was multinational, but mainly consisted of Europeans; participants were from the UK, Italy, Spain, Poland, Portugal, the United States, Canada and Mexico. As can be seen in Table 1, government restrictions were comparable across most of the included nations in the first half of May and in June. Although there were small differences between countries in the UK, due to their large similarities, participants from England, Wales, Scotland and Northern Ireland were combined.

2.1.2. Instruments

2.1.2.1. Coolidge Axis-II Inventory. In this study, we used the 70-item Coolidge Axis-II Inventory-Short Form (SCATI; F. Coolidge, 2001). It has been used to predict PDs in subclinical (F.L. Coolidge et al., 2010) and clinical (Watson & Sinha, 1996) populations and in other studies (D. L. Segal et al., 2001, 2006). The SCATI (F. Coolidge, 2001) includes 70 items that have been operationalised to measure 14 PDs. Ten of these are from the *DSM–5*, another two are from cluster B of the *DSM-IV-TR* and the final two are from the *DSM-III-R*. The included PDs are antisocial, avoidant, borderline, dependent, depressive, histrionic, narcissistic, obsessive-compulsive, paranoid, passive-aggressive, sadistic, self-defeating, schizotypal and schizoid. The SCATI has also been used to assess PDs in clinical (Watson & Sinha, 1996) and subclinical (F.L. Coolidge et al., 2010) populations. Items are measured on a 4-point scale from *strongly false* to *strongly true*. In our study, we used the measure to assess trait-like dimensions of PDs (Widiger & Trull, 2007). For the present purpose, we examined PD correlates of COVID-19 attitudes at the facet and domain levels. In this respect, we focused on the externalising-internalising dimensionality of PDs (Caspi & Moffitt, 2018).

2.1.2.2. NEO-Five Factor Inventory-3. The NEO Five Factor Inventory-3 (NEO-FFI3) measures the five-factor model of personality across 60 items (neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness; McCrae & Costa, 2007). It includes a subset of the items from the NEO-Personality Inventory-3 (NEO-PI3). Items are measured on a 5-point scale, from *strongly disagree* to *strongly agree*.

2.1.2.3. COVID-19 beliefs about government restrictions. Nineteen items were initially written by four experts in questionnaire design to describe reactions to, and beliefs about, government-implemented restrictions to reduce contamination by the virus, as well as attitudes and affective reactions to the pandemic. Items were inspired by media descriptions of reactions to the pandemic and restrictions decided by worldwide authorities in the first half of May 2020. Items were centred around beliefs

Table 1
Countries of residence of participants and coronavirus statistics upon data collection (applies to Studies, 1, 2, and 3).

			May 4, 2020				June 21, 2020						
Country	*n*	2020 population (millions) [a]	Total cases[b]	Cases/ 100,000	Total deaths[c]	Deaths/ 100,000	Total cases[b]	Cases/ 100,000	Total deaths[c]	Deaths/ 100,000	Localized lockdown began	National lockdown began	Government hygiene advice
United Kingdom (specified and unspecified)	330	67.89	186,599	274.86	28,446	41.900	303,110	446.47	28,323	62.732	_	March 23, 2020[d]	People required to stay at home, except for very limited purposes; certain businesses and venues closed; all gatherings of more than two people in public stopped[r]
Portugal	61	10.2	25,424	249.25	1063	10.422	38,841	42,589	394.10	14.980	–	March 19, 2020[j]	Isolation for infected; vulnerable to stay indoors, only leave the house if necessary; follow rules of the DGS; social distancing, hygiene[j]
Poland	58	37.85	13,693	36.177	678	1.791	31,620	380.79	34,610	3.556	–	March 13, 2020[f]	Remain at home[f]; non-essential businesses shut down, ban on public gathering of two or more people; only 5 people at religious services[o]
United States	16	331	1,160,000	350.45	67,682	20.448	2,260,000	1528	31.25	36.169	March 17, 2020[h]	_	Handwashing; disinfection; avoid touching face; face coverings in public, particularly on mass-transit[g]
Spain	31	46.76	219,205	468.79	25,428	54.380	246,272	83.540	190	60.571	_	March 14, 2020[i]	Trips only for groceries and pharmacy; non-essential workers to stay at home[o]
Italy	16	60.46	210,717	348.52	28,884	47.774	238,275	1346	267.64	57.244	March 8, 2020[e]	March 11, 2020[e]	No non-essential travel; only leave home for exercise, groceries, and necessities[o]
Greece	22	10.42	2626	25.202	144	1.382	3256	682.779	8410	1.823	_	March 23, 2020[l]	No non-essential travel, social distancing[q]; citizens leaving homes are required to carry their passports[s]
Canada	23	37.74	59,474	157.59	3682	9.756	101,008	119,719	135.89	22.284	_	March 16, 2020[m]	Handwashing and general hygiene (catching sneezes, etc.); physical distancing; stay at home; physical distancing; face coverings[n]
Mexico	14	128.93	23,471	18.204	2154	1.671	175,202	526.67	20,781	16.113	–	March 23, 2020[k]	World Health Organization–based guidance: social distancing, masks, handwashing[p]

[a] All of Our World Data (2020a)
[b] All of Our World Data (2020b)
[c] All of Our World Data (2020c)
[d] Sparrow et al. (2020).
[e] Paterlini (2020)
[f] Jones (2020)
[g] The White House (2020)
[h] Ravani (2020)
[i] Hernández (2020)
[j] Sampson (2020)
[k] Medical Express (2020)
[l] Georgiopoulos (2020)
[m] Erksine (2020)
[n] Government of Canada (2020)
[o] Deutsche Welle (2020)
[p] LaJornada (2020)
[q] Constantine (2020)
[r] UK Government (2020)
[s] In.gr (2020)

and reactions to social isolation and hand hygiene. These were shown to other experts and completed by around a dozen people. Previous research has found that semantic relationships between items may produce spurious statistical effects (J.K. Arnulf et al., 2014). To avoid this, we performed an analysis with semantic algorithms to minimise the semantic overlap between items while at the same time retaining a representative set. This procedure ensures that the ensuing statistics are due to the subject matter being measured and not created by latent semantic relations in the measurement instrument itself (J.K. Arnulf, Larsen, Martinsen, et al., 2018). It is akin to an automated Q-sort with a factor analysis to group items (J.K. Arnulf, Larsen, Dysvik, et al., 2018). Additionally, we removed items that indicated possible floor and ceiling effects. Items were measured on a 5-point scale, from *strongly disagree* to *strongly agree*. We analysed the scales separately, but we also assumed that there was a common core in the COVID-19 scales and items that we included, where low scores indicated opposition to restrictions, low compliance and low levels of social distancing and hygiene behaviours.

2.1.2.4. COVID-19 Health Behaviours. In addition to the measure described above, we used a measure published in Blagov (2020). This measure included 10 items and two scales: six items measured social distancing behaviour and four items measured hygiene behaviour. The focus was on behavioural descriptions, like handwashing, covering one's face while coughing, etc. Items were formulated as current behaviours.

2.1.2.5. Individual differences. In addition to the measures above, we included gender, age, and one item measuring political preference on a 9-point scale from conservative (1) to liberal (9).

2.1.3. Procedure

This study used a partial longitudinal design, collecting data with three online surveys. The first survey was completed in November 2019 and included the SCATI and demographic variables. The second survey was completed between 4 and 12 May 2020 and included the NEO-FFI and the COVID-19 Beliefs measure. The third survey was completed between 21 and 28 June 2020 and included Blagov's (2020) health behaviour inventory. The first two surveys also included measures unrelated to the current study; the sample was originally invited to investigate the relationship between personality and creativity. The results from that project will be reported in other publications.

Participants were recruited and re-recruited anonymously using Prolific, an online participant recruitment website. Participants were paid a minimum of £4 per hour on average in all three cases. Data from the same participant were combined using anonymous Prolific IDs, a unique code linked to each account recorded in both surveys. Data from online samples have been found to give results that are similar to conventional data, and equivalent to or better than university student samples (Palan & Schitter, 2018; Walter et al., 2018). Prolific has been shown to have better, more diverse samples than sites like Amazon's mTurk (Peer et al., 2017). The project was evaluated by the Norwegian Centre for Research data (project no. 599123) and found to comply with the General Data Protection Regulation (GDPR).

2.2. Results

Missing data were minimal, with 217 points missing over the 153 variables (0.35%); they were assumed to be missing at random. Missing data were replaced using multiple imputation.

2.2.1. COVID-19 beliefs: EFA and CFA

To analyse the items from our COVID-19 inventory and to identify and cross-validate a structure in these data, we randomly split the sample in two and performed a principal component analysis (as EFA) in the first half of the sample. We subsequently performed CFA to cross-validate the identified structure in the second half of the sample. This procedure was originally suggested by Jøreskog (1971) to cross-validate a factor structure.

In the first sample ($N = 205$), an initial Scree plot (Cattell, 1966) revealed two factors: one after two components and another (smaller) one after five components. Considering the two- and five-factor solutions and item contents, we decided to apply the two-factor solution. Three items were subsequently removed because they did not fit well into a two-factor structure, and 16 items remained for analyses. In EFA of these, the Kaiser–Meyer–Olkin (KMO; Kaiser, 1974) value was 0.88 and Bartlett's test of sphericity (Bartlett, 1951) was highly significant. Communalities ranged from 0.216 to 0.645, with 11 out of 16 items having values higher than 0.50. One item had relatively strong cross-loading ('I have carefully followed advice about hand-washing and keeping my distance from others') and although it had two meanings, it was included because of its relevance to the situation. The correlation between the two factors was −0.53.

In CFA – using EQS 6.3 (Bentler & Wu, 2016) and the same two-factor solution as above, including one cross-loading and based on sample 2 ($N = 199$) – the model had adequate fit (χ^2 (102, $N = 404$) = 205.74; CFI = 0.96; RMSEA = 0.072, 90% CI [0.057, 0.085]; SRMR = 0.065). The pattern of factor loadings was similar to the results from EFA in the first sample, except loadings for two items on the second factor that seemed slightly lower. The correlation between the two factors was −0.49.

The first factor was labelled *opposition against restrictions*, and the second was labelled *compliance with restrictions*. Our further analyses were based on mean scores for these two variables. Items are exhibited in Table 2.

2.2.2. CFA for health behaviour inventory

We analysed the two-factor structure in Blagov's (2020) instrument with EQS 6.3 and allowed three cross-loadings based on Blagov's (2020) reported findings. This model gave adequate fit (χ^2(31, $N = 362$) = 111.23; CFI = 0.98; RMSEA = 0.066, 90% CI [0.053, 0.079]; SRMR = 0.041). Our subsequent analyses were based on mean scores for these two variables, and we labelled these *social distancing* and *hygiene*.

2.2.3. CFA for Covid-19 second-order factor

We assumed that there would be a general factor in the two COVID-19 belief factors and the two health behaviour factors. Thus, we included all 26 items from the two measures above in a model with four first order and one second-order factor using EQS 6.3. We allowed cross-loadings as

Table 2
Items in the Covid-19 beliefs measure.

Opposition against restrictions	Compliance with restrictions
I think the whole issue has been exaggerated.	I have carefully followed advice about hand-washing and keeping my distance from others.
Whatever the government/health official says I will go out and see my friends.	The world will never be the same after this epidemic.
I think we will look back at all this scare-mongering with amazement and disbelief.	I rather like self-isolating.
I hate and resist the government telling us what to do.	I am sure the crisis will last for many months.
I go out all the time, ignoring all those ridiculous warnings.	I am really terrified of becoming a victim of this virus.
The virus will only infect those who are old and weak and they are soon to die in any case.	I painstakingly follow routines for handwashing and keeping the recommended distance to other people.
I do things the way I'm used to.	I kind of like all the rules and systems that have been developed for hygiene and socializing.
Isolation is not for me – I go and see people.	
It is not necessary to fear the virus-it will probably pass away soon.	

specified in the above analyses. Two disturbances (first-order factors' error terms) were fixed to be equal to identify the second-order part of the model (Byrne, 2012). This second-order model gave satisfactory fit ($\chi^2(293, N = 362) = 767.48$; CFI = 0.95; RMSEA = 0.068, 90% CI [0.062, 0.073]; SRMR = 0.071). The primary factors' loadings from CFA in EQS on the second-order factor were − 0.664 (opposition), 0.770 (compliance), 0.675 (social distancing) and 0.714 (hygiene).

Based on this analysis, we used factor scores (from SPSS 26; IBM Corp., 2019) based on principal axis factoring, and extracted factor scores based on the regression method to be included in further analysis (described below). In this analysis, KMO (Kaiser, 1974) was 0.72 and Bartlett's test of sphericity (Bartlett, 1951) was highly significant. Communalities ranged from 0.340 to 0.479, and one factor explained 55.11% of the variance.

High scores on this COVID-19 factor score variable indicated low opposition to authorities' restrictions, high compliance with restrictions, a high level of social distancing behaviours and a high level of hygiene behaviours. We interpreted low scores to mean the opposite. Correlations in Table 2 between these factor scores and the other measures are based on our principal axis factor scores. We labelled this variable *Covid factor* in several analyses described below.

2.2.4. EFA for personality disorder factors

To simplify our subsequent analyses, we sought to reduce the included PD measures based on the well-validated distinction between internalising and externalising PDs (Wolf et al., 2012). Thus, we sought to fit the theoretically based two-factor model using CFA in EQS 6.3 to the 14 included PDs. Still, a two-factor model was hard to fit: The model did not converge, or the results included several Heywood cases when we modified the model. To reduce the number of variables, we then used EFA (principal axis factoring with promax rotation) to extract two factors.

In this analysis, KMO (Kaiser, 1974) was 0.91 and Bartlett's test of sphericity (Bartlett, 1951) were highly significant. The two factors explained 53.35% of the variance in the 14 variables and communalities ranged from 0.258 to 0.701. Thirteen of the variables had communalities above 0.40. Factor one, internalising, was dominated by strong loadings from avoidant, dependent, depressive, paranoid, self-defeating and schizoid. The externalising factor had strong loadings from antisocial, histrionic, narcissistic and sadistic. There were cross-loadings on the two factors for schizotypal, passive-aggressive and obsessive-compulsive. The two factors correlated with $r = 0.594$. We saved the two factors as variables using the regression method for this task in SPSS 26, and we used the factor scores for externalising and internalising in the subsequent analyses.

2.2.5. Descriptive statistics

Descriptive statistics, including measured variables, demographics, and the factor scores described above, are displayed in Table 3. The results showed that reliabilities were generally sufficient for research purposes. Upon inspection, none of the variables had severe skewness or kurtosis.

The correlation matrix revealed several insights. First, gender and age correlated with the four COVID-19 variables. Being liberal versus conservative correlated with two of the COVID-19 measures, and in opposite directions. These results supported hypotheses H1 and H2, and part of H3. Next, the Big Five traits were quite differentially correlated with the COVID-19 measures, while agreeableness and conscientiousness correlated with them all. Finally, the PDs also correlated differently with the included Covid-19 measures. In particular, antisocial, narcissistic, sadistic and externalising factors correlated more strongly with the COVID measures than the remaining PDs. Otherwise, some of the correlations in Table 3 were not large, and they may have stronger theoretical than practical implications.

2.2.6. Regression analyses

We considered the number of variables/sample size ratio to be too small to use *SEM* with latent variables, so we conducted several regression analyses with the observed variables and the COVID factor as the dependent variable. We used hierarchical analysis and included age, gender and political orientation in the first step, the externalising and internalising factor scores in the next step, the NEO-FFI-3 traits in the third step, and the exploratory two-way interactions between the latter in the fourth step. In the final model, shown in Table 4, we retained only significant predictors. The included variables explained almost 25% of the variance in the dependent COVID-factor variable.

Table 4 shows that gender, age, externalising, neuroticism, agreeableness and conscientiousness contribute to explaining the dependent variable. Consequently, individuals who do not comply, who oppose restrictions, who do not socially distance themselves and who do not apply appropriate hygiene behaviours, as lower scores on the COVID factor indicate, tend to be male and to be younger. They also tend to have higher scores on the externalising PD factor and to have low scores on neuroticism, agreeableness and conscientiousness. We also identified an interaction between neuroticism and agreeableness. Thus, our hypotheses H1, H2, H4c, H4d, H4e, and H5a were supported. The direction of the interaction is shown in Fig. 1, and indicates that those with low neuroticism and high agreeableness, as well as those with low agreeableness and high neuroticism, tend to comply.

To investigate more specifically the relationship between dark- and bright-side personality predictors—as this could be dependent on the order of inclusion in the regression analysis—we completed two additional analyses. In the first analysis, we inserted the five bright-side variables in the regression model. We then included the externalising and internalising dark-side variables in the second. Here, R^2 for the bright-side variables was 0.171, while the two dark-side factors explained an additional 3.2% (total $R^2 = 0.202$). In the second analysis, we inserted the two dark-side factors in the first and then the bright-side variables in the second step. R^2 for the dark-side variables was 0.089, while bright-side variables added 11.4% to this (total R^2 was still 0.202). Consequently, both dark- and bright-side variables contributed significantly to explaining the COVID factor.

When we analysed the dark-side variables as 14 separate PDs, eight of them significantly predicted the COVID factor. The R^2 for these was 0.206; the following PDs contributed significantly (β coefficients in parentheses): antisocial (−0.175), borderline (0.175), dependent (−0.132), narcissistic (−0.32), obsessive-compulsive (0.166), paranoid (0.248), passive-aggressive (−0.156) and schizoid (−0.19). The R^2 for these and the bright-side variables together was 0.276. Controlling for dark-side variables, the three bright-side traits (neuroticism, agreeableness, and conscientiousness) were still significant predictors, although conscientiousness was only marginally so.

When bright-side traits were entered first, only dependent, narcissistic, obsessive-compulsive, paranoid and schizoid contributed significantly to explaining the COVID factor. Taken together, these findings lend support to our hypotheses H5b and H5e, and the results verify that both bright- and dark-side traits contribute to explaining central aspects of COVID-19 beliefs and behaviours. Beyond this, including the 'PD facets' seemed to explain more variance in the dependent variable than using the externalising and internalising domain scores. When only significant variables, including gender and age, were included, the R^2 for predicting the general COVID factor was 0.294.

2.2.7. Canonical analyses

To further investigate the relationship between our independent and the four specific COVID-19 variables, we performed a canonical analysis. Here, we included gender, political view, age, neuroticism, extraversion, openness, agreeableness, conscientiousness, internalising, externalising, opposition, compliance, social distancing and hygiene. This analysis resulted in four canonical functions, and the model was found to be statistically significant with Wilks $\lambda = 0.486$ (F[40,1317.64]

Table 3
Correlations and descriptive statistics for Study 1.

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1. Gender	–	–												
2. Age	30.43	11.09	0.183**											
3. Liberal	5.79	1.87	0.163**	−0.093										
4. Antisocial	1.75	0.68	−0.197**	−0.177**	−0.066	(0.68)								
5. Avoidant	2.47	0.83	0.016	−0.142**	0.078	0.312**	(0.72)							
6. Borderline	2.16	0.77	−0.011	−0.227**	0.079	0.571**	0.550**	(0.60)						
7. Dependent	1.90	0.64	−0.003	−0.196**	0.024	0.477**	0.608**	0.621**	(0.68)					
8. Depressive	2.55	0.97	0.016	−0.215**	0.078	0.314**	0.678**	0.628**	0.591**	(0.82)				
9. Histrionic	2.10	0.74	−0.068	−0.309**	−0.017	0.496**	0.080	0.453**	0.283**	0.204**	(0.67)			
10. Narcissistic	2.32	0.81	−0.200**	−0.310**	−0.035	0.397**	0.190**	0.359**	0.234**	0.230**	0.561**	(0.73)		
11. Obsessive-compulsive	2.39	0.68	0.035	−0.148**	−0.014	0.275**	0.317**	0.333**	0.284**	0.346**	0.286**	0.453**	(0.54)	
12. Paranoid	2.40	0.80	−0.052	−0.168**	−0.019	0.366**	0.602**	0.482**	0.413**	0.597**	0.230**	0.408**	0.423**	(0.70)
13. Passive-aggressive	2.31	0.66	−0.118*	−0.227**	0.015	0.451**	0.506**	0.556**	0.437**	0.551**	0.333**	0.453**	0.415**	0.610**
14. Sadistic	1.55	0.61	−0.231**	−0.171**	−0.126*	0.591**	0.203**	0.368**	0.388**	0.204**	0.400**	0.427**	0.212**	0.400**
15. Self-defensive	2.07	0.68	−0.098*	−0.183**	−0.015	0.487**	0.600**	0.628**	0.634**	0.615**	0.282**	0.228**	0.309**	0.537**
16. Schizotypal	1.86	0.65	−0.038	−0.177**	−0.129**	0.551**	0.476**	0.556**	0.504**	0.426**	0.326**	0.396**	0.433**	0.555**
17. Schizoid	2.08	0.75	−0.097	−0.019	−0.018	0.392**	0.559**	0.414**	0.468**	0.540**	0.011	0.134**	0.216**	0.478**
18. Internalising	0.00	0.96	−0.055	−0.214**	0.023	0.558**	0.848**	0.762**	0.753**	0.834**	0.271**	0.345**	0.439**	0.742**
19. Externalising	0.00	0.93	−0.169**	−0.325**	−0.063	0.769**	0.354**	0.690**	0.532**	0.427**	0.769**	0.761**	0.515**	0.577**
20. Neuroticism	3.20	0.75	0.223**	−0.213**	0.192**	0.198**	0.548**	0.491**	0.508**	0.687**	0.135**	0.070	0.198**	0.432**
21. Extraversion	3.00	0.58	−0.045	−0.061	−0.130**	−0.004	−0.516**	−0.200**	−0.258**	−0.489**	0.290**	0.121*	−0.060	−0.308**
22. Openness	3.32	0.51	0.161**	−0.018	0.308**	−0.054	−0.089	0.063	−0.167**	0.009	0.049	−0.037	−0.027	−0.115*
23. Agreeableness	3.41	0.52	0.303**	0.290**	0.070	−0.457**	−0.205**	−0.303**	−0.270**	−0.271**	−0.285**	−0.364**	−0.223**	−0.435**
24. Conscientiousness	3.38	0.58	0.115*	0.159**	−0.131**	−0.324**	−0.371**	−0.350**	−0.476**	−0.420**	−0.092	−0.034	0.057	−0.219**
25. Opposition	1.92	0.74	−0.262**	−0.173**	−0.254**	0.360**	0.009	0.118*	0.158**	−0.036	0.254**	0.289**	0.070	0.131**
26. Compliance	3.62	0.60	0.241**	0.102*	0.128**	−0.124*	0.007	−0.007	−0.070	−0.007	−0.088	−0.095	0.127*	0.111*
27. Social distancing	4.13	0.69	0.184**	0.211**	0.010	−0.197**	−0.048	−0.159**	−0.125*	−0.078	−0.257**	−0.248**	−0.066	−0.103
28. Hygiene	3.99	0.80	0.235**	0.213**	−0.073	−0.128*	−0.160**	−0.064	−0.204**	−0.075	−0.065	−0.191**	−0.015	−0.022
29. Covidfactor	0.00	1.00	0.307**	0.229*	0.084	−0.271**	−0.045	−0.105*	−0.181**	−0.033	−0.215**	−0.278**	−0.009	−0.025

For variables 1–26, $N = 405$–407; for variables 27 and 28, $N = 362$. Data for externalising and internalising are presented as factor scores. For gender, male = 1 and female = 2; for political beliefs, conservative = 1 and liberal = 10.

*$p < .05$ (two-tailed).

**$p < .01$ (two-tailed).

= 6.9, $p < .001$). The model explained just over 51% of the variance shared between the two sets of variables. The squared canonical correlations of each function were 0.350, 0.155, 0.075, and 0.044, respectively. Although all four of the functions were significant, only the first two functions will be considered here, because they explained 85% of the cumulative variance, with function 1 explaining 63.33% and function 2 explaining 21.60% of the variance.

Table 5 shows the standardised canonical coefficients and the structure coefficients for functions 1 and 2. With regard to the coefficients for function 1, the relevant criterion variable is opposition; this finding is consistent with the structure coefficients. However, social distancing also has a large structure coefficient (0.523), but a small, standardised coefficient, findings that suggest multicollinearity between the variables. The negative sign suggests a negative relationship between opposition and the function.

Examining the predictor set for function 1 shows that agreeableness and externalising are the main contributors. The magnitudes of the standardised and structure coefficients are similar. Agreeableness has a positive relationship, and externalising has a negative relationship. *These results suggest that individuals who score high on agreeableness and low on externalising behaviour tend to have lower opposition*. This function can be labelled as *low opposition*.

With regard to the coefficients for function 2, the relevant criterion variables are hygiene and current compliance; this pattern is consistent with the structure coefficients. The negative signs suggest a negative relationship between hygiene, current compliance and the synthetic variable.

Examining the predictor set for function 2 shows that neuroticism, conscientiousness and extraversion are the main contributors. However, the structure coefficients show a lower magnitude for neuroticism. All three personality variables have a negative relationship with the synthetic variable. *These results suggest that individuals who score low on conscientiousness, extraversion, and neuroticism tend to have lower levels of compliance and hygiene*. This function can be labelled as *low compliance and hygiene*.

We also did canonical analysis of these variables for each gender separately. Results from these suggest that men who score high on extraversion and externalising behaviour but low on agreeableness tend to have higher opposition. Moreover, men who score high on extraversion, openness, and conscientiousness tend to have higher levels of hygiene. For females results suggest that women who score low on externalising behaviour and high on agreeableness tend to have lower opposition and somewhat lower compliance but have higher social distancing behaviour. Detailed results from these analyses are included in supplemental materials.

2.3. Discussion

The results above show that all our hypotheses were fully or partly supported, and that almost 30% of the variance in the COVID factor could be accounted for by individual differences. We also found differential effects of individual differences on different aspects of COVID-19 behaviours, where agreeableness and externalising PDs explained opposition against restrictions and avoidance of social distancing, while neuroticism, conscientiousness and extraversion explained hygiene behaviours and compliance.

Whilst these findings are not surprising for differential psychologists (though many would be impressed by the percentage of variance accounted for), they may present problems for health professionals, who tend not to comprehend when and why there is so much variation in the response to their recommendations. It is not always easy to target people based on their personality profile and adapt recommendations such that they increase the uptake of sound medical advice. However, with a great increase in the research in social media, it becomes possible to

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
(0.57)															
0.425**	(0.70)														
0.573**	0.446**	(0.62)													
0.506**	0.459**	0.518**	(0.61)												
0.449**	0.354**	0.578**	0.426**	(0.66)											
0.717**	0.456**	0.829**	0.679**	0.712**	–										
0.668**	0.690**	0.571**	0.690**	0.341**	0.656**	–									
0.332**	0.109*	0.487**	0.348**	0.373**	0.621**	0.271**	(0.87)								
−0.264**	0.025	−0.324**	−0.075	−0.507**	−0.463**	0.068	−0.436**	(0.79)							
0.071	−0.197**	−0.006	−0.083	−0.086	−0.064	−0.038	0.054	0.004	(0.69)						
−0.475**	−0.547**	−0.349**	−0.364**	−0.322**	−0.413**	−0.530**	−0.159**	0.149**	0.127*	(0.74)					
−0.308**	−0.185**	−0.423**	−0.196**	−0.407**	−0.465**	−0.232**	−0.478**	0.415**	0.044	0.345**	(0.84)				
0.166**	0.451**	0.147**	0.282**	0.201**	0.147**	0.380**	−0.108*	0.171**	−0.203**	−0.421**	−0.119*	(0.89)			
−0.085	−0.102*	−0.082	0.046	−0.113*	−0.030	−0.080	0.135**	0.023	−0.012	0.135**	0.150**	−0.436**	(0.63)		
−0.228**	−0.197**	−0.114*	−0.158**	−0.110*	−0.140**	−0.284**	−0.014	−0.063	−0.026	0.269**	0.098	−0.435**	0.396**	(0.88)	
−0.161**	−0.147**	−0.121*	−0.073	−0.175**	−0.155**	−0.147**	−0.024	0.128*	0.091	0.173**	0.243**	−0.278**	0.401**	0.451**	(0.76)
−0.212**	−0.291**	−0.151**	−0.144**	−0.204**	−0.144**	−0.292**	0.084	−0.034	0.086	0.331**	0.203**	−0.724**	0.758**	0.776**	0.71**

understand how to reach people with different profiles and adapt messages to make them more attractive and appealing to the recipients.

3. Study 2

In the first study, many participants had beliefs and attitudes related to government advice in the lower range, which governments may wish to change given the severe consequences of the pandemic. Clearly, it is important to address how effects of advice and regulations aiming at reducing transmission can be increased. Thus, the purpose of our second study was to investigate how personality-based and unwanted reactions to government advice could be modified.

We showed in study 1 that personality is a strong predictor of such reactions, it is also a fact that it isstrongly genetically based (Plomin, 2018), and it can be hard to change when acting against advice and regulations (Borghuis et al., 2017; Loehlin & Martin, 2001). However, behaviour regulation is also dependent on situation strength and trait activation (Roberts et al., 2006). In the current context, it seems important to increase situation strength so that people limit their expression of traits through non-conducive health behaviours (Mussel & Spengler, 2015; Niepel et al., 2020; Tett & Guterman, 2000). Providing instructions, knowledge and regulations may facilitate this.

In a recent review of principles for behaviour change related to the COVID-19 pandemic, West et al. (2020) summarised theory in this area and listed nine principles for behaviour change. These nine principles are education, persuasion, incentivisation, coercion, training, restriction, environmental restructuring, modelling and enablement (West et al., 2020, p. 458). In addition to these 10 principles, we added that (increased) risk perception can be an important cause of behaviour change (Ferrer & Klein, 2015). West et al. (2020, p. 452) stated that no previous studies exist in which these several principles have been tested. Thus, it seems of critical importance to initiate studies based on the principles above to investigate to what extent behaviour change can be facilitated despite the impact of personality.

Consequently, we conducted an experiment to test the effects of instructions that were based on several of the 10 principles described above. We posited that such instructions would increase social distancing and hygiene behaviours, as well as increase compliance and reduce opposition beliefs compared with a control group. We also investigated whether these instructions interacted with any of the variables included in study 1.

3.1. Method

3.1.1. Sample

Participants from study 1 were re-recruited; 362 of the original 407 participated. Of these, 177 were men and 185 were women. The mean age was 31 years ($SD = 11.3$). This sample participated in the November 2019 and May 2020 surveys, and responded to the measures of PDs, NEO-FFI and our COVID-19 measure including opposition and compliance in the previous surveys. The experiment was conducted between 21 and 28 June 2020.

3.1.2. Instruments

We used the same measures as in study 1. In addition to the measures described in study 1, we included future-oriented versions of the four COVID-19 measures to be used as dependent variables in the experiment. In these measures, we adjusted the wording of opposition and compliance to be future-oriented. We also adopted the future-oriented versions of Blagov's (2020) health behaviour scales, including social distancing and hygiene.

3.1.3. Experimental treatments

As described above, we composed an experimental instruction based

Table 4
Regression analysis with Covid-19-factor scores as the dependent variable.

	Step 1	Step 2	Step 3	Step 4
Gender	0.274**	0.251**	0.129*	0.123*
Age	0.181**	0.118*	0.129*	0.113*
Externalising		−0.217**	−0.194**	−0.192**
Neuroticism			0.265	0.275**
Agreeableness			0.124*	0.138*
Conscientiousness			0.215**	0.202**
Neuroticism × agreeableness				−0.123**
ΔR^2		0.042**	0.066**	0.014**
R^2	0.124**	0.166**	0.233**	0.247**
F (df)	25.421 (2358)	23.732 (3357)	17.890 (6354)	16.553 (7353)

* $p<.05$ (two-tailed).
** $p<.01$ (two-tailed).

Table 5
Standardised canonical coefficients and structure coefficients for functions 1 and 2.

Variable	Standardised coefficients		Structure coefficients	
	1	2	1	2
Current compliance	−0.181	−0.598	0.334	−0.658
Current opposition	−0.985	−0.264	−0.982	0.065
Social distancing	0.150	0.380	0.523	−0.118
Hygiene	0.046	−0.821	0.315	−0.814
Gender	0.027	−0.379	0.426	−0.497
Age	0.082	−0.381	0.315	−0.270
Political beliefs	0.202	0.106	0.321	0.154
Neuroticism	0.335	−0.639	0.158	−0.120
Extraversion	−0.306	−0.576	−0.324	−0.490
Openness	0.155	−0.044	0.340	−0.075
Agreeableness	0.436	0.375	0.726	−0.024
Conscientiousness	0.263	−0.608	0.222	−0.531
Internalising	−0.046	0.055	−0.277	0.097
Externalising	−0.432	−0.078	−0.707	−0.141

on the theoretical principles for behaviour change summarised by West et al. (2020), and risk perception as reviewed by Ferrer and Klein (2015). The experimental instructions represented a 'shotgun approach', in which we tested the accumulated effect of several principles integrated into one experimental instruction. We based our analyses on a principle according to which we maximised the difference between control and experimental group instructions (Kerlinger & Lee, 1999). However, since the experimental instructions were lengthier, the amount of exposure was part of the design. We did not know how to increase the amount of exposure in the control group without risking unknown biases. The experimental and control group instructions are shown in Table 6.

Participants were randomly assigned to two groups using a function for this in the Qualtrics survey system. There were 180 participants in the control group and 182 participants in the experimental group.

3.1.4. Procedure

We employed a randomised pre-test, post-test design. The function 'survey flow' in the Qualtrics software for surveys was set to randomly assign half participants to the experimental or control condition/intervention. We used four COVID-19 measures (opposition, compliance, social distancing, and hygiene) from study 1 as pre-tests. We had four similar but future-oriented measures as post-tests after the experimental treatment. We administered the experiment as part of an electronic survey. Participants were allowed up to 7 min to read the experimental instructions before they had to proceed. There was more text in the experimental instructions compared with the control instructions, and we therefore found it useful to instruct participants in both groups to read the instructions carefully. When they finished reading the instructions, they were asked to enter as many keywords as they could in an open field in the survey. We used this tactic to facilitate comprehension and to create a sense of importance in order to assist participants in memorising what was written in the instructions. Participants were debriefed in writing at the end of the survey.

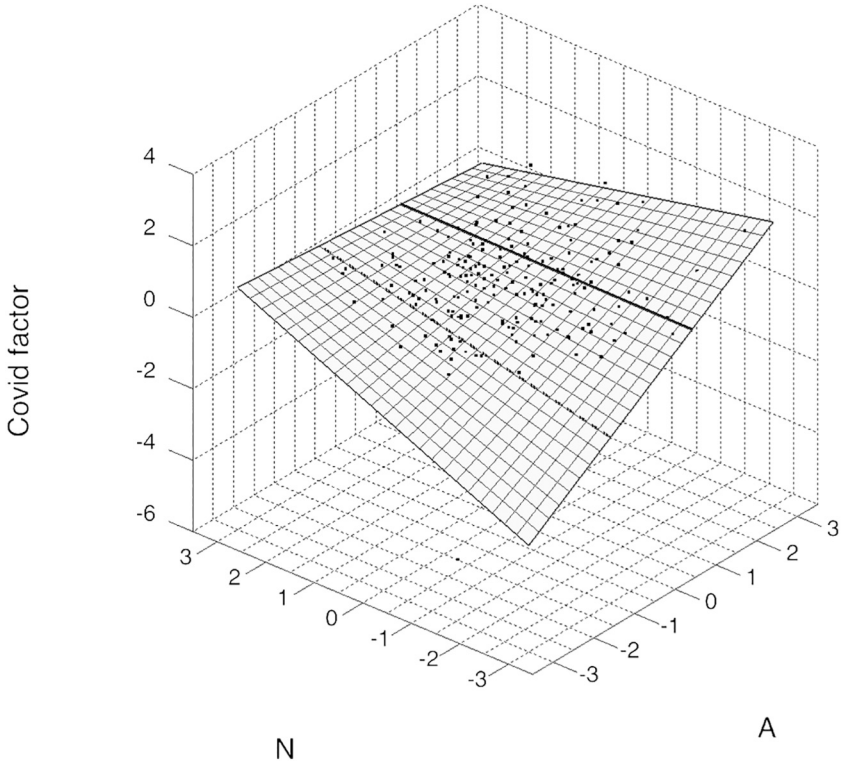

Fig. 1. Interaction plot of Neuroticism (N) and Agreeableness (A) on the Covid factor. Note. The solid black line on the surface indicates +1 *SD* A, whereas the dashed black line on the surface indicates −1 *SD* A.

Table 6
Experimental instructions.

Experimental instructions:	Control group instruction:
Background The current pandemic still spreads and has many consequences. There is no cure, vaccine, or ways to treat people who become ill. Many people will still experience that friends, relatives, colleagues or themselves get ill and in many cases seriously ill. The spread of the virus and its consequences is also affecting the economy so that many people will lose their jobs. Long-term effects on public health and economy are not known. Although the situation seems somewhat better at the moment, the spread of the virus may increase again in a second wave. **Facts** The Covid-19 is transmitted in communities directly by travelling through the air from an infected person's airways, mouth or nose to a recipient's eyes, nose or mouth. If someone infected is out among people, and has sneezed or coughed in his hands, the virus may also contaminate an object or surface if touched. If such objects and surfaces are touched by a recipient who then goes on to touch their face, the person will get infected. Infection through mouth, nose or eyes is the primary route for the virus to cause infection. It does not enter through the skin. (This text was taken from West et al., 2020, p. 451). **What is the risk of being infected?** If society doesn't do enough to limit contact, the probability of becoming infected will increase rapidly. If you then are less careful in regard to social contact and lower your guard in relation to hand-hygiene, the probability that you will become ill will be much higher. With more and more people infected the number of serious illnesses and deaths will also increase rapidly. **Government imposed restrictions** To protect people, governments have demanded/recommended isolation, social distancing (staying at home except for essential journeys), frequent handwashing, and to keep a distance (typically 2 m) from other people at all times to reduce risks of transmission. There are no other known ways to stop the virus from spreading further. Although it is inconvenient, costly, and demanding for people, governments have done these things to protect people and their long-term welfare. **Reasons for being careful** Although all people have their right to be independent and make their own decisions, the current pandemic is dependent on social contact between people because it transmits from one person to another. That means that every individual, if they are not careful, can be responsible for other people's illness and even deaths. You are responsible for the health of your family, friends and those around you in your community. A major difficulty in the situation is that the virus is not visible, and some people may carry it without any symptoms. They may then transmit it without knowing it. Moreover, many people are in one of the risk groups associated with the disease and may suffer from fatal illness if infected. Thus, it is important to follow regulations at all times to protect both ourselves and others. Your loved ones will thank you for protecting them and keeping them healthy. **Necessary actions** To succeed, everybody must wash their hands several times a day. Every time hands are washed it must be done for 90 s with soap and water. All parts of the hand and wrist should be cleaned. When you are unable to wash your hands, hand-disinfectants can be used. Wash your hands every time you enter your home from outside, before you prepare or eat food and drink and every 3 h throughout the day (you can set a timer on your phone). At all times it is necessary to keep the distance (2 m/6 ft) to others, when outside you can cross the road, walk in single file or stop to allow others to pass at a safe distance. You can work from home if possible. Avoid public transport, crowds and gatherings where social distance is impossible to maintain. If you intend to leave your house, ask yourself: Is this an essential trip? Is there no alternative? Will I be able to maintain social distancing? If you answer "no" to any of these questions you may want to reconsider leaving your home. **Restructure your environment** How can you plan and set goals for yourself to avoid situations in which you can't social distance? If you work in a setting where you are being exposed to other people (in a shop, in a service office, in health care etc), think about how you can design your working space to avoid being infected or infecting others. Is it possible to have a screen between yourself and others? Do you regularly disinfect surfaces? Consider how you can actively design your workspace to reduce contamination. **Future implications of violating the rules** If the virus spreads in a second wave, police may be authorized to fine people who clearly break the social distancing rules. Those who commit more severe actions for example coughing, sneezing or spitting on other people may be jailed. **Rewards for being careful** The great reward of following government restrictions and advice is that the whole pandemic will disappear much faster than it will if people don't	**Background** The current pandemic still spreads and has many consequences. There is no cure, vaccine, or ways to treat people who become ill. Many people will still experience that friends, relatives, colleagues or themselves get ill and in many cases seriously ill. The spread of the virus and its consequences are also affecting the economy so that many people will lose their jobs. Long-term effects on public health and economy are not known. Although the situation seems somewhat better at the moment, the spread of the virus may increase again in a second wave. **Facts** The Covid-19 transmits through air or it can transmit if people touch object surfaces and then their face. While the spread of the virus has been extensive in many countries and more moderate in other countries, the situation is now improving in many places. There are fewer people infected, fewer people in hospital, and fewer people who die each day. **Implications of restrictions** During the last months government restrictions have limited activities and the economy has been under great pressure. Many people have lost their jobs, and many have felt bad because of the several restrictions. Since the situation now is improving in many countries, it is now likely that government restrictions will be gradually loosened so that society can get back to normal. This will most likely happen even if the virus starts spreading rapidly again. **Future advice** However, advice about hand-hygiene and social distancing will remain and everybody is expected to follow this advice.

(continued on next page)

Table 6 (*continued*)

Experimental instructions:	Control group instruction:
care about the restrictions. If people don't care, the pandemic will keep on for a long time, perhaps even years. If people everywhere care, it will disappear within a much shorter time. We can all soon live normally again, the economy will recover faster, and bring back more wealth to our lives.	

3.2. Results

Missing data were again minimal, with 23 points missing over the 44 variables (0.14%) and were assumed to be missing at random. No more than three points were missing per variable.

We initially analysed a second order COVID-19 factor as we had in study 1, but now for the four future-oriented dependent variables (opposition, compliance, social distancing and hygiene). We used EQS 6.3 and modelled four primary factors based on 26 items. We then included a second-order factor. Two disturbances were again constrained to be equal to identify the second-order factor, and four items were allowed to cross-load. The model had adequate fit ($\chi^2(293, N = 362) = 1005.44$; CFI = 0.95; RMSEA = 0.064 90% CI [0.059, 0.068]; SRMR = 0.072). All four primary factors loaded substantially on the second-order factor (−0.637, 0.854, 0.685 and 0.832, respectively).

Based on these findings, we followed the same procedure as in study 1 and used a one-factor principal axis factor solution in SPSS as the basis for extracting factor scores for the future COVID-19 factor. We used these factor scores in our subsequent analyses. However, we also used multivariate analyses in which we included our four original as well as our future-oriented COVID-19 variables to test for differential effects of the experimental manipulations. Descriptive statistics are presented in Table 7. On inspection, there were no serious deviations from the normal distribution. As in the first study, some of the correlations in Table 7 were not large.

Initially, we analysed potential personality-treatment effects on the dependent variables. We explored a regression model in which we used the future COVID-19 factor as a dependent variable and the current COVID-19 factor, the experimental treatment variable and the full set of individual difference variables as predictors. Here, we included interaction terms for individual differences and the experimental variable to check whether experimental treatment interacted with any of the individual differences. We found no significant interactions in this analysis.

Secondly, we investigated whether the *future* COVID-19 factor was related to the individual differences described in study 1. Using multiple regression, and based on findings from study 1, we found that R^2 for gender, age, neuroticism, agreeableness, conscientiousness and externalising on the future COVID-19 factor was 0.188. All the betas were significant, and the direction of the betas was the same as in study 1. We then inserted the current COVID-19 factor in the model. The result was that all the above-mentioned betas became non-significant, except for neuroticism, which was still significant, but changed sign (−0.079). Although this was not a formal test of mediation, it seemed to support the supposition that the current COVID-19 factor included most of the individual differences impact in the model. Thus, we controlled for current COVID-19 beliefs and behaviour in our further analyses below.

In our first analysis of the experimental effects, the experimental effect on the future COVID-19 factor was significant (control group estimated marginal mean = −0.163, *SE* = 0.038, 95% CI [−0.237, 0.088]; experimental group estimated marginal mean = 0.045, *SE* = 0.038, 95% CI [−0.029, 0.120]; $F[1359] = 15.04$, $p = .000$, $\eta_p^2 = 0.04$) when controlling for the current COVID-19 factor (used as a covariate). These results showed that the experimental treatment had the expected effect of increasing 'positive' COVID-19 beliefs and behaviours. MANOVA showed that social distancing and hygiene increased while opposition decreased. Details for this analysis is included in supplemental materials.

We then investigated further the influence of the experimental condition by conducting a two-way repeated measures ANOVA. For each of the dependent variables – compliance, opposition, social distancing and hygiene – the current variable was measured at time 1 and the future variable was measured at time 2. We coded each participant as to whether they were in the control or experimental group. Means and standard deviations for pre- (current) and post-tests (future) for the four variables in each of the two experimental groups are shown in Table 8.

The main effect of time was found to be significant for all four dependent variables: compliance ($F[1359] = 22.28$, $p < .001$, $\eta_p^2 = 0.059$); opposition ($F[1359] = 41.55$, $p < .001$, $\eta_p^2 = 0.104$); social distancing ($F[1359] = 54.19$, $p < .001$, $\eta_p^2 = 0.131$); and hygiene ($F[1359] = 59.09$, $p < .001$, $\eta_p^2 = 0.141$). There was a significant interaction effect between time and experimental group for three of the dependent variables: opposition ($F[1359] = 4.82$, $p = .029$, $\eta_p^2 = 0.013$); social distancing ($F[1359] = 16.32$, $p < .001$, $\eta_p^2 = 0.043$); and hygiene ($F[1359] = 8.48$, $p = .004$, $\eta_p^2 = 0.023$). For compliance ($F[1359] = 0.22$, $p = .639$, $\eta_p^2 = 0.001$), this interaction was not significant.

Figs. 2–5 plot these interactions. Compliance (figure two) increased from time 1 to time 2, and this effect was similar across both the control and experimental groups. Opposition (figure three) increased from time 1 to time 2, but the increase was less for the experimental than the control group. Social distancing (figure four) behaviour decreased from time 1 to time 2, but the decrease was less for the experimental compared with the control group. Hygiene (figure five) increased from time 1 to time 2, and this increase was larger for the experimental than the control group.

3.3. Discussion

In-depth analyses showed that the experimental instructions had the effects of increasing desirable hygiene behaviours and reducing an increase in undesirable social behaviours. These results may reflect the idea that it is indeed possible to change health-related behaviours, but also that social distancing behaviours are tougher to comply with than hygiene behaviours in the long run.

Again, we found that individual difference factors do play a part, as expected, in 'following instructions'. For instance, we know that from a motivational point of view, extraverts seem more sensitive to promise of reward, while introverts are more sensitive to threat of punishment, and neurotics are very vigilant with regard to ego-threatening messages (A. Furnham, 2018). This suggests, as we found, that if well-established behaviour change methods are employed (West et al., 2020), people will modify their beliefs and behaviours. However, this modification will still be affected by individual difference factors.

4. Study 3

Our third study sought to replicate the second for two main reasons. The first is that it is important to replicate studies in psychology to investigate if findings are reliable, and this is a core idea in what has been called the *replication crisis* in this field (Maxwell et al., 2015). Moreover, the sample in study 2 included participants from several countries, and we considered replication in a nationally more homogeneous sample to be important to determine if national culture could have influenced results in unexpected ways. This time we did not include any individual difference variables.

4.1. Method

4.1.1. Sample

The sample in the previous study was international, but mainly European, and because there can be some uncertainty with regard to the similarity of COVID-19 conditions across countries, we included a

Table 7
Correlations and descriptive statistics for Study 2.

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Gender	–	–	–																			
2. Political beliefs	5.86	1.83	0.166**	–																		
3. Age	31.06	11.32	0.165**	−0.142**	–																	
4. Internalising	−0.03	0.96	−0.043	0.067	−0.190**	–																
5. Externalising	−0.04	0.93	−0.158**	0.002	−0.307**	0.648**	–															
6. Neuroticism	3.19	0.76	0.241**	0.201**	−0.205**	0.639**	0.283**	(0.87)														
7. Extraversion	2.99	0.59	−0.031	−0.133*	−0.060	−0.483**	0.060	−0.467**	(0.80)													
8. Openness	3.32	0.51	0.183**	0.342**	−0.013	−0.057	−0.031	0.073	−0.018	(0.69)												
9. Agreeableness	3.43	0.52	0.317**	0.033	0.288**	−0.415**	−0.527**	−0.184**	0.152**	0.133*	(0.75)											
10. Conscientious	3.39	0.58	0.094	−0.176**	0.163**	−0.460**	−0.223**	−0.495**	0.426**	0.027	0.352**	(0.84)										
11. Current opposition	1.89	0.71	−0.261**	−0.212**	−0.164**	0.138**	0.384**	−0.127*	0.187**	−0.203**	−0.411**	−0.132*	(0.88)									
12. Current compliance	3.63	0.59	0.234**	0.103	0.091	−0.001	−0.056	0.160**	0.026	−0.001	0.132*	0.137**	−0.444**	(0.65)								
13. Current distance	4.14	0.68	0.178**	0.015	0.207**	−0.140**	−0.284**	−0.012	−0.060	−0.023	0.271**	0.100	−0.431**	0.399**	(0.88)							
14. Current hygiene	3.99	0.80	0.234**	−0.073	0.212**	−0.155**	−0.147**	−0.023	0.128*	0.092	0.173**	0.243**	−0.277**	0.400**	0.455**	(0.76)						
15. Experimental group	–	–	−0.019	−0.015	−0.002	0.010	0.007	0.015	−0.018	0.045	0.076	−0.017	0.028	−0.054	−0.004	−0.045	–					
16. Future opposition	2.08	0.68	−0.229**	−0.127*	−0.147**	0.102	0.340**	−0.064	0.177**	−0.140**	−0.358**	−0.073	0.680**	−0.353**	−0.536**	−0.251**	−0.065	(0.84)				
17. Future compliance	3.76	0.59	0.257**	0.098	0.175**	−0.101	−0.151**	0.038	0.120*	0.033	0.230**	0.174**	−0.421**	0.643**	0.507**	0.578**	−0.034	−0.421**	(0.71)			
18. Future distance	3.94	0.84	0.199**	0.021	0.163**	−0.062	−0.230**	0.024	−0.082	0.032	0.257**	0.066	−0.433**	0.447**	0.775**	0.459**	0.129*	−0.557**	0.564**	(0.88)		
19. Future hygiene	4.17	0.76	0.250**	0.000	0.171**	−0.174**	−0.144**	−0.041	0.175**	0.143**	0.213**	0.257**	−0.301**	0.381**	0.385**	0.831**	0.044	−0.292**	0.608**	0.500**	(0.78)	
20. Current Covid-19 factor	0.00	1.00	0.304**	0.087	0.226**	−0.144**	−0.292**	0.085	−0.032	0.088	0.331**	0.204**	−0.772**	0.760	0.775**	0.711**	−0.044	−0.614**	0.724**	0.716**	0.633**	–
21. Future Covid-19 factor	−0.06	1.00	0.295**	0.078	0.208**	−0.137**	−0.273**	0.028	0.011	0.106*	0.334**	0.178**	−0.58**	0.584**	0.707**	0.669**	0.065	−0.715**	0.83**	0.842**	0.755**	0.855**

Listwise deletion $N = 361$. Externalising and internalising are factor scores (explained in study 1). For experimental group, control = 1 and experimental = 2. For gender, male = 1 and female = 2. For political beliefs, conservative = 1 and liberal = 10.

* $p < .05$ (two-tailed).

** $p < .01$ (two-tailed).

Table 8
M and SD values for the dependent variables for the experimental and control groups (Study 2).

	Control group		Experimental group	
	Pre-test	Post-test	Pre-test	Post-test
Opposition	1.87 (0.70)	2.13 (0.67)	1.92 (0.72)	2.04 (0.68)
Compliance	3.66 (0.57)	3.77 (0.59)	3.60 (0.61)	3.74 (0.59)
Distancing	4.14 (0.64)	3.83 (0.80)	4.12 (0.73)	4.04 (0.88)
Hygiene	4.02 (0.76)	4.14 (0.77)	3.95 (0.84)	4.20 (0.76)

SD is presented in parentheses.

replication sample from the UK only. Two hundred and forty-nine participants took part in the experiment. They were recruited from the Prolific population of UK participants. Of these, 123 were men and 126 were women. The mean age was 35.77 years ($SD = 12.86$). There were 128 participants in the control group and 121 participants in the experimental group. We randomly assigned participants to groups. The survey was completed during the same week in June 2020 as the preceding study.

4.1.2. Instruments

In this study, we included the two dependent COVID-19 variables that were associated with the stronger findings in study 2: future-oriented social distancing and hygiene. Again, we used a randomised pre- and post-tests design and included current social distancing and hygiene as pre-tests and covariates. These measures were described previously.

4.1.3. Experimental instructions

We included the same experimental and control instructions as in study 2.

4.1.4. Procedure

We used the same experimental procedure as in study 2.

4.2. Results

Missing data were minimal, with eight points missing over 53 variables (0.027%). No more than two points were missing over one variable. Descriptive statistics are shown in Table 9. On inspection, the four COVID-19 variables were skewed, and kurtosis was in the higher range, especially for current distancing behaviours.

Results from MANOVA showed that scores on both social distancing and hygiene increased in the experimental group. Details are provided in supplemental materials. In order to investigate more in depth the influence of the experimental condition, we conducted a two-way repeated measures ANOVA. For both of the dependent variables – social distancing and hygiene – the current variable was measured prior to the intervention and the future variable was measured post-intervention. We coded each participant as to whether they were in the control or experimental group. Table 10 shows the *M* and *SD* values for pre- and post-tests for the two COVID-19 behaviours and in the two experimental groups.

The main effect of current versus future behaviour was significant for both dependent variables: social distancing ($F[1247] = 82.94$, $p < .001$, $\eta_p^2 = 0.251$) and hygiene ($F[1247] = 16.60$, $p < .001$, $\eta_p^2 = 0.063$). There was an interaction for both of the dependent variables: social distancing ($F[1247] = 15.23$, $p < .001$, $\eta_p^2 = 0.058$) and hygiene ($F[1247] = 5.30$, $p = .022$, $\eta_p^2 = 0.021$). Figs. 6 and 7 plot these interactions. As in study 2, social distancing behaviour (Fig. 6) decreased from current to future behaviour, but the decrease was less for the experimental than the control group. Hygiene behaviour (Fig. 7) increased from current to future behaviour, and this increase was larger for the experimental than the control group.

4.3. Discussion

The above results clearly replicated our findings from study 2. Hygiene behaviours increased, while distancing behaviours were reduced for both control and experimental groups. Again, however, they were reduced to a lesser extent for the experimental group. In this sense, we

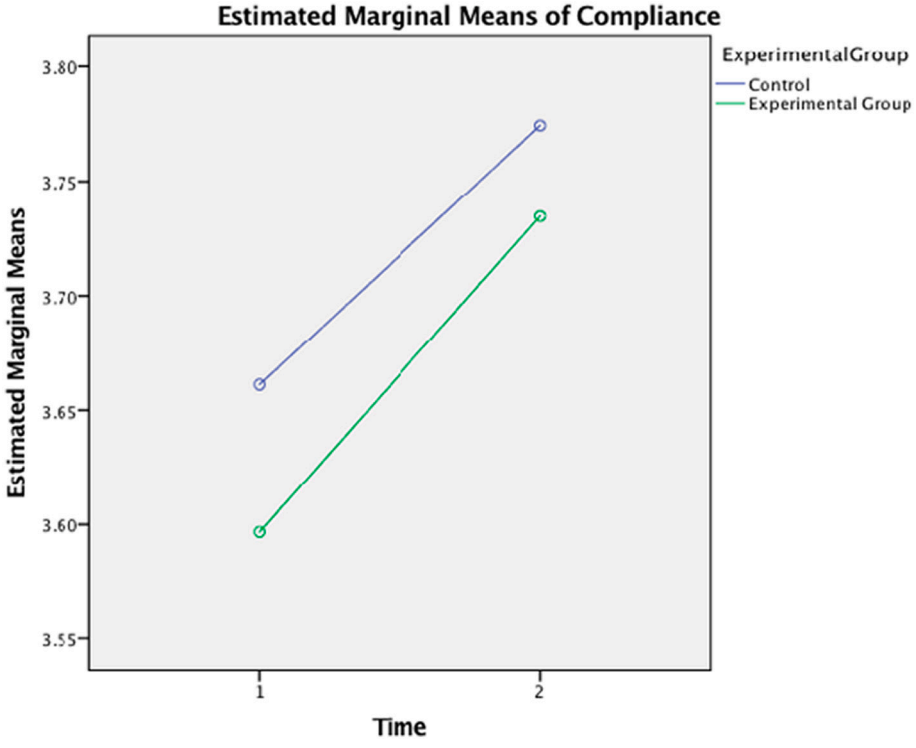

Fig. 2. Interaction plot between time (1 and 2) and experimental group (control and experimental) on future compliance (Study 2).

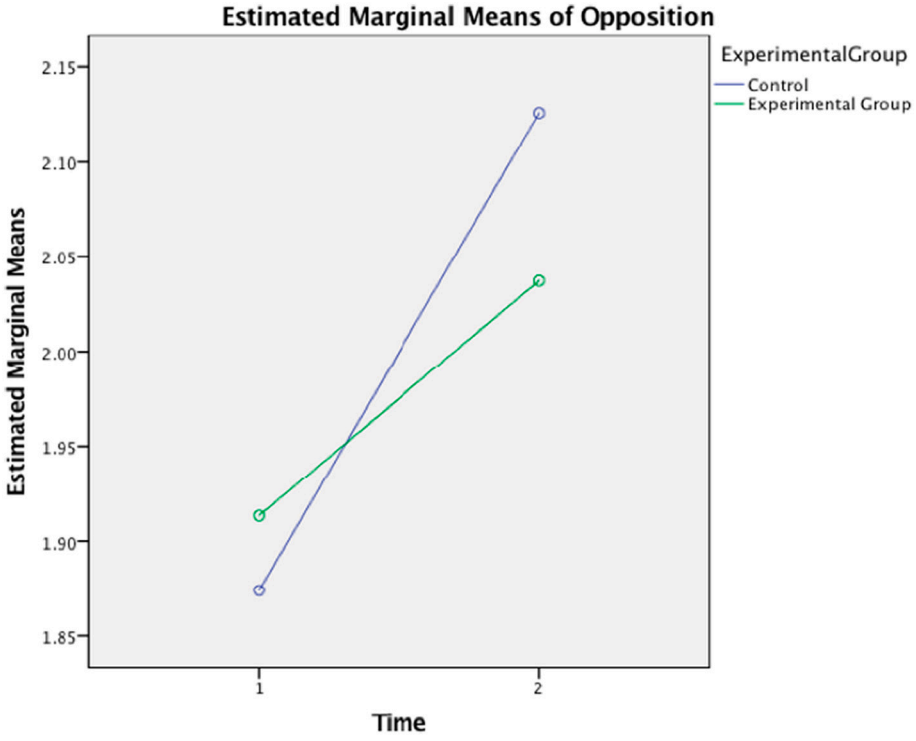

Fig. 3. Interaction plot between time (1 and 2) and experimental group (control and experimental) on future opposition (Study 2).

replicated study 2, as well as the studies in this area that validate theoretically based ideas about behaviour change.

We have demonstrated that with respect to COVID-19, some behaviour strategies work better than others with different outcomes. This is interesting and important in the particular context and has clear implications and applications for those in public health.

5. General discussion

In study 1, we hypothesised that individual differences might explain compliance with or opposition to public advice and health behaviours, as such factors have been shown to influence the effects of governmental warnings about threats to the public (Gutteling et al., 2018). Our results

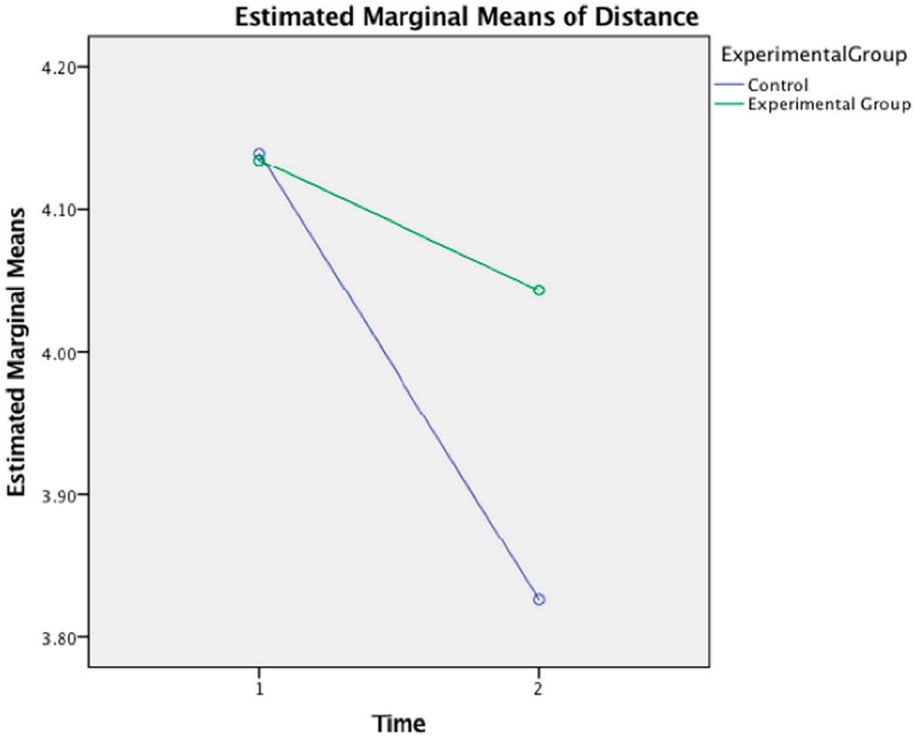

Fig. 4. Interaction plot between time (1 and 2) and experimental group (control and experimental) on future distancing (Study 2).

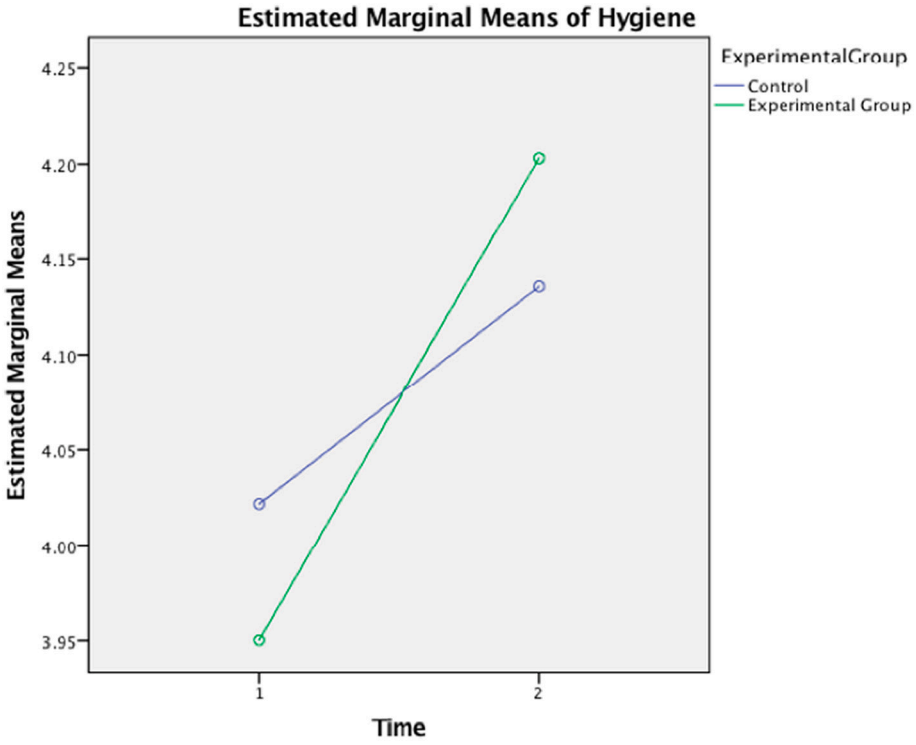

Fig. 5. Interaction plot between time (1 and 2) and experimental group (control and experimental) on future hygiene (Study 2).

showed that effects of individual differences could explain close to 30% of the variance in our COVID-19 measures.

Our second purpose was to conduct the first test of a strategy (West et al., 2020) to increase COVID-19 distancing and hygiene behaviours. Results from studies 2 and 3 supported this. Our experimental intervention explained a substantial amount of variance in the dependent variables. The causality in our experimental studies may be described as molar rather than molecular, and as descriptive rather than explanatory (Shadish et al., 2002).

An important finding in study 1 was that different traits were associated with different *aspects* of COVID-19 beliefs and behaviours, supporting a nuanced understanding of the dynamics involved. Thus, perceptions are influenced by individual characteristics. This is predictable from earlier research on stress and coping (Lazarus & Folkman, 1987). Stress-inducing threats are not neutral facts, but rather mobilise strong psychological processes involved in appreciating the relevance of the threat to the subject, eliciting different coping and defence mechanisms (Ackerman et al., 2018). Clearly, the psychological defence mechanisms involved seem to depend on a lack of awareness to be effective (Rosenzweig, 2016), which is likely to render people oblivious to the large differences in how others in their environment perceive and react to health-related information. As even the behaviours of small groups or individuals may have statistical impact on pandemic developments (Ndairoua et al., 2020), professionals engaged in creating preventive interventions may need knowledge about individual differences in responses.

Our findings suggest that any government-based recommendations should attempt to target those less likely to adhere to guidelines, like younger men. This approach has been successfully implemented in other areas of health-related behaviour such as addictions. Targeting different groups may involve consideration of the content and style of messages as well as where they are placed. Future educational programs to increase health behaviours may build on the principles used here and may be offered in schools and organizations to promote optimal health

Table 10
M and SD values for the dependent variables for the experimental and control groups (Study 3).

	Control group		Experimental group	
	Pre-test	Post-test	Pre-test	Post-test
Distancing	4.27 (0.71)	3.82 (0.87)	4.34 (0.67)	4.15 (0.85)
Hygiene	3.99 (0.85)	4.03 (0.86)	4.15 (0.76)	4.34 (0.77)

SD is presented in parentheses.

Table 9
Correlations and descriptive statistics for Study 3.*

	M	*SD*	1	2	3	4	5	6	7
1. Gender	_-	–							
2. Age	35.77	12.86	0.164**						
3. Current distance	4.31	0.69	0.066	0.261**	(0.88)				
4. Current hygiene	4.07	0.81	0.185**	0.091	0.527**	(0.80)			
5. Experimental group	–	–	0.061	0.027	0.046	0.105			
6. Future distance	3.98	0.88	0.054	0.202**	0.763**	0.465**	0.192**	(0.89)	
7. Future hygiene	4.19	0.83	0.234**	0.122	0.468**	0.838**	0.183**	0.554**	(0.82)

$N = 249$. For experimental group, control = 1 and experimental = 2. For gender, male = 1 and female = 2. Values in parentheses indicate Cronbach's α reliabilities.
* $p < .05$ (two-tailed).
** $p < .01$ (two-tailed).

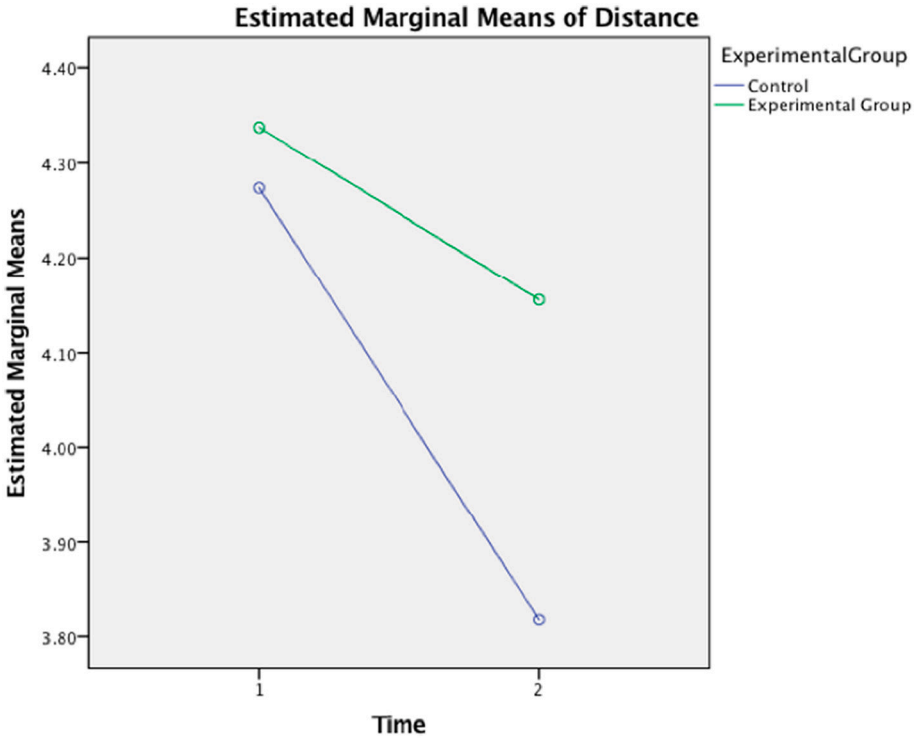

Fig. 6. Interaction plot between time (1 and 2) and experimental group (control and experimental) on future distancing (Study 3).

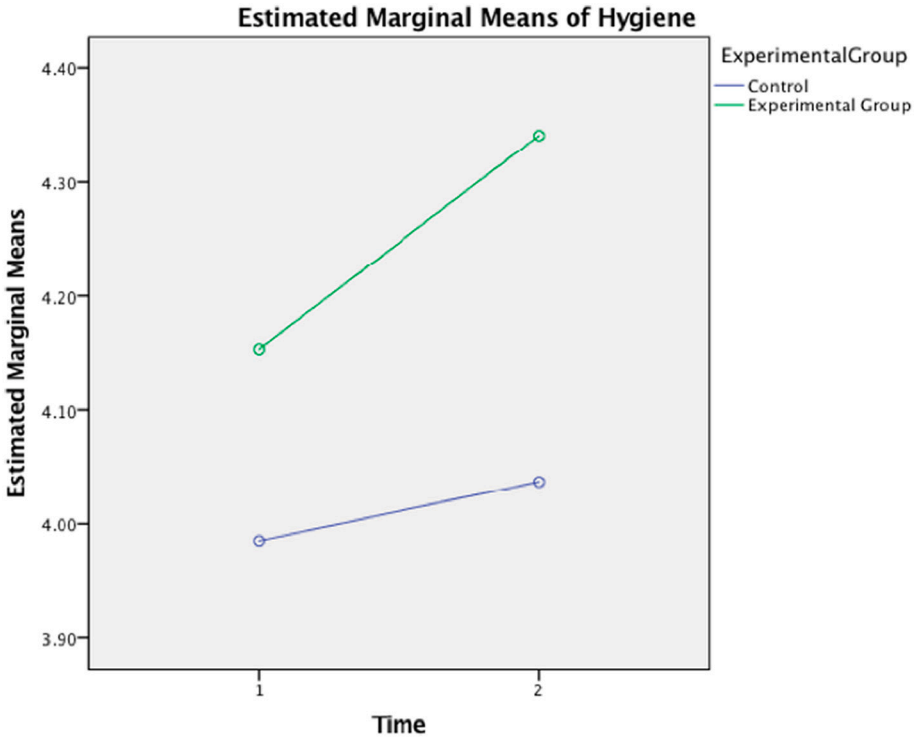

Fig. 7. Interaction plot between time (1 and 2) and experimental group (control and experimental) on future hygiene (Study 3).

behaviours during a pandemic.

We know that people with different personality profiles use social media differently. Thus, extraverted young men will use sites quite differently from agreeable older women or conscientious people with conservative political views. One of the implications of our research suggests researching these sites to find where people with different profiles go, so that health messages can be placed there in the style and tone that make them optimally attractive.

Like all studies, ours had limitations. It was a partly cross-sectional and self-report study for some of the variables in study 1, but still longitudinal for the majority of variables, and we applied experimental designs in studies 2 and 3. Although self-reports for health behaviours

can be biased (Brener et al., 2003), Diefenbacher et al. (2019) found that self-reports of handwashing habits correlated with observations of handwashing behaviour. Moreover, a study by Gollwitzer et al. (2020) found that self-reported social distancing behaviours were associated with daily step-counts (using smartphone pedometers) and reduced movement as registered by smart-phone coordinates. Based on findings from a related field, Kormos & Gifford (2014) found that self-reporting had a 0.46 correlation with objective measures of pro-environmental behaviour. Thus, we assume that self-reported COVID-19 health behaviours may be sufficiently valid, but that normal scientific precautions should be used when interpreting results.

Finally, we do not know whether our samples were representative for populations. However, our main focus in study 1 was on the relationships between traits and behaviours and less on mean sample characteristics. Finally, results from experiment 2 were replicated in a new sample in study 3 and showed that the findings were robust.

CRediT authorship contribution statement

Øyvind Lund Martinsen: Conceptualization, Methodology, Validation, Formal analysis, Resources, Writing – original draft, Project administration. **Adrian Furnham:** Conceptualization, Validation, Writing – original draft. **Simmy Grover:** Conceptualization, Methodology, Validation, Formal analysis, Resources. **Jan Ketil Arnulf:** Conceptualization, Methodology, Formal analysis. **George Horne:** Methodology, Validation, Formal analysis, Investigation.

Acknowledgement

Thanks to professor Ingela Lundin Kvalem, University of Oslo, Norway, for her comments on the experimental design in studies 1 and 2.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2021.111016.

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