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Estimated probabilities of positive, vs. negative, events show separable correlations with COVID-19 preventive behaviours

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ABSTRACT

Research has associated optimism with better health-protective behaviours, but few studies have measured optimism or pessimism directly, by asking participants to estimate probabilities of events. We used these probability estimates to examine how optimism and/or pessimism relate to protecting oneself from COVID-19. When COVID-19 first reached Turkey, we asked a snowball sample of 494 Istanbul adults how much they engaged in various COVID-protective behaviours. They also estimated the probabilities of their catching COVID-19, and of other positive and negative events happening to them. Estimated probability of general positive events (optimism) correlated positively with officially-recommended helpful behaviours (e.g. wearing masks), but not with less-helpful behaviours (e.g. sharing 'alternative' COVID-related information online). Estimated probabilities of general negative events (pessimism), or of catching COVID, did not correlate significantly with helpful COVID-related behaviours; but they did correlate with psychopathological symptoms, as did less-helpful COVID-related behaviours. This shows important nuances can be revealed by measuring optimism and pessimism, as separate variables, using probability estimates.

1. Introduction

The COVID-19 coronavirus pandemic was declared by the World Health Organization on 11th March 2020; Turkey's first case was recorded the same day. There was no full lockdown, but Turkish universities closed their campuses and began teaching online. By the end of April, Turkey had reported more than 120,000 cases (Republic of Turkey Ministry of Health, 2021, October). Throughout this time, Turkish citizens – like others around the world – were told to stay at home, practice social distancing, wear masks, and wash their hands regularly. One might expect people's adherence to these recommendations would depend on their perceptions of the risk: however, this relationship is not straightforward. Jovančević and Milićević (2020) found fear of infection correlated with reported protective behaviours; Taghrir et al. (2020) found perceived risk correlated *negatively* with protective behaviours; Shahnazi et al. (2020) found no significant relationship at all. This article argues that COVID-related behaviours are instead related to general optimism, and that optimism and pessimism have separable relationships with protective behaviours.

There are large individual differences in optimism, pessimism, and risk estimates, which show important relationships with psychopathology (e.g. Booth & Sharma, 2020; Scheier et al., 2001). The substantial literature on optimism/pessimism (Carver & Scheier, 2014) suggests optimism is related to better health (Peterson & Bossio, 2001). One explanation is that optimists exhibit good health-related behaviours: optimists have been observed to be more likely to rest following illness (Lin & Peterson, 1990), eat healthily (Giltay et al., 2007; Hingle et al., 2005), and exercise (Giltay et al., 2007; Steptoe et al., 2006). There is also preliminary evidence that optimists are more likely to follow recommendations to protect themselves from COVID-19 (Jovančević & Milićević, 2020). Optimists' higher feelings of efficacy might mean they feel in control of their health (Peterson & de Avila, 1995), and might help them stick to health-related goals (Rasmussen et al., 2006). Pessimists, on the other hand, are more likely to die early (Peterson et al., 1998).

There are two potential issues with this literature. Firstly, researchers have commonly focused on either optimism or (less commonly) pessimism, often assuming the two form a single continuum (e.g. Giltay et al.,

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2007; Jovančević & Milićević, 2020; Scheier et al., 1994). However, optimism and pessimism are somewhat separable (Chang et al., 1997; Robinson-Whelan et al., 1997) – although this issue is debated (Rauch et al., 2007; Segerstrom et al., 2011) – and can show separable relationships with health outcomes (Craig et al., 2021). Scheier et al. (2021) reanalysed 61 samples from this literature and found that pessimism correlated more with health outcomes than optimism did, and somewhat more than a combined optimism/pessimism measure did (see Felt et al., 2020; Whitfield et al., 2020). Importantly, optimism and pessimism can also show independent relationships with health *behaviours*: Taylor et al. (2004) found pessimism, more than optimism, correlated with the activity levels of Black girls (see also Serlachius et al., 2015; Thompson & Gaudreau, 2008). It is therefore essential to assess optimism and pessimism as two separate dimensions if we are to understand their relationships with health behaviours.

Secondly, previous studies may not have measured optimism/pessimism directly. Most studies (see Scheier et al., 2001) on optimism/pessimism and health behaviours have either used the Life Orientation Test (LOT; Scheier et al., 1994), or the Attributional Style Questionnaire (ASQ; Peterson et al., 1982). The LOT is a face valid self-assessment, with items like "I'm always optimistic about my future"; it measures 'dispositional optimism', meaning "generalized expectations of good versus bad outcomes in life" (Scheier et al., 1994, p. 1072), as assessed reflectively by the participant. The ASQ asks respondents to explain why hypothetical events might happen to them, and their explanations are rated according to how much they imply similar things could happen in the future. These instruments are valid and have produced many useful findings, but they measure different (Hirsch & Connor, 2006; Tomakowsky et al., 2001) aspects of the optimism construct. Importantly, neither instrument directly asks participants how probable positive and negative events are. Indeed, neither measure correlates very strongly with such probability estimates (Monzani et al., 2021, Supplementary materials B; Peterson & Vaidya, 2001; although see Wichman et al., 2006). Therefore, it is valuable to verify the literature's conclusions on optimism and health behaviours using direct measures of probability estimates, which model optimism and pessimism as separate dimensions (for other objective measures of optimism, see Andersen et al., 1992; Felt et al., 2020; Stankevicius et al., 2014).

Our suggestions above are supported by work with the Future Events Scale (FES; Andersen, 1990), an optimism/pessimism measure which asks participants' probability estimates for 13 positive and 13 negative events. Wichman et al. (2006) found these events loaded on separate optimism and pessimism factors; furthermore, these factors showed stronger correlations with depression-related constructs than the LOT did. While this supports our arguments, no-one (to our knowledge) has examined the FES's relationships with health behaviours.

We therefore examined how people's probability estimates for positive events (optimism) and negative events (pessimism) related to their COVID-related behaviours, soon after the pandemic first reached Turkey. Rather than using the FES, we presented more specific events with a non-numerical response scale, which is more sensitive to bias effects (Mitte, 2007). We predicted optimism and pessimism would have distinct, separable relationships with behaviours. We also measured psychopathological symptoms, to check whether these could account for any relationships we found between probability estimates and protective behaviours.

2. Method

The study was approved by MEF University's Ethics Committee, and was carried out in accordance with the World Medical Association's Declaration of Helsinki.

2.1. Participants

Data were collected between 29th April and 30th May 2020, early in Turkey's initial (partial) COVID-19 lockdown. Participants completed numerous measures as part of a joint project. Participants were recruited by MEF University undergraduate students: 106 students participated, and then recruited at least one male and one female participant (who could also be students) to earn course credit. Given the timing and nature of the joint project, we simply collected as many data as we could during our self-imposed testing window. Of 497 who completed the study, we excluded three who skipped more than two items on a key variable or who skipped a block of questions, implying they were not paying attention. Our final sample included 494 (307 female, 182 male, 1 other, 4 unspecified; aged from 16 to 79, $M = 27.59$, $SD = 11.05$) participants. Ninety had at least one financial dependent; 200 were not working; 130 were working remotely; 31 were working non-remotely; 26 were on unpaid leave and 8 had lost their jobs from the pandemic. Their mean self-rated socioeconomic status was 5.82 ($SD = 1.49$) on Adler et al.'s (2000) ladder, and their mean political affiliation was 5.29 ($SD = 1.31$) on a 1 (left-liberal) to 7 (right-conservative) scale. This sample has 0.80 power to detect correlations as small as $\rho = 0.125$ (G*Power, v3.1).

2.2. Measures and procedure

We here focus on the measures addressed in this article (see Supplementary materials for all measures). The study was conducted in Turkish.

2.2.1. COVID-19 risk

Participants estimated their probability of contracting COVID-19, on a 1 ("I'm not at risk at all") to 7 ("I have a high level of risk") scale. Given the rapidly-emerging situation, we created this measure ad hoc.

2.2.2. COVID-related behaviours questionnaire

This was based on a scale by Imhoff and Lamberty (2020), extended and translated by Koc et al. (2021). It asks participants how much they engage in 24 behaviours in response to the COVID-19 outbreak (see Table 1). Participants responded on a 1 ("Never") to 5 ("Always") Likert scale.

Table 1
Structure matrix of promax-rotated factor loadings for COVID-related behaviours items.

Item	Helpful behaviours	Less-helpful behaviours
Disinfect hands after going outside	0.54	−0.03
Avoid social interactions	0.70	−0.11
Wash hands after being outside	0.67	−0.20
Avoid crowds	0.79	−0.03
Not touching face while outside	0.40	0.04
Stay at home during lockdown	0.56	−0.05
Stockpile food	0.16	0.38
Stockpile petrol and motor oil	−0.21	0.57
Withdraw money from my bank account	0.02	0.54
Wear a protective face mask outside the house	0.44	0.09
Make investments on the stock market	−0.13	0.37
Use alternative medicines, like essential oils	−0.12	0.60
Search for information on alternative online media	0.16	0.48
Share information online (with friends on WhatsApp, Facebook etc.)	0.11	0.44
Frequently air the house	0.52	0.05
Avoid public transport	0.43	0.03
Change route when I see a large group of people approaching	0.56	0.13
Frequently use online shopping sites	0.13	0.32
Frequently check my body temperature	0.04	0.47
Being extra careful when communicating with or passing by elderly individuals	0.43	0.19

2.2.3. Optimism/pessimism

We adapted Booth and Sharma's (2020) measure of probability estimates. Participants rated 12 positive and 12 negative events (see Table 2) on a verbal seven-point scale with the options "Would never happen to me", "Would probably not happen to me", "Might not happen to me", "Might happen to me, might not", "Would probably happen to me", and "Would definitely happen to me", which were converted to 1–7 scores for analysis.

2.2.4. Psychopathology

The Brief Symptom Inventory is an abridged Symptom Checklist (Derogatis, 1992; translation by Şahin & Durak, 1994). It asks how much participants were distressed by 53 symptoms in the previous seven days, on a 0 (not at all) to 4 (extremely) scale, and yields scores for categories of symptoms alongside a 'global severity index'. We used this index in the analyses presented here ($\alpha = 0.97$), since it showed the overall strongest correlations with our other measures (see Supplementary materials).

2.3. Data analysis

First, we checked the factor structure of both COVID-related behaviours and optimism/pessimism. Both measures were subjected to exploratory factor analyses, and factor scores calculated for subsequent hypothesis testing.

We tested optimism and pessimism's correlations with our other variables, using Spearman's rank correlations as they were not normally distributed. We estimated Bayes factors (van Doorn et al., 2020), so we could quantify the evidence for a correlation's absence where necessary ($BF_{10} < 0.30$ represents evidence the effect is zero in the population). Where optimism and pessimism showed different relationships with third variables, we compared them using Meng et al.'s (1992) technique. Where significant relationships were found, we tested whether these could be accounted for by estimated COVID-19 risk or psychopathology, using partial correlation.

Table 2
Structure matrix of promax-rotated factor loadings for optimism/pessimism. Note the factors are moderately correlated (see Table 3), which inflates items' loadings on their secondary factors.

Item	Pessimism	Optimism
You will become very rich.	−0.12	0.47
You will greatly enjoy your next holiday or trip.	−0.17	0.51
You will be successful in your next venture or goal.	−0.15	0.66
You will become well known for an important achievement.	−0.03	0.54
You will be perceived favourably at your next party or social event.	−0.12	0.45
At your next checkup, your doctor will say you are in excellent physical health.	−0.25	0.54
You will have a wonderful 90th birthday celebration.	−0.08	0.50
Tomorrow will be a wonderful day for you.	−0.07	0.54
You will be alive and healthy into old age.	−0.35	0.68
You will be the victim of a violent crime.	0.57	−0.19
You will embarrass yourself at your next party or social event.	0.40	−0.20
You will be involved in a serious traffic accident in the next five years.	0.58	−0.06
You will lose or seriously damage your phone in the next year.	0.35	−0.08
You will be seriously injured in a natural disaster.	0.58	−0.14
You will lose someone you love in the next year.	0.41	−0.07
You will be diagnosed with a serious physical illness.	0.62	−0.24
You will be diagnosed with cancer in your lifetime.	0.59	−0.19
You will lose the use of your legs and be confined to a wheelchair.	0.69	−0.10

3. Results

Raw data are available at https://doi.org/10.17605/OSF.IO/FMAZV.

3.1. Data reduction

3.1.1. Factor structure of COVID-related behaviours

A principle factors analysis was conducted, with a promax rotation since we had no theoretical reason to constrain factors to be orthogonal. Initially, parallel analysis suggested three factors were present, but after removing four cross-loaded items, two factors remained, explaining 35.64% of the variance: factor scores were calculated for use in further analyses. Factor loadings are presented in Table 1: we interpreted the first factor as representing helpful behaviours, recommended by medical experts; we interpreted the second factor as representing less-helpful behaviours, perhaps guided by panic or speculation. These factors are fairly consistent with those reported by Imhoff and Lamberty (2020).

3.1.2. Factor structure of optimism/pessimism

We subjected probability estimates to the same factor analysis procedure. After removing four items with item-total correlations below 0.35, parallel analysis suggested four factors were present. We noticed that two factors – both comprised only of negative events – correlated strongly ($r = 0.58$) and were clearly redundant; removing the one item which loaded most strongly (loading = 0.64) on the weaker of these two factors, and which was also cross-loaded on the fourth factor (loading = −0.30), caused the structure to resolve to two factors. We then removed one more item which seemed unable to adequately distinguish the remaining factors (loadings = 0.40 and −0.28). This left us with the expected two factors: one for positive events (optimism), and one for negative events (pessimism; see Table 2 for loadings). Again, factor scores were calculated for the analyses below. See Supplementary materials for alternative analyses of probability estimates.

3.2. Hypothesis tests

3.2.1. Correlations among variables

Spearman correlations are presented in Table 3. Optimism's correlation with helpful behaviours was modest but significant, and was significantly stronger (difference = 0.26, 95% CI [0.12, 0.39], $z = 3.59$, $p < .001$) than its (apparently absent) correlation with unhelpful behaviours. Conversely, pessimism did not correlate with either behaviours factor. This supports the argument that optimism and pessimism are separable dimensions.

Strikingly, COVID-19 risk was unrelated to both behaviours factors. As expected, it did correlate (somewhat weakly) with pessimism, but not with optimism; again, these correlations were significantly different from one another (difference = 0.25, 95% CI [0.11, 0.38], $z = 3.44$, $p < .001$), further supporting the argument that optimism and pessimism are separable dimensions.

Psychopathology was clearly unrelated to helpful behaviours, but did correlate positively with less-helpful behaviours. Psychopathology's correlations with optimism and pessimism were significant, and were of opposite sign but similar size.

3.2.2. Controlling for psychopathology and COVID-19 risk

Given the correlations between our variables, we wanted to confirm that optimism still significantly correlated with helpful COVID-related behaviours when COVID-19 risk and psychopathology were controlled. Partial ρ (489) = 0.20, $p < .001$, indicating that optimism's association with helpful behaviours was independent of these other variables.

Table 3
Spearman's ρ correlations, with [95% confidence intervals] and BF_{10}, and descriptive statistics.

	2	3	4	5	6	*M*	*SD*
1. Helpful COVID-related behaviours	ρ = 0.18** [0.09, 0.26], BF_{10} = 12.05	ρ = −0.09 [−0.17, 0.00], BF_{10} = 0.16	ρ = 0.21** [0.12, 0.29], BF_{10} > 100	ρ = −0.05 [−0.14, 0.04], BF_{10} = 0.21	ρ = −0.03 [−0.12, 0.05], BF_{10} = 0.07	0.00	0.93
2. Less-helpful COVID-related behaviours		ρ = 0.05 [−0.03, 0.14], BF_{10} = 0.13	ρ = 0.05 [−0.04, 0.14], BF_{10} = 0.16	ρ = 0.06 [−0.03, 0.15], BF_{10} = 0.40	ρ = 0.20** [0.11, 0.28], BF_{10} > 100	0.00	0.87
3. COVID-19 risk			ρ = −0.08 [−0.16, 0.01], BF_{10} = 0.15	ρ = 0.17** [0.09, 0.26], BF_{10} > 100	ρ = 0.10* [0.01, 0.18], BF_{10} = 0.90	3.54	1.54
4. Optimism				ρ = −0.31** [−0.39, −0.23], BF_{10} > 100	ρ = −0.29** [−0.37, −0.21], BF_{10} > 100	0.00	0.90
5. Pessimism					ρ = 0.23** [0.15, 0.32], BF_{10} > 100	0.00	0.90
6. Psychopathology symptoms						59.82	39.56

Note. $N = 494$.
* $p < .05$.
** $p < .001$.

4. Discussion

Although there is a rich literature on optimism/pessimism and health behaviours, little or none of that work assessed optimism and pessimism directly using probability estimates, and much of it focused on optimism *or* pessimism, not both. We asked participants to estimate the probabilities of positive and negative general events, and their COVID-19 risk. Reporting helpful behaviours correlated with optimism, and this was independent of psychopathology and COVID-19 risk. Pessimism did not correlate with COVID-related behaviours and, surprisingly, neither did COVID-19 risk.

Our findings do not contradict the existing literature on optimism/pessimism and health behaviours (e.g. Boehm et al., 2013; Giltay et al., 2007; Steptoe et al., 2006), but they do add nuance. Echoing Serlachius et al. (2015) and Taylor et al. (2004), we found that optimism and pessimism had clearly separable relationships with health behaviours: while optimism was associated with COVID-protective behaviours, pessimism was not, despite their having similar-sized correlations with psychopathological symptoms. These results confirm that optimism and pessimism are best modelled as separate dimensions (Chang et al., 1997; Robinson-Whelan et al., 1997), and they show the value of confirming previous findings with more direct measures: this can avoid response bias, for example by more depressed participants choosing responses which reflect badly on them.

Optimism was, counter-intuitively, associated with taking effective action to prevent infection. This is congruent with the better health behaviours optimists often display (e.g. Boehm et al., 2013; Giltay et al., 2007; Hingle et al., 2005), and presumably results from optimists' feeling of having control over their health (Peterson & de Avila, 1995). More pessimistic individuals can exhibit low or disengagement-based motivation (Lin & Peterson, 1990; Thompson & Gaudreau, 2008), which may have impaired their ability to engage in effective protective behaviours. More pessimistic people may neglect their health partly because they feel they have little control over it (Peterson & de Avila, 1995).

While pessimism has shown stronger relationships with health *outcomes* than optimism has (Felt et al., 2020; Scheier et al., 2021; Whitfield et al., 2020), we found pessimism was unrelated to health *behaviours*. Studies on pessimism and health outcomes generally assessed pessimism with the items "If something can go wrong for me, it will"; "I hardly ever expect things to go my way"; and "I rarely count on good things happening to me" from the LOT. These are more general than the specific negative events we used, and focus more on the respondent themselves than on potential future events. Perhaps poor health outcomes are associated with having an image of oneself as pessimistic and/or unlucky, more than overestimation of negative events' probability. This interpretation is speculative, but Wichman et al. (2006) showed that the LOT and FES probability estimates showed unique relationships with depression-related constructs, and concluded the instruments measure different things. This reinforces the value of using different measures of optimism and pessimism, and especially more direct measures, to verify conclusions from this literature.

COVID-related behaviours were unrelated to perceived infection risk. Others have found this relationship can be variable (Jovančević & Milićević, 2020; Shahnazi et al., 2020; Taghrir et al., 2020). Due to the quickly-evolving situation, our measures of COVID-19 risk and optimism/pessimism were prepared by different authors: COVID-19 risk was assessed using a single item with a numeric response scale, which can weaken bias effects (Mitte, 2007); optimism and pessimism were assessed with verbal scales. Possibly, participants found their infection risk too abstract early in the pandemic, and responded based on general expectancies or attitudes towards risk. We may have found relationships between perceived infection risk and protective behaviours if we had sampled older people with a higher risk of mortality, or if we had run our study later when death rates were rising.

Our study examined optimism and pessimism's relationships with health behaviours in the context of a novel health threat. It was conducted in the first weeks of the pandemic, when many people were uncertain and cautious; today, probability estimates might show different relationships with protective behaviours. Early in the pandemic, misinformation or cognitive dissonance from previous choices was unlikely to have influenced their decisions. University closures forced us to rely on self-report measures, but our results are consistent with earlier behavioural studies (Taylor et al., 2004). Our snowball sample included a large proportion of students from Istanbul: effect sizes might vary where the population density is lower, or international news is less available.

We found that optimism regarding the probability of general positive events correlated with COVID-protective behaviours. This effect, though modest, reinforces the idea that decision making can be less than rational, even when it concerns survival. Myriad subtle factors influence our responses to even very real, salient threats. This helps us understand why the COVID-19 pandemic, which arguably could have been contained within weeks if everyone had followed experts' recommendations (Berger et al., 2020), is still raging.

CRediT authorship contribution statement

All authors contributed to study design. B. B. Yavuz and A. Aksu supervised data collection. R. W. Booth analysed the data and wrote the first draft. All authors contributed to redrafting and editing the manuscript.

Appendix A. Supplementary materials

Supplementary material to this article can be found online at htt

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