

Conceptual replication and extension of health behavior theories' predictions in the context of COVID-19: Evidence across countries and over time

Georgios Abakoumkin¹  | Eleftheria Tseliou¹  | Kira O. McCabe²  | Edward P. Lemay Jr.³ | Wolfgang Stroebe⁴ | Maximilian Agostini⁵ | Jocelyn J. Bélanger^{6,7} | Ben Gützkow⁵ | Jannis Kreienkamp⁵ | Maja Kutlaca⁸  | Michelle R. VanDellen⁹  | Jamilah Hanum Abdul Khaiyom¹⁰ | Vjollca Ahmedi¹¹ | Handan Akkas¹² | Carlos A. Almenara¹³ | Mohsin Atta¹⁴ | Sabahat Cigdem Bagci¹⁵ | Sima Basel¹⁶ | Edona Berisha Kida¹⁷ | Allan B. I. Bernardo¹⁸ | Nicholas R. Buttrick¹⁹  | Phatthanakit Chobthamkit²⁰ | Hoon-Seok Choi²¹  | Mioara Cristea²²  | Sára Csaba²³ | Kaja Damjanovic²⁴ | Ivan Danyliuk²⁵  | Daniela Di Santo²⁶ | Karen M. Douglas²⁷  | Violeta Enea²⁸ | Daiane Gracieli Faller²⁹ | Gavan Fitzsimons³⁰ | Alexandra Gheorghiu³¹ | Ángel Gómez³² | Joanna Grzymala-Moszczyńska³³ | Ali Hamaidia³⁴ | Qing Han³⁵ | Mai Helmy^{36,37} | Joevarian Hudiyana³⁸ | Bertus F. Jeronimus⁵  | Ding-Yu Jiang³⁹ | Veljko Jovanović⁴⁰ | Željka Kamenov⁴¹ | Anna Kende⁴² | Shian-Ling Keng⁴³ | Tra Thi Thanh Kieu⁴⁴ | Yasin Koc⁵ | Kamila Kovyazina⁴⁵ | Inna Kozytska²⁵ | Joshua Krause⁵ | Arie W. Kruglanski³ | Anton Kurapov^{25,46} | Nóra Anna Lantos⁴² | Cokorda Bagus Jaya Lesmana⁴⁷ | Winnifred R. Louis⁴⁸  | Adrian Lueders⁴⁹ | Najma Iqbal Malik¹⁴ | Anton Martinez⁵⁰ | Jasmina Mehulić⁴¹ | Mirra Noor Milla³⁸ | Idris Mohammed⁵¹ | Erica Molinario⁵² | Manuel Moyano⁵³  | Hayat Muhammad⁵⁴ | Silvana Mula⁵⁵ | Hamdi Muluk³⁸  | Solomiia Myroniuk⁵  | Reza Najafi⁵⁶ | Claudia F. Nisa⁶ | Boglárka Nyúl⁴² | Paul A. O'Keefe⁵⁷ |

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Jose Javier Olivas Osuna⁵⁸  | Evgeny N. Osin⁵⁹ | Joonha Park⁶⁰ |
Gennaro Pica⁶¹  | Antonio Pierro⁶² | Jonas Rees⁶³ |
Anne Margit Reitsema⁶⁴ | Elena Resta⁵⁵ | Marika Rullo⁶⁵ |
Michelle K. Ryan^{66,67} | Adil Samekin⁶⁸ | Pekka Santtila⁶⁹ |
Edyta Sasin⁶ | Birga Mareen Schumpe⁷⁰ | Heyla A. Selim⁷¹ |
Michael Vicente Stanton⁷²  | Samiah Sultana⁵ | Robbie M.
Sutton²⁷ | Akira Utsugi⁷³ | Jolien Anne van Breen⁷⁴ | Caspar J. Van
Lissa⁷⁵ | Kees Van Veen⁷⁶ | Alexandra Vázquez³² |
Robin Wollast⁷⁷ | Victoria Wai-lan Yeung^{78,79} | Somayah Zand⁸⁰ | Iris
Lav Žeželj²⁴ | Bang Zheng⁸¹ | Andreas Zick⁸² | Claudia Zúñiga⁸³ | N.
Pontus Leander^{5,84}

Correspondence

Georgios Abakoumkin, Laboratory of
Psychology, Department of Early Childhood
Education, University of Thessaly, Argonafton
& Filellinon, Volos 382 21, Greece.
Email: gabak@uth.gr

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New York University Abu Dhabi; University of
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Abstract

Virus mitigation behavior has been and still is a powerful means to fight the COVID-19 pandemic irrespective of the availability of pharmaceutical means (e.g., vaccines). We drew on health behavior theories to predict health-protective (coping-specific) responses and hope (coping non-specific response) from health-related cognitions (vulnerability, severity, self-assessed knowledge, efficacy). In an extension of this model, we proposed orientation to internal (problem-focused coping) and external (country capability) coping resources as antecedents of health protection and hope; health-related cognitions were assumed as mediators of this link. We tested these predictions in a large multi-national multi-wave study with a cross-sectional panel at T1 (Baseline, March-April 2020; $N = 57,631$ in 113 countries) and a panel subsample at two later time points, T2 (November 2020; $N = 3097$) and T3 (April 2021; $N = 2628$). Multilevel models showed that health-related cognitions predicted health-protective responses and hope. Problem-focused coping was mainly linked to health-protective behaviors (T1-T3), whereas country capability was mainly linked to hope (T1-T3). These relationships were partially mediated by health-related cognitions. We conceptually replicated predictions of health behavior

theories within a real health threat, further suggesting how different coping resources are associated with qualitatively distinct outcomes. Both patterns were consistent across countries and time.

KEYWORDS

coping, country capability, COVID-19, health behavior theories, hope, problem-focused coping, virus mitigation behavior

1 | INTRODUCTION

The impact of behavior on health is considerable (Stroebe, 2011) and the context of the COVID-19 pandemic is no exception. Virus mitigation behavior (i.e., any behavior that contains SARS-CoV-2, like social distancing) has been, and still is, a powerful means to fight the pandemic (Ruiz & Revenson, 2020; Van Bavel et al., 2020; West et al., 2020). In the present research, we drew on health behavior theories (Janz & Becker, 1984; Rogers, 1983) to predict health-related behavior during the pandemic from health-related cognitions. Further, we drew on approaches combining health behavior and health behavior theories with attribution theory (e.g., King, 1982; Roesch & Weiner, 2001) to examine possible internal and external coping resources as antecedents of health-related cognitions and behavior.

Health behavior theories, including the health belief model (HBM; Janz & Becker, 1984; Rosenstock, 1974) and protection motivation theory (PMT; Rogers, 1975, 1983) view threat and coping appraisal as key determinants of health behavior, and empirical evidence supports these theories (e.g., de Hoog et al., 2007; Floyd et al., 2000; Milne et al., 2000; Tannenbaum et al., 2015; Witte & Allen, 2000).

Although HBM and PMT are two distinct theories, they have some major premises in common. One key premise is that health behavior is determined by how people evaluate the threat from a certain disease for their health. This typically includes perceived vulnerability to acquiring the disease and perceived severity of the consequences of the disease. The higher the perceived vulnerability and severity, the more serious one assesses the health threat.

In addition to evaluating a health threat, people also assess the extent of the available coping potential. This refers to individuals' evaluations of the effectiveness of available coping responses (response efficacy), their ability to enact these responses (self-efficacy), and the possible disadvantages or costs of this behavior (response costs). The higher the response efficacy, the estimated self-efficacy and the less the perceived disadvantages of a behavioral response, the higher the perceived coping potential. Taken together, the higher the perceived threat and the higher the perceived coping potential, the higher the likelihood that one would engage in the respective health behavior.

These theories have been used in the context of COVID-19 to predict health-protective behaviors or vaccination intention (e.g., Badr et al., 2021; Barattucci et al., 2022; Eberhardt & Ling, 2021; Ezati Rad et al., 2021; Kowalski & Black, 2021; Nudelman, 2023; Shmueli, 2021; Wang et al., 2021; Wong et al., 2021). Findings from these studies supported theoretical predictions.

Further, health-related cognitions, namely threat and coping appraisal, may serve as cognitive mediating processes between possible antecedents and resulting intentions and behavior (e.g., King, 1982; Rippetoe & Rogers, 1987; Rogers, 1975). In addition, some approaches suggest antecedents based on attribution theory, which considers both internal and external forces that people perceive as causes for a target person's behavior. Accordingly, control over one's health might be viewed as internal or external to the referent person (Hook & Markus, 2020; King, 1982; Maschi et al., 2014; Roesch & Weiner, 2001; Schreiber et al., 2020; Shaw, 1999).

Taken together, when facing a health threat, individuals might orient themselves to internal or external coping resources for protection and coping (Hook & Markus, 2020; Maschi et al., 2014). Internal (vs. external) orientation would mobilize the individual and foster coping-specific responses (e.g., social distancing) to counter the threat. Simi-

larly, external (vs. internal) orientation would mobilize the individual less and foster coping non-specific responses (e.g., threat denial) against the threat. The association between orientation to coping resources (internal vs. external) and coping responses (specific vs. non-specific) should be mediated by activated health-related cognitions (threat and coping appraisal). This general conceptual model is depicted in Figure 1.

2 | OVERVIEW

We examined the conceptual model (Figure 1) with data from the PsyCorona Study, a large multinational project starting on 19 March 2020 (the pandemic beginning). The examination of this model had two parts. We first sought to conceptually replicate the specific predictions of health-protective behaviors from health-related cognitions based on assumptions of health behavior theories. Given the multinational data of this study, we also tested whether these predictions varied cross-nationally. We then tested the overall conceptual model, which included a branch with longitudinal data in two more time points.

The coping-specific responses used to test this model were health-protective behaviors recommended by WHO and several governments at the pandemic's onset (Otete Omeife, 2020, April 24; West et al., 2020; WHO, 2020, March 22), namely hand hygiene, social distancing, and self-isolation. We also examined mask use at the two subsequent time points. As a coping non-specific response, we used hope. Hope might be considered as an emotional response, close to wishful thinking (e.g., Rose & Aspiras, 2020) and opposite to hopelessness, which is considered as a maladaptive response to health threats (Rippetoe & Rogers, 1987). Yet, hope has also been conceptualized as an agency to achieve goals (Snyder, 2002).

Regarding health-related cognitions, threat appraisal was assessed via perceived vulnerability to, and perceived severity of, COVID-19 infection (e.g., Janz & Becker, 1984; Rogers, 1983); coping appraisal was assessed via perceived personal knowledge of COVID-19 (e.g., Badr et al., 2021; Kaphingst et al., 2016; Wang et al., 2021), and perceived efficacy of masks (e.g., Janz & Becker, 1984; Rogers, 1983).

Finally, we used problem-focused coping (Lazarus & Folkman, 1984), a coping style (Carver et al., 1989), as internal coping resource. As external coping resource, we used trust in an entity at the societal level (e.g., Fragkaki et al., 2021; Han et al., 2023b; Lalot et al., 2022), here, trust in one's country capability to deal with COVID-19.

We expected health-related cognitions to positively predict health-protective behaviors and negatively predict hope. Overall, orientation to an internal coping resource should mainly be associated with health-protective behaviors, whereas orientation to an external coping resource should mainly be associated with hope. In both relations, health-related cognitions should act as mediators. Moreover, we examined whether this pattern would remain when

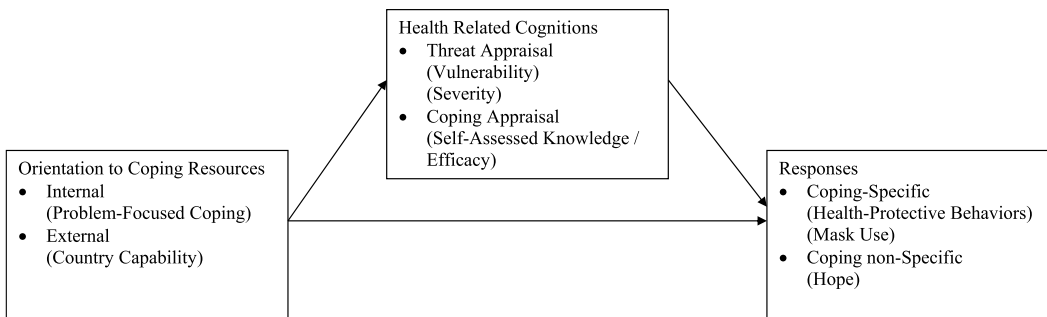


FIGURE 1 Conceptual Model: From internal and external oriented coping resources, to health-related cognitions, to coping-specific and coping non-specific responses. Labels of specific variables used in the present research are in parentheses.

predicting from baseline the outcomes in the two subsequent time points (see [Supplement](#) for more detailed hypotheses formulation).

3 | METHOD

3.1 | Participants and procedure

We used data from the PsyCorona Study (<https://www.rug.nl/rudolf-agricola-school/research/previous-themes/psycorona/>), a multinational project concerning the COVID-19 pandemic. Leander et al. (2020) have provided an overview of this project (for data, see Agostini et al., 2022); details have been described in previous papers (e.g., Han et al., 2023a, 2023b; Stroebe et al., 2021; Van Lissa et al., 2022). Data collection began on 19 March 2020. A baseline panel was created by continuously recruiting participants during the following weeks. This baseline panel served as a platform to recruit participants for a second, longitudinal version of the study. Participants from the baseline panel were invited to sign up for a subsequent multi-wave longitudinal study after completing the baseline survey. Hence, there were two separate recruitment procedures and informed consent forms. We used baseline data (cross-sectional panel) collected over six weeks (March 19 to April 29) in 113 countries (T1). From the longitudinal study, we used data from follow-up surveys administered on 13 November 2020 (T2) and on 13 April 2021 (T3). To consider time points in the pandemic context one might refer to relevant databases (e.g., JHU CSSE COVID-19 Data, <https://github.com/CSSEGISandData/COVID-19>).

The baseline panel comprised $N = 57,631$ participants. We excluded participants who did not report their country of residence ($n = 101$), who indicated they had already been infected by the virus ($n = 401$), and those with missing data on the vulnerability measure ($n = 174$). The final sample in T1 was $N = 56,968$. Demographic data are presented in supplemental Table S1. Regarding participants in the longitudinal study, in T2, 3163 participants completed the survey (excl. 65 infected and 1 missing data on vulnerability). In T3, 2723 participants completed the survey (excl. 95 infected).

Participants completed the study online. The survey was available in 30 languages and was distributed at baseline through multiple channels including convenience sampling, representative sampling (including paid participants), and snowball sampling. Only volunteers from the baseline panel participated in the longitudinal part. The study was approved by the ethics committee of psychology at the University of Groningen (PSY-1920-S0390) and by the institutional review board at New York University Abu Dhabi (HRPP-2020-42).

3.2 | Measures

Most measures were brief to maximize response rates and some items were developed ad hoc to account for the rapidly-unfolding pandemic context. Brief measures, including one-item measures with strong face validity, can be psychometrically satisfactory (Bowling, 2005; Burisch, 1997; Gosling et al., 2003). Moreover, we conducted a validation study (see [Supplement](#)) including the measures that were brief and new. Findings from this study support the validity of these measures.

3.2.1 | Health protection

Participants' engagement in three health-protective behaviors, recommended by WHO and several governments (West et al., 2020; WHO, 2020, March 22), were assessed with three items. After "To minimize my chances of getting coronavirus, I ..." the text of the respective items followed, namely "...wash my hands more often.", "...avoid crowded spaces.", and "...put myself in quarantine." ($-3 = Strongly disagree$; $+3 = Strongly agree$). The items were averaged to

TABLE 1 Descriptive statistics and intercorrelations of problem-focused coping, country capability, vulnerability, severity, self-assessed knowledge, health-protective behaviors (WHO), and hope at T1.

Measure	M (SD)	2	3	4	5	6	7
1. Problem-focused coping	3.70 (0.85)	0.10***	0.03***	0.08***	0.20***	0.25***	0.13***
2. Country capability	0.88 (1.61)		-0.17***	-0.02***	0.09***	0.13***	0.58***
3. Vulnerability	3.55 (1.40)			0.10***	0.01*	0.07***	-0.15***
4. Severity	3.93 (1.23)				0.05***	0.25***	0.01+
5. Self-assessed knowledge	3.74 (0.84)					0.22***	0.09***
6. Health-protective behaviors	2.21 (0.98)						0.16***
7. Hope	1.24 (1.51)						

Note: T1 = Panel at Baseline (19 March to 29 April 2020; N = 56,968).

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

build a scale at baseline ($\alpha = 0.74$), T2 ($\alpha = 0.64$), and T3 ($\alpha = 0.67$). Descriptive statistics of this scale and all measures at baseline, T2, and T3, are presented in Table 1, Supplemental S2, and S3, respectively.

In T2 and T3, participants completed an additional measure assessing their mask use. Although not initially recommended by WHO, it was soon broadly adapted as an important virus mitigation behavior. We used the item "In the past week, I have covered my face in public places" (1 = *(Almost) never*; 5 = *(Almost) always*). Because this item was not administered in T3 (April 2021), we used the same item administered at a later wave (July 2021).

3.2.2 | Health-related cognitions

Perceived vulnerability was assessed with an item adapted from Stroebe et al. (2017): "How likely is it that the following will happen to you in the next few months? ... You will get infected with coronavirus." (1 = *Exceptionally unlikely*; 7 = *All but certain*). The item also offered the reply option 8 (*Already happened*).

Perceived severity was measured with the item "How personally disturbing would you find the following possible consequences of the coronavirus? ... Me contracting the virus." (1 = *Not disturbing at all*; 5 = *Extremely disturbing*).

Self-assessed knowledge was measured with an item adapted from Leander et al. (2019): "How knowledgeable are you about the recent outbreak of Covid-19, commonly referred to as the Coronavirus, in this country ([country of residence])?" (1 = *Not at all knowledgeable*; 5 = *Extremely knowledgeable*).

We administered a measure of self-assessed efficacy of mask use at a later wave (May 2020). The text "I believe that wearing a mask ..." was followed by "protects myself." (-2 = *Strongly disagree*; +2 = *Strongly agree*).

3.2.3 | Hope

Hope was assessed with the item: "Agree or disagree: ... I have high hopes that the situation regarding coronavirus will improve." (-3 = *Strongly disagree*; +3 = *Strongly agree*). Assessing *high* hopes ensured that participants responded to the item in a manner consistent with other hope scales (Snyder, 2002; see Supplement).

3.2.4 | Orientation to internal and external coping resources

Problem-focused coping was measured with three items from the planning subscale of COPE (Carver et al., 1989). After "When dealing with stressful situations, what do you usually do?", the wording of the three items was "I try to

come up with a strategy about what to do,” “I make a plan of action,” and “I think hard about what steps to take.” (1 = *(Almost) never*; 5 = *(Almost) always*). The items were averaged to build a scale ($\alpha = 0.84$).

Country capability was assessed with the item “Agree or disagree: ... I think that this country ([country of residence]) is able to fight the Coronavirus.” (−3 = *Strongly disagree*; +3 = *Strongly agree*).

4 | RESULTS

4.1 | From health-related cognitions to health protection and hope

We examined the conceptual replication of the prediction of health-protective behaviors from health-related cognitions on the basis of health behavior theories with data from the panel (T1). In this part, we also examined the prediction of hope from health-related cognitions. Specifically, we used multilevel modeling to test whether vulnerability, severity, and self-assessed knowledge predicted health-protective behaviors and hope. Data were at the level of individuals (Level 1) and at that of countries (Level 2). We examined three models for each outcome: (a) an unconditioned model of health behaviors and hope, (b) a model testing the fixed effects of Level 1 predictors (vulnerability, severity, and self-assessed knowledge), and (c) we controlled for the influence of demographic variables as Level 1 fixed effects (gender, age, and educational level). Predictors were centered at country level. For variance partitioning (i.e., calculating R^2 and ΔR^2), we followed the calculation procedures presented in McCabe and Fleeson (2016).

The parameter estimates of the multilevel models are presented in Table 2. Relevant correlations are presented in Table 1. Health-protective behaviors varied mostly within countries (i.e., 95% within-country variance, which includes error variance) with only small differences between countries (i.e., 5% between-country variance). Consistent with our hypothesis, vulnerability, severity, and self-assessed knowledge predicted health-related behaviors. This pattern held when controlling for gender, age, and educational level. Thus, we conceptually replicated predictions of health behavior theories. The observed effects displayed high cross-national stability.

Hope varied mostly within countries (91%), with only small differences between countries (9%; Table 2). All three health-related cognitions predicted hope. The pattern of this prediction was not altered when controlling for gender, age, and educational level.

Comparing above findings, health-related cognitions accounted for more variance of health-protective behaviors ($R^2 = 0.107$) than of hope ($R^2 = 0.036$). Vulnerability had a positive relationship with health behaviors and, as hypothesized, a negative relationship with hope. That is, the more participants felt susceptible to contracting the virus, the less they felt hope that the situation with the virus will improve. Severity had a positive relationship with health-protective behaviors and only a weak, even if positive, relationship with hope. Finally, self-assessed knowledge predicted health-protective behaviors and hope in a similar, positive, pattern.

4.2 | From problem-focused coping and country capability to health protection and hope

We examined the proposed model (Figure 1) with outcomes at Baseline as well as outcomes from the longitudinal study (including mask use) at T2 and T3. Correlations of relevant variables at Baseline, T2, and T3 are presented in Tables 1, S2, and S3, respectively.

We ran a set of multilevel models for each antecedent-response combination. Each set comprised four multilevel models. Three models were used to predict each of the three mediators from each antecedent controlling for the second antecedent (paths a). In the fourth model, we predicted one response entering all mediators in the model and controlling for the antecedents (paths b and c'). One set of models examined cross-sectional mediations at Baseline. Further sets were prospective using outcomes at T2 and T3. All models included random intercepts for the country variable and coefficient estimations of independent and mediator variables as Level 1 fixed effects. All variables were

TABLE 2 Prediction of health-protective behaviors and hope by vulnerability, severity, and self-assessed knowledge at T1.

	Health-protective behaviors	Hope
Unconditioned model		
Variance between countries (%)	0.049 (5.06)	0.214 (9.18)
Variance within countries (%)	0.923 (94.94)	2.113 (90.82)
Conceptual model		
Variance between countries (%)	0.044 (5.08)	0.202 (9.00)
Variance within countries (%)	0.824 (94.92)	2.040 (91.00)
Parameter	Estimate [CI]	Estimate [CI]
Vulnerability	0.033 [0.027, 0.039]	-0.146 [-0.154, -0.137]
Severity	0.185 [0.179, 0.192]	0.032 [0.022, 0.042]
Self-assessed knowledge	0.236 [0.227, 0.245]	0.216 [0.202, 0.231]
R ²	0.107	0.036

Note: T1 = Panel at Baseline (19 March to 29 April 2020; N = 56,968). CI = 95% confidence interval.

standardized before analyses (Lorah, 2018). To calculate confidence intervals for the indirect effects of Level 1 variables, we used the Monte Carlo calculator developed by Selig and Preacher (2008).

4.2.1 | Problem-focused coping to health protection

First, we examined the prediction of health-protective behaviors at Baseline by problem-focused coping via the three health-related cognitions controlling for country capability. The relevant indices are depicted in Supplemental Table S4. Problem-focused coping predicted health-protective behaviors in the expected pattern: The more individuals were oriented towards problem-focused coping, the more they reported engaging in health-protective behaviors. This relationship was partially mediated by health-related cognitions in the expected pattern: There were positive indirect effects through all three mediators. The pattern was similar when predicting health-protective behaviors at T2 and at T3 (Table S4). In addition, when controlling for health-protective behaviors at Baseline, besides the effect of self-assessed knowledge that became non-significant, the pattern remained the same (Table S4, Footnotes a and b). Similar findings were obtained for mask use at T2 and T3 (Table S5).

4.2.2 | Problem-focused coping to hope

The next set of multilevel models pertained to the prediction of hope from problem-focused coping via health-related cognitions controlling for country capability. Problem-focused coping positively predicted hope and this relationship was partially mediated by health-related cognitions (Table S6). As expected, all effects were smaller in magnitude as compared to the effects on health-protective behaviors. Given the negative relationship of vulnerability with hope, the respective indirect effect was also negative. The other two indirect effects (via severity and knowledge) were positive. The prediction of hope at T2 and at T3 (Table S6) yielded similar direct effects. However, only the negative indirect effect of vulnerability at T2 and the positive indirect effect of self-assessed knowledge at T3 were significant. All other indirect effects were non-significant. This pattern hardly changed when controlling for hope at Baseline.

4.2.3 | Effects of country capability

The indices for the relevant models are presented in Tables S7 to S9. Country capability positively predicted health-protective behaviors at Baseline. This relationship was partially and negatively mediated by vulnerability, positively mediated by self-assessed knowledge, and not mediated by severity. The negative indirect effect of vulnerability reflected that the higher individuals attributed capability to their country the less vulnerable they felt and thereby the less they engaged in protective behaviors. The positive indirect effect of self-assessed knowledge indicated that the higher individuals attributed capability to their country the more they considered themselves knowledgeable about the virus and thereby the more they engaged in protective behaviors. Country capability was unrelated to perceived severity. The pattern was similar at T2 and T3 except that country capability was negatively related to severity, resulting in significant negative indirect effects on the health-protective behaviors. A similar pattern was observed with masks at T2 and T3.

Country capability mainly predicted hope over protective behaviors. This effect was partially mediated by vulnerability and self-assessed knowledge, but not by severity. This pattern was approximately similar at T2 and T3.

5 | DISCUSSION

In the present research, we conceptually replicated the prediction of health-protective behaviors from health-related cognitions based on assumptions of health behavior theories, within a real health threat context, adopting a meas-

ure of self-reported behavior rather than a measure of attitude or intention. The findings displayed remarkable low variability between countries and stability over time, thus providing evidence for the universality of these effects. Health-related cognitions predicted hope, but to a lesser degree than health-protective behaviors.

Our proposed theoretical extension (Figure 1) was supported by our data at three time points. Specifically, problem-focused coping consistently predicted health-protective responses over three time points. Health-related cognitions partially mediated these predictions. The patterns of these effects remained in T2 and T3 even after controlling for the respective outcomes at T1. Problem-focused coping also predicted hope mainly directly. Indirect effects over health-related cognitions were either weak or non-significant. Regarding country capability, the reverse pattern was observed. It had strong direct effects on hope at all time points and rather weak or non-significant direct effects on health-protective responses. It also exhibited weak indirect effects mainly to health-protective responses and less so to hope.

5.1 | Limitations

One possible limitation concerns our mostly short measures. The measures were taken in a context (the pandemic) that called for quick action within a large-scale study that opted to assess a series of constructs. Thus, many measures were short or ad-hoc and had to be fitted to the specific pandemic context without a history of research to provide such variables. Nevertheless, we conducted a validation study (Supplement), which lends some support to our measures.

Our behavioral measures were based on self-reports. Future research could include measures of actual behavior.

We see a further limitation in the correlational design of our study. Both the health behavior theories as well as our conceptual model extension propose a particular causal direction of effects. Despite our longitudinal data, future research should test the causal direction especially of our proposed antecedents.

5.2 | Conclusion

In a context of a real health threat, namely the COVID-19 pandemic, health behavior theories seem useful to predict whether people will engage in health-protective behaviors. Specific behavioral measures are crucial to combat a pandemic both in the absence and in the presence of pharmaceutical means (Brewer et al., 2017; Van Bavel et al., 2020; West et al., 2020). Moreover, our conceptual extension suggests that, on the one hand, orientation to internal coping resources is associated with coping-specific responses and can be seen as promoting threat and danger control. On the other hand, orientation to external coping resources is associated with coping non-specific responses and can be seen as promoting fear control. We see merit in considering both paths when fighting against a health threat.

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AFFILIATIONS

- ¹Laboratory of Psychology, Department of Early Childhood Education, University of Thessaly, Volos, Greece
- ²Department of Psychology, Carleton University, Ottawa, Ontario, Canada
- ³Department of Psychology, University of Maryland, College Park, Maryland, USA
- ⁴Department of Social and Organizational Psychology, University of Groningen, Groningen, The Netherlands
- ⁵Department of Psychology, University of Groningen, Groningen, The Netherlands
- ⁶Department of Psychology, New York University Abu Dhabi, Abu Dhabi, United Arab Emirates
- ⁷Faculty of Arts and Sciences, Carnegie Mellon University in Qatar, Doha, Qatar
- ⁸Department of Psychology, Durham University, Durham, UK
- ⁹Department of Psychology, University of Georgia, Athens, Georgia, USA
- ¹⁰Department of Psychology, International Islamic University Malaysia, Kuala Lumpur, Malaysia
- ¹¹Department of Pedagogy, Pristine University, Pristina, Kosovo
- ¹²Organizational Behavior, Ankara Science University, Ankara, Turkey
- ¹³Faculty of Health Science, Universidad Peruana de Ciencias Aplicadas, Lima, Peru
- ¹⁴Department of Psychology, University of Sargodha, Sargodha, Pakistan
- ¹⁵Department of Psychology, Sabanci University, Istanbul, Turkey
- ¹⁶Department of Social Sciences, New York University Abu Dhabi, Abu Dhabi, United Arab Emirates
- ¹⁷Faculty of Education, Pristine University, Pristina, Kosovo
- ¹⁸Department of Psychology, De La Salle University, Manila, Philippines
- ¹⁹Department of Psychology, University of Virginia, Charlottesville, Virginia, USA
- ²⁰Department of Psychology, Thammasat University, Pathumthani, Thailand
- ²¹Department of Psychology, Sungkyunkwan University, Jongno-gu, South Korea
- ²²Department of Psychology, Heriot Watt University, Edinburgh, UK
- ²³Doctoral School of Psychology, ELTE Eötvös Loránd University, Budapest, Hungary
- ²⁴Department of Psychology, University of Belgrade, Beograd, Serbia
- ²⁵Department of Psychology, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine
- ²⁶Department of Political Sciences, University of Pisa, Pisa, Italy
- ²⁷School of Psychology, University of Kent, Canterbury, UK
- ²⁸Department of Psychology, Alexandru Ioan Cuza University, Iasi, Romania
- ²⁹Tropical Marine Science Institute, National University of Singapore, Singapore, Singapore
- ³⁰Marketing and Psychology, Duke University, Durham, North Carolina, USA
- ³¹Center for European Studies, Faculty of Law, Alexandru Ioan Cuza University, Iasi, Romania
- ³²Social and Organizational Psychology, Universidad Nacional de Educación a Distancia, Madrid, Spain
- ³³Institute of Psychology, Jagiellonian University, Krakow, Poland
- ³⁴Psychology/ Research Unit Human Resources Development, Setif 2 University, Setif, Algeria
- ³⁵The School of Psychological Science, University of Bristol, Bristol, UK
- ³⁶Psychology Department, College of Education, Sultan Qaboos University, Muscat, Oman
- ³⁷Psychology Department, Faculty of Arts, Menoufia University, Shebin El-Kom, Egypt
- ³⁸Department of Psychology, Universitas Indonesia, Depok, Indonesia
- ³⁹Department of Psychology, National Chung-Cheng University, Minxiong, Taiwan
- ⁴⁰Department of Psychology, Faculty of Philosophy, University of Novi Sad, Novi Sad, Serbia
- ⁴¹Faculty of Humanities and Social Sciences, University of Zagreb, Zagreb, Croatia
- ⁴²Department of Social Psychology, ELTE Eötvös Loránd University, Budapest, Hungary
- ⁴³Psychology, Monash University Malaysia, Bandar Sunway, Malaysia
- ⁴⁴Department of Psychology, HCMC University of Education, Ho Chi Minh City, Vietnam
- ⁴⁵Independent Researcher, Almaty, Kazakhstan

- ⁴⁶Department of Psychology, Faculty of Natural Sciences, Paris Lodron University of Salzburg, Salzburg, Austria
- ⁴⁷Department of Psychiatry, Udayana University, Bukit Jimbaran, Indonesia
- ⁴⁸School of Psychology, University of Queensland, Saint Lucia, Queensland, Australia
- ⁴⁹Department of Communication, University of Hohenheim, Stuttgart, Germany
- ⁵⁰Department of Psychology, University of Sheffield, Sheffield, UK
- ⁵¹Mass Communication, Usmanu Danfodiyo University Sokoto, Sokoto, Nigeria
- ⁵²Department of Psychology, Florida Gulf Coast University, Fort Myers, Florida, USA
- ⁵³Department of Psychology, University of Cordoba, Cordoba, Spain
- ⁵⁴Department of Psychology, University of Peshawar, Peshawar, Pakistan
- ⁵⁵Dipartimento dei Processi di Sviluppo e Socializzazione, University "La Sapienza", Rome, Italy
- ⁵⁶Department of General Psychology, University of Padova, Padova, Italy
- ⁵⁷Department of Management, University of Exeter Business School, Exeter, UK
- ⁵⁸Department of Political Science and Administration, National Distance Education University (UNED), Madrid, Spain
- ⁵⁹Laboratory LINP2, University of Paris Nanterre, Nanterre, France
- ⁶⁰Department of Management, Nagoya University of Commerce and Business, Nagoya, Japan
- ⁶¹School of Law, University of Camerino, Camerino, Italy
- ⁶²Department of Social and Developmental Psychology, University "La Sapienza", Rome, Italy
- ⁶³Department of Social Psychology, Research Institute Social Cohesion, Institute for Interdisciplinary Research on Conflict and Violence, University of Bielefeld, Bielefeld, Germany
- ⁶⁴Department of Developmental Psychology, University of Groningen, Groningen, The Netherlands
- ⁶⁵Department of Social, Political, and Cognitive Sciences, University of Siena, Siena, Italy
- ⁶⁶The Global Institute for Women's Leadership, The Australian National University, Canberra, Australia
- ⁶⁷Faculty of Economics and Business, University of Groningen, Groningen, The Netherlands
- ⁶⁸School of Liberal Arts, M. Narikbayev KAZGUU University, Astana, Kazakhstan
- ⁶⁹Department of Psychology, New York University Shanghai, Shanghai, China
- ⁷⁰Faculty of Social and Behavioural Sciences, University of Amsterdam, Amsterdam, The Netherlands
- ⁷¹Department of Psychology, King Saud University, Riyadh, Saudi Arabia
- ⁷²Department of Public Health, California State University, East Bay, Hayward, California, USA
- ⁷³Graduate School of Humanities, Nagoya University, Nagoya, Japan
- ⁷⁴Institute of Security and Global Affairs, Leiden University, Leiden, The Netherlands
- ⁷⁵Department of Methodology & Statistics, Tilburg University, Tilburg, The Netherlands
- ⁷⁶Department of Sociology, University of Groningen, Groningen, The Netherlands
- ⁷⁷Laboratoire de Psychologie Sociale et Cognitive, Université Clermont-Auvergne, Auvergne, France
- ⁷⁸Department of Psychology, Lingnan University, Hong Kong, China
- ⁷⁹Wofoo Joseph Lee Consulting and Counselling Psychology Research Centre, Lingnan University, Hong Kong, China
- ⁸⁰Department of Psychology, University of Milano-Bicocca, Milan, Italy
- ⁸¹Ageing Epidemiology Research Unit, School of Public Health, Faculty of Medicine, Imperial College London, London, UK
- ⁸²Institute for Interdisciplinary Research on Conflict and Violence (IKG), University of Bielefeld, Bielefeld, Germany
- ⁸³Department of Psychology, Universidad de Chile, Santiago de Chile, Chile
- ⁸⁴Wayne State University, Detroit, Michigan, USA

CONFLICT OF INTEREST STATEMENT

In the present submission, Georgios Abakoumkin, the corresponding author of the manuscript, has acted as Handling Editor of some manuscripts for the Special Issue; Michelle vanDellen, an Editor of the Special Issue, is also a co-author of the manuscript. The submission was handled by a different Editor. The authors have no other known conflict of interest to disclose.

ETHICS STATEMENT

The research reported in this manuscript was carried out in accordance with established/APA ethical standards. It has been approved by the Ethics committee of psychology at the University of Groningen (PSY-1920-S-0390) and by the institutional review board at New York University Abu Dhabi (HRPP-2020-42). The validation study has been approved by the Ethics committee of the Faculty of Behavioural and Social Sciences at the University of Groningen (PSY-2223-S-0459).

ORCID

Georgios Abakoumkin  <https://orcid.org/0000-0002-1671-3561>
 Eleftheria Tseliou  <https://orcid.org/0000-0002-9114-731X>
 Kira O. McCabe  <https://orcid.org/0000-0001-7716-6808>
 Maja Kutlaca  <https://orcid.org/0000-0002-0748-8104>
 Michelle R. VanDellen  <https://orcid.org/0000-0002-3457-194X>
 Nicholas R. Buttrick  <https://orcid.org/0000-0002-1165-8938>
 Hoon-Seok Choi  <https://orcid.org/0000-0001-8360-1888>
 Mioara Cristea  <https://orcid.org/0000-0002-2944-3791>
 Ivan Danyliuk  <https://orcid.org/0000-0002-6522-5994>
 Karen M. Douglas  <https://orcid.org/0000-0002-0381-6924>
 Bertus F. Jeronimus  <https://orcid.org/0000-0003-2826-4537>
 Winnifred R. Louis  <https://orcid.org/0000-0003-2996-982X>
 Manuel Moyano  <https://orcid.org/0000-0001-6745-0936>
 Hamdi Muluk  <https://orcid.org/0000-0002-9400-3055>
 Solomiia Myroniuk  <https://orcid.org/0000-0002-6374-7449>
 Jose Javier Olivás Osuna  <https://orcid.org/0000-0002-9877-8480>
 Gennaro Pica  <https://orcid.org/0000-0003-3739-7462>
 Michael Vicente Stanton  <https://orcid.org/0000-0002-8142-6569>

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Wong, M. C. S., Wong, E. L. Y., Huang, J., Cheung, A. W. L., Law, K., Chong, M. K. C., Ng, R. W. Y., Lai, C. K. C., Boon, S. S., Lau, J. T. F., Chen, Z., & Chan, P. K. S. (2021). Acceptance of the COVID-19 vaccine based on the health belief model: A population-based survey in Hong Kong. *Vaccine*, 39(7), 1148–1156. <https://doi.org/10.1016/j.vaccine.2020.12.083>

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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