Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Short communication

Mental associations with COVID-19 and how they relate with self-reported protective behaviors: A national survey in the United States

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ABSTRACT

Rationale: To understand novel diseases, patients may draw comparisons to other diseases.
Objective: We examined whether mentally associating specific diseases with COVID-19 was related to self-reported protective behaviors early in the pandemic.
Methods: In March 2020, a national sample of 6534 U.S. adults listed diseases that came to mind when thinking of COVID-19. They self-reported protective behaviors, demographics, and COVID-19 risk perceptions.
Results: Participants associated COVID-19 with common infectious diseases like seasonal influenza (59%), common cold (11%), and pneumonia (10%), or emergent infectious diseases like pandemic influenza (28%), SARS/MERS (27%), and Ebola (14%). Seasonal influenza was most commonly mentioned, in all demographic groups. Participants mentioning seasonal influenza or common cold reported fewer protective behaviors. Those mentioning pneumonia or emergent infectious diseases reported more protective behaviors. Mentioning pneumonia, SARS/MERS, and Ebola was associated with the most protective behaviors, after accounting for other generated diseases, demographics, and risk perceptions (e.g., for avoiding crowds, OR = 1.52, 95% CI = 1.26, 1.83; OR = 1.28, 95% CI = 1.13, 1.46; OR = 1.30, 95% CI = 1.11, 1.52, respectively).
Conclusions: Early in the pandemic, most participants mentally associated COVID-19 with seasonal flu, which may have undermined willingness to protect themselves. To motivate behavior change, COVID-19 risk communications may need to mention diseases that resonate with people while retaining accuracy.

1. Introduction

As COVID-19 spread across the world, people faced a novel health threat. To limit disease transmission, the U.S. Centers for Disease Control and Prevention started recommending protective behaviors such as hand hygiene and social distancing in March 2020 (New York Times, 2020), adding non-medical mask use in April 2020 (National Public Radio, 2020a). Mass adoption of these behaviors is especially important when pharmacological interventions are not yet available (Bruine de Bruin et al., 2006).

Drawing comparisons with familiar threats has been advocated as a tool for communicating about novel risks (Edwards, 2003). Such comparisons may include metaphors and analogies, which respectively identify specific features or relationships within a familiar domain that are like those in the novel domain (Gentner and Holyoak, 1997; Gentner and Markman, 1997). This process should allow recipients to draw new inferences and improve their mental model of the novel domain.

However, the use of comparisons in risk communication may backfire. For example, comparing smallpox to chickenpox can not only facilitate people's understanding of smallpox transmission but also promote the misunderstanding that smallpox is a disease that affects mostly children (Bostrom, 2008). Additionally, a 2003 analysis of UK newspapers found that SARS was described as similar to seasonal influenza and pneumonia, but mentioning seasonal influenza was associated with describing SARS as less severe (Wallis and Nerlich, 2005).

COVID-19 was also compared to seasonal influenza early on in the pandemic, perhaps to downplay the need for protective behaviors. For example, U.S. President Trump compared COVID-19 to seasonal influenza while arguing against business closures (National Public Radio, 2020b). The World Health Organization (2020) warned that, despite similarities in symptoms and transmission routes, COVID-19 had greater

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rates of severe disease and mortality than seasonal influenza, and no licensed vaccines or therapeutics.

Comparisons between COVID-19 and other diseases also appeared in the public discourse. Policymakers and health care providers in Israel and the UK used comparisons to pandemic influenza rather than to seasonal influenza (Atkinson et al., 2020; Gesser-Edelsburg and Hijazi, 2020). An analysis of Flemish newspaper articles published early in the pandemic found that COVID-19 was compared with pandemic influenza (Spanish flu, H1N1), SARS, MERS, and Ebola (De Ridder, 2020).

Early in novel outbreaks when uncertainty is greatest, which other diseases come to patients' minds could have implications for their willingness to implement protective behaviors. In an exploratory study, we therefore examined the following research questions:

(1) Which diseases do participants mentally associate with COVID-19?
(2) How are the diseases participants mention related to self-reported protective behaviors, even after taking into account demographics and risk perceptions?

2. Methods

2.1. Sample

Between March 10–31, 2020, 6534 of 8489 (77%) invited members of the University of Southern California's Understanding America Study (UAS) answered the questions analyzed here. The UAS is a panel of U.S. households who are regularly invited to participate in online surveys (https://uasdata.usc.edu/index.php). To obtain a nationally representative sample, UAS members were recruited from randomly selected U.S. addresses, invitations were written in English and Spanish, sampling probabilities were adjusted for underrepresented populations, and internet-connected tablets were provided to interested individuals if needed (Alattar et al., 2018). Following the survey literature (Valliant et al., 2013), post-stratification weights were used to further align our sample to the U.S. adult population regarding age, gender, race/-ethnicity, education, and location (https://uasdata.usc.edu/page/Weights).

Overall, 64% of participants were non-Hispanic white, 11% non-Hispanic African-American, 16% Hispanic/Latinx, 9% other minority. Mean age was 48.52 (SD = 16.58; Range = 18–101; Median = 47). Additionally, 48% were male, 35% had a college degree, and 22% lived in one of the states that were worst hit at the time, including Massachusetts, New Jersey, New York, and Washington. Median income was $50,000-$59,999 (16% were below the Federal Poverty Level for their state and household size, according to the U.S. Department of Health and Human Services, 2020). By comparison, the U.S. Census Bureau (2018) finds that the U.S. population is 63% non-Hispanic white, 13% non-Hispanic African-American, 18% Hispanic/Latinx, 63% non-Hispanic white, 6% other minority, 16% aged 65 or older, 49% male, 32% college-educated (if aged 25^{+}), 25% living in the worst-hit states (Massachusetts, New Jersey, New York and Washington), with median income being $60,293.

There were no significant differences between invitees who completed the questions analyzed here and those who did not, in terms of percent male, non-Hispanic non-black minority, and living in worst-hit states (all $p > 0.10$). However, those who completed the survey included significantly more participants who were white (64% vs. 45%), χ^2 (2) = 55.95, $p < 0.001$, aged 65 or older (20% vs. 13%), χ^2 (2) = 10.66, $p < 0.01$, and with a college degree (34% vs. 25%), χ^2 (2) = 15.26, $p < 0.01$, as well as fewer African-Americans (11% vs. 22%), χ^2 (2) = 39.19, $p < 0.001$, Hispanic/Latinx (16% vs. 24%), χ^2 (2) = 13.88, $p < 0.01$, and individuals living in poverty (16% vs. 25%), χ^2 (2) = 142.29, $p < 0.001$.

2.2. Procedure

The online survey was approved by U.S.C's Institutional Review Board. Survey and data are publicly available (https://uasdata.usc.edu/index.php; #230). The survey was available in English and Spanish, but 99% of participants selected English. The survey questions presented below were used in our analyses. In order, participants completed the questions that asked about risk perceptions, protective behaviors, and diseases mentally associated with COVID-19.

Mental associations. Participants were asked "When you think of the coronavirus (COVID-19), what other diseases come to mind?" followed by three text boxes. Using an inductive data-driven coding procedure, participants' open-ended responses were categorized as (1) seasonal, regular, common, or unspecified flu or influenza, influenza A or B; (2) cold or common cold, (3) pneumonia, (4) pandemic, Spanish, 1918/19, Hong Kong, Asian, H1N1, H5N1, avian, bird, swine flu or influenza, (5) Severe Acute Respiratory Syndrome (SARS) or Middle-East Respiratory Syndrome (MERS), or (6) Ebola. Codes were applied by a coder who was blind to our research questions, and reliability coding was conducted through an automated algorithm. Cohen's Kappa was $\geq$.95 for each code.

Protective behaviors. Participants were asked: "Which of the following have you done in the last seven days to keep yourself safe from coronavirus in addition to what you normally do?" They indicated yes/no for the following recommended behaviors by the Centers for Disease Control and Prevention (New York Times, 2020): (1) "washed hands with soap or used hand sanitizer several times per day," (2) "avoided public spaces, gatherings, or crowds," (3) "avoided contact with people who could be high-risk", and (4) "canceled or postponed air travel for work" and "canceled or postponed air travel for pleasure", for which responses were combined. Non-medical mask use was not included because it was not recommended by the Centers for Disease Control and Prevention until April 2020 (National Public Radio, 2020a).

Risk perceptions. Participants answered "On a scale from 0 to 100%, what is the chance that you will get the coronavirus in the next three months?" and "If you do get infected with the coronavirus, what is the chance you will die from it?" on a validated visual linear scale ranging from 0% to 100% (Bruine de Bruin and Carman, 2018).

Demographics. Demographic information was already on record, including at-risk age over 65 (yes = 1; no = 0), male gender (yes = 1; no = 0), race/ethnicity (non-Hispanic white, non-Hispanic African-American, Hispanic/Latinx or other minority; yes = 1; no = 0 for each), college degree (yes = 1; no = 0), household income below the US Department of Health and Human Services' (2020) federal poverty level (yes = 1; no = 0 for each), and residing in a state that was worst hit at the time, including Massachusetts, New Jersey, New York, and Washington (yes = 1; no = 0 for each). The date on which participants completed the survey was treated as a dichotomized variable (March 10–12 2020 = 0; March 13–31 2020 = 1) because half completed the survey before March 13 (Bruine de Bruin and Bennett, 2020), when the White House issued a national emergency, the European travel ban went into effect, and several states announced school closures and bans of large gatherings (White House 2020a, 2020b; Yeung et al., 2020).

2.3. Analyses

All analyses were conducted in SPSS Version 26 and used post-stratification weights. To examine which diseases participants mentally associated with COVID-19 (research question 1), we computed the percentage of participants who mentioned each disease, overall and by demographic group (Table 1), with chi-square tests (Table 1) and logistic regressions (Table 2) examining demographic differences in generating specific diseases. Phi correlations examined which diseases tended to be mentioned together (Table 3). To examine how the diseases participants mentioned related to self-reported protective behaviors (research question 2), we computed the percent of participants engaging

Table 1
Percent of participants mentioning specific diseases when thinking of COVID-19 and mean risk perception, by demographic group.

	Seasonal influenza	Common cold	Pneumonia	Pandemic influenza	SARS or MERS	Ebola
All participants ($N = 6534$)	59%	11%	10%	28%	27%	14%
Race/ethnicity						
White ($N = 4170$)	61%**	12%**	10%	30%	29%	12%
African-American ($N = 741$)	59%	10%	12%*	19%	14%	16%
Hispanic/Latinx ($N = 1059$)	57%	9%	8%	27%	21%	19%***
Other minority ($N = 564$)	53%	7%	10%	31%***	40%***	14%
At-risk age group (≥65 years)						
Yes ($N = 1317$)	59%	11%	10%	24%	23%	15%
No ($N = 5217$)	59%	10%	10%	29%***	28%***	13%
Gender						
Male ($N = 3155$)	59%	12%*	9%	32%***	32%***	14%
Female ($N = 3379$)	60%	10%	10%	25%	22%	14%
College degree						
Yes ($N = 2249$)	61%*	11%	11%*	35%***	42%***	15%
No ($N = 4285$)	58%	10%	9%	25%	19%	13%
Below-FPL income[a]						
Yes ($N = 1010$)	51%	11%	8%	17%	11%	15%
No ($N = 5524$)	61%***	11%	10%*	30%***	30%***	13%
Live in worst-hit state[b]						
Yes ($N = 1447$)	55%	10%	7%	29%	36%***	14%
No ($N = 5087$)	60%***	11%	10%***	28%	24%	14%
Survey completed after March 13, 2020						
Yes ($N = 3231$)	58%	11%	9%	31%***	26%	13%
No ($N = 3303$)	61%**	10%	10%	26%	27%	14%

***p < 0.001; **p < 0.01; *p < 0.05.
Note: Chi-Square tests were used to examine demographic differences, and the highest percentage is flagged when significant.
[a] FPL=Federal Poverty level (U.S. Department of Health and Human Services, 2020).
[b] Worst-hit states in March 2020 included Massachusetts, New Jersey, New York, and Washington.

Table 2
Odds ratios (95% Confidence Intervals) for logistic regressions predicting whether or not participants mentioned specific diseases when thinking of COVID-19.

	Model 1: Seasonal influenza	Model 2: Common cold	Model 3: Pneumonia	Model 4: Pandemic influenza	Model 5: SARS or MERS	Model 6: Ebola
African-American (vs. white)	1.04	0.84	1.38**	0.60***	0.53***	1.49**
	(0.88, 1.22)	(0.64, 1.10)	(1.07, 1.78)	(0.49, 0.74)	(0.42, 0.66)	(1.19, 1.86)
Hispanic/Latinx (vs. white)	0.94	0.78*	0.89	0.86	0.68***	1.85***
	(0.81, 1.08)	(0.61, 0.99)	(0.69, 1.14)	(0.74, 1.01)	(0.57, 0.80)	(1.53, 2.23)
Other minority (vs. white)	0.75**	0.63**	1.06	0.95	1.28*	1.21
	(0.62, .89)	(0.44, 0.88)	(0.78, 1.44)	(0.78, 1.16)	(1.05, 1.55)	(0.94, 1.58)
At-risk age group (vs. younger)	0.93	1.05	1.02	0.67***	0.64***	1.23*
	(0.82, 1.06)	(0.86, 1.28)	(0.82, 1.25)	(0.58, 0.77)	(0.55, 0.74)	(1.03, 1.47)
Male (vs. not)	0.95	1.20*	0.86	1.35***	1.54***	1.06
	(0.86, 1.05)	(1.03, 1.42)	(0.73, 1.02)	(1.21, 1.51)	(1.37, 1.73)	(0.92, 1.23)
College degree (vs. not)	1.09	1.06	1.23*	1.39***	2.53***	1.17*
	(0.98, 1.22)	(0.89, 1.26)	(1.03, 1.47)	(1.24, 1.56)	(2.25, 2.85)	(1.00, 1.37)
Below-FPL income (vs. not)	0.67***	1.14	0.72*	0.57***	0.45***	1.10
	(0.58, .078)	(0.90, 1.43)	(0.55, .94)	(0.48, 0.69)	(0.37, 0.57)	(0.90, 1.35)
Live in worst-hit states (vs. not)	0.81**	0.90	0.63***	1.02	1.73***	1.00
	(0.72, 0.95)	(0.74, 1.11)	(0.50, .79)	(0.89, 1.16)	(1.52, 1.98)	(0.84, 1.18)
Surveyed after March 13, 2020 (vs. earlier)	0.86**	1.06	0.90	1.27***	0.98	0.95
	(0.78, 0.95)	(0.91, 1.24)	(0.76, 1.06)	(1.14, 1.42)	(0.87, 1.10)	(0.83, 1.10)
χ^2 test of model	69.12***	21.77**	40.75***	222.82***	681.62***	49.75***
Nagelkerke R^2	0.01	0.01	0.01	0.05	0.14	0.01

***p < 0.001; **p < 0.01; *p < 0.05.
a FPL=Federal Poverty level (U.S. Department of Health and Human Services, 2020).
b Worst-hit states in March 2020 included Massachusetts, New Jersey, New York, and Washington.

in each behavior and mean risk perceptions, by whether or not each specific disease was generated (Table 4). We conducted logistic regressions that predicted each protective behavior from whether or not each specific disease was mentioned, while accounting for demographic variables and risk perceptions (Table 5). To further understand the role of risk perceptions, we conducted linear regressions that predicted risk perceptions from whether or not each specific disease was mentioned, while accounting for demographic variables (Table 6). We also examined whether main conclusions held when considering only the first disease participants generated (Online Supplement).

3. Results

3.1. Mental associations

In response to the open-ended question about which diseases come to mind when thinking of COVID-19, participants generated common infectious diseases such as seasonal influenza (59%), common cold (11%), and pneumonia (10%), as well as emergent infectious diseases such as pandemic influenza (28%), SARS or MERS (27%), and Ebola (14%) (Table 1). Overall, 86% of participants mentioned at least one of these diseases.

Table 3
Correlations between mentions of specific diseases.

	Common infectious diseases			Emergent infectious diseases		
Analogy	Seasonal influenza	Common cold	Pneumonia	Pandemic Influenza	SARS/MERS	Ebola
			Common infectious diseases			
Seasonal influenza	–					
Common cold	0.23***	–				
Pneumonia	0.14***	0.09***	–			
			Emergent infectious diseases			
Pandemic influenza	−0.30***	−0.12***	−0.14***	–		
SARS/MERS	−0.12***	−0.12***	−0.10***	0.16***	–	
Ebola	−0.12***	−0.11***	−0.09***	0.09***	0.11***	–

***p < 0.001.
**p < 0.01.
*p < 0.05. Pearson correlations (r) between dichotomous variables represent phi correlations.

Table 4
Percent of participants reporting protective behaviors and mean COVID-19 risk perceptions by disease mentioned (vs. not).

	Common infectious diseases						Emergent infectious diseases					
	Seasonal influenza		Common cold		Pneumonia		Pandemic influenza		SARS/MERS		Ebola	
Mentioned	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
						Percent reporting protective behaviors						
Washed hands	90%	89%	87%	90%*	93%**	89%	91%	89%	92%***	89%	90%	89%
Avoided crowds	55%	59%**	51%	57%**	62%**	56%	59%*	56%	62%***	55%	63%***	56%
Avoided high-risk individuals	57%	60%**	55%	58%	62%*	58%	60%*	57%	61%*	55%	63%**	57%
Canceled travel	34%	39%***	30%	37%***	38%	36%	37%	36%	39%**	35%	42%***	35%
						Mean (SD) COVID-19 risk perceptions						
Getting infected	20.57	22.46**	21.22	21.35	22.07	21.26	24.49***	20.09	25.64***	19.68	22.34	21.18
	(22.33)	(23.74)	(21.83)	(23.06)	(22.63)	(22.91)	(23.43)	(22.62)	(24.01)	(22.29)	(23.47)	(22.85)
Dying if infected	13.49	17.73***	11.75	15.62***	16.71	15.06	13.37	15.94***	11.35	16.53***	14.89	15.27
	(21.12)	(24.18)	(20.98)	(22.65)	(23.85)	(22.36)	(20.88)	(23.09)	(19.00)	(23.40)	(21.64)	(22.65)

***p < 0.001; **p < 0.01; *p < 0.05. χ2 tests were used to compare percentages. T-tests were used to compare means. Where significant differences emerged, the higher number was flagged.

In each demographic group, seasonal influenza was the most commonly mentioned disease, with pandemic influenza and SARS/MERS completing the top three (Table 1). Race/ethnicity was the only demographic variable that showed a significant difference in mentioning each disease (Table 1), which remained significant after accounting for other demographic variables (Table 2). Specifically, relatively more non-Hispanic white participants mentioned seasonal influenza and the common cold, relatively more non-Hispanic African-Americans mentioned pneumonia, relatively more Hispanic/Latinx participants mentioned Ebola, and relatively more participants from other minorities mentioned SARS/MERS (Table 1).

Correlations among mentions of specific diseases were small to moderate (Table 3). Common infectious diseases were more likely to be mentioned with other common infectious diseases, and less likely to be mentioned with emergent infectious diseases. Similarly, emergent infectious diseases were more likely to be mentioned with other emergent infectious diseases, and less likely to be mentioned with common infectious diseases.

3.2. Relationships with protective behaviors

Across participants, 90% indicated washing hands, 57% avoiding public spaces or crowds, 58% avoiding high-risk individuals, and 37% canceling or postponing travel. With few exceptions, mentioning (vs not mentioning) seasonal influenza or the common cold tended to be associated with lower likelihood of reporting protective behaviors, while mentioning (vs. not mentioning) pneumonia or emergent infectious diseases (pandemic influenza, SARS/MERS, and Ebola) tended to be associated with greater likelihood of reporting protective behaviors (Table 4).

When considering the independent contributions of mentioning specific diseases while also accounting for demographics and risk perceptions, we found that mentioning the common cold was associated with lower likelihood of reporting two of the four protective behaviors (Table 5). Additionally, mentions of pneumonia, SARS/MERS, and Ebola were associated with greater likelihood of reporting three of the four protective behaviors (Table 5). When only considering diseases that were mentioned first, mentioning pneumonia predicted greater likelihood of implementing all protective behaviors, SARS/MERS two, and Ebola one (Online Supplement, Table S4).

Subsequent analyses suggested why controlling for COVID-19 risk perceptions had little to no effect on relationships between diseases participants mentioned and their self-reported protective behaviors. Although COVID-19 risk perceptions have been positively associated with protective behaviors (Bruine de Bruin and Bennett, 2020), they showed only limited variation with the diseases participants mentioned (Table 4). First, we examined associations of mentioning specific diseases with perceived risk of getting infected with COVID-19. Mentioning (vs. not mentioning) seasonal influenza was associated with perceiving slightly lower risk of getting infected, while mentioning (vs. not mentioning) pandemic influenza or SARS/MERS was associated with perceiving slightly greater risk of getting infected (Table 4). In linear regressions accounting for other diseases mentioned and for demographics, the positive relationship of pneumonia, pandemic influenza, and SARS/MERS with perceived risk of getting infected held (Table 6, Model 1). When considering diseases that were mentioned first, only SARS/MERS was associated with risk perceptions of getting infected with COVID-19 (Table S5, Model 1). Second, we examined associations of mentioning specific diseases with perceived risk of dying if getting infected with COVID-19 Mentioning (vs. not mentioning)

Table 5
Odds ratios (95% Confidence Intervals) for logistic regressions predicting protective behaviors.

	Model 1: Washed hands	Model 2: Avoided crowds	Model 3: Avoided high-risk individuals	Model 4: Canceled travel
Common infectious diseases				
Seasonal influenza	1.13	1.02	0.96	0.89
	(0.94, 1.35)	(0.90, 1.14)	(0.86, 1.08)	(0.79, 1.00)
Common cold	0.81	0.81*	0.94	0.77**
	(0.63, 1.05)	(0.68, 0.97)	(0.79, 1.12)	(0.63, .93)
Pneumonia	1.82***	1.52***	1.38**	1.18
	(1.30, 2.54)	(1.26, 1.83)	(1.15, 1.65)	(0.98, 1.42)
Emergent infectious diseases				
Pandemic influenza	1.15	1.02	1.08	0.94
	(0.94, 1.40)	(0.89, 1.15)	(0.95, 1.22)	(0.83, 1.07)
SARS/MERS	1.37**	1.28***	1.14*	1.05
	(1.11, 1.70)	(1.13, 1.46)	(1.00, 1.29)	(0.92, 1.20)
Ebola	0.97	1.30**	1.23*	1.24**
	(0.76, 1.25)	(1.11, 1.52)	(1.05, 1.43)	(1.06, 1.45)
Risk perceptions (divided by 10)				
Getting infected	1.19***	1.10***	1.08***	1.04***
	(1.13, 1.24)	(1.07, 1.13)	(1.05, 1.10)	(1.04, 1.10)
Dying if infected	0.99	1.08***	1.03**	1.05***
	(0.95, 1.03)	(1.06, 1.11)	(1.01, 1.06)	(1.02, 1.08)
Demographics				
African-American (vs. white)	1.97***	1.30**	1.56***	1.94***
	(1.46, 2.65)	(1.09, 1.55)	(1.31, 1.86)	(1.63, 2.31)
Hispanic/Latinx (vs. white)	2.16***	1.82***	1.56***	1.82***
	(1.63, 2.86)	(1.56, 2.13)	(1.34, 1.82)	(1.57, 2.12)
Other minority (vs. white)	1.24	1.95***	1.89***	2.01***
	(0.90, 1.70)	(1.59, 2.38)	(1.55, 2.31)	(1.66, 2.44)
At-risk age group (vs. younger)	1.20	1.21**	1.11	0.96
	(0.98, 1.48)	(1.05, 1.39)	(0.97, 1.27)	(0.83, 1.10)
Male (vs. not)	0.51	0.84**	0.83***	0.92
	(0.43, .61)	(0.75, 0.93)	(0.74, 0.92)	(0.83, 1.03)
College degree (vs. not)	1.34**	1.38***	1.05	1.73***
	(1.11, 1.63)	(1.22, 1.56)	(0.93, 1.18)	(1.53, 1.95)
Below-FPL income[a] (vs. not)	0.73**	1.28**	1.32**	1.36***
	(0.58, 0.91)	(1.09, 1.50)	(1.13, 1.54)	(1.16, 1.59)
Live in worst-hit states[b] (vs. not)	1.35**	1.13	1.15*	1.30***
	(1.09, 1.67)	(0.99, 1.28)	(1.01, 1.30)	(1.14, 1.48)
Surveyed after March 13, 2020 (vs. earlier)	2.10***	3.39***	2.85***	3.05***
	(1.76, 2.50)	(3.04, 3.77)	(2.56, 3.16)	(2.73, 3.41)
χ^2 test of model	335.97***	917.24***	644.25***	805.52***
Nagelkerke R^2	0.10	0.18	0.13	0.16

***p < 0.001; **p < 0.01; *p < 0.05.

[a] FPL=Federal Poverty level (U.S. Department of Health and Human Services, 2020).

[b] Worst-hit states in March 2020 included Massachusetts, New Jersey, New York, and Washington.

Table 6
Linear regressions predicting COVID-19 risk perceptions.

Diseases mentioned	Model 1: Perceived risk of getting infected	Model 2: Perceived risk of dying if infected
Common infectious diseases		
Seasonal influenza	−1.02	−4.47***
	(0.61)	(0.59)
Common cold	1.12	−3.50**
	(0.93)	(0.91)
Pneumonia	2.27*	2.39*
	(0.96)	(0.93)
Emergent infectious diseases		
Pandemic influenza	2.29**	−1.97**
	(0.66)	(0.63)
SARS/MERS	4.03***	−3.09***
	(0.68)	(0.66)
Ebola	0.72	−0.78
	(0.82)	(0.80)
Demographics		
African-American (vs. white)	−5.71***	1.61
	(0.92)	(0.89)
Hispanic/Latinx (vs. white)	−1.82*	−0.06
	(0.80)	(0.77)
Other minority (vs. white)	0.28	0.90
	(1.02)	(0.99)
At-risk age group (vs. younger)	−4.18***	10.37***
	(0.71)	(0.69)
Male (vs. not)	0.37	−1.31*
	(0.57)	(0.55)
College degree (vs. not)	3.50***	−5.54***
	(0.62)	(0.61)
Below-FPL income[a] (vs. not)	−0.17	3.82***
	(0.82)	(0.79)
Live in worst-hit states[b] (vs. not)	0.43	0.61
	(0.68)	(0.66)
Surveyed after March 13, 2020 (vs. earlier)	6.71***	0.41
	(0.56)	(0.54)
χ^2 test of model	F (15, 6518) = 26.72***	F (15, 6518) = 37.31***
R^2	0.06	0.08

Note: ***p < 0.001; **p < 0.01; *p < 0.05. .

[a] FPL=Federal Poverty level (U.S. Department of Health and Human Services, 2020).

[b] Worst-hit states in March 2020 included Massachusetts, New Jersey, New York, and Washington.

seasonal influenza, common cold, pandemic influenza, and SARS/MERS were associated with perceiving slightly lower risk of dying if infected (Table 4). In linear regressions accounting for other diseases mentioned and for demographics, all of these relationships held, while pneumonia became associated with perceiving slightly greater risk of dying if infected (Table 6, Model 2). When only considering diseases mentioned first, mentioning any of the diseases was associated with lower risk perception of dying if infected – with the exception of pneumonia (Table S5, Model 2).

4. Discussion

When faced with a novel disease such as COVID-19, people may try to draw comparisons to various other diseases (Atkinson et al., 2020; Gesser-Edelsburg and Hijazi, 2020; De Ridder, 2020). Such comparisons could have implications for their motivations to implement protective behaviors (Edwards, 2003). In a nationally representative U.S. sample, we therefore examined which diseases came to mind when thinking of COVID-19, and relationships with reported protective behaviors. Participants mentioned common infectious diseases such as seasonal influenza, common cold, and pneumonia as well as emergent infectious diseases such as pandemic influenza, SARS/MERS, and Ebola. Across demographic groups, seasonal influenza was mentioned by far the most. Additionally, common infectious diseases tended to be mentioned together, as were emergent infectious diseases.

Generally, mentioning common infectious diseases like seasonal flu and the common cold was associated with lower likelihood of reporting protective behaviors, and mentioning pneumonia or emergent infectious diseases was associated with greater likelihood of reporting protective behaviors. Independent of which other diseases were mentioned, pneumonia, SARS/MERS, and Ebola were the diseases that were associated with the most (three of four) reported protective behaviors. When only considering the diseases that were listed first, mentioning pneumonia remained the best predictor of reported protective behaviors. These relationships held after controlling for demographic variables and risk perceptions for COVID-19 infection and dying if infected. Instead, other perceptions of pneumonia, SARS/MERS, and Ebola may have motivated protective behaviors, including their transmission routes, symptoms, or disease severity.

4.1. Limitations

Like any study, the present study has limitations. One main limitation is that our exploratory study was cross-sectional and does not

warrant causal conclusions. To examine causal effects on protective behaviors, confirmatory research is needed in which participants are randomly assigned to COVID-19 risk communications that mention different diseases. Additionally, our study focused on a U.S. sample, and the diseases that people generate when thinking of COVID-19 may vary between countries, cultures, and languages. Mask use was not included as a protective behavior, because the CDC did not yet recommend mask use in March 2020 (National Public Radio, 2020a). We did not use a holistic assessment of COVID-19 risk perception, which may have been better at capturing experiential and cultural factors (Dryhurst et al., 2020). We also did not assess participants' full mental models of COVID-19 and other infectious diseases, leaving it for future research to examine why participants mentioned diseases such as pneumonia, SARS/MERS, and Ebola, or how associating these diseases with COVID-19 associating these diseases with COVID-19 motivated participants to engage in protective behaviors.

5. Conclusions

COVID-19 risk communications that aim to promote protective behaviors may be more effective if they avoid drawing comparisons to seasonal influenza or common cold, and instead mention pneumonia, SARS/MERS, or Ebola. Because symptoms of COVID-19 are more similar to those for pneumonia and SARS/MERS than to Ebola, those may be the more appropriate diseases to mention.

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Author statement

All authors designed the study and devised the analysis plan. Bruine de Bruin and Carman verified and analyzed the data. Bruine de Bruin wrote the first draft. All authors helped to revise the first draft. Bruine de Bruin reports consulting income from the UK's Behavioural Insights Team and Save The Children.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2021.113825.

References

Alattar, L., Messel, M., Rogofsky, C., 2018. An introduction to the Understanding American Study internet panel. Soc. Secur. Bull. 78, 13–28. https://heinonline.org/HOL/Page?handle=hein.journals/ssbul78&div=11.

Atkinson, P., Gobat, N., Lant, S., Mableson, H., Pilbeam, C., Solomon, T., Tonkin-Crine, S., Sheard, S., 2020. Understanding the policy dynamics of COVID-19 in the UK: early findings from interviews with policy makers and health care professionals. Soc. Sci. Med. 266, 113423. https://doi.org/10.1016/j.socscimed.2020.113423.

Bostrom, A., 2008. Lead is like mercury: risk comparisons, analogies, and mental models. J. Risk Res. 11, 1–2. https://www.tandfonline.com/doi/full/10.1080/13669870701602956.

Bruine de Bruin, W., Bennett, D., 2020. Relationships between initial risk perceptions about the novel coronavirus and self-reported protective behaviors: evidence from a national Survey. Am J Pub Med 59, 157–167. https://www.sciencedirect.com/science/article/pii/S0749379720302130.

Bruine de Bruin, W., Carman, K.G., 2018. Measuring subjective probabilities: the effect of response mode on the use of focal responses, validity, and respondents' evaluations. Risk Anal. 38, 2128–2143. https://doi.org/10.1111/risa.13138.

Bruine de Bruin, W., Fischhoff, B., Brilliant, L., Caruso, D., 2006. Expert judgments of pandemic influenza risks. Global Publ. Health 1, 178–193. https://doi.org/10.1080/17441690600673940.

De Ridder, B., 2020. When the analogy breaks: historical references in the Flemish news media at the onset of the COVID-19 pandemic. Appl. Hist. 2, 1–16. https://doi.org/10.1163/25895893-bja10003.

Dryhurst, S., Schneider, C.R., Kerr, J., Freeman, A.L.J., Recchia, G., van der Bles, A.M., Spiegelhalter, D., van der Linden, S., 2020. Risk perceptions of COVID-19 around the world. J. Risk Res. 7–8, 994–1006. https://doi.org/10.1080/13669877.2020.1758193.

Edwards, A., 2003. Communicating risks through analogies. BMJ 749. https://doi.org/10.1136/bmj.327.7417.749.

Gentner, D., Holyoak, K.J., 1997. Reasoning and learning by analogy: introduction. Am. Psychol. 52, 32–34. https://psycnet.apa.org/doi/10.1037/0003-066X.52.1.32.

Gentner, D., Markman, A., 1997. Structure mapping in analogy and similarity. Am. Psychol. 52, 45–56. https://psycnet.apa.org/doi/10.1037/0003-066X.52.1.45.

Gesser-Edelsburg, A., Hijazi, R., 2020. When politics meets pandemic: how prime minister netanyahu and a small Team communicated health and risk information to the Israeli public during the early stages of COVID-19. Risk Manag. Healthc. Pol. 13, 2985–3002. https://doi.org/10.2147/FRMHP.S280952.

National Public Radio, 2020a. CDC Now Recommends Americans Consider Wearing Cloth Face Coverings Om Public. Published: April 3, 2020. Accessed: January 31, 2021. https://www.npr.org/sections/coronavirus-live-updates/2020/04/03/826219824/president-trump-says-cdc-now-recommends-americans-wear-cloth-masks-in-public.

National Public Radio, 2020b. FACT CHECK: Trump Compares Coronavirus to the Flu, but it Could Be 10 Times Deadlier. Published: March 24, 2020. Accessed: January 31, 2021. https://www.npr.org/sections/coronavirus-live-updates/2020/03/24/820797301/fact-check-trump-compares-coronavirus-to-the-flu-but-they-are-not-the-same.

New York Times, 2020. Wondering about Social Distancing? Published: March 16, 2020. Accessed: January 31, 2021. https://www.nytimes.com/2020/03/16/smarter-living/coronavirus-social-distancing.html.

US Census Bureau, 2018. QuickFacts United States. Population Estimates, July 1, 2019. Accessed January 31, 2021. https://www.census.gov/quickfacts/fact/table/US/PST045218.

US Department of Health and Human Services, 2020. 2020 Poverty Guidelines. Published: January 21, 2020. Accessed: January 31, 2021. https://aspe.hhs.gov/2020-poverty-guidelines.

Valliant, R., Dever, J.A., Kreuter, F., 2013. Practical Tools for Designing and Weighting Survey Samples. Springer, New York.

Wallis, P., Nerlich, B., 2005. Disease metaphors in new epidemics: the UK media framing of the 2003 SARS epidemic. Soc. Sci. Med. 60 (11), 2629–2639. https://doi.org/10.1016/j.socscimed.2004.11.031.

White, House, 2020a. Proclamation on Declaring a National Emergency Concerning the Novel Coronavirus Disease (COVID-19) Outbreak. Published: March 13, 2020. Accessed January 31, 2021. https://trumpwhitehouse.archives.gov/presidential-actions/proclamation-declaring-national-emergency-concerning-novel-coronavirus-disease-covid-19-outbreak/.

White, House, 2020b. Proclamation—Suspension of Entry as Immigrants and Nonimmigrants of Certain Additional Persons Who Pose a Risk of Transmitting 2019 Novel Coronavirus. Published: March 11, 2020. Accessed: January 31, 2021. https://trumpwhitehouse.archives.gov/presidential-actions/proclamation-suspension-entry-immigrants-nonimmigrants-certain-additional-persons-pose-risk-transmitting-2019-novel-coronavirus/.

World Health Organization, 2020. Influenza and COVID-19 – Similarities and Differences. Accessed June 12, 2020. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/q-a-similarities-and-differences-covid-19-and-influenza?gclid=Cj0KCQjwz4z3BRCgARIsAES_OVczmkLylNb_27_q8_IdYuxMbDiXyLwUsKIVbn_gpYZQZqb3xvVMWakaAiBHEALw_wcB.

Yeung, J., Berlinger, J., Renton, A., Wagner, M., Hayes, M., Rocha, V.. CNN March 13 coronavirus news. Published: March 13, 2020. Accessed: January 31, 2021. https://www.cnn.com/world/live-news/coronavirus-outbreak-03-13-20-intl-hnk/h_b598bc1fba2dc834b255c7c58a3f8c84.