Research article

Rapid discovery of optimal messages for behavioral intervention: the case of Hungary and Covid-19

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A B S T R A C T

The right messaging plays an important role in the fight against the spread of COVID-19. The present study aims at uncovering the way people think about governmental measures against COVID-19. Two hundred and sixteen Hungarians participated in this on-line study. A conjoint-based experimental design was used to reveal the power of messages as drivers of voluntary social distancing based on the perceived risk of COVID-19, the ways to practice social distancing and to assure it, and preferences regarding the communicator of the social distancing policy. Results revealed three major mindsets: Pandemic observers, Order-followers, and Health-conscious. Members of each mindset respond differently to messages. To enhance compliance with social distancing and contain the virus, we suggest using the prediction tool we developed to identify the belonging of people or groups in the population to mindsets in the sample and address people using effective mindset-tailored messaging.

1. Introduction

Evidence points to the effectiveness of social distancing as the most visible public health intervention in halting the COVID-19 pandemic [1, 2]. Social distancing refers to people maintaining a physical distance from others and limiting their social interactions beyond their immediate household members [3]. Social distancing encompasses stay-at-home orders, school closures and distance learning; limited sport and music activities; closure of restaurants and places of entertainment, and restrictions on social gatherings [4, 5, 6, 7, 8]. Studies found that reducing social interactions of confirmed cases for two weeks steadily reduced the rate of infection by 37% [1]. In the absence of a vaccine, social distancing is the primary intervention to reduce the transmission of COVID-19 [9]. While mandatory stay-at-home restrictions explained half of the decline in foot traffic, self-regulation explained more than three-quarters of the decline in foot traffic [6]. Public health authorities across countries, therefore, expect the public to voluntarily practice social distancing [10].

1.1. Compliance with social distancing

Cellular mobility data, however, show that despite expectations, rates of compliance with social distancing greatly vary within and across countries [11]. Recent studies found that compliance is higher among conservatives [11, 12, 13]; groups with higher income [9]; people with higher physical fitness; people with a greater perceived risk of the virus [14, 15, 16, 17]; people with higher values of social responsibility, social trust, and lower self-interest [17]; and people with higher moral obligation [18]. Since the COVID-19 pandemic continues to spread, the importance of social distancing is unlikely to change until effective treatments and vaccines become widely available [3, 19]. Cellular mobile data revealed that as soon as COVID-19 cases were observed, voluntary compliance improved, but two weeks later, the improvement stopped despite the rise in COVID-19 cases [20]. Politicization of COVID-19 may prompt people to discount mainstream media reports regarding the severity of the virus, downplay its risks, and reduce compliance with social distancing [13]. The infection rate and the extent of the implementation of social distancing shape compliance across communities [21].

1.2. Drivers of social distancing

A recent research on drivers of voluntary compliance with social distancing found that social distancing greatly varies by partisanship, media consumption, and racial and ethnic composition [15]. Another study found that a 10% increase in cable viewership led to a 1.3% reduction in compliance with social distancing [22]. In addition, the type and extent of information regarding social distancing shaped situational awareness, which promoted compliance [23]. Furthermore, conflicting messages from health leaders and politicians about the severity of the pandemic reduced voluntary compliance with social distancing [14]. These studies highlight the importance of communication messaging in promoting compliance [15]. Understanding how communication about social distancing affects voluntary compliance with social distancing will enable health authorities to develop and use communication that may enhance voluntary compliance with social distancing long term [24]. To optimize voluntary long-term social distancing, researchers recommend using clear messaging crafted to affect behavior both at the local and national level [15, 25].

The systematic identification of the content and the specific language of messages to promote compliance with social distancing is essential for health policy makers and health authorities, especially because messaging is an inexpensive behavioral intervention [18]. Studies testing the effectiveness of communication messaging on compliance with voluntary social distancing are scant [3]. Messages that highlight the individual's obligation to others and the moral imperative of protecting the most vulnerable are expected to enhance compliance with social distancing in one's environment (e.g., workplaces and grocery stores) [18]. Thus, social distancing changes the way we live, how we interact, how we source our needs, how we look after ourselves and others, and is necessary to contain the virus [26]. Physical distancing continues to be a major strategy to reduce the spread of the virus but the compliance with social distancing is low and varies [14, 16, 27]. While communication was proven to make a difference in compliance, studies on specific messages that may drive compliance are scant [28, 29, 30]. This study responds to previous calls to systematically identify specific messages to affect willingness to comply with social distancing [15, 18, 25]. This study sought to close this gap in the literature and identify specific messages that may drive voluntary compliance with social distancing. This study employed narrative persuasion communication theory to identify messages that drive willingness to comply with social distancing.

1.3. The theoretical anchor and hypotheses development

Much of the health communication literature has been written within the structure of the narrative paradigm [31]. A narrative comprises cohesive and coherent statements which constitute a story with an identifiable beginning, middle, and end. The narrative story provides information about an ordinary, daily phenomenon and conveys a specific point to another party [32, 33]. A narrative is a "*representation of connected events and characters that has an identifiable structure, is bounded in space and time, and contains implicit or explicit messages about the topic being addressed*" [34]. N Since narrative messaging was found to modify public both attitudes towards health policies and public behaviors, narrative messaging may modify public behaviors of social distancing [35, 36, 37]. .

Narrative messages may touch upon the individual's perception of being at risk and impact one's willingness to comply with social distancing contingent on one's perceived risk of the virus; the perceived benefits of social distancing [14, 17, 38, 39]; and one's trust in the agent communicating the social distancing policy [40, 41, 42]. Some of the narrative messages regarding social distancing may exert a strong effect on willingness to comply while other messages may have a weaker effect [32].

Hypothesis 1. *The effect of narrative messages on willingness to comply with social distancing will differ according to the agent communicating the*

message, the perceived risk of the infection, the perceived benefits of social distancing practices, and the environment.

Since narrative persuasion is interpretive, it explores the impact of each communication message asking for whom; under what circumstances; how; and which messages achieve an optimum effect of willingness to comply. The ability of narrative messages to influence willingness to comply with social distancing may depend, in part, on the extent to which people identify with the different messages [43, 44]. Therefore, different communication messaging may carry a different appeal to different groups of people, who show a similar pattern of response to specific narrative persuasion messages regarding social distancing. These emergent dispositions, revealed by the similarity in patterns of responses to a set of narrative messages, are so-called 'mindsets.' Individuals who differ from each other in many ways may share a pattern of responses to specific messaging, with defined granular communication regarding social distancing and may, therefore, belong to the same mindset.

Hypothesis 2. The similarity in patterns of response to different narrative messages regarding social distancing in the COVID-19 pandemic will show the existence of distinct mindsets.

2. Methods and materials

2.1. Participants

The study was approved by the Ethics Committee of the academic institution with which the second author is affiliated and was conducted according to established ethical guidelines. The expected minimum sample size was set at 150 but the final number of respondents was 216. This sample size accords with the suggested number (100–300) of respondents in studies aiming for stable utilities [45]. The sample comprised 40% males and 60% females according to the gender distribution of Hungary in 2020 as presented by the Hungarian Central Statistical Office (http://www.ksh.hu/interaktiv/korfak/orszag_en.html). This study was open only for adults over 18 years. Table 1 presents the demographics of the sample.

2.2. Procedure

We utilized a conjoint based experimental design in which we allocated participants to different groups using repeated measures, where the same participants took part in each condition of each of the independent variables (within groups, or within-subjects design) [46]. To control the results, we alternated the order by which participants performed in different conditions of an experiment. This experimental design enables, higher variation, randomization, analysis of co-variance and control, compared to typical observational studies [46]. To simulate our complex

Table 1. Basic demographic description of the sample. Total sample size was $n = 216$.

Variable	Levels	Size (n)
Gender	Male	82
	Female	134
Place of living	Budapest	111
	Rural	105
Age Group	25–34 yrs.	78
	18–24 yrs.	81
	35–44 yrs.	30
	45–54 yrs.	20
	55–64 yrs.	7
Education	Ph.D.	26
	M.A.	67
	B.A.	123

reality where many stimuli may interact with one another, we used a conjoint based experimental design that tests numerous messages with no limitation of degrees of freedom through the Mind-Genomics experimental design methodology® [47]. Responses to vignettes and messages are disentangled by statistics based on the underlying experimental design [47, 48]. We created a typical 4 × 4 conjoint experimental design, with willingness to comply with social distancing as the dependent variable and known contributors to willingness to comply as the independent variables [48].

Conjoint based experimental designs require the creation of questions, representing independent variables, and answers for each question. In this case we set four questions, each for an independent variable and four answers for each which are messages that may drive or inhibit willingness to comply with social distancing [46, 47, 49]. Together questions and answers tell a narrative. Each respondent evaluated a unique set of 24 vignettes, constituting a full experimental design for that respondent [50]. Vignettes may not necessarily contain each four messages; there are cases when only three or two messages are presented. Participants were recruited through social media platforms and the university by Lucid.Inc, a research company, which distributed the digital link for this online study through social networks. Respondents began with an orientation page, signed an informed consent, completed three demographic questions for classification and rated the 24 vignettes of messages. It took three weeks to collect data. To obtain a balanced presentation of the messages according to the experimental design, the 16 messages appear in a statistically independent manner from each other as a preparation for an ordinary least-squares regression analysis (OLS). With 261 respondents, this study covers 5186 possible combinations of messages. The structure of each vignette (e.g., the presence and absence of each of the 16 answers for each vignette) is stored in a binary table which is available for download once the study is closed [51]. Respondents read the vignette and rated it as a whole, on a scale from 1 to 9 by answering the rating question 'What is your agreement with these sentences for compliance with social distancing?', where 1 means strongly disagree and 9 means strongly agree. The questions and the answers appear in Table 2.

Figure 1 shows an example of the vignette, including the rating question.

2.3. Data analysis

To reduce error, the 9-point rating scale was transformed into a binary scale (ratings of 1–6 were transformed to 0; ratings of 7–9 were transformed to 100) highlighting the messages respondents rated as those with which they strongly agree Ratings over and below 7 were grouped so that the differences between the ways participants use the scales have been eliminated. The binary table of the present/absent value (codes 0 for absent, 1 for present) constitutes the set of independent variables. The transformed rating scale was used as a dependent variable. OLS was performed for each participant on the 24 vignettes evaluated, with the independent variables being the 16 messages. Each message was coded as 1 in the data set when the message was present in a vignette and coded 0 when absent from the data set. The dependent variable is the 'agreement' binary value (1–6 recoded as 0, 7–9 recoded as 100). Next, OLS regression estimated the parameters of the equations, the additive constant, and the 16 coefficients. The regression models were estimated without the presence of an additive constant in the model. The 16 coefficients present the power of each message as a driver of the willingness to comply with social distancing. The higher the coefficient the stronger the message drives willingness to comply.

To test differences in response patterns to the messages, respondents were clustered using *k*-means clustering [52], a widely used approach to

Table 2. Study design. The vignettes and the messages created by the research team after a careful and throughout analysis of the scientific literature of drivers of social distancing.

Code	Questions/Answers
	Question A: Perceived risk of COVID-19
A1	COVID-19 is a dangerous virus spreading wildly.
A2	COVID-19 is not dangerous, but the media overplay new strain of influenza…people are panicking.
A3	COVID-19 is not dangerous, but all the news seems to be about it.
A4	Health experts suggest that the government has been reactive rather than proactive to the pandemic.
	Question B: Practice of social distancing
B1	To practice social distancing, everyone should stay 2 m (6 ft) apart.
B2	To practice social distancing, people should be confined to within 100 m (300 ft) of home.
B3	To practice social distancing, people should wear a mask everywhere.
B4	To practice social distancing, people should socialize and work only from home on internet, e.g., Zoom/Skype.
	Question C: Assuring social distancing
C1	A military lockdown will assure compliance with social distancing.
C2	To assure compliance, only aged 60 and over are allowed to buy groceries during first 2 h of the store day.
C3	To assure compliance, shopping is to be limited to 3 people at a time for food shopping and 1 person at a time for pharmacy shopping.
C4	To assure compliance, designated young volunteers are to do priority shopping for the elderly and disabled.
	Question D: Who communicates the social distancing policy
D1	State government should communicate the social distancing policy.
D2	The central government should communicate the social distancing policy.
D3	Religious leaders should communicate the social distancing policy.
D4	The media should communicate the social distancing policy.

identify patterns in data respondents provide, with the measure of distance between pairs of respondents defined as the quantity (1-R), where R is the Pearson correlation, computed by using the 16 correlation coefficients of each respondent. These groups are called 'mindsets' because they represent different patterns of thinking about compliance with social distancing [53]. Once each respondent was defined by age and gender, based on the classification data, the respondent was assigned to one of the three mindsets (clusters).

To identify the messages that received the high ratings by clusters, we tested the consistency within and between groups, thereby concluding what the strongest communication messages are for members of each mindset. Thus, the entire array of data was reanalyzed by OLS regression for all respondents (Total). These so-called 'grand' models incorporate all data observations for each respondent. Thus, with 216 respondents, and with 24 combinations per respondent (one for each vignette evaluated by the respondent), there were 216 × 24 (5184) different observations for the regression. Data analysis was done using SYSTAT (ver. 13. 2, Systat Software, Inc) [54].

Last, based on the coefficients of the mindset-segmentation we developed a personal viewpoint identifier tool (PVI). We used a decision tree algorithm to define the six most mindset-discriminating messages. With these messages, the system generates a short, easy to distribute online questionnaire with a binary scale (agree vs. disagree) that assigns individuals or groups in the population to one of the predefined mindsets.

Figure 1. Example of a vignette and the rating scale.

Table 3. Ordinary least squares regression coefficients for agreement with the elements by total panel, gender, and age groups. Significant differences among the two genders and age groups are highlighted in bold. Letters denote homogenous subgroups determined by Tukey HSD post hoc test.

	Total Panel	Gender		Age group				
		Male	Female	25–34	18–24	35–44	45–54	55–64
Base size	216	82	124	78	81	30	20	7
Additive constant	32.3	29.1	33.9	38.8	31.8	18.4	20.4	44.6
Elements								
The COVID-19 is a dangerous virus spreading wildly	1.4	-0.8a	2.9a	-1.1a	3.1a	5.1a	2.8a	-5a
The COVID-19 is not dangerous, but the media overplays new strain of influenza… people are panicking.	0.8	0.8a	0.8a	-0.9a	0.1a	6a	5.5a	-7.9a
The COVID-19 is not dangerous, but all the news seems to be about it.	1.2	0.8a	1.8a	-1.3a	2.7a	2.1a	5.3a	-1.9a
Health experts suggest that government has been reactive rather than proactive to the pandemic.	1.9	-0.1a	3.3a	-3.1a	5.4a	4.8a	2.9a	5.7a
To practice social distancing, everyone should stay 2 m (6 ft) apart.	1.6	1.4a	1.7a	-2.1a	4.6a	7.8a	-5.1a	-1.5a
To practice social distancing people should be confined to within 100 m (300 ft) of home.	1.2	1.6a	1.2a	-6.3a	5.3a	9.8a	-0.8a	11.1a
To practice social distancing, people should wear a mask everywhere.	1.9	**-4.3a**	**5.6b**	-5.1a	6a	13.2a	-0.3a	-8.2a
To practice social distancing, people should socialize and work only from home on internet, e.g., Zoom/Skype.	1	**-3.2a**	**3.9b**	-5.3a	3.9a	10.4a	0.2a	-0.1a
A military lockdown will assure compliance with social distancing.	1.2	2.4a	0.5a	0a	0.2a	4a	9.2a	1.7a

(continued on next page)

Table 3 (*continued*)

	Total Panel	Gender		Age group				
		Male	Female	25–34	18–24	35–44	45–54	55–64
To assure compliance only aged 60 and over are allowed to buy groceries during first 2 h of the store day.	4.6	5.7a	4a	-1.2a	4.4a	15a	14.9a	2.1a
To assure compliance, shopping is to be limited to 3 people at a time for food shopping and 1 person at a time) for pharmacy shopping.	1.9	4.1a	0.4a	-0.7a	3.2a	6.2a	3.7a	4.2a
To assure compliance, designated young volunteers are to do priority shopping for elderly and disabled.	0.8	2.8a	-0.5a	-6.2a	3a	12a	6.6a	-6a
State government should communicate the social distancing policy.	-0.7	4.8a	-4a	-0.2a	-1.7a	0.3a	9.4a	-21.4a
The central government should communicate the social distancing policy.	0.6	0.9a	0.7a	0.3a	0a	9.1a	0.9a	-24a
Religious leaders should communicate the social distancing policy.	-2.7	3.1a	-5.9a	-1.5a	-5.2a	-0.3a	4.6a	-17.3a
The media should communicate the social distancing policy.	1.4	0.4a	2.2a	2.9a	0.2a	5.1a	5.1a	-23.1a

The mindset assignment enables to communicate with individuals and groups according to their mindset "membership".

3. Results

3.1. Total panel

Table 3 presents results for the total panel. The numbers in the columns are the coefficients from the OLS regression, where each model comprises 16 coefficients and an additive constant. Coefficients are around zero, with no significance. Only one message was significant, with a coefficient higher than 4: *"To assure compliance, only aged 60 and over are allowed to buy groceries during first 2 h of the store day."* Other messages were not significant. In view of these less-than-promising results for the total panel, we analyzed differences among messages across geo-demographic groups. Findings indicate that compared to male participants, female participants showed significantly higher agreement with two messages: "To practice social distancing, people should wear a mask everywhere", and "To practice social distancing, people should socialize and work only from home on internet, e.g., Zoom/Skype". There were no additional significant differences present and no significant differences across age groups. The standard deviations within groups were high and overlapped with other groups.

Next, testing for additional differences, we ran OLS on education and place of residence. Table 4 presents the OLS results. Participants with a Ph.D., had higher agreement with the message: "To assure compliance, designated young volunteers are to do priority shopping for elderly and disabled." Comparing differences between participants living in Budapest (capital of Hungary) and participants living outside the capital (denoted as rural), those from Budapest had significantly higher agreement with the message: "The media should communicate the social distancing policy."

3.2. Mindset-segmentation

Table 5 presents results of *the k-*means clustering analysis. Three mindsets emerged each with members who responded similarly to each message. The OLS coefficients of the participants with *k*-means clustering reflects similarly in the thinking of participants who are grouped into the

same mindset. Any message that drives willingness to comply appears in the proper group. The mindsets show higher deviations across groups among the messages.

In the final step, we used the clusters to develop the PVI. Figure 2 p presents the PVI available at: https://www.pvi360.com/TypingToolPage.aspx?projectid=1260&userid=2008.

4. Discussion

This study made several contributions. Theoretically, this study extended the narrative persuasion theory to the COVID-19 context. This study begins to fill the gap in the state of the art regarding specific communication messaging that health authorities may use to drive voluntary social distancing in the context of the COVID-19 [3]. This study tested the power of specific messages as drivers of voluntary compliance with social distancing, identified commonalities in patterns of response to each message, revealed three different mindsets that emerged from commonalities in responses to each message, accorded effective messages to drive members of each mindset to comply with social distancing, and developed a web-based prediction tool to assign individuals and groups into mindsets. Methodologically, the unique methodology that we used in this study, a patented algorithm for an experimental design enabled a simulation of the complex reality that exposes the public to numerous messages. The experimental design enabled testing thousands of messages with no limitation of degrees of freedom, while bypassing biases of typical surveys. Thus, instead of using general communication, we identified effective communication message tailored by mindset-belonging, similarly, to personalized developments in contexts other than a health crisis [55, 56, 57]. Practically, this study enables health authorities to use mindset-tailored powerful messages that drive willingness to comply with social distancing among the young in Hungary based on the narrative persuasion communication theory in health.

The first hypothesis, which stated that the effect of narrative messages on willingness to comply with social distancing differs according to: the agent communicating the message, the perceived risk of the infection, the perceived benefits of social distancing practices and the environment, was corroborated at group level in the mindset-segmentation. In the total sample regression results suggest only one message that was significant (*"To assure compliance, only aged 60 and over are allowed to buy groceries during first 2 h of the store day"*). *Also,* across geo-demographic groups only

Table 4. OLS regression coefficients for agreement with the messages by education and place of living. Bold coefficients denote significant differences among education levels and places of residence. Letters denote homogenous subgroups determined by Tukey HSD post hoc test.

	Education			Place of living	
	PHD	MA	BA	Budapest	Rural
Number	26	67	123	111	105
Additive constant	26.4	33.7	33	25.9	38.6
Elements					
The COVID-19 is a dangerous virus spreading wildly	1.1a	1.3a	1.7a	0.8a	1.8a
The COVID-19 is not dangerous, but the media overplays new strain of influenza… people are panicking	7a	0.8a	-0.6a	0.7a	0.7a
The COVID-19 is not dangerous, but all the news seems to be about it	7.3a	1.6a	-0.3a	3a	-0.9a
Health experts suggest that government has been reactive rather than proactive to the pandemic.	6.9a	1.7a	0.8a	1.5a	2.2a
To practice social distancing, everyone should stay 2 m (6 ft) apart.	4.5a	-1.2a	2.4a	3.4a	-0.3a
To practice social distancing, people should be confined to within 100 m (300 ft) of home.	4.3a	1.7a	0.2a	2.9a	-0.2a
To practice social distancing people should wear a mask everywhere.	6a	1.7a	1.1a	3.9a	0a
To practice social distancing people should socialize and work only from home on internet, e.g., Zoom/Skype.	1.6a	1.6a	0.5a	4.1a	-2.2a
A military lockdown will assure compliance with social distancing.	1.7a	-0.5a	1.9a	3.3a	-0.9a
To assure compliance, only aged 60 and over are allowed to buy groceries during first 2 h of the store day.	1.4a	2.2a	6.3a	2.5a	6.8a
To assure compliance shopping is to be limited to 3 people at a time for food shopping and 1 person at a time) for pharmacy shopping.	-9a	1.7a	4.1a	0.8a	3.3a
To assure compliance, designated young volunteers are to do priority shopping for elderly and disabled.	**-2.7a**	**0.8b**	**1.6b**	0.7a	1.2a
State government should communicate the social distancing policy.	5.3a	-5.8a	0.9a	1.6a	-2.9a
The central government should communicate the social distancing policy	4.3a	-3.1a	1.7a	2.6a	-1.3a
Religious leaders should communicate the social distancing policy	6.2a	-4.6a	-3.8a	-0.9a	-4.2a
The media should communicate the social distancing policy	7.4a	-2.6a	2.3a	**4.2b**	**-1.2a**

two differences were found suggesting that females respond strongly to two messages ("To practice social distancing, people should wear a mask everywhere"; "To practice social distancing, people should socialize and work only from home on internet, e.g., Zoom/Skype").

The second hypothesis, which stated that the similarity in patterns of response to different messages regarding social distancing in the COVID-19 pandemic yields distinct mindsets, was corroborated. Findings for Hypothesis 2 suggest that respondents belonging to Mindset 1, Pandemic Observers, showed the highest agreement with the message: "*The COVID-19 is not dangerous, but the media overplays new strain of influenza…people are panicking*". Members of this mindset cannot decide whether the virus is a real threat, or it is just overplayed by the media. Pandemic Observers had significantly high coefficients for the messages: "The COVID-19 is not dangerous, but all the news seems to be about it" and "The COVID-19 is a dangerous virus spreading wildly." Pandemic Observers respond better to

clear messaging about the risk of the virus and to communication regarding social distancing that comes from the government, religious leaders, or health experts.

Findings suggest that respondents belonging to Mindset 2, followers of the orders given by the government, are more willing to comply with social distancing if the communication regarding the policy comes from the media. Followers of orders from the government *respond positively to* the messages: "T*o practice social distancing, people should wear a mask everywhere*" and "T*o assure compliance, only aged 60 and over are allowed to buy groceries during first 2 h of the store day."* They are ready to keep a distance, wear masks, and work from home. Additionally, they would even accept a military lockdown if it were necessary to assure social distancing. Findings suggest that respondents belonging to Mindset 3, Health Conscious, are not sure that the virus is dangerous but are ready to follow the orders of the governments. They support grocery time

Table 5. OLS regression coefficients for agreement with the elements by mindsets (MS) determined by *k*-means clustering. Significant differences among mindsets are in bold. Letters denote homogenous subgroups determined by Tukey HSD post hoc test. Italicised highlights messages with strong coefficients higher than 7.

Codes		MS1	MS2	MS3
	Number	57	81	78
	Additive constant	40.5	23.9	33.5
	Elements			
A1	The COVID-19 is a dangerous virus spreading wildly.	**6.9c**	**-11.8a**	*11.5b*
A2	The COVID-19 is not dangerous, but the media overplays new strain of influenza… people are panicking.	*7.7b*	**-13.5a**	*10.3b*
A3	The COVID-19 is not dangerous, but all the news seems to be about it.	**6.5c**	**-16.2a**	*16.1b*
A4	Health experts suggest that government has been reactive rather than proactive to the pandemic.	**5.9b**	**-9.3a**	*10.2b*
B1	To practice social distancing, everyone should stay 2 m (6 ft) apart.	**-1a**	*9.4b*	**-3.8a**
B2	To practice social distancing, people should be confined to within 100 m (300 ft) of home.	**-1.7a**	*9.1b*	**-4.2ab**
B3	To practice social distancing people should wear a mask everywhere	**2.8a**	*10.5b*	**-5.8b**
B4	To practice social distancing people should socialize and work only from home on internet, e.g., Zoom/Skype.	**-4.1a**	*8.1a*	**-2.6a**
C1	A military lockdown will assure compliance with social distancing.	**-19b**	*9b*	*8a*
C2	To assure compliance only aged 60 and over are allowed to buy groceries during first 2 h of the store day.	**-17.9b**	*11.4b*	*12.9a*
C3	To assure compliance shopping is to be limited to 3 people at a time for food shopping and 1 person at a time) for pharmacy shopping	**-12.4b**	**5.8b**	*8.1a*
C4	To assure compliance designated young volunteers are to do priority shopping for elderly and disabled.	**-15.9b**	**6.8b**	*7.6a*
D1	State government should communicate the social distancing policy.	*7.3a*	**5.5b**	**-11.9b**
D2	The central government should communicate the social distancing policy.	**5.6a**	**6.7b**	**-9.2b**
D3	Religious leaders should communicate the social distancing policy.	**6.7a**	**0.4b**	**-11.6b**
D4	The media should communicate the social distancing policy.	**2.5a**	*10.6b*	**-8.2b**

zones for elderly and limiting the number of people in stores and could accept a military lockdown if needed for public health. Members of Mindset 3, however, show contradictory opinions regarding the dangerousness of the virus, as they have high coefficients for the message: "The COVID-19 is a dangerous virus spreading wildly" and "The COVID-19 is not dangerous, but all the news seems to be about it" as well.

Findings also extend the knowledge on the effect of socio-demographics on willingness to comply with social distancing. Age did not make a difference, a finding that may be explained by the potential suppression of the generationally relationship between age and compliance, as Millennials were found to be more compliant with social distancing than are Baby Boomers [10]. Education and the place of residence were drivers of willingness to comply in the total panel. The association between higher education and willingness to comply may be explained by the positive relationship between education and trust in the government, which is strongly associated with compliance with social distancing [58, 59]. The effect of place of residence may be in accordance with local political issues around the independence of media in Hungary [60]. Although these socio-demographic variables did not contribute to the explained variance, the high standard deviations of participants may have quashed the differences among opinions. To enhance compliance with social distancing, health authorities and leaders are called upon to acknowledge the diversity in responses of individuals and groups in the population to messages on social distancing, to employ the prediction tool developed in this study, and to use personalized messaging according to mindset belonging. Table 6 presents the findings for study hypotheses.

HUNGARY COVID PVI
11.20.2020.1

No Specialty Questions for This Study

TO ASSURE COMPLIANCE DESIGNATED YOUNG VOLUNTEERS ARE TO DO PRIORITY SHOPPING FOR ELDERLY & DISABLED

○ AGREE
○ DISAGREE

THE COVID-19 IS A DANGEROUS VIRUS SPREADING WILDLY

○ AGREE
○ DISAGREE

A MILITARY LOCKDOWN WILL ASSURE COMPLIANCE TO SOCIAL DISTANCING

○ AGREE
○ DISAGREE

TO ASSURE COMPLIANCE ONLY 60 AND OVER ARE ALLOWED TO BUY GROCERIES DURING FIRST 2 HOURS OF THE STORE DAY

○ AGREE
○ DISAGREE

THE COVID-19 IS NOT DANGEROUS BUT ALL THE NEWS SEEMS TO BE ABOUT IT

○ AGREE
○ DISAGREE

THE COVID-19 IS NOT DANGEROUS BUT THE MEDIA OVER BLOWS NEW STRAIN OF INFLUENZA…PEOPLE ARE PANICKING

○ AGREE
○ DISAGREE

Figure 2. Personal viewpoint identifier.

Table 6. Findings for study hypotheses.

Hypothesis 1	the effect of narrative messages on willingness to comply with social distancing will differ according to the agent communicating the message, the perceived risk of the infection, the perceived benefits of social distancing practices, and the environment.	corroborated only by group level in the mindset-segmentation
Hypothesis 2	We hypothesize that the similarity in patterns of response to different narrative messages regarding social distancing in the COVID-19 pandemic will show the existence of distinct mindsets.	corroborated

5. Conclusions

Members of the three mindsets are dispersed across population. To drive compliance with social distancing among young people in Hungary, health authorities are called upon to easily identify the mindset-belonging of individuals and groups using our prediction tool and to use messages by their effectiveness for members of each mindset. During pandemics, the communication resources of governments become scarce. Effective mindset-tailored messaging will enable health authorities to allocate resources based on real, immediate, and relevant data in enhancing compliance with social distancing. Thus, specific communication messages of health authorities will have a higher likelihood of driving voluntary compliance with social distancing while strengthening a collaboration among health policy researchers, health officials, and the public in containing COVID-19.

5.1. Study limitations

Findings should be interpreted in light of the limitations of this study. First, since the Mind-Genomics® experimental design is applied online, it requires participants to have access to a computer or smartphone excluding old participants, thereby, limiting our range. Second, study variables are based on a thorough literature analysis which may not entail variables that are yet to be revealed as drivers of willingness to comply with social distancing. Third, given the continuing pandemic in Hungary, participants may have been previously exposed to similar messages regarding social distancing before participating in this study affecting their agreement with the messages. .,

5.2. Directions for future studies

Future studies may test the rate of compliance with social distancing resulting from identifying mindset-belonging and using mindset-tailored messaging regarding social distancing by mobile data.

Declarations

Data availability statement

Data will be made available on request.

Declaration of interests Statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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