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Communication and COVID-19 Physical Distancing Behavior Among Dutch Youth

EMPIRICAL PAPER

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ABSTRACT

Background: Although most young people do not become seriously ill from the coronavirus causing the COVID-19 disease, they do play a role in its spread. It is therefore important that they adhere to the recommended preventive behaviors, most importantly, physical distancing. This study aims to gain a better understanding of the psychosocial determinants of young people's physical distancing behavior and the role that direct (i.e., interpersonal) and mediated communication (i.e., mass media, social media) about COVID-19 plays in this.

Methods: A daily diary study was conducted among 481 Dutch adolescents (secondary school students; age range 10–18 years) and 404 young adults (university students; age range 17–25 years), involving 10 identical daily surveys administered on weekdays during a 2-week period during the first wave of the COVID-19 pandemic (May 2020). The hypotheses were tested with preregistered univariate and multivariate linear mixed-effects models.

Results: The perceived descriptive norm (i.e., what friends are doing) was the most important determinant of physical distancing behavior among both adolescents and young adults. The perceived injunctive norm, perceived response efficacy, and perceived severity were also positively associated with physical distancing, albeit less strong. Among adolescents, exposure to information about COVID-19 in the mass media increased their perceptions of the descriptive norm, which in turn increased their physical distancing behavior.

Conclusions: For those involved in studying and designing COVID-19-related behavioral interventions and campaigns targeting youth, it is important to consider the social norms that they relate to, and to take into account their perceived severity and response efficacy.

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Although most young people do not become seriously ill from the COVID-19 virus, they do play an important role in spreading the coronavirus. If they become infected, they run the risk of infecting others including those who are more vulnerable, such as the elderly and the chronically ill. It is, therefore, highly important that young people prevent themselves from becoming infected and infecting others by adhering to the recommended COVID-19 preventive behaviors.

One of the most important behavioral measures to prevent virus transmission recommended by experts and public health organizations, including the World Health Organization, is physical distancing (Anderson et al., 2020). Physical distancing, sometimes referred to as social distancing, means keeping a safe space (1,5 meter) between yourself and other people who are not from your household (Chu et al., 2020). Physical distancing behavior is different from many other health preventive behaviors, among other things because individual behaviour generates outcomes not only for the individual concerned, but also for others around them and wider society. In other words, individuals are engaged in a collective action problem or social dilemma where selfish and collective interests may not be aligned (Johnson et al., 2020; Kollock, 1998; Teck Ling & Chyong Ho, 2020).

To mitigate the COVID-19 pandemic, crisis teams, policymakers, and communication professionals face the challenge to educate young people about the usefulness and necessity of physical distancing behavior, and convince them to comply to this measure even if they feel the behavior is not in their own interest. To do so effectively, more insights are needed into the factors that explain the physical distancing behavior of young people. The current study aims to provide such insights, which can then be used to guide future research in examining young people's physical distancing behavior and may aid in the development of effective COVID-19 communication campaigns and interventions.

Given the importance of human behavior in mitigating the spread of the virus, several researchers and policymakers have already pointed to the relevance of the social and behavioral sciences in this pandemic (Bavel et al., 2020; Lunn et al., 2020). The current study adopts a behavioral science approach by examining the role of different psychosocial determinants in shaping the physical distancing behavior of young people. In addition, this study explores the role of mediated and interpersonal communication about COVID-19. During the COVID-19 pandemic, an extensive amount of information related to the coronavirus is disseminated by mass media, social media, and interpersonal communication (Lin et al., 2020). Insights from the health communication literature suggest that exposure to information about health risks and recommended coping behaviors can affect people's health behavior (Hornik, 2002). However, to date, insights into the relation between exposure to information about COVID-19 and physical distancing behavior among young people is still lacking.

Therefore, the aim of this study is to better understand young people's physical distancing behavior during the COVID-19 pandemic by investigating the psychosocial and communication-related determinants of this behavior. Specifically, we examine how (1) psychosocial factors (i.e., perceived threat, perceived coping efficacy, perceived social norms) and (2) exposure to communication about the coronavirus via mass media, social media, and interpersonal contact relate to young people's physical distancing behavior and (3) whether psychosocial determinants mediate the relation between exposure to communication and behavior. The study addresses this aim with a daily diary study among Dutch adolescents (secondary school pupils; age range 10–18 years) and young adults (university students; age range 17–25 years), involving 10 identical daily surveys administered on weekdays during a 2-week period in May 2020, a few months after the start of the COVID-19 pandemic.

PSYCHOSOCIAL DETERMINANTS OF YOUNG PEOPLE'S PHYSICAL DISTANCING BEHAVIOR

To gain more insight into the factors that determine young people's physical distancing behavior during the COVID-19 pandemic, this study draws on social-psychological theory explaining what drives people to engage in health-related behaviors, more specifically, the Health Belief Model (Glanz et al., 2015), the Protection Motivation Theory (Rogers, 1975; Witte, 1992), and Social Cognitive Theory (Bandura, 1986; Rosenstock et al., 2016). Based on these theories, we focus on three sets of determinants. According to the first two theories, the decision to engage in a certain behavior is governed by two distinct cognitive processes: perceptions of the threat and perceptions of the efficacy of the recommended coping behavior. In addition, according to Social Cognitive Theory, perceptions of social norms importantly steer behavior.

PERCEIVED THREAT

Perceived threat involves the perceptions of the magnitude and immediacy of danger, in this case being infected with the coronavirus disease and to infect others. The perceived threat includes the perceived severity of and the perceived susceptibility to the threat. Perceived severity involves an individual's belief about the seriousness of the threat (Witte, 1992). In the current study, perceived severity is conceptualized as the extent to which young people believe the spread of the coronavirus is a problem. This perception of severity is important, because young people who do not believe

the spread of the virus is a problem will be less motivated to engage in the preventive physical distancing behavior. Perceived susceptibility involves an individual's belief about his or her chance of experiencing the health threat (Witte, 1992). In the current study, perceived susceptibility is conceptualized as the extent to which young people feel they run the risk of getting infected by the COVID-19 virus themselves and, in turn, infect others. This perception of susceptibility is important, because when people do not feel that they can become infected by the virus or infect others, they will be less motivated to engage in physical distancing behavior, even when the threat itself is very serious.

Earlier research has shown that perceived threat (including perceived severity and susceptibility) influences behavior in many health contexts, such as vaccination, diet, exercise, smoking cessation, and contraception (Bish & Michie, 2010; Donadiki et al., 2014; Glanz et al., 2015; Kloeblen & Batish, 1999; Koch, 2002; Mantler, 2013; Nexøe et al., 1999). Recent research among adults shows that perceived threat is also a key determinant of preventive behavioral engagement in the context of COVID-19, such as information seeking (Park et al., 2020) or engaging in protective behaviors including hand washing, hand sanitizing, physical distancing, self-quarantining, disinfecting, mask-wearing (Kowalski & Black, 2021)). Therefore, we formulate the following hypothesis:

> H1: Higher levels of (a) perceived severity of the spread of the COVID-19 virus and (b) perceived susceptibility to the COVID-19 virus threat are related to more physical distancing behavior.

PERCEIVED EFFICACY

Prevailing health behavior theories postulate that behaviour change is the function of a perceived threat, but only when there is sufficient perceived efficacy (Witte, 1992). Perceived efficacy of a protective behavior includes an individual's evaluations of response efficacy and self-efficacy. Response efficacy is the belief that engaging in a certain behavior will result in the reduction of a health threat (Witte, 1992). This perception of efficacy is important, because people will usually not establish protecting behavior if they do not believe that this behavior is effective or beneficial (Rogers, 1975). In the context of the current study, response efficacy is conceptualized as the feeling that physical distancing is an effective way to avoid getting infected by the COVID-19 virus or infecting others with the virus. Self-efficacy is a person's belief in his or her own ability to carry out the recommended behavior (Glanz et al., 2015). People who believe in their capability to engage in protective behavior are assumed to be more likely to engage in the behavior than those with low self-efficacy (Rosenstock et al., 2016). In the current study, self-efficacy is conceptualized as young people's belief in their ability to keep a physical distance of 1.5 meters from others.

Earlier research has shown that perceived efficacy (including perceived response efficacy and perceived self-efficacy) influences protective health behavior in many other health contexts, such as condom use, blood donation, smoking cessation, and physical activity (Bish & Michie, 2010; Glanz et al., 2015; Sheeran et al., 2016). More recent research has shown that both types of perceived efficacy predict engaging in protective behaviors (Kowalski & Black, 2021). Therefore, we formulate the following hypothesis:

> H2: Higher levels of (a) perceived response efficacy and (b) perceived self-efficacy are related to more physical distancing behavior.

PERCEIVED SOCIAL NORMS

People's decision to engage in certain health behaviors does not occur in a vacuum, but also depends on their social context (Bavel et al., 2020; Chan et al., 2020). According to Social Cognitive Theory (Bandura, 1986, 2004; Rosenstock et al., 2016) people's behavior is influenced by their social environment, importantly, by the social norms in their environment. Perceived social norms are people's perceptions of what others are doing (i.e., descriptive norm) and of what they think others approve of or not (i.e., injunctive norm (Cialdini & Goldstein, 2004). Young people are highly reactive to the behaviors and opinions of others, especially their friends and other peers (Valkenburg & Piotrowski, 2017). They tend to adopt values, motives and behaviors that they perceive as normative within their group of friends or other peers they identify with. Also, physical distancing behavior typically takes place in social contexts, and the choice whether to keep a distance (or in other words, whether you adhere to the norm) is therefore highly visible to others. Moreover, physical distancing behavior can be seen as a collective action problem in which individuals typically only tend to cooperate when they believe that others are also likely to cooperate (Bolsen et al., 2014; Frey & Meier, 2004). Taken together, this suggests that social norms may play an important role in determining the successful performance of physical behavior among young people. In the current study, descriptive social norms are conceptualized as young people's perceptions of how often their friends keep a 1.5 meters distance from others. Injunctive social norms are conceptualized as young people's perceptions of whether their friends think that he or she ought to keep 1.5 meters away from others.

Earlier research has shown that social norms (both injunctive and descriptive) influence behavior in many other health contexts, such as diet, exercise, and smoking cessation (Sheeran et al., 2016). Preliminary evidence in

the context of COVID-19 also shows that social norms are a crucial determinant of people's engagement in a broad set of COVID-19 preventive behaviors, including physical distancing (Goldberg et al., 2020). Therefore, we formulate the following hypothesis:

> H3: Higher levels of (a) injunctive and (b) descriptive norms are related to more physical distancing behavior.

COMMUNICATION ABOUT COVID-19 AND PHYSICAL DISTANCING BEHAVIOR

People's decision to engage in a recommended health behavior can be influenced by external stimuli or sources of information, such as media messages and interpersonal communication about the health threat and the recommended behavior (Glanz et al., 2015; Hong & Kim, 2020; Witte, 1992). In the current study, we investigate the role of the level of exposure to various types of communication about COVID-19, the role of valence of affective responses to the various types of communication, and behavioral responses to press conferences.

LEVEL OF EXPOSURE TO COVID-19 COMMUNICATION

We focus on three types of communication: mass media communication, social media communication, and interpersonal communication. During the COVID-19 pandemic, mass media communication channels such as television, radio, newspaper, news apps, and websites are being used extensively by the government, health organizations, and journalists to share information about COVID-19 and specifically about physical distancing as one of the recommended behaviors to combat the virus. Information about COVID-19 and physical distancing is also shared via social media platforms (e.g., Twitter, Facebook, Instagram, TikTok), and via interpersonal communication. When talking about COVID-19 with others directly, young people not only receive information about their take on the COVID-19 crisis and the behavioral measures, but also experience directly how others deal with the 1.5-meter distance measure.

A recent study among younger and older adults (aged 18 to 60 years) in China indeed provides preliminary evidence that the consumption of COVID-19-related information on various digital media could prompt preventive behaviors (Liu, 2020). Based on these preliminary results and earlier research on health communication in other contexts, we expect that exposure to information about COVID-19 can directly trigger young people to engage in physical distancing behavior. Therefore, we formulated the following hypothesis:

> H4: A higher level of exposure to communication about COVID-19 (via mass media, social media, and interpersonal communication) is related to more physical distancing behavior.

Besides directly triggering people to perform the recommended health behavior, exposure to mediated and interpersonal health communication can also indirectly stimulate them to do so by changing the behavioral determinants: perceived threat, perceived efficacy, and social norms. That is, the exposure to communication about COVID-19 can affect people's perception of the virus and inform individuals what others are doing. We expect that increased exposure to communication about COVID-19, increases the chance of being exposed to information about the number of infections, hospitalizations, and deaths. This could affect young people's perceptions of the severity of the virus and their perceived susceptibility to the virus. Communication about COVID-19 could also provide information about the extent to which physical distancing helps to not get infected or infect others, which could increase the perceived efficacy of physical distancing as a coping behavior. Finally, communication about COVID-19, in particular when shared via social media and interpersonal communication, can provide information about what others are doing (e.g., do others comply with the physical distancing rule?) and what others approve and disapprove of (e.g., do others feel it's important to keep the 1.5-meter distance?), which can alter both the descriptive and injunctive social norm. Taken together, we hypothesize that:

> H5: The relations between the level of exposure to communication about COVID-19 and physical distancing behavior (see H4) are mediated by (a) perceived severity, (b) perceived susceptibility, (c) perceived efficacy, (d) injunctive norms, and (e) descriptive norms.

AFFECTIVE RESPONSES TO COVID-19 COMMUNICATION

Theories in social psychology suggest that people's feelings act as a form of information that they refer to when deciding whether or not to engage in particular health behaviors (E. Peters et al., 2006; Schwarz, 2012; Storbeck & Clore, 2008). This is also referred to as the affect-as-information hypothesis (Storbeck & Clore, 2008). If people experience negative affect, such as fear, this can stimulate people's decision to engage in the health behavior as it sensitizes them to risks for themselves or others (Harper et al., 2020; Loewenstein et al., 2001; Slovic et al., 2004). However, strong negative emotional reactions could also paralyze people and distract them from performing the desired behavior (Witte, 1992). Thus, negatively valenced affective

responses to communication can stimulate behavior, provided that the experience is not too negative. However, positively valenced affective responses to communication could trigger the desired behavior as well. Research in the field of positive media psychology shows that positive feelings elicited by media communication (such as awe, gratitude, elevation) can inspire people to take action, for example by acting more prosocially toward others (Coyne et al., 2018; Janicke-Bowles et al., 2019). This typically occurs when people are exposed to media content portraying humanity's better nature: altruism, kindness, compassion, perseverance, and love (Janicke-Bowles et al., 2019), examples of which often appeared in media during the first wave of the pandemic.

Therefore, in the current study we assume that both negative and positive feelings that young people experience when encountering COVID-19 information in the mass media, on social media, or via interpersonal communication can impact their physical distancing behavior. We formulate the following research question:

> RQ1: To what extent does the valence of youth's affective responses to communication about COVID-19 affect the relation between exposure to communication about COVID-19 and physical distancing behavior?

GOVERNMENT COVID-19 PRESS CONFERENCES AS A CALL FOR ACTION

In addition to information about a health threat via mediated and interpersonal communication, specific events can promote engagement in health-related behaviors (Glanz et al., 2015). Therefore, we also investigate the extent to which governmental press conferences affect young people's physical distancing behavior. In the country of this study, government press conferences involved the primary way to inform the public about the current COVID-19 situation and regulations. The conferences are prime time media events, which are followed by a large share of the public. During our data collection period, there were two important government press conferences. In the first one, at May 6, the prime minister presented a 'road map' containing the gradual phasing out of the strict lockdown measures (e.g., reopening primary schools, contact professions back to work, outdoor sports allowed). In the second press conference, on May 19, the prime minister presented a further relaxation of the lockdown (e.g., reopening secondary schools, restaurants, bars, museums, cinemas, theaters, etc.). The second press conference is particularly interesting because the Prime Minister directly addressed young people and called on them to come up with ideas on how to tackle the corona crisis. To explore whether the press conferences functioned as a call for action, we formulate the following research question:

> RQ2: To what extent did the government COVID-19 press conferences in May 2020 affect young people's physical distancing behavior?

METHODS

PARTICIPANTS

We used two distinct samples: a school sample of adolescents in secondary schools and a university sample of young adults. Both samples were analyzed separately. For the school sample, participants were recruited in five secondary schools in Rotterdam, the Netherlands. The adolescents in the schools were contacted via their dean or teacher and 485 adolescents had parental consent to participate in the study. Four participants were excluded from the sample because they did not meet de preregistered inclusion criteria for the maximum age of 18 years. Participants in the school sample (n = 481), were between 10 and 18 years old (M_{Age} = 14.80, SD_{Age} = 1.81, 34.27% male).

In the university sample, participants were recruited from the Erasmus University Rotterdam. The students were contacted via an email sent to all students, via social media channels of the university (i.e., Instagram, Twitter, and Facebook), and via the student well-being platform of the university ('Are you OK out there'). In response, 441 students provided consent to participate in the study. Of those, 37 participants were excluded from the sample because they did not meet de preregistered inclusion criteria for the maximum age of 25 years old or were not students (anymore) at the university. Participants in the university sample (n = 404), were between 17 and 25 years old (M_{Age} = 21.01, SD_{Age} = 1.93, 18.09% male).

DESIGN AND PROCEDURE

The data collection was part of a larger project investigating young people's well-being during the COVID-19 pandemic. An overview of all the studies and measured variables in the project can be found at the Open Science Framework (OSF): *https://osf.io/nh2ak/*. The hypotheses, measured variables, and plan of analysis were preregistered before gaining access to the data and can be found at *https://osf.io/aez5h/?view_only=fc7643d36c644ffab178360906488e6e*. Also, when writing the manuscript, we adhered to the Strengthening The Reporting of Observational Studies in Epidemiology (STROBE) checklist (von Elm et al., 2014).

The study used a daily diary study in which participants received 10 identical daily questionnaires administered via Qualtrics on weekdays for 2 weeks. Participants could fill out the digital questionnaires on a computer or other device connected to the internet (e.g., smartphone, tablet, laptop). Both samples had two starting points, resulting in two batches in each sample. Participants in the first batch were measured from May 4th until May

15th, 2020. The second batch started a week later, and participants were measured from May 11th until May 22nd, 2020. In the country of data collection, this was at the end of the first lockdown, when schools and universities were still closed. Each day, participants were reminded at noon (12:00 am) via email and received a reminder via text message at 8:00 pm to fill out the questionnaire. On the first, the fifth, and the last day, they received additional questions, for example on their demographic background.

MEASURES

Physical distancing

Physical distancing was measured by two items. The first measured how often participants over the past 24 hours had tried to keep 1.5 meters distance from others (regardless of whether these others came from their own or another household) on a 6-point scale, ranging from *never* (1) to *all the time* (6). Participants could also indicate that this question was *not applicable* (7) and was recoded into 'NA'. The second item measured, on the same 6-point scale, how often participants over the past 24 hours had succeeded in keeping 1.5 meters distance from others. A mixed-effects correlation, with a random intercept per participant, between the two items in the combined sample was high (r = .63, SE = .01, p < .001). Following the preregistration, the physical distancing variable was therefore calculated by averaging the two items. Not all respondents answered the questions each day, on average participants responded to the physical distancing question on 6.67 (SD = 2.81) of the 10 days. ***Table 1*** presents an overview of the means, standard deviations, and range of the physical distancing variable as well as all the other variables in the school and the university sample.

Psychosocial determinants

We measured five psychosocial determinants of physical distancing behavior: perceived severity, perceived susceptibility, response efficacy, descriptive norm, and injunctive norm. Due to a technical error, self-efficacy was not included in the daily questionnaires and, consequently, could not be included in the planned analyses.

Perceived severity

Perceived severity was measured by asking participants the question: "At this moment, do you think the spread of the coronavirus is a problem?" on a 6-point scale, ranging from *no, definitely not* (1) to *yes, definitely* (6).

Perceived susceptibility

For this variable, participants were asked: "At this moment, do you think that you can become contaminated with the coronavirus, and in that way contaminate others?" on a 6-point scale, ranging from *no, definitely not* (1) to *yes, definitely* (6).

Response efficacy

To measure response efficacy, participants responded to the question: "At this moment, do you think that by keeping 1.5 meters physical distance you will reduce the spread of the coronavirus?" on a 6-point scale, ranging from *never* (1) to *always* (6).

Perceived descriptive norm

The perceived descriptive norm was measured by asking participants the question: "How often do you think that, in the past 24 hours, your friends kept 1.5 meters physical distance from others?" on a 6-point scale, ranging from *never* (1) to *all the time* (6).

VARIABLE	SCHOOL SAMPLE (N = 481)				UNIVERSITY SAMPLE (N = 404)			
	MEAN	*SD*	MIN	MAX	MEAN	*SD*	MIN	MAX
Physical distancing	4.56	0.97	1.08	6.00	4.74	0.89	1.75	6.00
Perceived severity	5.11	0.88	1.00	6.00	5.14	0.84	1.00	6.00
Perceived susceptibility	4.76	1.15	1.00	6.00	4.80	1.07	1.00	6.00
Response efficacy	4.57	1.18	1.00	6.00	4.84	0.98	1.00	6.00
Descriptive norm	3.90	1.17	1.00	6.00	4.16	1.14	1.00	6.00
Injunctive norm	3.50	1.52	1.00	6.00	4.18	1.29	1.00	6.00
Mass media	2.32	0.79	1.00	4.00	2.32	0.73	1.00	4.00
Mass media valence	3.97	1.07	1.00	7.00	4.19	0.92	1.00	7.00
Social media	1.82	0.55	1.00	4.00	2.00	0.62	1.00	4.00
Social media valence	4.23	1.07	1.00	7.00	4.33	0.86	1.00	7.00
Interpersonal communication	1.93	0.56	1.00	4.00	2.06	0.61	1.00	4.00
Interpersonal communication valence	4.16	1.04	1.10	7.00	4.30	0.88	1.00	7.00

Table 1 Descriptives of Main Variables for the School and University Sample.

Perceived injunctive norm

The perceived injunctive norm was measured by asking participants the question: "Do you think that, in the past 24 hours, your friends believed that you should keep 1.5 meters physical distance from others?" on a 6-point scale, ranging from *no, definitely not* (1) to *yes, definitely* (6).

Communication-related determinants

The participants' exposure to information about COVID-19 was measured with a single item for each type of communication.

Mass media communication

The exposure to information about COVID-19 consumed on mass media was measured with the question "In the past 24 hours, how much did you see or hear about the coronavirus on other types of media (e.g., television, radio, newspapers, news apps, or websites)?" on a 4-point scale, ranging from *nothing* (1) to *a lot* (4).

Social media communication

The exposure to information about COVID-19 consumed on social media was measured with the question "In the past 24 hours, how much did you see or hear about the coronavirus on social media (e.g., Instagram, WhatsApp, Snapchat, YouTube, Facebook, TikTok)?" on the same 4-point scale.

Interpersonal communication

The exposure to information about COVID-19 via interpersonal communication was measured with the question "In the past 24 hours, how much did you see or hear about the coronavirus of people that you were talking to directly (e.g., friends, parents, or teachers)?" on the same 4-point scale.

Valence

For each of the three types of communication, the corresponding valence of affective response was measured. Directly after the specific media question, participants were shown seven pictures of faces ranging from a very sad face (1) to a very happy face (7) and were asked to select the face that best matched how they felt about the communication they had been exposed to.

Covariates

In the preregistration, we anticipated several covariates that should be controlled for in the analyses. The sex and age variables were measured on the first day. The categorical variable *sex* was recoded by using contrast coding so that the difference between females (–.5) and males (.5) was exactly 1, and the *age* (in years) variable was centered per sample so that the intercept represented the mode of the age in the sample and the average of females and males. In the school sample the mode was 15 years old, and in the university sample 23 years old. Socioeconomic status was also preregistered as a covariate, but it was unfortunately not measured and could not be included in the analyses.

Also, two time-related variables were preregistered as covariates of the developments of physical distancing over time. Both the week of the measurement (week 1 vs week 2) and the day of the week (1–5, in which the first day is a Monday) were added as covariates to control for a potential change in behavior between the two weeks or within the weeks.

After the preregistration, we realized that other factors might affect physical distancing. More specifically, we deemed it important to control for potential weather effects. For example, with higher temperatures and dry weather, participants would go outside more often, potentially having a harder time keeping a physical distance from others and using less mass media, whereas they would be more likely to stay at home when it was colder and raining. Therefore, the mean temperature and hours of precipitation per day in Rotterdam, the Netherlands during the measurements were taken from the website of the Royal Netherlands Meteorological Institute (*Royal Netherlands Meteorological Institute*, 2020). In addition, we controlled for a pilot behavioral boosting task that was offered as an option to a subsample of participants in the middle of the measurement period and which might have affected their physical distancing behaviors in the second week. The behavioral boosting task consisted of two subtasks: a self-persuasion task in which participants had to write down two reasons why they should keep a distance of 1.5 metres from others and an implementation intention task in which participants had to write down a plan for what they could do if were are in a situation in which they could not manage to keep a distance of 1.5 metres from others (e.g., if-then plan; (Gollwitzer, 1999; Hertwig & Grüne-Yanoff, 2017; Müller et al., 2009).

STRATEGY OF ANALYSIS

In the preregistration, we indicated that the preferred strategy to test the hypotheses was to use Bayes mixed-effects models. However, the BayesFactor package that we would use for this does not allow for missing values. As a result, we would only be able to include 1,826 of the 4,810 observations in the school sample and 1,411 of the 4,040 observations in the university sample. Therefore, we opted for the preregistered alternative and used NHST mixed-effects modeling in the lme4 package (Bates et al., 2014) in R (R Core Team, 2019). Standard Errors (SE), confidence intervals, degrees of freedom, and *p*-values were computed using Satterthwaite approximation (Satterthwaite, 1946), and confidence intervals not including 0 and $p < .05$ was considered statistically significant. To test the robustness of the mixed-effects models, a robust mixed-effects model, by using the rlmer

function in the robustlmm package (Koller, 2016), was estimated with all predictors included to inspect different parameter estimates and outcomes.

Before conducting the main analyses, we first tested the additional, non-preregistered, covariates. First, we modeled the mean temperature per day and the hours of rain per day in univariate mixed-effects models with physical distancing as the outcome variable and random intercepts per participant in a combined sample. Only the mean temperature per day was significantly associated with physical distancing (B = –.02, SE = .002, t = –5.884, p < .001) and, therefore, added to the preregistered covariates. Then, we tested the potential confounding effect of the pilot behavioral boosting task. The differences between the groups in the change of behavior from the first to the second week were tested with two planned contrasts distinguishing whether participants received the additional questionnaire (yes vs. no) and whether the participant took part in the behavioral boosting pilot (accepting vs. declining). Both planned contrasts showed no interaction with the week variable, indicating that there were no differences between the groups in the change in physical activity behavior between the first and the second week. Therefore, we did not control for exposure to the behavioral boosting questionnaire.

To test hypotheses 1–3, a multivariate linear mixed-effects model was specified with physical distancing as the dependent variable, the psychosocial behavioral determinants (i.e., perceived severity, perceived susceptibility, response efficacy, descriptive norm, injunctive norm), and the covariates as predictors, and random intercepts per participant.

To test hypothesis 4, a multivariate linear mixed-effects model was specified with physical distancing as the dependent variable, the three communication types (i.e., social media, mass media, interpersonal communication) and the covariates as predictors, and random intercepts per participant. To provide insight into the role of each of the studied psychosocial determinants and communication types separately, all studied relations were also tested in univariate models, only including the focal predictor, the covariates, and random intercepts per participant. These univariate results are needed to inform future intervention research and provide guidance on which determinants to select and target in an intervention stimulating the desired behavior (Crutzen & Peters, 2020).

To test hypothesis 5, the total relation of the communication types on physical distancing behavior was split into the direct relation and the indirect relation between the communication types and physical distancing behaviors mediated by the psychosocial determinants. Both relations were estimated simultaneously in the mlma package for multi-level mediation (Yu & Li, 2020a, 2020b), however, without the covariates. Statistical relevance of the paths was determined based on bootstrapped confidence intervals and we established mediation when the confidence interval of the indirect relation via one of the psychosocial determinants did not include 0. Furthermore, if the direct relation holds, we conclude partial mediation and when the direct relation is not statistically significant, we conclude that the psychosocial determinants fully mediates the relation.

Finally, addressing the exploratory research questions, we investigated the moderating role of the valence of affective responses to communication (RQ1) using the same model as in hypothesis 4, with the addition of an interaction term for the standardized score for each type of communication and the respective standardized valence of affective response. Significant interactions were plotted for interpretation of the different slopes.

To analyze the behavioral impact of the government COVID-19 press conferences (RQ2), we specified a similar multivariate linear mixed-effects model with physical distancing as the dependent variable, random intercepts per participant, the preregistered and temperature covariates, and a dummy variable that coded whether a COVID-19 press conference took place on that day (and a second dummy for the day after the press conferences) was added to the model. Also, we explored whether there was a linear decline in adherence to the regulations by using the same model but changing the press conference dummy for a continuous variable that measured the number of days since the last press conference.

First, we investigated whether adolescents and young adults would be more likely the keep physical distance on the day of the national press conferences. We created a dummy variable that marked both dates on which there was a national press conference. A second dummy variable marked both dates of the days after the national press conferences. Again, linear mixed-effects models were used in which physical distancing was predicted by the dummy variable and the covariates, and random intercept per participant.

RESULTS

THE RELATIONS BETWEEN PSYCHOSOCIAL DETERMINANTS AND PHYSICAL DISTANCING BEHAVIOR (H1-H3)

The fixed effects in multivariate model testing hypotheses 1 to 3 explained 44% of the variance in physical distancing in the school sample and 35% in the university sample (marginal R^2). The proportion of variance explained by both fixed and random effects was 69% in the school sample and 66% in the university sample (conditional R^2). As can be seen in ***Table 2***, the perceived severity of the spread of the COVID-19, the perceived response efficacy, and both the descriptive and injunctive norm significantly related to physical distancing in the school sample.

VARIABLE	B	95% CI FOR B		SE	β	DF	T	P
		LL	UL					
Intercept	2.16	1.84	2.48	0.16		1297.77	13.40	<.001
Perceived severity	0.05	0.00	0.10	0.02	0.05	1760.84	2.14	0.032
Perceived susceptibility	0.03	−0.01	0.08	0.02	0.03	1639.10	1.54	0.123
Response efficacy	0.08	0.04	0.12	0.02	0.09	1581.00	4.05	<.001
Descriptive norm	0.42	0.39	0.46	0.02	0.49	1803.12	24.61	<.001
Injunctive norm	0.07	0.04	0.10	0.02	0.10	1665.07	4.62	<.001
Sex (Male)	−0.13	−0.27	0.02	0.07	−0.05	344.75	−1.73	0.084
Age	−0.02	−0.06	0.01	0.02	−0.04	357.68	−1.27	0.206
Mean temperature	0.00	−0.01	0.01	0.00	0.00	1623.29	−0.05	0.959
Week	−0.21	−0.28	−0.14	0.04	−0.09	1602.70	−5.94	<.001
Day	−0.05	−0.07	−0.03	0.01	−0.06	1587.39	−4.73	<.001

Table 2 Multivariate Linear Mixed-Effects Model Predicting Physical Distancing Behavior in the School Sample.
Note: $N = 375$. $ICC_{Participant} = .46$. Marginal $R^2 = .44$. Conditional $R^2 = .69$.

VARIABLE	B	95% CI FOR B		SE	β	DF	T	P
		LL	UL					
Intercept	1.91	1.47	2.35	0.23		1008.75	8.45	<.001
Perceived severity	0.04	−0.01	0.10	0.03	0.04	1374.41	1.50	0.133
Perceived susceptibility	0.01	−0.04	0.06	0.03	0.01	1291.87	0.24	0.810
Response efficacy	0.14	0.09	0.20	0.03	0.14	1191.50	5.02	<.001
Descriptive norm	0.40	0.36	0.44	0.02	0.46	1401.92	19.32	<.001
Injunctive norm	0.05	0.01	0.09	0.02	0.06	1336.88	2.48	0.013
Sex (Male)	−0.02	−0.22	0.17	0.10	−0.01	268.17	−0.23	0.816
Age	−0.04	−0.08	0.01	0.02	−0.06	289.86	−1.66	0.097
Mean temperature	−0.01	−0.02	0.00	0.01	−0.02	1233.40	−1.36	0.174
Week	−0.08	−0.16	0.00	0.04	−0.03	1226.20	−2.04	0.041
Day	0.00	−0.03	0.03	0.01	0.00	1215.35	0.08	0.936

Table 3 Multivariate Linear Mixed-Effects Model Predicting Physical Distancing Behavior in the University Sample.
Note: $N = 305$. $ICC_{Participant} = .47$. Marginal $R^2 = .35$. Conditional $R^2 = .66$.

As ***Table 3*** shows, similar relations emerged, with the exception that we found no significant relation between perceived severity and physical distancing in the university sample.

Of all covariates, only the week and day variables were significantly related to physical distancing behavior. The week had a small negative effect on physical distancing behaviors, meaning that physical distancing was lower in the second week compared to the first week of measurement. In the school sample, there was also a small negative effect of the day of the week. This means that, besides an overall decline in adherence to the regulations from week to week, adolescents also decreased in their physical distancing behaviors as a week progressed from Monday to Friday.

The univariate analyses presented in ***Tables 4*** and ***5*** yielded significant relations for all psychosocial determinants with physical distancing, but the standardized coefficients suggested varying strength. In summary, the univariate analyses provided support for all hypotheses in both samples, although the effect sizes for the perceived susceptibility were relatively small ($b < .10$). The multivariate analyses provided support for H1a, (perceived severity) H2b (perceived response efficacy), H3a (descriptive social norm), H3b (injunctive social norm) in both samples, and for H1b (perceived susceptibility) in the school sample only. As indicated above, H2a (self-efficacy) could not be tested due to an omission in the questionnaire. In both the multivariate

PREDICTOR	CRITERION	*B*	*95% CI*		SE	*β*	*DF*	*T*	*P*
			LL	UL					
Perceived severity	Physical distancing	.13	.08	.16	.02	.12	3076.28	6.29	<.000
Perceived susceptibility	Physical distancing	.08	.04	.13	.02	.09	2844.83	4.00	<.000
Response efficacy	Physical distancing	.12	.10	.18	.02	.14	2784.65	6.67	<.000
Descriptive norm	Physical distancing	.47	.52	.58	.02	.55	1961.95	31.23	<.000
Injunctive norm	Physical distancing	.22	.27	.35	.02	.31	2089.63	14.08	<.000
Mass media	Physical distancing	.05	.01	.07	.02	.04	3073.08	2.29	.022
Social media	Physical distancing	.01	−.02	.04	.02	.01	2904.60	.53	.593
Interpersonal communication	Physical distancing	−.03	−.05	.01	.02	−.02	2952.31	−1.24	.213
Mass media	Perceived severity	.02	−.01	.04	.01	.02	3981.30	1.30	.194
Social media	Perceived severity	.03	.00	.05	.01	.02	3804.03	1.93	.054
Interpersonal communication	Perceived severity	−.02	−.04	.01	.02	−.01	3845.66	−1.27	.205
Mass media	Perceived susceptibility	−.03	−.04	.00	.01	−.02	3882.69	−1.83	.068
Social media	Perceived susceptibility	−.03	−.04	.00	.01	−.02	3737.34	−1.86	.064
Interpersonal communication	Perceived susceptibility	.00	−.02	.02	.02	.00	3768.29	−.15	.878
Mass media	Response efficacy	−.02	−.04	.01	.02	−.02	3887.26	−1.29	.198
Social media	Response efficacy	−.01	−.02	.02	.02	.00	3739.52	−.49	.626
Interpersonal communication	Response efficacy	−.02	−.03	.01	.02	−.01	377.80	−1.11	.268
Mass media	Descriptive norm	.06	.00	.09	.03	.05	2227.78	2.13	.033
Social media	Descriptive norm	−.03	−.05	.02	.03	−.02	2117.46	−.88	.379
Interpersonal communication	Descriptive norm	−.04	−.06	.01	.03	−.03	2146.49	−1.36	.175
Mass media	Injunctive norm	.00	−.03	.03	.03	.00	2526.49	.00	.997
Social media	Injunctive norm	−.03	−.04	.01	.03	−.02	2389.07	−1.12	.261
Interpersonal communication	Injunctive norm	−.06	−.06	.00	.03	−.03	2393.37	−2.04	.042

Table 4 Univariate Linear Mixed-Effects Predicting Physical Distancing Behavior in the School Sample.

and the univariate analyses, the perceived descriptive norm prevailed with the largest standardized effect size, being three to four times as strong as the other significant relations.

COMMUNICATION ABOUT COVID-19 AND PHYSICAL DISTANCING BEHAVIOR: DIRECT AND INDIRECT RELATIONS (H4-H5)

The fourth hypothesis focused on the level of exposure to communication about the COVID-19 pandemic from various types of communication on young people's physical distancing, hypothesizing that higher levels of exposure to COVID-19 information via (H4a) mass media, (H4b) social media, and (H4c) interpersonal communication would relate to more physical distancing behavior.

As can be seen in ***Table 6***, only the level of communication about the COVID-19 consumed on mass media significantly related to physical distancing in the school sample. As shown in ***Table 7***, none of the three types of communication were related to physical distancing in the university sample. The same patterns emerged for the univariate analyses (***Tables 4*** and ***5***). This means that we found almost no evidence that supports hypothesis 4, except for the partial evidence for hypothesis 4a in the school sample. That is, adolescents who had heard or seen more about COVID-19 on mass media, more often kept a physical distance from others.

The fifth hypothesis investigated whether the relation between exposure to communication about the COVID-19 pandemic from various types of communication and physical distancing behavior would be mediated by (a) perceived severity, (b) perceived susceptibility, (c) perceived efficacy, (d) descriptive norms, and (e) injunctive norms. For each of the hypothesized paths, the total relation was broken down into the direct relation between the communication type and physical distancing behavior, and the indirect relation mediated by one of the behavioral predictors.

Table 8 shows the total, the direct, and the indirect effects in the school sample. As can be seen, an indirect effect of descriptive norms was observed in the relation

PREDICTOR	CRITERION	*B*	*95% CI*		SE	*β*	*DF*	*T*	*P*
			LL	UL					
Perceived severity	Physical distancing	.14	.08	.16	.03	.12	2385.72	5.39	<.000
Perceived susceptibility	Physical distancing	.06	.02	.11	.02	.07	2349.69	2.98	.003
Response efficacy	Physical distancing	.24	.19	.28	.02	.23	1975.66	9.75	<.000
Descriptive norm	Physical distancing	.43	.45	.54	.02	.50	1391.40	22.12	<.000
Injunctive norm	Physical distancing	.21	.22	.31	.02	.27	2253.68	12.05	<.000
Mass media	Physical distancing	.02	–.02	.06	.02	.02	2507.38	1.13	.258
Social media	Physical distancing	.02	–.01	.05	.02	.02	2405.63	1.14	.253
Interpersonal communication	Physical distancing	–.03	–.06	.01	.02	–.02	2461.32	–1.32	.187
Mass media	Perceived severity	.02	.00	.05	.01	.02	3228.28	1.64	.100
Social media	Perceived severity	.04	.01	.06	.01	.04	3121.86	2.97	.003
Interpersonal communication	Perceived severity	.01	–.01	.03	.01	.01	3174.95	.83	.408
Mass media	Perceived susceptibility	.00	–.02	.03	.02	.00	3226.73	.22	.827
Social media	Perceived susceptibility	–.02	–.04	.01	.02	–.02	3123.81	–1.41	.158
Interpersonal communication	Perceived susceptibility	.04	.01	.05	.02	.03	3176.56	2.42	.016
Mass media	Response efficacy	–.03	–.05	.00	.01	–.02	3171.68	–1.99	.046
Social media	Response efficacy	–.03	–.05	–.01	.01	–.03	3089.05	–2.51	.012
Interpersonal communication	Response efficacy	–.02	–.04	.00	.01	–.02	3129.56	–1.75	.080
Mass media	Descriptive norm	–.04	–.08	.01	.03	–.03	1602.81	–1.36	.175
Social media	Descriptive norm	–.04	–.07	.01	.03	–.03	1534.41	–1.30	.194
Interpersonal communication	Descriptive norm	–.07	–.09	.00	.03	–.05	1585.68	–2.09	.037
Mass media	Injunctive norm	–.03	–.04	.01	.02	–.02	321.60	–1.42	.157
Social media	Injunctive norm	–.01	–.03	.02	.02	–.01	3111.61	–.52	.602
Interpersonal communication	Injunctive norm	.01	–.02	.03	.02	.01	316.94	.52	.601

Table 5 Univariate Linear Mixed-Effects Predicting Physical Distancing Behavior in the University Sample.

VARIABLE	*B*	*95% CI FOR B*		SE	*β*	*DF*	*T*	*P*
		LL	UL					
Intercept	4.86	4.66	5.07	0.10		2739.29	47.39	<.001
Social media	0.00	–0.04	0.04	0.02	0.00	2836.55	0.02	0.985
Mass media	0.05	0.01	0.09	0.02	0.04	3041.56	2.44	0.015
Interpersonal communication	–0.04	–0.08	0.01	0.02	–0.03	2905.09	–1.69	0.091
Sex (Male)	–0.07	–0.25	0.12	0.09	–0.03	455.50	–0.72	0.470
Age	–0.03	–0.08	0.02	0.02	–0.05	450.20	–1.24	0.216
Mean temperature	–0.01	–0.02	0.00	0.00	–0.03	2749.07	–2.24	0.025
Week	–0.12	–0.18	–0.06	0.03	–0.05	2741.65	–3.91	<.001
Day	–0.03	–0.05	–0.01	0.01	–0.04	2718.36	–2.95	0.003

Table 6 Multivariate Linear Mixed-Effects Model Predicting Physical Distancing Behavior in the School Sample.

Note: $N = 460$. $ICC_{Participant} = .61$. Marginal $R^2 = .01$. Conditional $R^2 = .62$.

VARIABLE	*B*	*95% CI FOR B*		SE	*β*	*DF*	*T*	*P*
		LL	*UL*					
Intercept	4.95	4.68	5.21	0.14	–	1960.33	36.52	<.001
Social media	0.02	−0.02	0.07	0.02	0.02	2364.65	1.01	0.314
Mass media	0.03	−0.02	0.07	0.02	0.02	2478.81	1.10	0.273
Interpersonal communication	−0.04	−0.09	0.00	0.02	−0.03	2420.56	−1.84	0.065
Sex (Male)	−0.09	−0.32	0.14	0.12	−0.03	377.99	−0.76	0.450
Age	−0.02	−0.06	0.03	0.02	−0.03	384.96	−0.71	0.475
Mean temperature	−0.02	−0.04	−0.01	0.01	−0.06	2246.58	−4.10	<.001
Week	−0.09	−0.15	−0.02	0.03	−0.04	2245.18	−2.72	0.007
Day	0.03	0.01	0.06	0.01	0.04	2224.17	3.06	0.002

Table 7 Multivariate Linear Mixed-Effects Model Predicting Physical Distancing Behavior in the University Sample.
Note: N = 380. $ICC_{Participant}$ = .59. Marginal R^2 = .01. Conditional R^2 = .59.

	TOTAL EFFECT	DIRECT EFFECT	INDIRECT EFFECT VIA				
			PERCEIVED SEVERITY	PERCEIVED SUSCEPTIBILITY	RESPONSE EFFICACY	DESCRIPTIVE NORM	INJUNCTIVE NORM
Mass media	.096*	.057*	.001	−.001	−.002	.039*	.002
Social media	.058*	.069*	.002*	−.001	<.001	−.012	−.001
Interpersonal communication	−.013	.016	−.002	<.001	−.001	−.022	−.004

Table 8 Total Effects, Direct Effects and Indirect Effects on Physical Distancing Behavior in the School Sample.
Note: N = 481.
* 95% Confidence Interval does not include 0.

between mass media communication about COVID-19 and physical distancing behavior, b = .039, $b_{bootstrapped}$ = .041, 95% CI = [.013, .069]. Because we also observed a significant total effect ($b_{bootstrapped}$ = .102, 95% CI = [.051, .152]) and direct effect ($b_{bootstrapped}$ = .060, 95% CI = [.018, .102]), we conclude that the perceived descriptive norm partially mediated the relation between mass media communication about COVID-19 and physical distancing behavior in the school sample.

Also, an indirect effect of perceived severity was observed in the relation between social media communication about COVID-19 and physical distancing behavior, b = .002, $b_{bootstrapped}$ = .002, 95% CI = [<.001, .005]. Again, a significant total effect ($b_{bootstrapped}$ = .063, 95% CI = [.009, .117]) and direct effect ($b_{bootstrapped}$ = .073, 95% CI = [.025, .122]) was observed. However, in the previous models, we have seen no indication of a relation between mass media communication about COVID-19 and physical distancing behavior, and potentially the direct and total effects are now observed because the control variables could not be included in the mediation models. Therefore, we are cautious in concluding that perceived severity partially mediated the relation between social media communication about COVID-19 and physical distancing behavior in the school sample.

Table 9 shows the total, the direct, and the indirect effects in the university sample. As can be seen, a negative indirect effect of descriptive norms was observed in the relation between interpersonal communication about COVID-19 and physical distancing behavior, b = −.030, $b_{bootstrapped}$ = −.030, 95% CI = [−.058, −.002]. And because the direct effect was not statistically significant, we conclude that the perceived descriptive norm fully mediated the relation between interpersonal communication about COVID-19 and physical distancing behavior in the university sample.

COMMUNICATION ABOUT COVID-19 AND PHYSICAL DISTANCING BEHAVIOR: THE ROLE OF AFFECTIVE RESPONSES AND PRESS CONFERENCES (RQ1-RQ2)

With regard to the role of the valence of the affective response to COVID-19 communication (RQ1), two models were used in which the (standardized) types of communication interacted with the (standardized) valence of the three types of communication. In the school sample, none of the interaction parameters related to physical distancing behavior.

However, in the university sample, the interaction between mass media and mass media valence did

have a small significant relation with physical distancing behavior, B = .04, 95% CI = [.004, .08], SE = .02, df = 2389.47, p = .028. Inspecting the simple slopes for negative (<3), neutral (3–5), and positive valence (>5) showed that the relation between physical distancing and mass media was different for those who experienced the valence of communication on mass media as negative (small negative non-significant trend) compared to those who experienced the valence of communication on mass media as neutral to positive (non-significant relation), see ***Figure 1***.

Our second research question explored the relation between COVID-19 national press conferences and young people's physical distancing behavior. In both samples, the average physical distancing was not higher on the day of the press conferences, nor on the day after the press conference as compared to the other days, see ***Figure 2***. In the figure, the days on which a national press conference was released are marked with a vertical line and square boxes.

Second, we looked at the linear relation between the number of days since the last national press conferences and physical distancing behaviors. In both samples, we did not observe a linear relation between the number of days since the last press conference and physical distancing behavior, see ***Figure 3***.

ADDITIONAL ANALYSIS: EXPLORING THE DIRECTIONALITY OF THE RELATION BETWEEN DESCRIPTIVE NORMS AND PHYSICAL DISTANCING BEHAVIOR

Finally, given the consistently large effect size observed for the relation between descriptive norm and physical distancing behavior, we decided to further investigate the directionality of this relation. Although based on the theory we assume that the direction points from descriptive norm to behavior, it is also conceivable that an individual's engagement in a behavior affects how they perceive peers in their social environment to behave. To test both effects simultaneously we used random intercept cross-lagged models the causal relations between the descriptive norm and physical distancing behavior on consecutive days and controlling for the observed association (covariance)

	TOTAL EFFECT	DIRECT EFFECT	INDIRECT EFFECT VIA				
			PERCEIVED SEVERITY	PERCEIVED SUSCEPTIBILITY	RESPONSE EFFICACY	DESCRIPTIVE NORM	INJUNCTIVE NORM
Mass media	–.001	.008	.001	.000	–.002	–.006	–.001
Social media	.025	.039	.002	–.001	–.004	–.011	–.001
Interpersonal communication	–.072*	–.041	.000	.001	–.002	–.030*	.001

Table 9 Total Effects, Direct Effects and Indirect Effects on Physical Distancing Behavior in the University Sample.
Note: N = 404.
* 95% Confidence Interval does not include 0.

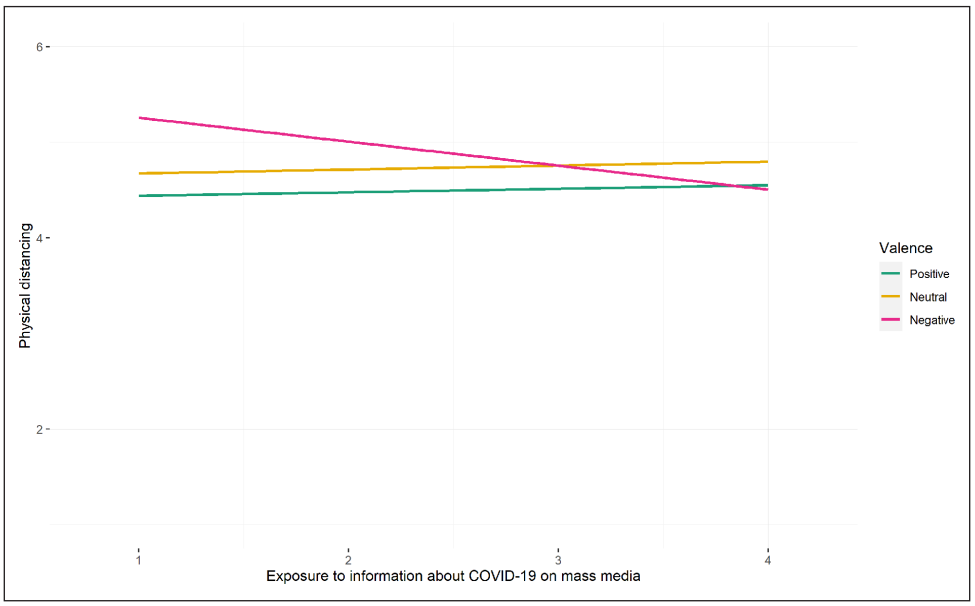

Figure 1 Simple Slopes of the Interaction Between Mass Media and Mass Media Valence on Physical Distancing in the University Sample.

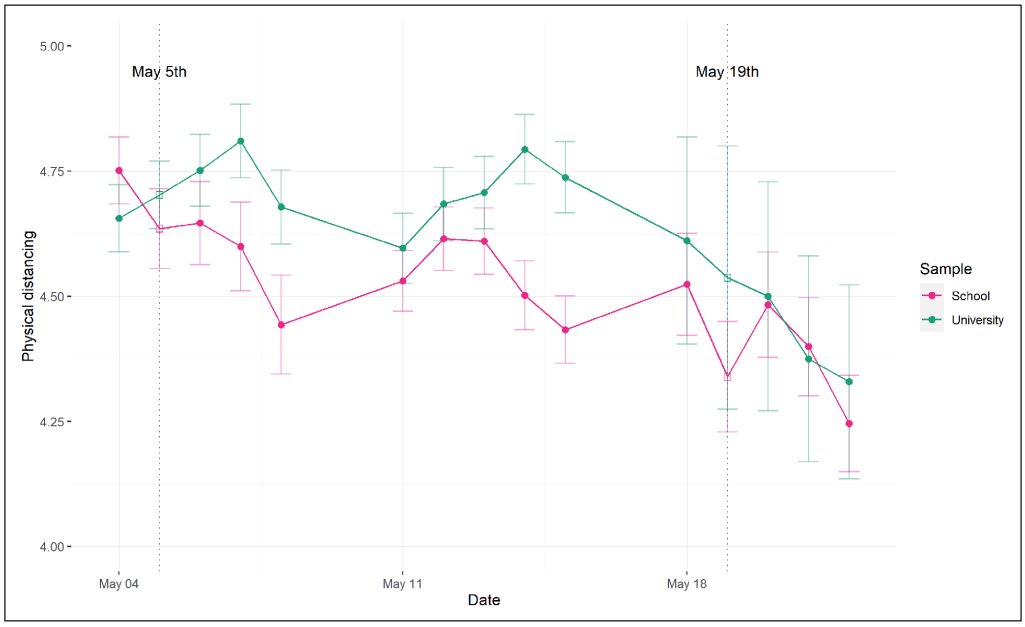

Figure 2 Average Physical Distancing Behavior in the Two Samples from Monday May 4th until Friday May 22nd.
Note: Days on which a press conference was held are marked with a box and a vertical line (May 5th and May 19th).

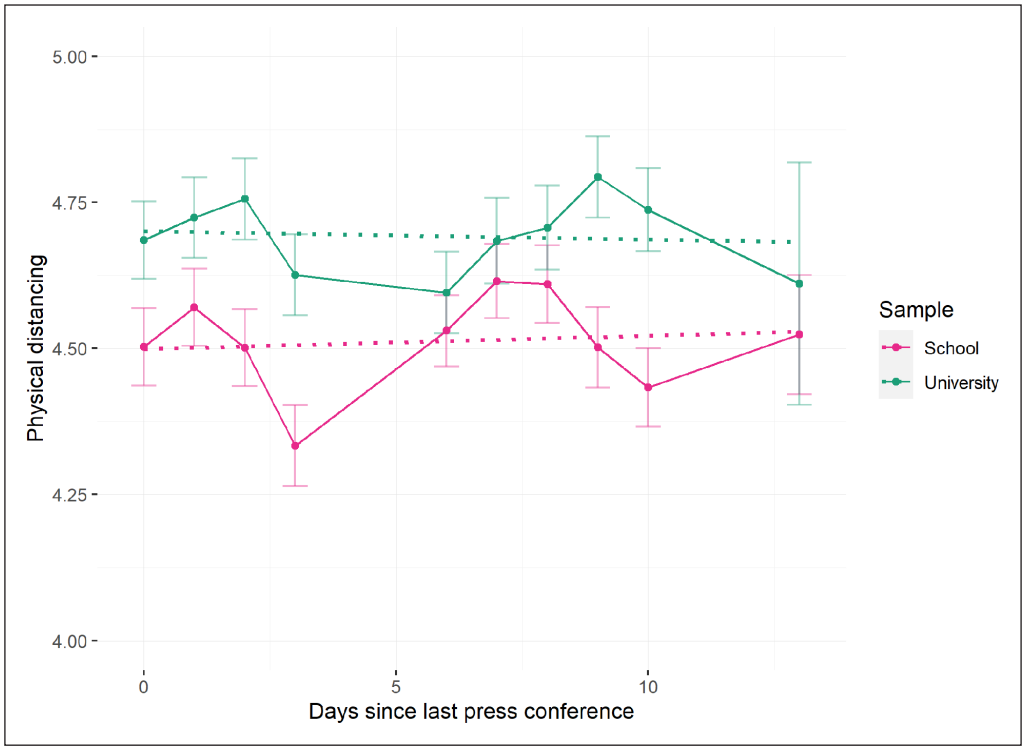

Figure 3 Average Physical Distancing Behavior in the Two Samples in the Days After a National Press Conference.
Note: The dotted line represents the estimated linear relation between the mean physical distancing behavior and the days since the last press conference.

between descriptive norm and physical distancing and their autoregressive effects (Hamaker et al., 2015). For each sample, a separate model was specified in which the lagged regressions predicted the behavior or the descriptive norms on the subsequent day of the week. The week (week 1 vs week 2) was added as a grouping variable to control for differences between the weeks. We constrained all covariances, autoregressive effects, and cross-lagged effects to be the same to have average effects for the school sample and the university sample.

The models had a good fit (Hu & Bentler, 1999; Kline, 2015) for the school sample; $\chi^2/df = 1.528$, CFI = .980, TLI = .980, RMSEA = .034, SRMR = .052, and the university sample; $\chi^2/df = 1.416$, CFI = .979, TLI = .980, RMSEA = .032, SRMR = .056. Also, significant average covariances of the descriptive norm and physical distancing behavior on the same day were observed in both the school sample (b = .335, SE = .022, z = 15.23, $p < .001$) and the university

sample (b = .241, SE = .020, z = 11.98, p < .001). As can be seen in ***Tables 10*** and ***11***, the autoregressive effect of the descriptive norm was found in the school sample and the autoregressive effects of physical distancing behaviors were observed in both samples. With regard to the directionality of the relation, only a significant effect of physical distancing on the descriptive norm in the subsequent day was observed in the university sample, indicating a reversed direction leading from physical distancing behavior to the perceived social norms. All other relations were nonsignificant, yielding no further insight into the directionality of the relation between perceived social norms and physical distancing behavior.

DISCUSSION

The aim of this study was to gain a better understanding of young people's physical distancing behavior during the COVID-19 pandemic. We specifically focused on investigating the psychosocial determinants of young people's physical distancing behavior, and the role of exposure to information about COVID-19 through direct (i.e., interpersonal) and mediated communication (i.e., mass media, social media). The aim was addressed in a daily diary study among Dutch adolescents (school sample) and young adults (university sample), involving daily surveys administered on weekdays during two weeks in May 2020, a few months after the start of the COVID-19 pandemic. Based on our findings, four main conclusions can be drawn.

First, our findings demonstrate that the perceived descriptive norm was the strongest predictor of physical distancing behavior among both adolescents and young adults, followed by the perceived response efficacy, and the injunctive norm. The perceived severity was only a significant predictor of physical distancing in the school sample. It should be noted that the average score for this measure was very high, which may indicate a ceiling effect (most adolescents experienced the spread of the COVID-19 virus as highly severe). Nevertheless, there was still enough variance in the variable to signal an effect, and robust estimation yielded similar results. The descriptive norm was even more strongly prevailing among adolescents, while the perceived response efficacy appeared to play a complementary important role among young adults. These results indicate that the descriptive norm seems, relatively, the most important psychosocial determinant to target in physical distancing interventions in young people. Interestingly, our multivariate analyses did not yield any evidence for perceived susceptibility as a predictor of physical distancing behavior, neither among adolescents nor young adults, while the univariate analyses showed only a weak association. Potentially, some of the individual behavioral determinants become redundant in predicting physical activity when all other predictors are considered, due to interrelatedness, or dependence, of these psychosocial constructs. Also, perceived susceptibility could overlap with other predictors, resulting in a non-significant unique explained variance that is not overlapping with any of the other predictors (G.-J. Peters & Crutzen, 2018).

These findings are largely in line with psychosocial models, such as the Health Belief Model (Glanz et al., 2015) and the Protection Motivation Theory (Rogers, 1975;

PREDICTOR	CRITERION (T+1)	B	95% CI FOR B		SE	Z	P
			LL	UL			
Descriptive norm	Descriptive norm	.10	.01	.19	.05	2.22	.026
Physical distancing	Descriptive norm	.03	–.07	.13	.05	0.62	.538
Descriptive norm	Physical distancing	.05	–.01	.11	.03	1.50	.134
Physical distancing	Physical distancing	.09	.01	.17	.04	2.18	.029

Table 10 Random Intercept Cross-lagged Panel Model for the School Sample.
Note: N = 464.

PREDICTOR`	CRITERION (T+1)	B	95% CI FOR B		SE	Z	P
			LL	UL			
Descriptive norm	Descriptive norm	0.02	–0.06	0.11	0.04	0.51	0.613
Physical distancing	Descriptive norms	0.10	0.00	0.19	0.05	1.96	0.050
Descriptive norm	Physical distancing	–0.03	–0.10	0.04	0.03	–0.92	0.360
Physical distancing	Physical distancing	0.21	0.12	0.29	0.04	4.84	0.000

Table 11 Random Intercept Cross-lagged Panel Model for the University Sample.
Note: N = 398.

Witte, 1992), showing that perceptions about the threat and perceptions about the efficacy of the recommended preventive behavior both related to physical distancing behavior. Additionally, in line with Social Cognitive Theory (Bandura, 1986, 2004), our findings show that perceived social norms are related to young people's physical distancing behavior as well. This confirms the argument previously made by others that when studying physical distancing behavior or other preventive health behaviors, social norms must be considered to gain a full understanding of the behavior (Bavel et al., 2020; Chan et al., 2020). Importantly, conclusions with regard to the relation between perceived social norms and physical distancing behavior should be interpreted with caution. Based on Social Cognitive Theory (Bandura, 1986, 2004) a plausible interpretation of this relation would be that young people's physical distancing behavior is influenced by how they perceive peers in their social environment behave. However, the observed relation could also be interpreted as a false consensus effect (Ross et al., 1977), whereby individuals exaggerate the likelihood that other people are like themselves. In other words, the young people in our sample could have assumed that their physical distancing behavior is relatively widespread among their friends. As such, their reflection on their own physical distancing behavior may have affected their perceptions of the behavior of their friends (i.e, perceived social norms). Although our additional analyses into the directionality of the relation between social norms and physical distancing give some indication that physical distancing influences the perceived social norm, we cannot tell based on our data whether this is caused by a false consensus effect.

Taken together, the above described findings suggest that for behavioral intervention (research), social norms, perceived severity, and perceived efficacy of the behavioral measures appear to be the most promising determinants to focus on. Despite the convincing and consistent importance of social norms in our analyses, we recommend intervention research to also investigate the potential of alternative determinants, because social norms may be more difficult to manipulate than perceived severity and response efficacy.

A second conclusion that we can draw based on our findings is that adolescents who are more exposed to communication about the COVID-19 pandemic on *mass media* also engage more in physical distancing behavior, which is explained by an increased perception of the behavior in their social environment. Adolescents who were more often exposed to communication about COVID-19 on mass media perceived that their friends more often kept a 1.5-meter distance from others, which in turn related to an increase in their own physical distancing behavior. This indicates that social norms can be derived through indirect mediated communication, for example through mass media (Hong & Kim, 2020; Rimal & Storey, 2020). It should be noted that we have not found any statistical evidence for this relation among young adults. Moreover, the above described results need to be interpreted with caution, because the observed relation for mass media is small and our study does not allow conclusions about the directionality for this mediated association.

Aside from a few weak indirect paths between the three types of communication and physical distancing, hardly any evidence was found that exposure to COVID-related information was related to physical distancing behavior. One explanation for this is that the COVID-19 related communication on mass media, overall, is more formal and controlled than information via social media and interpersonal communication. During the COVID-19 pandemic, mass media communication channels such as television, radio, newspaper, news apps, and websites are being used extensively by the government, health organizations, and journalists to share information about COVID-19 and specifically about physical distancing as one of the recommended behaviors to combat the virus. Information about COVID-19 and physical distancing on social media and between is also shared by informal sources (e.g., influencers, celebrities, friends, and other acquaintances) (Manganello et al., 2020), while interpersonal communication only involves informal sources. Our findings warrant further research to dive deeper into the specific content of the COVID-19 communication that individuals are exposed to, for example differentiating between more or less controlled and reliable content.

Providing further support for that recommendation, our exploratory analyses regarding affective responses to communication demonstrated that young adults' exposure to COVID-related mass media communication was negatively associated with physical distancing for those young adults who experienced more negative feelings with the exposure. This indicates that the valence of the feelings people experience about information about COVID-19 can influence the direction of the relation between exposure to communication about COVID-19 and physical distancing behavior.

This is in line with the affect-as-information hypothesis (Storbeck & Clore, 2008) and earlier research showing that more negative valenced experiences can deter people from performing the desired behavior, while more positively valenced experiences can actually stimulate people to perform the behavior (Janicke-Bowles et al., 2019; Witte, 1992). Confirmatory replications of these findings are needed to draw more robust conclusions, but these preliminary results suggest that the valence of the feelings people experience about information about COVID-19 should be taken into account when studying the impact of pandemic-related communication. Referring to our recommendation to dive deeper into the specific content of communication, affective

responses are highly likely to relate to the valence of the communication, for example distinguishing between more or less threatening, hopeful and/or inspiring content.

Fourth, in both the school and university samples, we did not observe an increase in physical distancing behavior on the day of the national press conferences nor on the days thereafter. However, in general, we did see a small decline in physical distancing behavior over time (within the weeks but also between the weeks). An explanation for this might be that in the period in which this research was conducted, the number of COVID-related infections, hospital admissions, and deaths in the Netherlands decreased and a 'road map' containing the gradual phasing out of the strict lockdown measures (e.g., reopening primary schools, contact professions back to work, outdoor sports allowed, reopening restaurants and bars) was presented by the government. Although the advice to keep a distance from others remained unabated despite these relaxations, it is quite possible that the participants in this study felt less compelled to adhere to it because of these positive developments.

Finally, our analyses yielded another opening for further investigation, namely that the weather conditions, particularly the daily temperature, played a significant role in young people's physical distancing behavior. Some of our analyses, in which the daily temperature was added as a covariate, showed that the higher the daily temperature, the less likely young people were to keep a distance. An explanation for this is that when the temperature rises, people go outside more often and meet with others, for example in a park, forest, or on the beach. This finding shows that contextual factors, such as the weather, can play an important role in young people's compliance with the behavioral regulations. This insight might be of interest to other researchers as well as professionals involved in COVID-19 policy development, which may not only involve behavioral intervention, stimulating ability and motivation to engage in the desired behavior, but also intervention in the physical environment, increasing the opportunity to engage in the behavior (Michie et al., 2011).

STRENGTHS, LIMITATIONS, AND RECOMMENDATIONS

By using a daily diary methodology to measure physical distancing behavior, its behavioral determinants, and exposure to communication about COVID-19, we were able to address some of the shortcomings of retrospective self-reported measures. More specifically, with the used methodology we were able to assess the variety of variables more accurately while addressing certain confounders that have to do with the timing of the measurement (for example, answering the questionnaire on Monday versus a Friday) or factors that differ between days (such as the weather or national press conferences). Furthermore, this study has pursued transparent, open-science practices in which the hypotheses and analyses have been preregistered and the data and scripts are publicly available.

The research also has some limitations that must be considered when interpreting the findings and that can be addressed in future research. First, although we intended to measure perceived self-efficacy as one of the behavioral determinants, unfortunately, this variable was not included in the daily questionnaires due to a technical error. According to health behavior theory and research (Glanz et al., 2015; Witte, 1992), people who believe in their capability to engage in protective behavior (i.e., high self-efficacy) are more likely to engage in the behavior than those with low self-efficacy (Rosenstock et al., 2016). In order to fully understand what drives young people's physical distancing behavior, future research should investigate the importance of self-efficacy (i.e., young people's belief in their own ability to keep a physical distance of 1.5 meter from others) as one of the behavioral determinants of young people's physical distancing behavior.

Second, physical distancing was measured through self-report. The respondents were asked to report each day how often they had kept a physical distance from others in the past 24 hours. It is conceivable that the actual physical distancing behavior of the participants deviated from what they reported, partly because self-reporting of behavior is subject to recall bias. Even though the measures used were adequate to assess fluctuations and associations with the determinants, future research could try to investigate the physical distancing behavior of young people more objectively, for example by using smartphone Bluetooth technology with which proximity to others can be automatically recorded (Simoski et al., 2020; Woudenberg et al., 2020). Or perhaps, with additional consent, using data from corona exposure apps.

Third, a comparable limitation applies to the measurement of exposure to information about COVID-19, which indicated young people's subjective assessment of the amount of information they were exposed to. The actual, objective amount of information exposure can deviate from this subjective assessment. Also, as indicated above, because information exposure was measured at a general level we do not know to what specific COVID-19 related content they were exposed. For future research, it is important to investigate in a more objective way how much of what kind of information young people consume and how that is, subsequently, related to their physical distancing behavior, for example by using media use tracking tools combined with content analysis.

Fourth, in this study, students could voluntarily register for participation. A disadvantage of this method is that self-selection bias can occur, which in this study may have caused a gender imbalance (more young women

than young men) in the sample. Based on the data, we cannot conclude that there are differences in the physical distancing behavior of young men and women, although other studies have found lower compliance among young males. A possible explanation is that the young males who agreed to participate were those inclined to be more conscientious or public-spirited and as a result also more inclined to adhere to the COVID-preventive measures, such as physical distancing. Consequently, they may not be representative of the broader young male population.

Finally, it should be noted that based on our data and analyses, no conclusions can be drawn about the directionality or the causality of the relations found. Our preliminary analyses exploring the directionality of the relation between the descriptive social norm and physical distancing behavior did not yield unambiguous additional insights. It is conceivable that these relations take more time to grow, or merely co-occur after the first steep increase in the early days of the crisis. It should be noted that most of our participants engaged in physical distancing behaviors, and fluctuations might pertain to slight dents in the maintenance of the behavior (for example due to temporary decreased ability or motivation). Further longitudinal research is needed to establish the causality of the relations found, varying between different intervals of time used in the analytical models. Furthermore, experimental research is needed to come to decisive conclusions about the causality of the relations observed, and their value for public intervention policies. Rapid-cycle experiments might be the most promising next step to select a strategy for larger-scale field interventions, testing and comparing the efficacy of targeting the various behavioral determinants. The rapid-cycle evaluation approach (Cody & Asher, 2014) involves small-scale studies that use random assignment to determine the impact of (components of) an intervention program over a short time-span and, thereby, allow to test and compare various intervention strategies to develop and improve intervention programs.

Our study indicates that such interventions should focus on descriptive and injunctive norms, and/or the perceived severity and the perceived efficacy of the behavioral measure. Social network intervention might provide a promising avenue (Smit et al., 2020; Valente, 2012; Van Woudenberg et al., 2020), in which selected peer influencers (or even social media influencers) can be encouraged to explain and endorse the publicly communicated behavioral measures, emphasizing the severity of the spreading of the virus and the efficacy of the behavior in stopping the virus from spreading. Such influencers might even encourage the use of reliable public information, for example following official sources such as governmental sources and the national health institute. Based on the literature on communication to young people (Buijzen, in press; Smit et al., in press; Yeager et al., 2018), it is crucial that such interventions are developed in collaboration with the target group and the influencers, and that the information provided is clear and simple, preferably focusing on one target behavior.

DATA ACCESSIBILITY STATEMENT

The data, syntax and output files are all stored on the Open Science Framework (OSF, *https://osf.io/3qgud/*).

ETHICS AND CONSENT

Informed consent was obtained from the participants before the start of the first measurement. For participants younger than 16, informed consent was obtained from one of the parents. Study procedures were approved by the Ethics Committee of the Erasmus University Rotterdam on April 16th, 2020 (application number 20–036).

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COMPETING INTERESTS

The authors have no competing interest to disclose.

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