



Prosocial nudges and visual indicators increase social distancing, but authoritative nudges do not

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Social distancing reduces the transmission of COVID-19 and other airborne diseases. To test different ways to increase social distancing, we conducted a field experiment at a major US airport using a system that presented color-coded visual indicators on crowdedness. We complemented those visual indicators with nudges commonly used to increase COVID-19-preventive behaviors. Analyzing data from 57,146 travelers, we find that visual indicators and nudges significantly affected social distancing. Introducing visual indicators increased the share of travelers practicing social distancing, and this positive effect was enhanced by introducing nudges focused on personal benefits (“protect yourself”) and public benefits (“protect others”). Conversely, an authoritative nudge referencing the Centers for Disease Control and Prevention (“don’t break CDC COVID-19 guidelines”) did not change social distancing behavior. Our results demonstrate that visual indicators and informed nudges can boost social distancing and potentially curb the spread of contagious diseases.

COVID-19 | public health messaging | nudge | reactance

Public health guidelines for social distancing are designed to reduce COVID-19 transmission and save lives. Although those guidelines are relatively straightforward—keep 6 ft apart from others—following them is not always simple. To boost compliance with social distancing guidelines, visual indicators, such as floor markings at 6-ft intervals, are often provided. Yet, information alone does not guarantee the behavior that it is intended to promote (1). To encourage social distancing, visual indicators are frequently accompanied by short messages or nudges. Different nudges have been widely employed during the pandemic to encourage social distancing and other COVID-19 risk-mitigating behaviors, including handwashing, mask wearing, and vaccination. In many cases, these nudges highlight how compliance benefits oneself and others (2–5) or emphasize the medical expertise and authority behind the promoted behavior (6, 7).

Research suggesting that nudges focusing on oneself or others foster preventive behaviors is often survey based. Furthermore, results are inconclusive with respect to the relative effectiveness of nudges that emphasize benefits to oneself vs. nudges that emphasize benefits to others (2–4, 8–10). Relatedly, despite their ubiquity in public health messaging, it is unclear how authoritative nudges affect compliance with health guidelines and whether they trigger psychological reactance causing contrarian behavior (7). To address this knowledge gap and provide empirical evidence to policy makers and public health officials, we examined how such commonly used nudges affect the adoption of COVID-19-preventive behavior in a real-world setting.

In a field study, we tested whether social distancing is affected by visual indicators accompanied by nudges emphasizing personal benefits, public benefits, or authority (building on three, five, and seven) (Table 1). The study was conducted at a major US

Table 1. Nudge text by condition

Condition	Nudge text
Baseline	<i>No text was displayed</i>
Generic	Go toward green for less crowded areas
Self	PROTECT YOURSELF. Go toward green for less crowded areas
Others	PROTECT OTHERS. Go toward green for less crowded areas
Authoritative	DON'T BREAK CDC COVID-19 GUIDELINES. Go toward green for less crowded areas

Conditions were randomly assigned to two 24-h periods starting at 8:00am local time, balancing between weekdays and weekends. Crowdedness monitoring system displays as well as airport wayfinding and check-in monitors showed the condition's message (i.e., nudge) to travelers throughout the terminal, while color-changing poles presented crowdedness levels at each gate (*Materials and Methods* and *SI Appendix*). Nudge text are the verbatim messages displayed to travelers. CDC is a known abbreviation for the Centers of Disease Control and Prevention.

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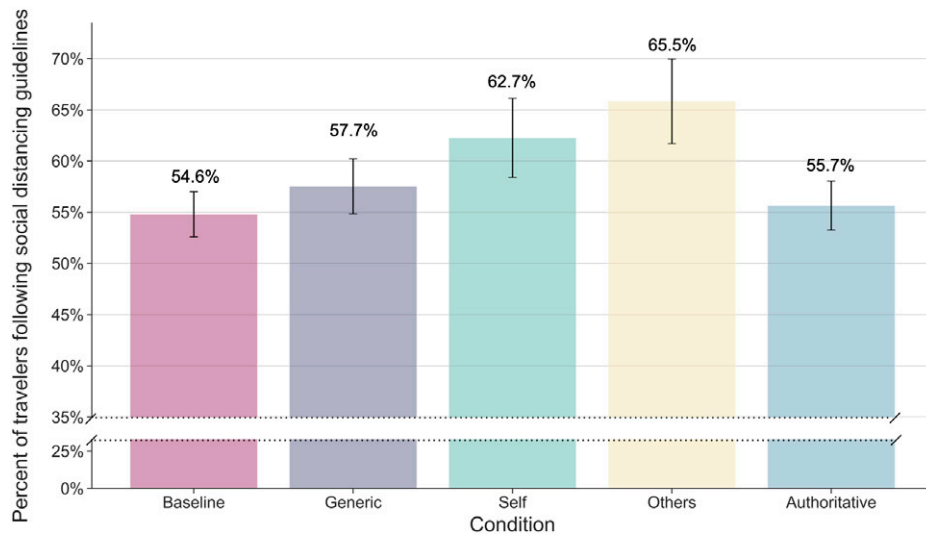


Fig. 1. Average social distancing at the terminal level at 30-min intervals as a function of the condition. Error bars are bootstrapped 95% CIs with 10,000 iterations. Observations are matched across conditions by the number of travelers.

airport during a 10-d period in January 2021. We monitored the minute-by-minute locations of 57,146 travelers and examined how social distancing varied in response to nudges presented on displays throughout a terminal (*Materials and Methods* and *SI Appendix, section 2*).

Results

Using a nonparametric approach, we first match observations across conditions by the number of travelers (11) and then, compare average social distancing compliance between conditions over 30-min time periods by estimating bootstrapped means, CIs, and P values (*SI Appendix, section 3* has the detailed methodology). Fig. 1 presents average social distancing for all conditions, and Table 2 presents results of pairwise comparisons at the terminal level and gate level.

First, to isolate the effects of visual indicators, we compare social distancing between the baseline and generic conditions. We find that social distancing in the generic condition was marginally higher than the baseline in the terminal-level analysis

($P < 0.10$) and significantly higher in the more granular gate-level analysis ($P < 0.01$).

Next, we compare social distancing between conditions (i.e., self, others, and authoritative) to examine the effectiveness of each nudge. Both analyses indicated that social distancing compliance was higher in the others and self conditions compared with the generic condition (Table 2). In contrast, social distancing was not statistically different between the authoritative condition and generic conditions.

Finally, we examine the consistency of social distancing differences between conditions across crowdedness levels at each airport gate. Crowdedness is the number of travelers at the gate divided by the gate's capacity. Gate capacity is the maximum number of travelers that can occupy the gate while maintaining social distancing (*SI Appendix, section 2.3*).

As depicted in Fig. 2, for lower crowdedness levels (between 15 and 25%), social distancing was higher in the self and others conditions (72%) compared with the generic condition (66%; P values < 0.05). As gates become more crowded, differences in social distancing between conditions become more apparent.

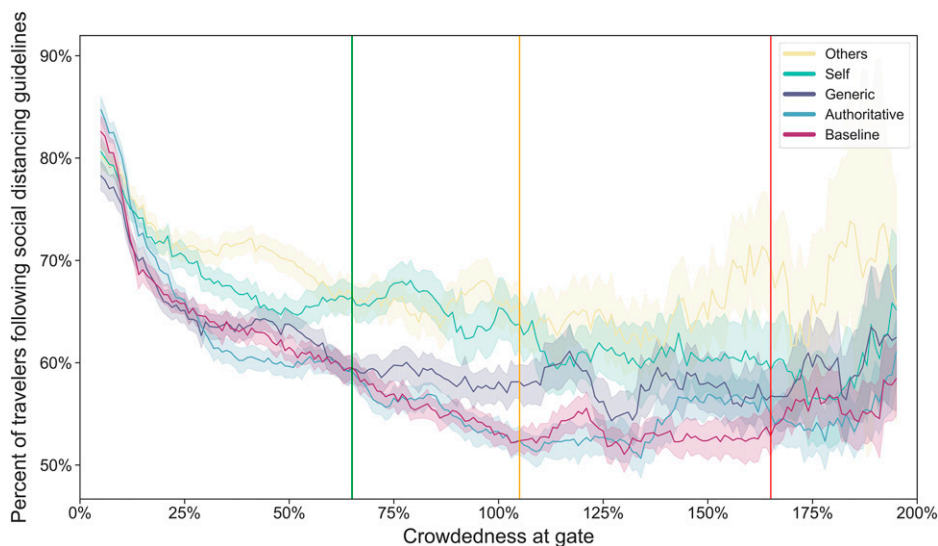


Fig. 2. Social distancing as a function of condition across gate crowdedness levels. Lines represent moving averages at 10% intervals for the share of travelers maintaining social distancing. Shaded areas represent bootstrapped 95% CIs with 10,000 iterations. Vertical lines mark the crowding thresholds for visual indicators to change colors (from light green to dark green at 65%, orange at 105%, and red at 165%).

Table 2. Differences in percentages of travelers complying with social distancing guidelines between condition pairs

Comparison	Analysis	
	Terminal level	Gate level
Generic vs. baseline	3.1*	4.4***
Others vs. generic	7.9***	4.8*
Self vs. generic	5.0***	5.0**
Authoritative vs. generic	-2.0	-1.8
Others vs. self	2.3	1.1
Observations	247	472

Each value is social distancing compliance of the latter condition subtracted from the former condition. CI and *P* values were bootstrapped with 10,000 iterations. Observations were aggregated into 30-min intervals and matched between conditions by the number of travelers. **P* < 0.10; ***P* < 0.05; ****P* < 0.01.

For example, between 70 and 80% crowdedness, social distancing in the self (68%) and others (66%) conditions remained higher than in the generic condition (60%; *P* values < 0.05). In contrast, at those crowdedness levels, the authoritative nudge decreased social distancing (57%; *P* values < 0.05).

Discussion

Visual indicators accompanied by nudges highlighting personal or public benefits of social distancing increased social distancing between ~9 and 16 percentage points. However, while public health communications often refer to a medical authority (6), our results suggest that such efforts may be in vain and fail to increase compliance.

This research serves as a timely reminder that people may not follow authoritative nudges, even if doing so harms themselves and others. Nevertheless, it is possible that people who travel during a pandemic are more risk tolerant and less inclined to adhere to CDC recommendations than the general public. In addition, as nudges were randomized across different days, there may be characteristic differences between travelers in each of the conditions. Since our findings are derived from a quasiexperimental design, subsequent research could utilize parallel interventions or a regression discontinuity design. Future work may also test the effects of different authority types (e.g., CDC vs. physicians) and milder reminders of authority (12). Individual differences, such as risk tolerance, political ideology (13), and individualist vs. collectivist cultural backgrounds (14), may also affect the adoption of different preventive behaviors and their enforcement (15).

With the persistence of new cases and hospitalizations, COVID-19 remains dangerous around the world. Our findings demonstrate how nudges can promote or hinder the prevention of COVID-19 and other contagious diseases.

- G. J. Hollands *et al.*, The impact of communicating genetic risks of disease on risk-reducing health behaviour: Systematic review with meta-analysis. *BMJ* **352**, i1102 (2016).
- N. Rabb, D. Glick, A. Houston, J. Bowers, D. Yokum, No evidence that collective-good appeals best promote COVID-related health behaviors. *Proc. Natl. Acad. Sci. U.S.A.* **118**, e210062118 (2021).
- M. Ceylan, C. Hayran, Message framing effects on individuals' social distancing and helping behavior during the COVID-19 pandemic. *Front. Psychol.* **12**, 579164 (2021).
- J. J. Jordan, E. Yoeli, D. G. Rand, Don't get it or don't spread it: Comparing self-interested versus prosocial motivations for COVID-19 prevention behaviors. *Sci. Rep.* **11**, 20222 (2021).
- K. L. Milkman *et al.*, A megastudy of text-based nudges encouraging patients to get vaccinated at an upcoming doctor's appointment. *Proc. Natl. Acad. Sci. U.S.A.* **118**, e2101165118 (2021).
- D. J. Birnbach, L. F. Rosen, M. Fitzpatrick, R. Everett-Thomas, K. L. Arheart, A ubiquitous but ineffective intervention: Signs do not increase hand hygiene compliance. *J. Infect. Public Health* **10**, 295-298 (2017).
- R. Díaz, F. Cova, Reactance, morality, and disgust: The relationship between affective dispositions and compliance with official health recommendations during the COVID-19 pandemic. *Cogn. Emot.* **36**, 120-136 (2022).

Materials and Methods

Our study was conducted in accordance with the institutional review board at Ben-Gurion University of the Negev (no. TM100920). We collaborated with a company operating a crowd monitoring system in a terminal of a major US airport. The system consisted of sensors anonymously recording each traveler's location and digital screens that displayed real-time crowdedness levels at each of the terminal's nine gates. Crowdedness for each gate and minute was calculated by dividing the number of travelers at the gate by the maximum number of travelers who could fit in the gate area while maintaining social distancing. At each gate, a color-changing pole reflected real-time crowdedness: from light green (<65% crowdedness) through dark green, orange, and finally, red (>65, 105, and 165% crowdedness, respectively). This green-red color gradient mirrors a traffic light, where green signifies safety and red signifies danger. Simultaneously, five stand-alone displays, along with check-in and wayfinding monitors, presented a short message—also known as a nudge—discouraging crowding. We were unable to measure how much each individual traveler was exposed to nudges, but the visibility of poles and monitors in the terminal ensured that travelers were aware of them.

Between 14 January and 23 January 2021, we manipulated the nudges displayed according to the four experimental conditions. In the baseline condition, all system displays were intentionally deactivated such that no message was displayed. Each condition ran for two nonconsecutive 24-h periods starting at 8 AM local time. *SI Appendix, section 1* has further details.

To analyze the effect of visual indicators and nudges on social distancing, we examined the proportion of travelers who maintained social distancing and were at least 6 ft apart from other travelers, excluding airport employees and groups traveling together. We focus our analysis on observations with greater than 65% crowdedness because the poles changed colors at this threshold, and we aggregate observations to 30-min intervals (*SI Appendix, section 3.4*). To control for variations in crowdedness between conditions, we matched observations by the number of travelers (11), which entailed randomly sampling an equal number of observations for each condition from corresponding similarity windows (*SI Appendix, section 3.2*). In the gate-level analysis, we matched observations on traveler counts for each airport gate to account for any characteristic differences between gates. We then examined differences in social distancing compliance between conditions nonparametrically by calculating bootstrapped CIs to derive *P* values.

Finally, we examined social distancing across conditions as a function of crowdedness at the gate level (Fig. 2). Specifically, we calculated a moving average of social distancing compliance for 10% crowdedness intervals and computed bootstrapped CIs for the following: between 15 and 25% crowdedness, between 70 and 80% crowdedness, and between 145 and 155% crowdedness.

Data, Materials, and Software Availability. Observational data have been deposited in GitHub (<https://github.com/mohinbanker/airport>) (16).

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- N. Favero, M. J. Pedersen, How to encourage "Togetherness by Keeping Apart" amid COVID-19? The ineffectiveness of prosocial and empathy appeals. *J. Behav. Public Adm.*, 10.30636/jbpa.32.167 (2020).
- M. Ashworth, L. Thunström, T. L. Cherry, S. C. Newbold, D. C. Finnoff, Emphasize personal health benefits to boost COVID-19 vaccination rates. *Proc. Natl. Acad. Sci. U.S.A.* **118**, e2108225118 (2021).
- A. Luttrell, R. E. Petty, Evaluations of self-focused versus other-focused arguments for social distancing: An extension of moral matching effects. *Soc. Psychol. Personal. Sci.* **12**, 946-954 (2021).
- E. A. Stuart, Matching methods for causal inference: A review and a look forward. *Stat. Sci.* **25**, 1-21 (2010).
- D. Krpan, P. Dolan, You must stay at home! The impact of commands on behaviors during COVID-19. *Soc. Psychol. Personal. Sci.* **13**, 333-346 (2022).
- H. Allcott *et al.*, Polarization and public health: Partisan differences in social distancing during the coronavirus pandemic. *J. Public Econ.* **191**, 104254 (2020).
- J. G. Lu, P. Jin, A. S. English, Collectivism predicts mask use during COVID-19. *Proc. Natl. Acad. Sci. U.S.A.* **118**, e2021793118 (2021).
- E. Mantzari, G. J. Rubin, T. M. Marteau, Is risk compensation threatening public health in the COVID-19 pandemic? *BMJ* **370**, m2913 (2020).
- M. Banker, Social distancing data for an airport field experiment. GitHub. <https://github.com/mohinbanker/airport>. Deposited 29 November 2021.