Defending Against Air Pollution: the Role of Active Nudge and Attention

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Heavy air pollution represents a major health hazard in many developing countries such as China and India, and in industrialized countries during episodes of wildfires and volcano eruptions. Typical defensive behaviors include staying indoors and wearing anti-smog facemasks (ASFs) during outdoor time. However, we routinely observe people outside engaging in physical activities on bad pollution days without wearing any ASFs. On the other hand, in places with heavy pollution such as Beijing, some residents wear ASFs even on low pollution days, causing discomfort and possibly reduced outdoor activities. A public health challenge is to improve the optimal defensive behavior, namely reducing outdoor time and wearing ASFs during smog days, but increasing outdoor time and not wearing ASFs on low or no pollution days.

We conduct a randomized control trial in Shenyang, the capital city of Liaoning province in northeastern China, to study the effects of passive and active information provision and economic incentives on defensive behaviors of time spent outdoors (outdoor time) and time spent wearing ASFs when outdoors (ASF time), in response to PM pollution. Through clustered sampling, we surveyed 2296 individuals from 40 neighborhoods in 9 urban districts, through a baseline face-to-face interview in November 2018. They are then invited to participate in a four-month long study during the winter heating season of 2018 – 2019 in which they are incentivized to fill out daily logs recording their outdoor time and ASF time. At the end of each month, they are also surveyed about their hospital visits due to respiratory or cardiovascular diseases (RCDs), two health consequences of exposure to PM (especially PM2.5) pollution. With a participate rate of about 57%, we successfully collected daily journals of 1306 residents.

The individuals are randomly assigned to a number of treatments including (i) **one-shot passive information nudge**, where subjects are provided with a brochure containing information about the nature of PM pollution (especially PM2.5), their health effects, and important information about ASFs including proper ways of wearing them. While the brochure was explained to all subjects during the baseline survey, only treated subjects are allowed to take the brochures home; (ii) **active information nudge** where in addition to taking home the brochure, a subject is required to record in the daily journal the publicly reported air quality level and check a row in a convenient table showing the associated health effects; (iii) **active ASF nudge** where each row in the table also contains an entry about the necessity of wearing ASFs in response to the reported air quality level; (iv) **mask treatment** where three free ASFs are provided; and (v) **high frequency passive information nudge** where a WeChat group was established for all subjects in the same neighborhood, through which they receive daily reported air quality levels and daily reminders of filling out their journals. Participants were asked to submit their journals at the end of each month and were provided gifts for doing so.

We find that the mask treatment caused more mask wearing and reduced outdoor time on both high and low pollution days, and reduced RCD related hospital visits. Relative to the control group, active nudges are the most effective among all treatments in promoting optimal defensive behavior. Both the active information nudge and active ASF nudge reduced (raised) outdoor time and increased (reduced) mask wearing on high (low) pollution days, while the two passive information nudges had negligible effect on the behaviors. The two active nudges also reduced the incidence of RCD related hospital visits, while the

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two passive nudges did not lead to significant health benefits. In addition, the active ASF nudge was more effective than the active information nudge in promoting optimal behaviors and reducing RCD illness.

To investigate the channels through which active nudges influence behavior, we develop nonparametric and parametric measures of a respondent’s daily inattention to air quality and to the health effects of air pollution. Respondents in the two active nudge treatments are asked to report in their daily journals each day’s air quality index (AQI), as well as the associated health effects from outdoor exposure which can be read from a simple table provided in the journal. Measures of inattention to air quality are based on the difference between the self-reported AQI and the true AQI, while measures of inattention to health effects are based on the mismatch between the self-reported AQI level and the self-reported health effects. We find that both types of inattention led to suboptimal behavior: higher inattention levels reduced outdoor time and raised mask wearing on low pollution days but had the opposite effects on high pollution days. Further, relative to the active information nudge, respondents in the active ASF nudge treatment paid more attention to both AQI and the health effects on high pollution days.

Our results suggest that active nudges where respondents are asked to undertake easy tasks are more effective than passive information nudges in reducing inattention and promoting optimal behavior. These findings are relevant for promoting defensive behavior against pollution, and for the design of nudge intervention in general. Our study also highlights an important aspect of defensive behavior that is often ignored in the literature, namely the need to avoid adopting costly defensive behaviors in face of low or no pollution.

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