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Do Decision Biases Predict Bad Decisions? Omission Bias, Naturalness Bias, and Influenza Vaccination

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Purpose. *Numerous studies using hypothetical vignettes have demonstrated decision biases or deviations from utility theory. Do people who commit biases in questionnaire studies make worse real-world decisions than do less biased people?* ***Methods.*** *Two hundred seventy university faculty and staff participated in a questionnaire study in which they reported whether they accepted a free influenza vaccine offered at their work place. Influenza vaccine acceptance was the measure of real-world decision making. Participants responded to 3 hypothetical scenarios. Two scenarios measured the omission bias and described a vaccine (scenario 1) and a medication (scenario 2) that prevented a negative health outcome but that itself could cause the negative health outcome. The omission bias is a preference for not vaccinating or medicating even when the vaccine/medication lowers the total risk of the negative outcome. A 3rd scenario measured the naturalness bias by presenting a choice between 2 chemically identical medications, one extracted from a natural herb and the other synthesized in a laboratory. Preference for the natural medication indicated the naturalness bias.* ***Results.*** *The results indicated that a substantial proportion of participants exhibited these biases and that participants who exhibited these biases were less likely to accept the flu vaccine.* ***Conclusions.*** *To the extent that declining a free flu vaccine is a worse real-world decision, people who demonstrate the naturalness and omission biases in hypothetical scenarios make worse real-world decisions.* ***Key words:*** *omission bias; naturalness bias; influenza; vaccination.* ***(Med Decis Making XXXX;XX:xx–xx)***

Many medical outcomes depend on choices made by patients. From deciding whether or not to exercise, go on a diet, or obtain a flu vaccine, patients make numerous health decisions. Unfortunately, as with any decision, people do not always decide in a normatively rational manner. A large body of research has identified decision biases or deviations from normative theory (for reviews, see Gilovich and others[1] and Kahneman and others[2]).

Traditionally, these decision biases have been demonstrated through hypothetical scenarios or laboratory tasks.[3] It remains unclear the extent to which exhibiting decision biases in a hypothetical scenario is indicative of making poor decisions in real life. Although some studies have examined the relationship between individual difference variables and decision biases and composite measures of decision biases and health behaviors,[4–6] few studies have examined the prospective relationship between demonstrating a decision bias in a questionnaire and making a poor real-world decision.

Influenza Vaccination

The current study focuses on the relationship between decision biases demonstrated in a questionnaire and a subsequent real-world health decision: whether or not to obtain the influenza vaccine. For purposes of this study, we defined receipt of the vaccine as the better choice and declining the vaccine as the poorer choice. Current health guidelines recommend that anyone older than 6 mo should obtain the flu vaccine, especially those at risk for complications from the flu (e.g., pregnant women, those older than 50 y, those with chronic conditions[7]). Influenza vaccination is contraindicated only for a small proportion of people due to allergies

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or recent illnesses.[7] Therefore, the present study investigates whether decision biases assessed via hypothetical scenarios predict real-world nonnormative behavior (i.e., not obtaining a flu vaccine).

Decision Biases

Within the context of flu vaccination, 2 decision biases are particularly relevant: the omission bias and the naturalness bias. The omission bias is the tendency to view a negative outcome resulting from inaction (omission) as more favorable than the same negative outcome resulting from action (commission[8–12]). For example, in a study by Ritov and Baron,[10] participants were presented with a scenario in which a child faces a 10 in 10,000 risk of dying from the flu. A vaccine eliminates this risk but can itself cause the flu in rare cases, resulting in a 5 in 10,000 risk of death from the vaccine. Many participants choose to decline the vaccine, implying that a death from the disease is more acceptable than a death from the vaccine (even if it is more likely).

Only a few studies have investigated the implications this bias may have on real-world outcomes. One study, which investigated obstetricians' and gynecologists' attitudes toward hormone replacement therapy (HRT), found a small relationship between the omission bias and attitudes about HRT.[13] The dependent measure in this study was attitude, not actual behavior. Two additional studies found that the omission bias was associated with parents' decisions about whether to vaccinate their children against pertussis.[14,15] Parents who declined to vaccinate their child against pertussis were more likely than vaccinating parents to demonstrate the omission bias in a hypothetical scenario.[15] An additional study implemented a longitudinal design of pregnant women's decisions to vaccinate their children and found that the omission bias was inversely associated with later vaccination status.[16]

However, all of the studies that assessed actual behavior focused on surrogate decision making (i.e., mothers making vaccination decisions on behalf of their children), and 2 of them assessed the omission bias through a hypothetical vaccine scenario. It is possible that the relationship between this bias and behavior is different when adults make these decisions for themselves and if the omission bias is assessed through nonvaccination scenarios. Specifically, it may be that the omission bias is not functionally related to vaccination behavior but that responses to vaccination omission scenarios serve as a marker for negative attitudes toward vaccination. Consequently, in the current study, we used 2 omission bias scenarios: one that concerned vaccination and was, therefore, superficially similar to the real-world behavior and another that did not concern vaccination.

We also investigated the naturalness bias, defined as the tendency to prefer natural products or substances even when they are identical to or worse than synthetic alternatives.[13,17–20] The flu vaccine, like many other medical interventions, is synthetic; therefore, exhibiting a naturalness bias may be an especially important predictor of the decision to forgo vaccination. Few studies have investigated this bias, and none have examined its implications for real-world health decisions, although a study by Baron and others[13] found that exhibiting a naturalness bias was associated with less favorable attitudes toward HRT.

In the current study, we assessed the omission bias and the naturalness bias using hypothetical scenarios. We subsequently assessed participants' intentions to receive the flu vaccine and their actual vaccination behavior. Each participant was categorized as exhibiting each bias or not, and we examined whether those who exhibited these biases were less likely to vaccinate than were participants who did not exhibit these biases.

METHOD

Participants and Procedure

Participants were faculty and staff employees of Rutgers University and the University of Medicine and Dentistry of New Jersey, who participated as part of a larger longitudinal study. In spring 2002, the questionnaire was mailed to 1560 university employees, 714 (46%) of whom responded. The fall 2003 questionnaire was mailed to 688 participants, 557 (81%) of whom responded. The spring 2003 questionnaire was mailed to 552 participants, 491 (89%) of whom responded. The fall 2003 questionnaire was mailed to 492 participants, 444 (90%) of whom responded.

Of these final 444 participants, only 270 participants responded to all measures in this study, and only these participants were included in the analyses. Attrition analyses revealed no significant differences on any of the bias variables used in this study between the participants who remained in the study and those who dropped out. These participants were largely female (58.7%) and of European

Imagine that you have the flu and wish to take a medication to speed your recovery.

Suppose that your only two treatment options are two antiviral medications. The two medications are chemically identical to one another (as confirmed by the Food and Drug Administration). They both fight the influenza virus and reduce the duration of a flu illness by one or two days. Both medications carry the same very low risk of side effects, and both cost about the same.

Drug X was developed by a well-known natural medicine company. Its active ingredient is Triazene, which is extracted from the natural herb Tinsonweed. You take one tablet twice a day.

Drug Y was developed by a well-known pharmaceutical company.Its active ingredient is a form of Triazene that is chemically synthesized in the laboratory. Thus, it is chemically identical to Drug X, but it is not derived from natural herbs. You take one tablet twice a day.

Which drug would you prefer to take?

❐ strongly prefer Drug X ❐ somewhat prefer Drug X ❐ no preference ❐ somewhat prefer Drug Y ❐ strongly prefer Drug Y

How confident are you that Drug X and Drug Y are really chemically identical to one another?

❐ not at all confident ❐ somewhat confident ❐ fairly confident ❐ very confident ❐ 100% confident

Figure 1 *Naturalness bias scenario.*

Imagine that it is the year 2010, and that a new infectious disease called *nauseosis* is now fairly common. People who get nauseosis experience nausea, stomach cramps, and fatigue. The symptoms resolve in 2 or 3 weeks, and there are no long-term consequences.Imagine that 10% of people in New Jersey contract nauseosis each year.

Now imagine that a new vaccine is available that will prevent you from getting nauseosis. The vaccine is always effective – it always prevents people from catching nauseosis. However, the risk of the vaccine is that a small number of people actually get nauseosis from the vaccine itself. A person's chance of getting nauseosis from the vaccine is less than their chance of getting nauseosis if they aren't vaccinated. There is no other risk of the vaccine. Consider the different chances of getting nauseosis from the vaccine shown below. Compare each chance to the 10% chance of getting nauseosis without the vaccine, and indicate whether you would accept or decline the nauseosis vaccine. *Check one box per line:*

Compared to a 10% chance of getting nauseosis without the vaccine, there is a...	Accept vaccine	Decline vaccine
0% chance of getting nauseosis from the vaccine	❐	❐
1% chance of getting nauseosis from the vaccine	❐	❐
2% chance of getting nauseosis from the vaccine	❐	❐
3% chance of getting nauseosis from the vaccine	❐	❐
4% chance of getting nauseosis from the vaccine	❐	❐
5% chance of getting nauseosis from the vaccine	❐	❐
6% chance of getting nauseosis from the vaccine	❐	❐
7% chance of getting nauseosis from the vaccine	❐	❐
8% chance of getting nauseosis from the vaccine	❐	❐
9% chance of getting nauseosis from the vaccine	❐	❐
10% chance of getting nauseosis from the vaccine	❐	❐

Figure 2 *Omission bias scenario about vaccination.*

descent (83.9%), with a mean age of 47 y ($s = 10.8$; range $= 25 - 72$).

Measures

Flu vaccine intention (spring 2002, spring 2003). A single trichotomous item ("no," "yes," "don't know") assessed each participant's intention to obtain a flu vaccine ("Do you plan to get a flu shot this coming fall?"). Participants who responded "don't know" were eliminated from the analyses.[a]

Flu vaccine behavior (fall 2002, fall 2003). A single dichotomous item ("no"/"yes") assessed each participant's flu vaccine behavior ("Did you receive a flu shot at any time this fall?").

Naturalness bias (spring 2002). Participants were given a hypothetical scenario describing 2 chemically equivalent drugs (1 natural and 1 synthetic) that speed the recovery from influenza (see Figure 1). The naturalness bias was assessed by determining which drug participants preferred on a 5-point scale (ranging from *strongly prefer drug X* to *strongly prefer drug Y*). Because both drugs are chemically identical, normative theory would predict that participants would have no preference. If participants preferred drug X to drug Y (i.e., scored a 1 or 2), this indicated a naturalness bias. We also included a 5-point scale item assessing the confidence participants had that the 2 drugs were chemically identical (from *not at all confident* to *100% confident*). This item was included to rule out the possibility that participants preferred the natural drug merely because they did not believe that the 2 drugs were actually chemically identical.

Vaccination omission bias (fall 2002). We assessed the vaccination omission bias with a scenario in which participants faced a 10% chance of contracting a fictitious infectious illness. A vaccine always prevents infection but could cause the same illness itself, at a risk lower than 10%. A series of choices was used to determine the point at which participants would refuse to accept a vaccine for the disease. Specifically, we varied the probability of contracting this disease from the vaccine itself and determined whether a participant would accept or decline the vaccine (see Figure 2). A consequentialist normative theory would prescribe that a person should accept the vaccine if it will reduce the probability of contracting this disease. Based on the scenario provided, if a participant declined a vaccine that had a 9% chance or less of infecting him or her,

[a] We also reran our analyses recoding participants who responded "don't know" into "no" because a clear majority (more than 85%) of these participants do not end up getting vaccinated. This alternative method does not change the pattern of results, so we opted to report only the findings from our original approach.

Imagine that you have just been diagnosed with a disease called *dentilosis*. 10% of people with dentilosis develop chronic tooth pain. There are no other consequences of having dentilosis.

Your doctor tells you that a medication is available that will cure dentilosis. The medicine is totally effective – it always cures dentilosis completely. However, the risk of the medicine is that a small number of people develop chronic tooth pain from the medication itself. The type of tooth pain one gets from the medication is the same as that caused by dentilosis itself. A person's chance of developing tooth pain from the medicine is less than their chance of developing tooth pain if their dentilosis is not cured. There are no other side effects of the medicine.

Consider the different chances of developing tooth pain from the medicine shown below. Compare each chance to the 10% chance of developing tooth pain if your dentilosis is not cured, and indicate whether or not you would take the medicine. *Check one box per line*:

Compared to a 10% chance of getting tooth pain without the medicine, there is a…	**Accept medicine**	**Decline medicine**
0% chance of developing tooth pain from the medicine	❐	❐
1% chance of developing tooth pain from the medicine	❐	❐
2% chance of developing tooth pain from the medicine	❐	❐
3% chance of developing tooth pain from the medicine	❐	❐
4% chance of developing tooth pain from the medicine	❐	❐
5% chance of developing tooth pain from the medicine	❐	❐
6% chance of developing tooth pain from the medicine	❐	❐
7% chance of developing tooth pain from the medicine	❐	❐
8% chance of developing tooth pain from the medicine	❐	❐
9% chance of developing tooth pain from the medicine	❐	❐
10% chance of developing tooth pain from the medicine	❐	❐

Figure 3 Omission bias scenario about medication.

then that response would be consistent with an omission bias (because by declining the vaccine, the individual has a higher probably of contracting the disease than if he or she accepted the vaccine).

Medication omission bias (spring 2003). We also assessed the omission bias using a 2nd medical scenario, in the same manner as the vaccination omission scenario. However, both the type of fictitious disease (tooth pain instead of a flulike condition) and the type of preventive action (a medicine instead of a vaccine) were changed so as to reduce superficial similarity with the influenza vaccine (see Figure 3).

Vaccination attitudes (fall 2002). Participants' beliefs about the vaccine and the influenza virus were also measured. Specifically, we assessed beliefs about the vaccine's effectiveness (on a 5-point scale ranging from *not at all effective* to *extremely effective*) and the probability of an adverse reaction from the vaccine (a 5-point scale ranging from *not at all likely* to *extremely likely*). Because of adequate reliability (Cronbach's $\alpha = 0.62$), these 2 items were combined to form a single vaccination attitude score.

RESULTS

For each of the 3 scenarios, we first examined whether the bias of interest occurred. We then examined whether the participants who exhibited the bias were less likely to intend to vaccinate and less likely to actually vaccinate against influenza, compared with participants who did not exhibit the bias. For each scenario, we used 2 influenza vaccination-dependent measures: 1 intention measure and 1 behavioral measure. One of these measures was assessed in the same questionnaire as the scenario (cross-sectional), and the other was assessed 6 mo later in the following questionnaire (prospective; see Table 1).

Naturalness Bias

For the hypothetical scenario of 2 chemically identical drugs (1 herbal and 1 synthetic), normative theory prescribes that there should be no preference for 1 drug over the other. Therefore, a systematic preference for the herbal drug was classified as a naturalness bias. The mean preference rating was 2.66, significantly less than the midpoint of 3, $t(269) = -4.88$, $P < 0.0001$, indicating the overall presence of a naturalness bias. Indeed, a large percentage of participants ($n = 109$, 40.4%) demonstrated this bias (20.4% demonstrated a preference for the synthetic drug, and 39.3% had no preference). However, it might be possible that the preference for an herbal drug exists because participants do not believe an herbal drug is really equivalent to the synthetic version (even though this was stated in the scenario). We addressed this issue by assessing how confident participants were that the 2 agents were chemically identical. The correlation between the 5-point confidence scale and the 5-point preference scale was not significant, $r(270) = -0.02$, ns, indicating that demonstrating a naturalness bias was not related to the belief that the natural drug is any different from the synthetic version.

Omission Bias

For the 1st hypothetical scenario, normative theory prescribes that participants should accept a vaccine that has up to, and including, a 9% risk of the disease (because the base rate is 10%, a vaccine with a 9% risk of the disease still has a favorable consequence). Therefore, an omission bias would be present if the acceptance threshold of this hypothetical vaccine is less than 10%. This was the case for most participants ($n = 163$; 60.4%), as many began declining the vaccine well before this point ($\bar{x} = 6.43\%$, median $= 6\%$). This mean was significantly lower than the acceptance threshold of 10%, $t(269) = -15.08$, $P < 0.0001$, indicating that

Table 1 Timeline of When Each Independent (Either Naturalness or Omission Bias) and Dependent Variable (Flu Vaccine Intention or Flu Vaccine Behavior) Was Assessed

	Data Collection Wave			
Decision Bias and Measures	**Spring 2002**	**Fall 2002**	**Spring 2003**	**Fall 2003**
Naturalness bias				
Scenario	X			
Intention	X			
Behavior		X		
Omission bias, vaccination				
Scenario		X		
Intention			X	
Behavior		X		
Omission bias, medication				
Scenario			X	
Intention			X	
Behavior				X

participants declined a vaccine that they, normatively speaking, should accept.

For the 2nd hypothetical scenario, we would expect the same pattern as above (i.e., that the acceptance threshold is less than 10%). Indeed, this was the case for a large number of participants ($n = 144$; 53.3%), as many began declining the medication well before this point ($\bar{x} = 7.5\%$, median = 9%). This mean was significantly lower than the acceptance threshold of 10%, $t(269) = -11.54$, $P < 0.0001$. Interestingly, the mean acceptance threshold for the medication scenario was significantly higher than the mean acceptance threshold for the vaccination scenario, $t(269) = 4.07$, $P < 0.0001$.

Decision Biases, Intentions, and Behavior

Naturalness bias. To test our prediction that the naturalness bias would be associated with real-world decisions, we first used our continuous measure of naturalness bias to predict flu vaccination intentions cross-sectionally in a logistic regression. As expected, the more a participant preferred the herbal drug over an equivalent synthetic drug, the less likely they were to intend to vaccinate, $\chi^2(1) = 6.22$, $\beta = -0.18$, $P = 0.013$, odds ratio OR = 0.747. In an analogous logistic regression predicting vaccination behavior prospectively, as expected, the more a participant preferred the herbal drug over a chemically identical synthetic drug, the less likely he or she was to obtain a flu vaccine, $\chi^2(1) = 9.63$, $\beta = -0.22$, $P = 0.002$, OR = 0.701. This pattern is also illustrated in Table 2, in which vaccination intention and behavior rates are categorized by presence or absence of the naturalness bias (and the omission bias).

We then tested the possibility that the relationship between naturalness preferences and intention and behavior are primarily driven by vaccination attitudes. That is, the naturalness measure may be merely a marker for negative attitudes toward vaccination rather than a measure of a preference for natural substances, per se. It may be that only the negative attitudes toward vaccines influence the relationship with behavior.

To test this hypothesis, we examined whether controlling for vaccination attitudes would eliminate the relationship between the naturalness bias and intention and behavior. Naturalness bias (our 5-point preference scale) was our independent variable, intention and behavior were our dependent variables, and vaccination attitudes (our composite score) was our covariate.

We had already established the relationship between the naturalness bias (independent variable) and vaccination intention ($\beta = -0.18$, $P = 0.013$, OR = 0.747) and behavior ($\beta = -0.22$, $P = 0.002$, OR = 0.701; dependent variables). We then tested the relationship between the naturalness bias and vaccination attitudes (the covariate). Using linear regressions, we found that the naturalness bias was inversely related to vaccination attitudes ($\beta = -0.28$, P < 0.0001). Lastly, we tested whether controlling for vaccination attitudes would reduce (or eliminate) the association between the naturalness bias and intentions and behavior. When using both the naturalness bias ($\beta = -0.09$, $P = 0.40$, OR = 0.87) and vaccination attitudes ($\beta = 1.25$, $P <$

Table 2 Percentage of Participants Who Intended to Vaccinate and Who Reported Actually Vaccinating as a Function of Decision Biases ($N = 270$)

	Flu Shot Intention (% Intended)	Flu Shot Behavior (% Vaccinated)
Naturalness bias		
No	69.6	65.2[a]
Yes	58.7	47.7
Vaccination omission bias		
No	78.5[a]	70.1[a]
Yes	55.2	50.3
Medication omission bias		
No	68.3	61.1
Yes	61.1	52.1

a. Indicates a percentage that differs from the percentage below, $P < 0.05$.

0.0001, OR = 4.37) to predict intentions, only vaccination attitudes were significant. Similarly, when using the naturalness bias ($\beta = 0.04$, $P = 0.66$, OR = 1.07) and vaccination attitudes ($\beta = 1.26$, $P < 0.0001$, OR = 4.83) to predict behavior, only vaccination attitudes were significant. These results suggest that the association between the naturalness bias and intention and behavior is primarily (if not exclusively) due to the fact that naturalness bias is a stand-in for negative attitudes toward the vaccine.

Omission bias. We then explored the relationship between the vaccine omission bias and real-world decision making. As expected, in a prospective analysis, the higher the acceptance threshold, the more likely participants were to intend to obtain a flu vaccine, $\chi^2(1) = 34.22$, $\beta = 0.43$, OR = 1.23, $P < 0.0001$. Also, as expected, in a cross-sectional analysis, the higher the acceptance threshold, the more likely participants were to obtain the flu vaccine, $\chi^2(1) = 21.99$, $\beta = 0.33$, OR = 1.17, $P < 0.0001$.

Finally, we investigated the relationship between the medication omission bias and flu vaccine intention and behavior. Neither of these relationships was significant, although both had clear trends in the expected direction. Higher acceptance thresholds were marginally associated with intentions to obtain the vaccine, $\chi^2(1) = 3.08$, $\beta = 0.12$, OR = 1.07, $P = 0.08$, in a cross-sectional analysis and marginally associated with obtaining the vaccine in a prospective analysis, $\chi^2(1) = 2.87$, $\beta = 0.11$, OR = 1.06, $P = 0.09$.

Using a t test for dependent correlations, we found that the vaccination omission bias predicted intention significantly better than did the medication omission bias ($r = 0.35$ v. $r = 0.11$; $t[267] = 3.51$, $P = 0.001$). Similarly, we found that the vaccination omission bias predicted behavior significantly better than did the medication omission bias ($r = 0.28$ v. $r = 0.10$; $z = 2.43$, $P = 0.015$).[b] Nevertheless, the 2 omission biases were significantly related to one another ($r = 0.28$, $P < 0.0001$).

We further investigated the discrepancy in results between the medication and vaccination omission bias scenarios. We hypothesized that the reason that only the vaccination scenario is associated with vaccination intention and behavior is because it taps into participants' underlying vaccination attitudes rather than their omission/commission preferences per se. This would explain why the medication scenario shows no significant effect on vaccination intention and behavior.

To test this hypothesis, we examined whether omission bias predicted vaccination after controlling for vaccination attitudes. Because we already established the relationship between the vaccination omission bias (independent variable) and vaccination intention ($\beta = 0.43$, OR = 1.23, $P < 0.0001$) and behavior ($\beta = 0.33$, OR = 1.17, $P < 0.0001$; dependent variables), we then tested the relationship between the vaccination omission bias and vaccination attitudes (the covariate). Using linear regressions, we found that the vaccine omission bias was significantly related to vaccination attitudes ($\beta = 0.28$, $P < 0.0001$). Lastly, we tested whether controlling for vaccination attitudes would reduce (or eliminate) the association of the vaccine omission bias with intentions and behavior. When using the omission bias ($\beta = 0.34$, $P = 0.001$, OR = 1.17) and vaccination attitudes ($\beta = 1.24$, $P < 0.0001$,

[b] Because the omission biases were used to predict the same intention variable, whereas omission biases were used to predict different behavior variables, different statistical tests were used as recommended by Steiger.[21]

OR = 4.31) to predict intentions, both variables were significant. Similarly, when using the omission bias (βg 0.19, $P = 0.04$, OR = 1.09) and vaccination attitudes ($\beta = 1.03$, $P < 0.0001$, OR = 3.39) to predict behavior, both variables were significant.

These results suggest that the association between omission bias and intention and behavior may partially be due to the fact that omission bias is in part a proxy for negative attitudes toward the vaccine (as the size of the beta weights decrease). This fact might help explain the difference between the 2 omission bias scenarios. However, there are clearly other differences. Furthermore, these differences may be the reason why the vaccine omission bias predicts intention and behavior and medication omission bias does not.

DISCUSSION

The large majority of decision biases have been examined exclusively in hypothetical scenarios and laboratory settings. Consequently, not much is known as to the real-world impact of succumbing to these biases. This study sought to address this gap by examining 2 decision biases, the naturalness and omission biases, and their respective association with a real health decision: whether or not to obtain a flu vaccine.

As hypothesized, there was a fairly large naturalness bias, such that a majority of participants preferred a natural drug over a chemically identical synthetic one. Also, as hypothesized, exhibiting this bias was inversely associated with both vaccination intention and behavior. This relationship, however, could be explained by the fact that the measure of naturalness bias served as a proxy for general attitudes about the vaccine. The results for the omission bias were more equivocal. Both scenarios of the omission bias replicated past research in that a large proportion of participants prefer harm done by inaction over harm done by action. Exhibiting the bias in the vaccination scenario was inversely related to vaccination intention and behavior, but although there was a consistent trend for the same relationship with the medication scenario, there was no significant relationship with real-world health decisions.

One reason for the discrepancy between the 2 omission bias scenarios may be that responses to the vaccination scenario are the result of general vaccination attitudes rather than a preference for inaction over action. It may be these attitudes, rather than the omission bias, that are responsible for the relationship with vaccination intention and behavior. This same interpretation could apply to the study by Asch and others,[14] which also found a relationship between responses to a vaccination omission bias scenario and real-world vaccination behavior. To test this account, we conducted additional analyses and found that the relationship between the vaccination omission bias and intention and behavior was only partially driven by vaccination attitudes. This finding suggests that there may indeed be a relationship between behavior and the omission bias per se and that the 2 omission bias scenarios differ in ways, apart from the fact that only 1 of them concerns vaccination.

In sum, this study has identified modest relationships between decision biases and real-world decisions. There are several important implications of this research. First, the association between the naturalness bias and future health behaviors may have profound public health implications in that the naturalness bias may cause people to decline effective synthetic treatments or pursue natural remedies that are ineffective or even harmful. Although there may be some instances in which natural remedies may be as effective as synthetic ones (in which case, a preference for the natural option is not problematic), the flu vaccine is not one of these instances. Therefore, it would be worthwhile to further investigate this particular bias, as it may be an important factor in why people forgo effective, albeit synthetic, preventive measures.

The omission bias also demonstrated a relationship with real-world health behavior (although the effect was not consistent across the 2 scenarios). Vaccination is an obvious case relevant to the omission bias, as many vaccines carry the risk of harm but at a lower probability than that caused by the disease itself. Other medical decisions, however, also entail the comparison of an omission and a commission, such as many types of prophylactic or therapeutic surgery. Passive versus active euthanasia provides another example. In these instances, a preference for harm resulting from inaction would cause people to forgo options that would lower their overall risk of the negative outcome. An important topic for future research is whether the omission bias ever causes decision makers to forgo vaccination or other risk-reducing treatments or whether, as suggested in the current study, general attitudes about vaccination or other medical options influence both responses to hypothetical scenarios and real-world health decisions.

The current results point to the importance of investigating decision biases outside the laboratory and examining the relationship between laboratory-based biases and real-world behavior. Many of these biases could potentially have a substantial influence on high-stakes health decisions and subsequently affect public health outcomes. However, this study also suggests that negative attitudes toward the health behavior (in this case, the flu vaccine) were associated with these biases. It may be worthwhile for public health officials to address these negative attitudes directly rather than the decision biases per se.

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