Original Article

MDM Medical Decision Making

Medical Decision Making
2020, Vol. 40(6) 774–784

DOI: 10.1177/0272989X20944190
journals.sagepub.com/home/mdm
SAGE

Attractive Flu Shot: A Behavioral Approach to Increasing Influenza Vaccination Uptake Rates

Amnon Maltz, and Adi Sarid

Background. We suggest and examine a behavioral approach to increasing seasonal influenza vaccine uptake. Our idea combines behavioral effects generated by a dominated option, together with more traditional tools, such as providing information and recommendations. **Methods.** Making use of the seasonal nature of the flu, our treatments present participants with 2 options to receive the shot: early in the season, which is recommended and hence "attractive," or later. Three additional layers are examined: 1) mentioning that the vaccine is more likely to run out of stock late in the season, 2) the early shot is free while the late one costs a fee, and 3) the early shot carries a monetary benefit. We compare vaccination intentions in these treatments to those of a control group who were invited to receive the shot regardless of timing. **Results.** Using a sample of the Israeli adult population ($n = 3271$), we found positive effects of all treatments on vaccination intentions, and these effects were significant for 3 of the 4 treatments. In addition, the vast majority of those who are willing to vaccinate intend to get the early shot. **Conclusions.** Introducing 2 options to get vaccinated against influenza (early or late) positively affects intentions to receive the flu shot. In addition, this approach nudges participants to take the shot in early winter, a timing that has been shown to be more cost-effective.

Keywords
behavioral economics, decoy effect, influenza, nudge, vaccination

Date received: November 19, 2019; accepted: June 11, 2020

Seasonal influenza is a significant health threat that circulates in all parts of the world. According to the World Health Organization, it leads to an estimated 3 to 5 million cases of severe illnesses and between 290,000 to 650,000 deaths globally each year.[1] In the United States alone, it causes more than 200,000 hospitalizations and more than 8000 deaths each year.[2,3] It is also associated with increased general practice consultation,[4] lost days of work,[5] impaired academic and work-related performance,[6,7] and overall pressure on the health care system during the winter months.[3]

The influenza vaccine has been shown to reduce morbidity and mortality rates[8–10] and is available at low cost. Nevertheless, many individuals who are recommended by their local health care authorities to receive the vaccine fail to do so.[11,12] Even health care workers' compliance rates are relatively low.[13,14] Reasons for refusing the shots and the determinants of compliance rates vary across countries and social groups. Family background, age, and health status play an important role in the decision[15] as do health insurance coverage[16,17] and advice within the household.[18] Many psychological factors, such as risk

University of Haifa, Haifa, IL, Israel (AM); Tel Aviv University and Sarid Research Services, Tel Aviv, IL, Israel (AS). The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. The author(s) received no financial support for the research, authorship, and/or publication of this article.

Corresponding Author
Amnon Maltz, University of Haifa, Abba Khoushy Ave 199, Haifa, IL 3498838, Israel (amaltz@econ.haifa.ac.il).

perceptions and social norms, have also been shown to affect the decision regarding vaccination.[19]

A large body of literature has examined different interventions to increase the rate of compliance with the seasonal flu shot. Among those, one can find more traditional interventions, such as education and financial incentives[20–23] as well as behavioral approaches that draw from the psychology and behavioral economics literature (also known as behavioral nudges). These include setting a default appointment to receive the shot,[24] emphasizing the benefits of the vaccine through invitation messages,[25,26] reminders,[27,28] personal invitations,[29,30] asking patients to make an active choice during their visit to the clinic,[31,32] and creating planning prompts, also known as implementation intentions.[33] Recently, it has been found that some of these behavioral interventions compare favorably with traditional ones in terms of their impact-to-cost ratio.[34]

This article suggests and measures the effect of a new intervention that uses the seasonal nature of the flu and splits the option to receive the flu shot into an early (recommended) shot and a late one. The late option is quite clearly inferior to the early one and is therefore likely to generate comparisons that highlight the advantages of the more attractive shot. This suggested comparative channel is similar to the one that emerges as one of the psychological explanations underlying the well-known decoy effect.[i] One advantage of our approach is that it allows the natural integration of more standard tools—providing additional information, recommendations, and financial incentives—that have been shown to have positive effects on flu vaccine uptake, into the design. Using a survey held in Israel, we found that this intervention has the potential to significantly increase influenza vaccination uptake rates. Moreover, it can lead those who intend to receive the vaccine to do so early in the winter season, which has been shown to be more cost-effective.[41,42] The suggested approach may be implemented at low costs and on a large scale.

Participants in our survey received a questionnaire in early September and were asked to imagine that on October 1, they will receive an invitation from their health maintenance organization (HMO) to get vaccinated against seasonal influenza. As in the standard protocol used by most HMOs in Israel today, all invitations began with an introduction that includes basic information about the disease and the vaccine.[ii] In the control group, the invitation continued to follow the standard protocol and stated that the vaccination is recommended by the Ministry of Health and is free and available until March 31. Participants in the control group were then asked whether they plan on getting the shot or not.

Our treatment groups added the timing dimension to the standard invitation by splitting the option to get vaccinated in two. The invitations started off with the exact same basic information as in the control. At this point, however, the invitation went on to describe 2 options to receive the shot: in early winter, until December 31, which is recommended by the Ministry of Health, or later in the season, from January 1 until March 31. Introducing vaccinations in this manner creates the basis for an early attractive flu shot option and a late inferior flu shot option. In our first treatment, the early shot was made attractive by the mere recommendation of the Ministry of Health alongside a brief explanation of the advantage of getting the shot early. The other treatments added an extra layer of attractiveness to the early shot compared with the late one. Here is the full list of treatments followed by a short description of their content:

- *Recommendation:* The Ministry of Health recommends to get the early shot in order to increase its effectiveness.
- *Stock:* As in the Recommendation treatment, and the invitation states that there is a higher chance that the vaccine will run out of stock after December 31.
- *Cost:* As in the Recommendation treatment, and the early shot is free while the late one costs a fee of 20 ILS.[iii]
- *Benefit:* As in the Recommendation treatment, and the early shot carries a benefit of 20 ILS that may be used for future doctor visits within the HMO. No benefit is offered for a late shot or for not getting vaccinated.[iv]

Following the invitation and the description of the vaccination options, we asked our participants whether they plan on 1) getting the shot early, 2) getting the shot late, or 3) not getting the shot at all. Our main interest was in comparing reported intentions to get the shot in each treatment to the intentions reported in the control. Participants in all groups were also asked how certain they are regarding their willingness to get the flu shot (with the answer reported on a 5-point Likert-type scale), whether they received the shot last year, and how many times they received the shot in the past 5 years (to the best of their memory).

We suggest that, while the inferior flu shot option would be rarely chosen, introducing it would increase the likelihood of picking the attractive flu shot option, that is, getting vaccinated by the end of the calendar year. In addition, the informational content regarding the advantage of the early shot and the extra recommendation by the Ministry of Health are likely to shift preferences in the same direction.[v] Since not all types of dominated options may be expected to increase the choice frequency of the dominating alternative,[43] we explored 4 different types of inferior options and examined whether they shift preferences toward accepting vaccination and which type of inferior flu shot generates a stronger effect. In choosing dominated (and dominating) options for the different treatments, we sought to vary the range of the suggested policy tools that maintain the freedom of choice of the individuals and are relatively easy to implement.

Our survey was completed by a sample of the Israeli adult population between the ages of 18 and 65 years and consisted of 3271 participants. All treatments led to increases in intentions. These ranged from 2.6 percentage points in the Recommendation treatment through 5.3 and 6.4 in the Cost and Stock treatments, respectively, to 9.4 percentage points in the Benefit treatment. A logistic regression that controls for the reported number of vaccinations in the past 5 years and other demographic variables showed that treatment effects are positive and that all of them are significant except for the one generated by the Recommendation treatment. Additional analysis showed that the treatments mostly affected those who received the vaccination at most once in the past 5 years, a finding that carries practical policy implications for HMOs and health care policy makers.[vi]

We also found that in all 4 treatments, the vast majority of participants who reported that they would receive the flu shot intended to do so by the end of the calendar year (only 3.3% of the participants in the treatment groups intended to receive the shot after December 31). In other words, the late option (in all treatments) was indeed perceived as an inferior option that was not attractive in its own right. Thus, our design nudges those who are willing to vaccinate to do so in early winter, a finding that has important policy implications: early vaccination assists in preventing the flu from spreading in the population, and it has been shown to be more cost-effective.[41,42] By analyzing participants' explanations of their choices, we provide evidence for the psychological comparative procedure triggered by the domination relation between the early shot and the late one.

Earlier, we mentioned the wide array of interventions that the behavioral literature has suggested over the past years to increase influenza vaccination uptake rates. These may be categorized and ordered according to their level of coercion, a ranking that has sometimes been referred to as an "intervention ladder."[45,46] Interventions along this ladder range from doing nothing through soft interventions, such as providing information, to more aggressive options, for example, default appointments. The ladder reflects a tradeoff that is well known to researchers studying this topic: more aggressive policies (higher on the ladder) are often more impactful in increasing vaccination rates,[31,33] but their implementation is often not feasible on a large scale, and they are prone to stronger ideological objections because of their relative aggression. Lower on the ladder, the softer interventions are easier to implement on a large scale but suffer from small effect sizes.[26,46] Our attractive flu shot approach has the potential to break this tradeoff and succeed on both fronts. While it is a relatively soft intervention that is easy to implement on a large scale, it has significant and substantial effects on vaccination intentions.

Methods

We conducted a survey among a sample of the Israeli adult population aged 18 to 65 years consisting of 3271 participants (136 additional respondents did not complete the entire survey and were excluded from the analysis).[vii] The survey was run by a professional survey company via an online panel that has about 30,000 registered panelists, out of which the sample was drawn. The mean age of the sample was 40.08 years, with a standard deviation of 12.05 years (for a comparison of the relevant age distribution between the sample and the Israeli population, see Supplementary Material E). The sample was slightly biased toward women due to the difficulty of reaching an accurately representative sample of the required size via an online panel: 1423 were male (43.5%) and 1848 were female (56.5%) versus 49.5% males in the population. Participants who completed the survey (which took, on average, 2 min), received a compensation of 1 ILS (about 0.3 USD). The survey was distributed during the first week of September 2019.

Participants were randomly assigned into either 1 of the 4 treatment groups or the control with an equal probability of 0.2. They were asked to imagine that on October 1, they will receive a message from their HMO inviting them to receive the seasonal influenza vaccine. The information included in the invitations in the control and treatment groups is described in the introduction section.

Following the invitation, participants in the treatment groups had to indicate whether they intend to 1) get the shot early, 2) get the shot late, or 3) not get the shot at

Table 1 Demographics by Treatment Group

General	Control	Recommendation	Stock	Cost	Benefit
Sample size (*n*)	659	644	644	663	661
% Female	57.7	57.9	57.6	54.4	54.9
Age, mean (SD)	40.8 (12.4)	39.7 (11.7)	41 (12.3)	39.4 (12.1)	39.6 (11.7)
Income, %					
Above	7.4	7.1	8.2	6.6	6.8
Slightly above	18.2	18	17.9	17.2	16.9
Average	16.1	18.5	18.3	17.5	18.9
Slightly under	20	20	18.9	21.3	20
Under	25.6	26.4	26.4	25	26.9
Missing	12.6	9.9	10.2	12.4	10.4
Education, %					
Academic, graduate	13.5	13.8	13	16.4	16.3
Academic, undergraduate	35.5	35.9	34.2	30.5	30.3
High school	25.5	29	27	29	27.5
Vocational	21.2	18.3	22	20.2	21.8
Elementary	0.9	0.6	0.9	1.4	1.5
Missing	3.3	2.3	2.8	2.6	2.6

all.[viii] They were then asked to answer 4 more questions. First, they were asked to provide a brief explanation of their intention (an open-ended question). Then, we asked how certain they feel regarding their willingness to get the shot on a 5-point Likert-type scale ranging from 1 (*not certain at all*) to 5 (*very certain*). Finally, they were asked whether or not they received the shot last year and how many times they received the shot in the past 5 years (to the best of their recollection). The full surveys are available in Supplementary Material D.[ix]

Results

A general overview of our participant pool's demographic characteristics is given in Table 1. As expected in a randomly controlled study, no significant differences appeared across treatments and control. An assessment of the quality of our data, based on 2 validation checks, showed that responses of our participants were highly consistent (see Supplementary Material C for details).

In Table 2, we provide an overview of vaccination intentions by treatment, broken down by number of vaccinations in the past 5 years. Starting with the overall effects (bottom row), we observed that all treatments had a positive effect on intentions, ranging from 2.6 to 9.4 percentage points. We used Pearson's chi-square test (with false discovery rate correction for multiple comparisons[47]) to examine whether vaccination intentions were independent of the treatments. The null hypothesis that overall intentions are not affected by treatments may be rejected ($\chi^2 = 13.8003$, $df = 4$, adjusted P value $= 0.034$). The table also shows that our design mostly affected those who received at most 1 vaccination in the past 5 years (top 2 rows). Once again, we used Pearson's chi-square test to examine whether intentions to vaccinate were independent of the treatments for participants with the same number of vaccinations in the past 5 years. We can reject (with marginal significance) the null hypothesis that vaccination intentions of those who did not get any vaccinations in the past 5 years and those who got the shot only once in that time period are not affected by treatments (zero vaccination group: $\chi^2 = 11.079$, $df = 4$, adjusted P-value $= 0.067$, one vaccination group: $\chi^2 = 9.8959$, $df = 4$, adjusted P-value $= 0.091$). Looking at the table, it is quite obvious that our treatments did not affect those who received 2 vaccinations or more in the past 5 years. For those with 2 vaccinations in the past 5 years, we obtained $\chi^2 = 3.656$, $df = 4$, and an adjusted P-value of 0.537. Almost all individuals in the remaining groups (3 or more vaccinations in the past 5 years) intended to receive the shot (899/928, 97%), and for these groups, the treatments had no effect on intentions.[x]

It seems somewhat surprising that our intervention affected those who received at most 1 vaccination in the past 5 years, since it is reasonable to think of this group

Table 2 Percentages of Reported Intentions to Receive the Vaccine in the Treatments and Control by Number of Vaccinations in the Past 5 Years

Vaccinations	Control	Recommendation	Stock	Cost	Benefit
0	16% (50/308)	17% (48/280)	22% (63/288)	25% (73/289)	23% (65/277)
1	47% (41/88)	53% (51/97)	61% (53/87)	50% (58/117)	65% (74/114)
2	81% (64/79)	76% (61/80)	84% (72/86)	84% (69/82)	87% (62/71)
3	92% (70/76)	91% (61/67)	94% (63/67)	96% (66/69)	95% (70/74)
4	96% (27/28)	100% (29/29)	97% (32/33)	97% (37/38)	97% (33/34)
5	100% (80/80)	100% (91/91)	100% (83/83)	97% (66/68)	100% (91/91)
Overall	50% (332/659)	53% (341/644)	57% (366/644)	56% (369/663)	60% (395/661)

as having strong preferences against the vaccine (especially those who did not comply even once in that period). Our results show that this is not necessarily the case. It may be that their attitude toward the vaccine is actually quite ambiguous and that this ambiguity leads them to behave passively (i.e., not vaccinate) especially considering the time cost associated with getting the shot. The tendency to remain passive and stick to the default (even when the costs of acting are much lower than those associated with getting vaccinated) is a well-known phenomenon in the psychology and behavioral economics literature.[48–50] If their attitude is indeed ambiguous, they may be prone to behavioral nudging.

To further examine this potential explanation, we checked the correlation between the number of vaccinations in the past 5 years and the level of certainty regarding the vaccine (on a scale of 1 to 5) and found that it is equal to 0.39 (medium-low correlation).[xi] Thus, it seems that the strength of preferences may be partially responsible for the lift in intentions among those with a low number of vaccinations in the past 5 years, but it is certainly not the only factor. Future research may shed more light on the relationship between recent compliance rates and the potential to be affected through nudging.

Next, we ran 3 logistic regression models in which the dependent variable equals 1 if the individual reported an intention to receive the shot and 0 otherwise. The results are reported in Table 3. The first model includes only treatment dummies as explanatory variables and therefore represents the overall treatment effects. All treatments (except for Recommendation), generated a positive effect on intentions with varying significance levels (the Cost treatment is significant only at the α = 10% level). The odds ratios of the Stock, Cost, and Benefit treatments are 1.297, 1.236, and 1.462, respectively. In the second column, we controlled for vaccination history (number of vaccinations in the past 5 years) as well as demographic variables. This strengthens the effects of the Stock, Cost, and Benefit treatments: The odds ratios are 1.513, 1.461, and 1.662, respectively, and all coefficients are significant at the 5% level (Stock and Benefit are significant at the 1% level). As may be expected, vaccination history is an important predictor of intentions to receive the shot (odds ratio of 4.03). This column provides 2 additional interesting findings that are unrelated to our study's main focus: men were more willing to receive the shot than women, and age had a negative (albeit small) effect on intentions (see Schmid et al.[19] for a recent systematic review of findings relating these demographic variables to influenza vaccination). In the third column, we added the interaction between treatments and vaccination history and found that although the treatment effects change very slightly, the interaction variables are not significant.

Our questionnaire not only provides information regarding positive or negative intentions to vaccinate. It also contains information about individuals' timing decision. The vast majority of participants in the treatment groups who intended to get the shot planned on doing so early in the season. Only 3.3% of participants in these groups (87 of 2612) planned to get the late shot. In Table 4, we ran a multinomial logit regression with participants from all treatment groups (excluding the control) in which the dependent variable takes 3 possible values: vaccinate early, vaccinate late, or not vaccinate at all. The benchmark group is taken to be the Recommendation treatment. The table shows that participants responded to the financial incentives introduced in the Benefit and Stock treatments: the Benefit treatment increased intentions to receive the early shot, while the Cost treatment lowered intentions to get the late shot.

One question in the survey recorded participants' open-ended responses for their stated intentions, which allowed us to gain insight into their psychological decision making procedure. Specifically, we examined whether the late option to receive the shot played a role and influenced their decisions. If many responses include a comparative argument between the early and late shots, this would support

Table 3 Logistic Regression Models[a]

	Dependent Variable		
	Vaccination Intentions		
	(1)	**(2)**	**(3)**
Recommendation	0.103	0.073	0.105
	(0.111)	(0.158)	(0.206)
Stock	0.260**	0.414***	0.428**
	(0.111)	(0.157)	(0.199)
Cost	0.212*	0.379**	0.571***
	(0.110)	(0.154)	(0.194)
Benefit	0.380***	0.508***	0.532***
	(0.111)	(0.155)	(0.197)
Vaccination history		1.394***	1.462***
		(0.052)	(0.114)
Recommendation × vaccination history			−0.039
			(0.162)
Stock × vaccination history			−0.002
			(0.168)
Cost × vaccination history			−0.259*
			(0.154)
Benefit × vaccination history			−0.017
			(0.172)
Gender (male)		0.57***	0.573***
		(0.101)	(0.101)
Age		−0.013***	−0.013***
		(0.004)	(0.004)
Income (above average)		0.013	0.023
		(0.256)	(0.257)
Income (slightly above average)		0.065	0.070
		(0.204)	(0.204)
Income (average)		0.43**	0.439**
		(0.198)	(0.198)
Income (slightly below average)		−0.053	−0.052
		(0.192)	(0.192)
Income (below average)		0.087	0.093
		(0.184)	(0.184)
Education (undergraduate)		0.043	0.038
		(0.160)	(0.160)
Education (high school)		0.012	0.003
		(0.170)	(0.170)
Education (vocational)		−0.102	−0.104
		(0.175)	(0.175)
Education (elementary)		−0.073	−0.070
		(0.430)	(0.429)
Constant	0.015	−1.425***	−1.480***
	(0.078)	(0.296)	(0.308)
Observations	3271	3182	3182
Log likelihood	−2243.192	−1311.734	−1309.756
Akaike information criterion	4496.385	2657.469	2661.512

[a]Numbers represent coefficients (β); standard errors are in parentheses.
$*P < 0.1$; $**P < 0.05$; $***P < 0.01$.

the conjecture that the late decoy option affects participants' reasoning through a psychological mechanism that is similar to the one underlying the decoy effect. Indeed, we found that 41% of participants in the treatment groups made a comparative statement between the early shot and the late one based on the former's relative attractiveness. It is possible that for some individuals, who perhaps would not have taken the shot given a standard

Table 4 Multinomial Logit Regression[a]

	Dependent Variable	
	Vaccination Intentions	
	Early	Late
Stock	0.175 (0.114)	−0.068 (0.29)
Cost	0.164 (0.113)	−0.904** (0.365)
Benefit	0.300*** (0.114)	−0.024 (0.291)
(Intercept)	0.032 (0.081)	−2.382*** (0.198)
Observations	2612	
Residual deviance	4223.546	
Akaike information criterion	4239.546	

[a]Numbers represent coefficients (β); standard errors are in parentheses.
*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$.

invitation message, this reasoning (on top of all other supporting arguments that they have in mind) may be the extra nudge they need to get the shot.[xii]

Examining comparative arguments by treatments, we found that 29% made such arguments in the Recommendation treatment and that 40%, 47%, and 49% did so in the Stock, Cost, and Benefit treatments, respectively. These percentages show that all of our late vaccination options affected individuals' reasoning to some extent. Notice the fact that the Recommendation treatment, which is the one that makes the weakest distinction between the early and late shots, had the lowest percentage of comparative arguments, followed by the Stock treatment, which creates a stronger distinction but one that is still not very tangible. The monetary treatments (Cost and Benefit) have the largest volume of comparative arguments, as they make the strongest distinction between the 2 shots, one that carries clear monetary consequences.

Discussion

We conducted a survey and measured how introducing two options to receive the flu shot—early and late—affects individuals' intentions to get vaccinated. We designed 4 treatments that differed in the manner in which they enhanced the early shot compared with the late one. All treatments increased vaccination intentions compared with the control, 3 of them significantly so. If HMOs would like to use this design and concentrate their efforts on specific subgroups that can be identified, they should focus on those who received at most 1 flu shot in the past 5 years.

Our intervention combines the psychological behavior triggered by the presence of a dominated option with more rational effects on behavior due to added information, repeated recommendations, and financial incentives. We now briefly examine these factors and the potential roles they play in our findings.

The Dominated Option Effect and Other Potential Factors

The literature on the decoy effect highlights the potential of a dominated option to trigger comparisons that enhance the attractiveness of the dominating option, which may, in turn, shift preferences in its favor. As reported in the Results section, we found support for this psychological channel in our data, as a substantial percentage of participants made arguments based on the comparative advantage of the early shot over the late one. Furthermore, these arguments appeared most frequently in the Benefit and Cost treatments, followed by the Stock treatment and finally the Recommendation treatment. In other words, the starker the dominance relation between the early and late vaccination options, the more comparative arguments were made. This shows that, if our design is to be implemented, it is important to maintain a clear dominance relation between the early and late shots to generate the maximal effect of the psychological comparative channel.

We would like to suggest 3 more potential contributing effects. First, compared with the control, the treatments provided additional information regarding the advantages of receiving the shot early in the season. In the treatments' invitations, it was stated that "the Ministry of Health recommends to get the shot early, in the beginning of the season, until December 31st, in order to increase its effectiveness for you and for the rest of the population." Educating and providing information have been found to have positive effects on influenza vaccinations.[20,22]

Another potential effect may be due to the fact that the treatments' invitations included 2 recommendations by the Ministry of Health, whereas the control included only one. The first recommendation appeared in all treatments and control and referred to influenza vaccination in general. The second recommendation appeared only in the treatment groups and referred to the early option. Some studies have already shown that individuals react to recommendations,[51,52] and although we are not aware of studies examining the role of repeated recommendations, it is plausible that such repetitions may encourage higher compliance rates. It is important to note, however, that the informational content and the repeated recommendations are common to all of our treatment groups. Hence, while they may account for an overall positive lift of intentions compared with the control group, they cannot account for the heterogeneous effects of the different treatments. The heterogeneity of our treatment effects is, in our opinion, mostly due to the differences in the late options across treatments and the variation in their ability to trigger a comparison that favors the early shot.

Finally, in the Benefit treatment, the early shot carried a monetary reward that may be used to cover the copay for doctor visits within the HMO. This is the only treatment in which a financial incentive in the form of a bonus was used, and as prior research has shown, such incentives are likely to have a positive impact on vaccination uptake rates.[20,21,53] It is therefore plausible that the incentive introduced in this treatment is responsible for at least part of its relatively large effect on intentions.

Policy Implications

Two of our treatments involved monetary transfers, that is, benefits to those who come early or a fee paid by those who arrive late. These transfers were relatively small and comparable with the fee associated with a visit to a specialist in most insurance plans available in Israel today. However, since monetary transfers may be problematic from a regulatory perspective, policy makers may prefer to consider the Recommendation and Stock treatments that generate substantial effects on intentions by simply conveying different information through their invitation messages.

In contemplating which attractive flu shot may be most appropriate to implement, it is important to note that the nonmonetary treatments may be less effective in practice since their separation between the early and late shots is less tangible than the separation made by the monetary treatments. In the Recommendation treatment, for example, there are actually no material consequences for receiving the late shot. In the other nonmonetary treatment (Stock), it is indeed more likely that the vaccine will run out of stock later in the season, but it is not likely that this will happen exactly on December 31, and individuals will most probably be aware of that. By contrast, in the Benefit and Cost treatments, getting the shot after December 31 carries the consequence of not receiving a bonus/paying a fee, which may more naturally resonate on people's minds. Thus, the monetary treatments may be more effective, whereas the nonmonetary treatments may require more publicity to maintain their effectiveness.[xiii]

Limitations

This study examined intentions rather than actual vaccination uptake rates. However, it has been shown that positive intentions are associated with a much higher likelihood of actually receiving the shot.[17,54,55] Moreover, it was pointed out that those with positive intentions are more likely to follow their provider's recommendation to receive the shot.[54] Thus, influencing intentions is likely to have important and significant positive effects on actual uptake rates. To provide more accurate estimates of the effectiveness of our attractive flu shot design, it would be helpful to examine how actual vaccination rates respond to such an intervention, a task that remains to be explored in future work.

The participant pool we analyzed did not include elderly people (older than 65 years), who are considered a major high-risk population that is recommended to receive the flu shot (in fact, as the age distribution in the sample is representative of the age range that we were able to sample, only 26% of the participants were 50 years or older). Yet, it is important to keep in mind that although younger individuals may be less vulnerable to complications related to the disease than the elderly, an increase in the vaccination rates of the younger population has been shown to generate positive external effects for the elderly.[56] In addition, younger adults are less likely to receive the flu shot and less likely to follow standard health recommendations by providers.[57] This age group might require new approaches to increase its uptake rates, such as the one suggested in this study.

Authors' Note

This research was approved by the Committee for Ethical Research and the Protection of Human Participants, the Faculty of Social Sciences, University of Haifa (approval number 260/16). This study has been preregistered on the AEA RCT Registry, and its unique identifying number is AEARCTR-0004584. All data and analysis code are available through this preregistration ID and on the following GitHub repository: https://github.com/sarid-ins/attractive_flu_shot_v2.

Acknowledgments

We thank Arie Melnik for helping us discover our interest in this topic. We also thank Ayala Arad and Moti Michaeli for important comments and fruitful discussions. Finally, we would like to thank 3 anonymous reviewers who invested from their time and efforts to significantly improve this article.

ORCID iD

Amnon Maltz https://orcid.org/0000-0003-3488-8223

Supplemental Material

Supplementary material for this article is available on the *Medical Decision Making* Web site at http://journals.sagepub.com/home/mdm.

Notes

i. The decoy effect, also known as the attraction effect or the asymmetric dominance effect, is attributed to Huber et al.[35] and refers to the following behavioral tendency: given a 2-option set, adding a third option that is clearly dominated by one option but not by the other may shift preferences in the direction of the dominating alternative. This phenomenon has been documented over a vast range of goods and in various contexts, including medical decision making.[36,37] The comparative channel that emerges by the presence of the decoy option has been discussed by Simonson,[38] Tversky and Simonson,[39] and Shafir et al.[40]

ii. The full questionnaires appear in Supplementary Material D.

iii. 20 ILS were roughly equal to 5.5 USD at the time of the study.

iv. Standard health care coverage in Israel requires a fee for the first visit to a specialist in each yearly quarter.

v. We expect the Benefit treatment to further increase intentions because of the financial bonus associated with getting the early shot.

vi. In Supplementary Material A, we also examine the treatment effects by degree of certainty and find that they have a stronger effect on those with weaker preferences regarding the vaccine, a finding that is in line with the discussion in Huber et al.[44] regarding the relationship between the decoy effect and the strength of preferences. We note, however, that the question regarding participants' certainty level appeared after participants marked their intentions and therefore may have been influenced by it.

vii. The planned number of completed surveys was calculated using a power test, which was based on pilot rounds. The test is reported in the preregistration of this study alongside all experimental details, hypotheses, data, and codes on the AEA RCT Registry (unique identifying number AEARCTR-0004584).

viii. Participants in the control group were asked whether they intend to get the shot or not.

ix. Questions appeared on the screen one at a time with no option to go back.

x. Because of the small numbers of participants who do not intend to get the shot in these groups, we pooled them together and performed Fisher's exact test, which confirmed that they were unaffected by the treatments ($P = 0.955$).

xi. We note that this value should be taken with caution since the certainty question was asked after participants marked their vaccination intentions, and this may have biased their sense of certainty. For more on the level of certainty, see Supplementary Material A.

xii. We also examined the responses of the minority of participants who intended to vaccinate late. These individuals mostly emphasized their personal taste for not rushing and acting on their own pace. Some of them mentioned that they do not view the recommendation/fee/benefit as valuable enough to make them change their plans.

xiii. One may expect the treatments involving monetary transfers to be more effective for participants with lower income levels. However, this turns out not to be the case. For an examination of our treatment effects for different income levels, see Supplementary Material B.

References

1. World Health Organization. Influenza (seasonal), fact sheet, 2018. Available from: http://www.who.int/news-room/fact-sheets/detail/influenza-(seasonal)
2. Thompson WW, Shay DK, Weintraub E, et al. Mortality associated with influenza and respiratory syncytial virus in the united states. *JAMA*. 2003;289(2):179–86.
3. Thompson WW, Shay DK, Weintraub E, et al. Influenza-associated hospitalizations in the united states. *JAMA*. 2004;292(11):1333–40.
4. Glezen WP. Serious morbidity and mortality associated with influenza epidemics. *Epidemiol Rev*. 1982;4:25–44.
5. Nichol KL, Mendelman PM, Mallon KP, et al. Effectiveness of live, attenuated intranasal influenza virus vaccine in healthy, working adults: a randomized controlled trial. *JAMA*. 1999;282(2):137–44.
6. Nichol KL, Heilly SD, Ehlinger E. Colds and influenza-like illnesses in university students: impact on health, academic and work performance, and health care use. *Clin Infect Dis*. 2005;40(9):1263–70.
7. Nichol KL, Heilly SD, Ehlinger E. Burden of upper respiratory illnesses among college and university students: 2002-2003 and 2003-2004 cohorts. *Vaccine*. 2006;24(44–46):6724–5.
8. Nichol KL, Margolis KL, Wuorenma J, Von Sternberg T. The efficacy and cost effectiveness of vaccination against influenza among elderly persons living in the community. *N Engl J Med*. 1994;331(12):778–84.
9. Gross PA, Hermogenes AW, Sacks HS, Lau J, Levandowski RA. The efficacy of influenza vaccine in elderly persons: a meta-analysis and review of the literature. *Ann Intern Med*. 1995;123(7):518–27.

10. Nichol KL, Baken L, Nelson A. Relation between influenza vaccination and outpatient visits, hospitalization, and mortality in elderly persons with chronic lung disease. *Ann Intern Med*. 1999;130(5):397–403.
11. van Essen GA, Palache AM, Forleo E, Fedson DS. Influenza vaccination in 2000: recommendations and vaccine use in 50 developed and rapidly developing countries. *Vaccine*. 2003;21(16):1780–5.
12. Centers for Disease Control and Prevention. Public health and aging: influenza vaccination coverage among adults aged > or = 50 years and pneumococcal vaccination coverage among adults aged > or = 65 years—United States, 2002. *MMWR Morb Mortal Wkly Rep*. 2003;52(41):987–92.
13. Canning HS, Phillips J, Allsup S. Health care worker beliefs about influenza vaccine and reasons for non-vaccination–a cross-sectional survey. *J Clin Nurs*. 2005;14(8):922–5.
14. Shahrabani S, Benzion U, Din GY. Factors affecting nurses' decision to get the flu vaccine. *Eur J Health Econ*. 2009;10(2):227–31.
15. Schmitz H, Wübker A. What determines influenza vaccination take-up of elderly Europeans? *Health Econ*. 2011; 20(11):1281–97.
16. Parente ST, Salkever DS, DaVanzo J. The role of consumer knowledge of insurance benefits in the demand for preventive health care among the elderly. *Health Econ*. 2005;14(1): 25–38.
17. Maurer J. Inspecting the mechanism: a longitudinal analysis of socioeconomic status differences in perceived influenza risks, vaccination intentions, and vaccination behaviors during the 2009–2010 influenza pandemic. *Med Decis Making*. 2016;36(7):887–99.
18. Taylor E, Atkins KE, Medlock J, Li M, Chapman GB, Galvani AP. Cross-cultural household influence on vaccination decisions. *Med Decis Making*. 2016;36(7):844–53.
19. Schmid P, Rauber D, Betsch C, Lidolt G, Denker M-L. Barriers of influenza vaccination intention and behavior-a systematic review of influenza vaccine hesitancy, 2005-2016. *PloS One*. 2017;12(1):e0170550.
20. Moran WP, Nelson K, Wofford JL, Velez R, Case LD. Increasing influenza immunization among high-risk patients: education or financial incentive? *Am J Med*. 1996;101(6): 612–20.
21. Nexøe J, Kragstrup J, Rønne T. Impact of postal invitations and user fee on influenza vaccination rates among the elderly: a randomized controlled trial in general practice. *Scand J Prim Health Care*. 1997;15(2):109–12.
22. Kimura AC, Nguyen CN, Higa JI, Hurwitz EL, Vugia DJ. The effectiveness of vaccine day and educational interventions on influenza vaccine coverage among health care workers at long-term care facilities. *Am J Public Health*. 2007;97(4):684–90.
23. Bronchetti ET, Huffman DB, Magenheim E. Attention, intentions, and follow-through in preventive health behavior: field experimental evidence on flu vaccination. *J Econ Behav Organ*. 2015;116:270–91.
24. Chapman GB, Li M, Colby H, Yoon H. Opting in vs opting out of influenza vaccination. *JAMA*. 2010;304(1):43–4.
25. Marsh HA, Malik F, Shapiro E, Omer SB, Frew PM. Message framing strategies to increase influenza immunization uptake among pregnant African American women. *Matern Child Health J. 2014;* 18(7):1639–47.
26. Yokum D, Lauffenburger JC, Ghazinouri R, Choudhry NK. Letters designed with behavioural science increase influenza vaccination in medicare beneficiaries. *Nat Human Behav*. 2018;2:743–9.
27. Barton MB, Schoenbaum SC. Improving influenza vaccination performance in an HMO setting: the use of computer-generated reminders and peer comparison feedback. *Am J Public Health*. 1990;80(5):534–36.
28. Stockwell MS, Westhoff C, Kharbanda EO, et al. Influenza vaccine text message reminders for urban, low-income pregnant women: a randomized controlled trial. *Am J Public Health*. 2014;104(S1):e7–12.
29. Igoe G, Bedford D, Howell F, Collins S. How to improve the uptake of influenza vaccination in older persons at risk. *Irish J Med Sci*. 1999;168(2):107–8.
30. Furey A, Robinson E, Young Y. Improving influenza immunisation coverage in 2000-2001: a baseline survey, review of the evidence and sharing of best practice. *Commun Dis Public Health*. 2001;4(3):183–7.
31. Patel MS, Volpp KG, Small DS, et al. Using active choice within the electronic health record to increase influenza vaccination rates. *J Gen Intern Med*. 2017;32(7):790–5.
32. Kim RH, Day SC, Small DS, Snider CK, Rareshide CAL, Patel MS. Variations in influenza vaccination by clinic appointment time and an active choice intervention in the electronic health record to increase influenza vaccination. *JAMA Netw Open*. 2018;1(5):e181770.
33. Milkman KL, Beshears J, Choi JJ, Laibson D, Madrian BC. Using implementation intentions prompts to enhance influenza vaccination rates. *Proc Natl Acad Sci U S A*. 2011;108(26):10415–20.
34. Benartzi S, Beshears J, Milkman KL, et al. Should governments invest more in nudging? *Psychol Sci*. 2017;28(8): 1041–55.
35. Huber J, Payne JW, Puto C. Adding asymmetrically dominated alternatives: violations of regularity and the similarity hypothesis. *J Consumer Res*. 1982;9(1):90–8.
36. Schwartz JA, Chapman GB. Are more options always better? the attraction effect in physicians' decisions about medications. *Med Decis Making*. 1999;19(3):315–23.
37. Rubaltelli E, Burra P, Sartorato V, et al. Strengthening acceptance for xenotransplantation: the case of attraction effect. *Xenotransplantation*. 2008;15(3):159–63.
38. Simonson I. Choice based on reasons: the case of attraction and compromise effects. *J Consumer Res*. 1989;16(2):158–74.
39. Tversky A, Simonson I. Context-dependent preferences. *Manage Sci*. 1993;39(10):1179–89.
40. Shafir E, Simonson I, Tversky A. Reason based choice. *Cognition*. 1993;49(1–2):11–36.

41. Lee BY, Tai JHY, Bailey RR, Smith KJ. The timing of influenza vaccination for older adults (65 years and older). *Vaccine*. 2009;27(50):7110–5.
42. Myers ER, Misurski DA, Swamy GK. Influence of timing of seasonal influenza vaccination on effectiveness and cost-effectiveness in pregnancy. *Am J Obstet Gynecol*. 2011; 204(6):S128–40.
43. Frederick S, Lee L, Baskin E. The limits of attraction. *J Market Res*. 2014;51(4):487–507.
44. Huber J, Payne JW, Puto C. Let's be honest about the attraction effect. *J Market Res*. 2014;51(4):520–5.
45. Nuffield Council on Bioethics (Great Britain). *Public Health: Ethical Issues*. London: Nuffield Council on Bioethics; 2007.
46. Patel MS. Nudges for influenza vaccination. *Nat Hum Behav*. 2018;2(10):720–1.
47. Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. *J R Stat Soc Ser B Methodol*. 1995;57(1):289–300.
48. Samuelson W, Zeckhauser R. Status quo bias in decision making. *J Risk Uncertain*. 1988;1(1):7–59.
49. Baron J, Ritov I. Reference points and omission bias. *Organ Behav Hum Decis Process*. 1994;59(3):475–98.
50. Dibonaventura MD, Chapman GB. Do decision biases predict bad decisions? Omission bias, naturalness bias, and influenza vaccination. *Med Decis Making*. 2008;28(4):532–9.
51. de Lataillade C, Auvergne S, Delannoy I. 2005 and 2006 seasonal influenza vaccination coverage rates in 10 countries in Africa, Asia Pacific, Europe, Latin America and the Middle East. *J Public Health Policy*. 2009;30(1):83–101.
52. Böhm R, Meier NW, Korn L, Betsch C. Behavioural consequences of vaccination recommendations: an experimental analysis. *Health Econ*. 2017;26:66–75.
53. Drees M, Wroten K, Smedley M, Mase T, Schwartz JS. Carrots and sticks: achieving high healthcare personnel influenza vaccination rates without a mandate. *Infec Control Hosp Epidemiol*. 2015;36(6):717–24.
54. Harris KM, Maurer J, Lurie N. Do people who intend to get a flu shot actually get one? *J Gen Intern Med*. 2009; 24(12):1311–3.
55. Gargano LM, Painter JE, Sales JM, et al. Seasonal and 2009 h1n1 influenza vaccine uptake, predictors of vaccination, and selfreported barriers to vaccination among secondary school teachers and staff. *Hum Vaccines*. 2011;7(1): 89–95.
56. Ward CJ. Influenza vaccination campaigns: is an ounce of prevention worth a pound of cure? *Am Econ J Appl Econ*. 2014;6(1):38–72.
57. Uscher-Pines L, Maurer J, Kellerman A, Harris KM. Healthy young and middle age adults: What will it take to vaccinate them for influenza? *Vaccine*. 2010;28(46):7420–2.