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Health policy 134 (2023) 104858

Contents lists available at ScienceDirect

Health policy

journal homepage: www.elsevier.com/locate/healthpol

How does nudging the COVID-19 vaccine play out in people who are in doubt about vaccination?☆

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ARTICLE INFO

Keywords:
COVID-19 vaccination
Nudging
Autonomy
Field experiment

ABSTRACT

In spite of the growing availability of COVID-19 vaccines, a substantial number of people is reluctant or uncertain about getting the vaccine. Nudges may improve vaccine uptake but it is unclear how this plays out with the experience of autonomous choice, decision competence, decision satisfaction, and being pressured to make a choice. In an online experiment among a representative sample ($N = 884$), we examined whether a social norm nudge or a default nudge (either or not transparent) was effective in steering the desired choice of making a hypothetical early vaccination appointment as compared to making a later appointment or no appointment. We also examined how both nudges affected autonomy and related downstream consequences. None of the nudges proved effective in making the desired choice of early vaccination and neither did they impact on downstream consequences. Rather, our results indicate that participants who were certain about their choice (i.e., opted for the earliest available vaccination opportunity or not getting vaccinated at all) reported higher levels of autonomy, competence and satisfaction than participants who did not know yet about vaccination or who postponed the moment of getting their vaccination. We conclude that the experience of autonomy and related downstream consequences is determined by having made up one's mind about vaccination, and is not affected by attempts to nudge the individual.

Vaccines are critical for controlling the COVID-19 pandemic. However, mobilizing people to get the vaccine has proven a challenge because a significant minority of people is unwilling or hesitant about getting vaccinated. Despite the growing availability of COVID-19 vaccines in 2021, about 30% of US adults were reluctant or uncertain about getting the vaccine [1] and these rates were similar in many other countries that had vaccines at their disposal [2–6]. Vaccine hesitancy (being unsure about getting a vaccine) is more prevalent than vaccine resistance (objecting to vaccines) and associated with concerns about effectiveness or side effects of COVID-19 vaccines, indifference toward COVID-19, or lack of trust in authorities [2-4,7,8].

One way to improve vaccine uptake is to make COVID-19 shots mandatory [9] but the downside of this strategy is that it may create serious reactance [10]. Nudges, defined as interventions that make the desired option more prominent without forbidding the alternative [11], are a more sophisticated alternative for compulsory vaccination as they have been found to increase vaccination rates while still preserving freedom of choice [12,13]. Findings from pre-COVID studies on large-scale vaccination in adult populations (i.e., influenza vaccination) reveal that different types of nudges (e.g., defaults or reminders to get shots that were already reserved for the patient) may boost vaccination rates up to 5% [14,15]. Similar improvements in uptake have been reported for nudging intentions to get the COVID-19 vaccine [16], either by emphasizing ownership of the vaccine dose [17] or by highlighting the prosocial benefits of vaccination [18]. These promising findings stand in contrast with financial incentives failing to generate any effect in COVID-19 vaccination uptake, regardless whether they concerned small, guaranteed rewards or lotteries that gave vaccinated individuals a chance to win $1 million [19], albeit not consistently [20].

In spite of these initial successes of nudging COVID-19 vaccination, it is unknown to what extent nudges have a positive impact on vaccination choice in people who are hesitant about the vaccine. Previous research suggests that nudges especially benefit people in doubt by providing them with a gentle push in the right direction and are less effective in

☆ **Source of funding**: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
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https://doi.org/10.1016/j.healthpol.2023.104858
Received 25 October 2022; Received in revised form 30 May 2023; Accepted 11 June 2023
Available online 12 June 2023

people who have already made up their mind either in favor or against the suggested choice [20]. In addition, a recent review on nudgeability suggests that nudges are ineffective when they do not accord with people's preference for a choice [21]. These findings indicate that nudges might especially boost vaccine uptake among people who are uncertain about vaccination and support them in following through on their vaccination intentions when they tend to procrastinate or forget about getting their shot. However, it may also turn out differently considering that people in doubt about COVID-19 vaccination are confused because of conflicting information from public health authorities and social media. In this case, nudges may contribute to indecision rather than resolve it as previous research has demonstrated that autonomous choice was compromised in people who experience difficulties in decision making after having been nudged to make a choice (i.e., about organ donation registration) [22]. As a result, nudging vaccination choice may negatively impact on doubts about vaccination. Whereas nudges in general are for the most part appreciated by the general public [23], it may be that nudges for promoting vaccination during the pandemic raise more concern. Even though nudges in principle allow for the possibility of choosing the less desired alternative of not getting vaccinated, public debate about governments mandating COVID-19 mitigation measures may amplify existing uneasiness that nudge effectiveness relies on cognitive flaws in human reasoning and compromises autonomous decision making [24,25]. The potential bypass of deliberative capacities by employing nudges to influence vaccination decisions may raise particular worry because autonomy is considered a central value in health decision making contexts [26–28].

In the present study, we will first examine, in a hypothetical context, whether nudges aimed at increasing COVID-19 vaccination uptake are effective, both in people who are certain about either or not getting vaccinated and people who are unsure. Based on the existing evidence on vaccination nudges [17,18], we expect that nudges are effective in stimulating the desired choice of vaccination. Next, we will examine whether nudges affect personal autonomy, defined as the subjective experience of autonomous decision making [29] along with associated concepts of competence to make a decision about vaccination, decision satisfaction, and the experience of pressure to decide. In view of recent research demonstrating that nudge effects are also present when people (are encouraged to) use their reflective reasoning capacities [21,30], we expect that nudges allow for a balanced choice and will not infringe upon the experience of autonomy, nor on decision making competence, decision satisfaction, or the experience of pressure to make a decision. Third, we will examine how doubt about vaccination and the inability or unwillingness to make a vaccination choice affects personal autonomy and associated concepts. Previous research has demonstrated that autonomy is at stake when people find it difficult to make a choice because they are confused by the number of options or feel pressured to choose [31] – which may be the case when it involves a complex decision about a sensitive issue such as vaccination. However, in view of the scarce empirical evidence on how uncertainty about one's choice plays out with autonomy and associated concept, this research question is exploratory.

We will examine these questions in an online experiment with hypothetical choices about getting vaccinated in a large and representative sample at the very moment people had the opportunity for vaccination midway 2021 – thus making the choice situation imaginary but still personally salient, which contributes to the external validity of our experiment. To address our research questions, we will employ two types of nudges that are frequently used in a wide variety of settings (including vaccine uptake [15]) and have been found to be effective: social norm nudges [32] and default nudges [33]. Both types of nudges may make decisions easier because they communicate an implicit recommendation that the nudged option is valued by other people. Next to regular versions, we will test whether transparent versions of these nudges that are accompanied by an explanation of their purpose and working mechanism will be equally effective in view of recent research showing that transparency does not compromise nudge effects nor affects the experience of autonomous choice [21,29].

1. Method

1.1. Ethics statement

The study has been approved by the Ethics Committee of the Faculty of Social and Behavioural Sciences of Utrecht University and filed under number 21-0128. Data are available at the Open Science Framework (https://osf.io/g39zq).

1.2. Participants

Participants were recruited via a Dutch online panel agency (Flycatcher.eu). Recruitment was in accordance with the declaration of Helsinki and informed consent was obtained from all individual participants in the study. At the moment of data collection (20–28 May 2021), vaccine availability was high and everyone who wanted to get vaccinated had the opportunity to do so. Also, motivation for vaccination was high with up to 91.5% of the population reporting that they were positive about getting vaccinated [34]. A total number of 1222 participants between 18 and 40 years old (those who had the lowest chance of already having been vaccinated at the time of data collection because elderly people did have the opportunity for getting vaccinated at an earlier point in time) were approached to participate and screened for eligibility. They were included if they had not yet received their COVID-19 vaccination (N = 936; 77%). Invitees who were already vaccinated (N = 281; 23%) or who were not willing to share their vaccination status (N = 5; <1%) were excluded prior to participation.

On average, it took participants 249 s (SD = 140 s) to complete the survey. Participants who were either very slow (>1200 s, N = 28) or very fast (<90 s, N = 24) in survey completion were also excluded. The final sample thus consisted of 884 unvaccinated participants (427 male, 449 female, 8 other/rather not say) who were on average 28.45 (SD = 6.60) years old. About 56% of participants had completed a low or medium level of education and 44% a high level. As a result, higher educated participants were overrepresented in our sample.

1.3. Design and procedure

The experiment employed a one-factor between-subjects design with type of nudge as the independent variable and vaccination decision, personal autonomy, decision satisfaction, decision competence, and experienced pressure to make a decision as the main dependent variables. We used five experimental conditions: default nudge (N = 175), transparent default nudge (N = 176), social norm nudge (N = 174), transparent social norm nudge (N = 180), and a control condition (no nudge; N = 179).

1.4. Experimental manipulation

After having been explained the purpose of the study (including the hypothetical nature of the study), all participants were presented with the text "We contact you to make an appointment for getting your COVID-19 vaccine. You can indicate your preference for when you want to get the vaccine". In the control condition, participants could then immediately indicate their preference. In the default nudge condition, the preferred option of the earliest available opportunity ('next week') was marked; in the transparent default condition, participants read the following text before indicating their preference: "You can indicate your preference for when you want to get your vaccine. The option to plan an appointment next week has been marked. This is called a nudge. Scientific research has shown that when making a choice, people take account of a marked option. Of course, you can still make your own choice". The social norm condition included the text "You can indicate

your preference for when you want to get your vaccine. More than 70% of people chose to get their vaccine next week", which was supplemented by the text "This information shows the percentage of people who want to get their vaccine next week. This is called a nudge. Scientific research has shown that when making a choice, people take account of what the majority chooses. Of course, you can still make your own choice" in the transparent social norm condition.

1.5. Measures

Vaccination Decision. Participants were asked to indicate their decision about getting vaccinated from five options: next week, within 2 weeks, within 4 weeks, I don't know, I don't want to get vaccinated.

Personal Autonomy was assessed by nine items (e.g., 'I felt free to make the choice that I wanted to make') from the Nudge Autonomy Questionnaire [35]. Items were rated on a 5-point scale (1 = strongly disagree to 5 = strongly agree) and averaged into a Personal Autonomy score with good reliability (Cronbach's alpha 0.72).

Decision Competence was measured with six items (e.g., 'I was pretty skilled at making this decision') [36]. Items were rated on a 5-point scale (1 = strongly disagree to 5 = strongly agree) and averaged into a total score with good reliability (Cronbach's alpha 0.81).

Decision Satisfaction. Decision Satisfaction was measured with five items (e.g., 'My choice is the right one for my situation') on a 5 -point scale (1 = strongly disagree to 5 = strongly agree) [37]. The five scores were averaged into a total score with good reliability (Cronbach's alpha 0.84).

Pressure to Make a Decision was measured with a single item ('How much pressure did you experience to make a choice?'). Participants responded on a slider with labels on both extremes (0 = none at all to 100 = extreme pressure).

Vaccination Motivation was measured with a single item (How much are you willing to get vaccinated against COVID-19?) rated on a 1–100 scale (0 = not at all to 100 = most definitely).

Vaccination Hesitancy was assessed with ten items (e.g., 'I am concerned about the safety of the COVID-19 vaccine') that were rated on a 5-point scale (1 = strongly disagree to 5 = strongly agree). The ten scores were averaged into a Vaccination Hesitancy scale with good reliability (Cronbach's alpha 0.93) after having checked the dimensionality of the scale by a principal components analysis (PCA). The PCA revealed that only one component had an eigenvalue over Kaiser's criterion of 1 and explained 61% of the variance. The scree plot showed an inflexion that also justifies retaining one component. We therefore concluded that the hesitancy scale was unidimensional and employed it as such in our analyses.

1.6. Analyses

Preprocessing Steps. We defined outliers as 3 *SD*s away from the mean and set them missing for the main variables autonomy (3 participants), competence (3 participants), and satisfaction (4 participants); all outliers were on the lower end of the scales. All analyses were run with and without outliers, but this did not change any of the results in terms of direction or significance of effects. We will therefore report on the entire sample with inclusion of outliers. We will report on three series of analyses. First, we will examine the effect of nudge condition on the preferred choice (i.e., vaccination next week) by a series of Chi-squared analyses. Next, we will report on the effects of nudge condition on personal autonomy and associated concepts (satisfaction, competence, and pressure to make a decision). Finally, we will examine the effect of the vaccination decision (either of the five options chosen by participants) on personal autonomy and related downstream consequences.

2. Results

2.1. Descriptive statistics

On average, participants scored relatively high on autonomy (M = 3.72, SD = 0.53), decision competence (M = 3.82, SD = 0.62), and decision satisfaction (M = 3.97, SD = 0.68) regarding the hypothetical choice of making a vaccination appointment. Participants experienced little pressure to make a decision (M = 25.31, SD = 24.48). Motivation for getting vaccinated upon receiving an invitation was rather polarized (both zero-inflated and hundred-inflated), implicating that the minimum and maximum ends of the scale were used by about half of the participants: 108 (12%) participants scored on the minimum of the scale (zero) and were not at all willing to get vaccinated; 351 (40%) participants scored on the maximum of the scale (100) and were fully committed to getting vaccinated; 425 (48%) participants scored somewhere in between the extreme ends of the scale (on the range from 1 to 99). On average, participants scored relatively high on vaccination motivation (M = 69.60, SD = 37.09) with 629 participants (71%) scoring above the midpoint of the scale. In accordance with high vaccination motivation, vaccination hesitancy was relatively low (M = 2.51, SD = 0.87). Autonomy, competence, and satisfaction were strongly positively correlated; all three variables showed negative correlations with the experience of pressure to make a decision. Motivation for vaccination was positively but moderately correlated with autonomy, competence and satisfaction; and unrelated to pressure. In contrast, vaccination hesitancy was negatively related with autonomy, competence, and satisfaction, and positively with pressure – albeit all correlations were small. Age was not associated with vaccination motivation or vaccination hesitancy; associations of age with autonomy and associated concepts were significant albeit weak. All means and correlations are displayed in Table 1. We also examined whether vaccination motivation and vaccination hesitancy differed by gender or education. This proved to be the case. Male participants (M = 73.92, SD = 34.50) reported higher vaccination motivation than females (M = 65.57, SD = 38.95), $t(869) = 3.365$, $p = .001$, as well as lower vaccination hesitancy (M = 2.39, SD = 0.88) than females (M = 2.61, SD = 0.84), t (866) = −3.817, $p = .002$. Participants with higher education (M = 78.20, SD = 33.31) reported higher motivation than lower educated participants (M = 62.91, SD = 38.68), $t(874) = 6.332$, $p < 0.001$, and lower hesitancy (M = 2.21, SD = 0.81) than those with lower education (M = 2.74, SD = 0.85), $t(846) = -9.368$, $p < 0.001$.

2.2. Randomization check

Randomization of the 884 participants who were eligible for participation across the five experimental conditions was successful regarding gender, education, vaccination motivation, and vaccination hesitancy (all p's >0.466); but not for age, F (4, 867) = 2.57, $p = .037$. All analyses were run with and without age as a covariate, but this did not change any of the results in terms of direction or significance of effects. We will therefore report on the analyses without the inclusion of age as a covariate.

2.3. Nudge effectiveness

Across all five conditions, a substantial proportion of participants indicated in the hypothetical choice scenario that they would like to receive their vaccination in the upcoming week (38%; N = 336). Another 274 participants (31%) indicated that they didn't know when they wanted to get vaccinated, followed by a group of 149 participants (17%) who indicated they did not want to get vaccinated; 64 participants (7%) indicated they wanted to receive their vaccine in two weeks, and another 61 participants (7%) wanted to receive their vaccine in four weeks. In order to analyze whether the nudges that encouraged the choice for getting vaccinated in the following week (the preferred

Table 1
Means and correlation coefficients for age, autonomy, competence, satisfaction, pressure, vaccination motivation, and vaccination hesitancy ($N = 884$).

	Mean (SD)	Range	1	2	3	4	5	6
1. Age	28.45 (6.60)	18–40						
2. Autonomy	3.72 (0.53)	1.44–5.00	.067*					
3. Competence	3.82 (0.62)	1.67 –5.00	.133***	.612***				
4. Satisfaction	3.97 (0.68)	1.60–5.00	.094**	.644***	.731***			
5. Pressure	25.31 (24.48)	0–100	−0.081*	−0.203***	−0.212***	−0.240***		
6. Vacc. motivation	69.60 (37.09)	0–100	.029	.116***	.085**	.196***	−0.060	
7. Vacc. hesitancy	2.51 (0.87)	1.00–5.00	−0.061	−0.213***	−0.202***	−0.303***	.219***	−0.693***

Note.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

option) had an impact on the choices that participants made, we ran a Chi-squared analysis with condition (Control, Default, Social Norm, Transparent Default, Transparent Social Norm) as the independent variable and choice (next week, in two weeks, in four weeks, I don't know yet when, I don't want to get vaccinated) as the dependent variable. This analysis did not reveal a significant effect of condition on the choice that participants made regarding getting vaccinated, χ^2 (16, $N = 884$) = 21.49, $p = .161$. We also conducted a more parsimonious Chi-squared analysis with choice (next week vs. all other options) as the dependent variable, since the nudge intended to stimulate selection of the option for getting vaccinated the following week. Again, this analysis did not reveal a significant effect, χ^2 (4, $N = 884$) = 2.72, $p = .601$. All in all, these analyses reveal no significant effect of any nudge on vaccination choice.

Given the rather polarized positions regarding vaccination motivation, we also explored nudge effectiveness in the subsample of participants who did not score at any of the extremes (0 or 100) of our measure of motivation for getting vaccinated ($N = 425$). Within this subsample, and across all five conditions, about half of participants indicated that they did not know yet when to get vaccinated (49%; $N = 209$), followed by a group of 92 participants (22%) who wanted to get vaccinated in the upcoming week; 48 participants (13%) did not want get vaccinated, 39 participants (9%) within four weeks, and 37 participants (9%) within two weeks. In order to analyze whether the nudges affected choice in this subsample, we first ran the same Chi-squared analysis with the five choice options as dependent variable. This analysis again did not reveal a significant effect of condition on the choices that participants made regarding getting vaccinated, χ^2 (16, $N = 425$) = 9.32, $p = .900$. The more parsimonious Chi-squared analysis with choice (next week vs. all other options) as dependent variable did also not reveal a significant nudge effect, χ^2 (4, $N = 425$) = 2.16, $p = .706$. We thus also did not find a significant effect of the different nudges on vaccination choice within this subsample of participants who were at least somewhat ambiguous regarding their willingness to get vaccinated. Altogether, neither of the two nudges, either or not transparent, proved effective in influencing vaccination choice, regardless whether it concerned ambiguous people or people who were positive about vaccination.

2.4. Nudge effects on personal autonomy and associated concepts

As a next step in our analyses, we aimed to determine how nudges would affect personal autonomy and related downstream consequences. We render this analysis relevant even though nudges proved ineffective, as even the mere attempt to influence vaccination choice may impact autonomy, competence, satisfaction, or the experience of pressure to make a choice. In order to analyze whether the nudges had an effect on these four elements of participants' subjective evaluation of their choice, we ran a MANOVA with Condition as the independent variable and autonomy, competence, satisfaction and pressure as dependent variables. This analysis did not reveal a significant multivariate effect, F (16, 3516) = 1.154, $p = .298$. In line with this, univariate effects were insignificant as well (albeit marginally significant for pressure at $p = .055$, all other p's >0.656). Neither nudge did thus affect autonomy, competence, satisfaction, or pressure to make a decision.

2.5. Effects of choice on autonomy and associated concepts

As a final step in our analyses, we examined the role of choice as a proxy for inability or unwillingness to make a decision as a predictor of autonomy and associated concepts by running a MANOVA with choice as the independent variable and autonomy, competence, satisfaction, and pressure as dependent variables. This analysis did reveal a significant multivariate effect, F (16, 3516) = 15.119, $p < 0.001$.

Almost all univariate effects for autonomy, competence, and satisfaction were significant (all p's <0.029 after Tukey correction for multiple comparisons with the exception of a few non-significant associations shown in Table 2) with participants who were certain about their choice to get vaccinated feeling most autonomous, competent, and satisfied about their choice, while those who were more ambivalent about getting vaccinated reported lower levels on these variables. Specifically, participants who chose to get their vaccine at the earliest available opportunity (next week) or chose to not get a vaccination felt most autonomous, competent, and satisfied with their choice. There was not much of a difference between participants who didn't know yet about vaccination and those who wanted to get vaccinated in four weeks, suggesting that postponing one's vaccine uptake indicates doubt about vaccination. There were no differences for pressure to make a decision except for participants who chose to get vaccinated in four weeks and experienced more pressure as compared with participants who wanted to get vaccinated at the earliest available opportunity, again suggesting that postponing vaccination uptake is an indicator of doubt. On the whole, this pattern of results suggests that autonomy, competence, and satisfaction are largely determined by having made up one's mind about vaccination.

3. Discussion

COVID-19 vaccination has proven a sensitive issue with a significant minority of people being hesitant about vaccination or even resisting getting vaccinated [1–4]. Nudging, as in offering gentle directions to make the right decision [11], may help people to make the preferred choice of getting vaccinated as soon as possible in an attempt to curb the COVID-19 pandemic. Given debate about whether and how vaccination should be encouraged [26,38,39], it is important to investigate whether decision support by nudging is effective in accelerating a vaccination appointment and how it plays out with personal autonomy and related downstream consequences when making a choice about vaccine uptake. Our findings reveal that two well established types of nudges, a nudge presenting the preferred option as default and a nudge emphasizing the social norm of getting vaccinated, were ineffective in promoting the desired choice as compared to a control condition, regardless of whether these nudges were accompanied by an explanation of their presence and

Table 2
Means for autonomy, competence, satisfaction, pressure, motivation, and pressure broken down by type of choice ($N = 884$).

Choice	*Autonomy*	*Competence*	*Satisfaction*	*Pressure*	*Motivation*	*Hesitancy*
Don't know	3.51 (0.48) [a]	3.49 (0.55) [a]	3.56 (0.62)	27.86 (27.67)	64.68 (29.85)	2.76 (0.73)
Don't want	3.74 (0.47) [b]	3.98 (0.62) [b]	4.06 (0.65) [a b]	22.50 (30.08)	6.11 (13.22)	3.39 (0.71)
Next week	3.92 (0.51)	4.04 (0.60) [b]	4.31 (0.56)	21.98 (25.60) [a]	95.82 (9.95)	1.95 (0.63)
Within 2 weeks	3.72 (0.49) [b c]	3.76 (0.47) [c]	3.90 (0.56) [a c]	30.47 (36.09)	87.61 (17.43)	2.36 (0.77)
Within 4 weeks	3.50 (0.64) [a c]	3.70 (0.50) [a c]	3.83 (0.57) [b c]	33.70 (28.42) [a]	83.48 (19.41)	2.40 (0.79)

Note. Means for autonomy, competence, and satisfaction with similar superscripts do *not* significantly differ from each other. Means for pressure with similar superscript do differ significantly from each other. Means for motivation and hesitancy are descriptive and not included in the MANOVA.

working mechanism. However, given the hypothetical nature of this decision in our study, this should not be interpreted as evidence that nudging is ineffective for stimulating vaccination uptake [16–18]. In view of the generally favorable opinion about vaccination with on average high levels of vaccination motivation (despite a considerable number of participants scoring on the extreme lower end of the motivation question) and relatively low levels of vaccination hesitancy, the absence of nudge effects is somewhat surprising but in line with the overall modest number of positive decisions about vaccine uptake in our sample: regardless condition, only 38% of participants opted for the preferred choice of vaccination within one week and another 14% within two to four weeks whereas 48% did not know or was negative. Similar discrepancies between vaccination motivation and actual vaccination have been observed in previous research [40].

Our findings also reveal that neither nudge had an effect on personal autonomy whereas satisfaction about the decision, feeling competent to make a decision or the experience of pressure to make a decision were also unaltered by the presence of the nudge. This is in line with the results of a handful of empirical studies examining the impact of nudges on personal autonomy and associated concepts, generally showing that nudges do not have downstream consequences [29,41,42], regardless whether it concerns hypothetical choices about relatively minor issues (i.e., defaults for green arrangements when moving house) [29] or actual choices with high stakes (i.e., opt-out arrangements for organ donation registration) [22]. It may well be that the nudge being ineffective in steering the decision in the desired direction of vaccination was responsible for the absent effects on autonomy and associated concepts. However, our findings on how autonomy, competence, and satisfaction relate to a vaccination decision suggest that these outcomes are not invariable. Participants who were certain about getting the vaccine (i.e., opted for the earliest available opportunity) or not getting vaccinated at all reported higher levels of autonomy, competence and satisfaction than participants who did not know yet about vaccination or who postponed the moment of getting their vaccination. It thus seems that the experience of autonomy, competence, and satisfaction is determined by having made up one's mind about vaccination uptake, regardless of a nudge being present. These findings align well with the conceptualization of autonomy as self-constitution, defining autonomy as being able to make choices that correspond with one's preferences rather than with mere freedom of choice [43]. Apparently, as observed in our study, autonomy, competence, and satisfaction are experienced when people know about their preferences and decide in accordance with them. In contrast, people who were ambivalent about vaccination scored lower on these three elements of decision making and exposure to a nudge neither increased or decreased this inability to choose.

Previous research on susceptibility to nudge influence has demonstrated that pre-existing preferences determine nudge effectiveness [21]: when people hold a strong preference in agreement with the purpose of the nudge, nudges do not have an additional effect whereas strong preferences at odds with the purpose of the nudge render the nudge ineffective. While these preceding studies examined topics for which most people at least have a slight (positive) preference (e.g., healthy eating), these kind of effects may be more prominent when people are very opiniated as may be the case when vaccination is concerned. Holding strong preferences may not only account for an ineffective vaccination nudge but also, and even more so, for experiencing a high ability to choose, as expressed in high levels of autonomy, competence, and satisfaction. This association between knowing what one wants and decision ability is a clear sign that strategies that aim to facilitate difficult decisions should be more geared toward boosting the competence for making decisions rather than stimulating a preferred option [44].

Our research bears implications for public health policies regarding the promotion of COVID-19 vaccination. Although nudges proved ineffective in our study, previous research has demonstrated that nudges can significantly improve vaccine uptake and are more effective than encouraging people with financial rewards [16–18]. The very finding that nudges were ineffective in the present study may relate to participants being very opinionated about vaccination with about half of the participants knowing for certain that they wanted to get vaccinated or not – making the nudge redundant (in case of favorable opinions) or powerless (in case of negative opinions). Nonetheless, the most striking observation of our study is that the group of people for whom nudges potentially could have had the biggest impact (i.e., people in doubt about vaccination) did not benefit from the nudges. This finding is important for policy makers as our results suggest that implementing nudges targeting these people may have unintended consequences as shown in lower levels of autonomy, competency, and satisfaction with their decision. This may give reason to consider designing other (types of) nudges, but we suggest that supporting people in making up their minds may be a more promising strategy to increase vaccination uptake. Our finding that there was not much of a difference in autonomy and associated concepts between people who didn't know what to decide and those who postponed their appointment with a few weeks, attests to our observation that people who are hesitant about vaccination may need more support in decision making rather than directly steering their decision. Interestingly, our findings also show that participants who did not know about their decision experienced less pressure than those who postponed their appointment, suggesting that having a halfhearted appointment may result from the felt demand to decide. All things considered, the most prominent finding of our study relates to the distinction between participants who were certain about their decision and those who were not. In addressing the latter group of people, public health authorities should find ways to help these hesitant people to determine their preferences by making options relevant to them rather than directly nudging them to make the preferred choice [44]. These findings also bear relevance for nudging vaccination more generally, i.e. in case of influenza or measles where vaccination hesitancy is also prominent [14,15].

Our study has a number of limitations that should be noted. First, even though we presented participants with a choice making scenario that was very salient at the moment of study (as participants were in expectation of an invitation for a vaccination appointment any moment), contributing to the external validity of our findings, it should be emphasized that choices were hypothetical. Previous research has shown that people are more critical about nudges in hypothetical cases than after having been nudged for real and may thus overrate the expected impact of nudges [41,42]. In a similar vein, it may be that people

underestimate the effect of a nudge on their hypothetical choice because they are unable to estimate the motivating power in actual decision making. Second, we collected data at the very moment that COVID-19 vaccines became available. Now that COVID-19 has become endemic, motivation for getting vaccinated and/or vaccination hesitancy may have changed considerably. Nevertheless, given continued debate about vaccination in significant parts of the population our design may inform research on nudging vaccination against other infectious diseases or other sensitive topics where people experience difficulties in articulating their preferences. A third limitation relates to our findings on the association of type of choice and downstream consequences, which was not part of the original experimental design. As a result, it is unclear whether autonomy, decision competence, and decision satisfaction are caused by type of choice or the other way around. It may well be that autonomy, competence, and satisfaction are determined by being able to make up one's mind about vaccination uptake (regardless of a nudge being present). Alternatively, it may be that people who report high levels of autonomy, decision satisfaction, and decision competence are better able to make a decision about vaccination.

4. Conclusion

Notwithstanding these limitations, our study shows that nudges may not be effective in encouraging vaccine uptake and that they do not threaten personal autonomy or other downstream consequences of making a vaccination decision, although this may be different for effective nudges. The experience of choice in deliberating the COVID-19 vaccination seems to be mostly driven by being able and willing to determine one's preference for vaccination in either direction (positive or negative).

Declaration of Competing Interest

The authors report no conflict of interest.

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