

**Explaining the intention to get vaccinated against COVID-19: General attitudes towards
vaccination and predictors from health behavior theories**

Author Note: We have no conflict of interest to declare.

Abstract

The goal of our study was to examine the intention to get vaccinated using predictors from the 5C Model of Vaccination Attitudes, the Theory of Planned Behavior (TPB) and the Health Belief Model (HBM). Between August and November 2020, an online survey was delivered to 1428 participants in the UK and Germany (mean age = 40.6; 57% women), assessing socio-demographic and health factors, general vaccination attitudes, TBP and HBM variables and COVID-19 vaccination intention. Vaccination intentions did not differ by country or survey period. Predictors of intention with highest explanatory power in a relative weight analysis were confidence, collective responsibility (5C) perceived behavioral control, social norms, attitudes (especially negative affect & TPB cognitions) and perceived benefits (HBM). Women reported lower intention, although the effect size was small. Predictors from the TPB and HBM were effective to explain the intention to receive COVID-19 vaccines over and above socio-demographic, variables, health related factors and general vaccination attitudes. **The results are interpreted in the light of current vaccination campaigns.** Messages promoting sense of autonomy and control over the decision to get vaccinated, approval from significant others and reassurance that getting vaccinated will not be associated with fear or other negative feelings **are important factors for** vaccine uptake.

Keywords: COVID-19, Vaccination intention, 5C Model, Theory of Planned Behavior, Health Belief Model

Introduction

The coronavirus and the lung disease COVID-19 that it can trigger has had most of the world in a stronghold for more than **two years**. After months of intensive development, research, and trials, several vaccines against COVID-19 have been officially approved. **At the beginning of the vaccine dissemination**, some countries like Israel, the US, and the United Kingdom already reached high vaccination rates while in most European States the majority of the population was still unvaccinated and waiting for their turn. In most of the 15 countries surveyed in January 2021, a fairly high or very high intention to get vaccinated was reported (Ipsos, 2021). However, in all countries there was a certain proportion of people who are vaccine-hesitant or skeptical. For example, an AP-NORC poll published in February 2021 reported that a third of US adults are skeptical about COVID shots (Stobbe & Fingerhut, 2021).

As of March 2022, large vaccination campaigns have taken place, many people have been vaccinated, not only with a first and second, but also with a third, some with a fourth dose. Early predictions are reflected in the actual vaccination rates: they are high, but still a crucial amount of people in several countries did not get the vaccine yet. For example, in the US, 65% of the population are fully vaccinated, in the UK 72% and in Germany, 75% of the population (Our World in Data, 2022).

Intentions are an important prerequisite for behavior (Sheeran, 2002). Differences in COVID-19 vaccination intentions can be found between demographic groups. Ethnic minorities, especially Black people, people with lower education and lower income as well as people of the younger age groups and females are at higher probability to be vaccine-hesitant (Nguyen et al., 2021; Office for National Statistics, 2021; Pew Research Center, 2020). A recent systematic review and meta-analysis supposes that women might be less willing to have the COVID-19 vaccine (Zintel et al., 2021).

Psychological factors are important when trying to explain vaccination intentions and behavior in general. A systematic review identified lack of confidence, inconvenience, calculation and complacency as barriers to influenza vaccine uptake (Schmid et al., 2017). On the basis of these findings, Betsch and colleagues developed the 5C model of psychological antecedents of vaccination with the five dimensions confidence, complacency, constraints, calculation and collective responsibility (Betsch et al., 2018). Next to general attitudes towards vaccination as assessed in the 5C model, prior research has applied established health psychological models to explain vaccination behavior. Especially the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB) have been successfully applied in explaining HPV vaccination intention and uptake in both men and women (Catalano et al., 2017; Gerend & Shepherd, 2012; Koskan et al., 2021; Mehta et al., 2014) and swine flu vaccinations (Liao et al., 2013; Myers & Goodwin, 2011; Teitler-Regev et al., 2011).

Several studies have applied HBM and / or TPB to explain COVID-19-vaccination intentions. A study conducted by Wong et al. (2020) used components of the HBM (perceived susceptibility, severity, benefits and barriers) in a non-representative Malaysian sample to explain COVID-19 vaccination intention. A more comprehensive investigation of HBM components was conducted by Sherman et al. (2020) in a representative sample of 1500 UK adults, adding variables like self-efficacy, subjective norms, behavioral control and past/future influenza vaccination behavior. Similarly, among a non-representative sample of 1006 Greek employees, Zampetakis and Melas (2021) found significant direct effects on the development of intentions for all HBM constructs. Guidry et al. (2021) took a new approach in examining HBM and TPB factors together in the US. A recent US study integrated constructs from three health behavior theories including the Extended Parallel Process Model, HBM and TPB (Chu & Liu, 2021). These studies showed variables like more positive attitudes about the vaccination, higher perceived susceptibility, benefits and norms and lower barriers to be positively associated with vaccination intention. **In the study by Sherman et al. (2020), all**

variables could explain 76% of variance in vaccination intention. In the study by Guidry et al. (2021), 67% of variance in vaccination intention and in the study by Chu and Liu (2021), 82% of variance in vaccination intention could be explained. None of these studies assessed general attitudes towards vaccination using the 5C model. The question arises whether TPB and HBM constructs still play a role when general attitudes towards vaccination are controlled for. Understanding vaccine intention can inform public health messaging and policy since the effectiveness of the COVID-19 vaccination programme still needs to be improved.

Study Aim and Research Question. The aim of this study was to use three models of vaccine acceptance and general health behavior (5C, HBM, and TPB) to examine COVID-19 vaccination intention. Our objective was to examine and compare the predictive value of TPB and HBM and central scales from the 5C model. We hypothesized that the TPB and the HBM are useful frameworks for the prediction of the intention to get vaccinated against COVID-19 over and above socio-demographic and health-related variables as well as general vaccination attitudes.

Methods

Recruitment. The study was approved by the Research Ethics Committee of the Faculty of Behavioral and Cultural Studies, University Heidelberg, Germany. Data were collected online across three samples, two in Germany and one in the UK, between August and November of 2020. The first survey took place in Germany in August and September. A convenience sample of participants was recruited via advertisements in the local newspaper (Rhine-Neckar region), at university lectures (Heidelberg University), and via social media, and using a snowballing method by the research team. The second survey took place in October (UK) and the third in November (Germany). These last two samples were recruited via Prolific Academic, an online data panel. Participants were paid 2 pounds for participation. We aimed to collect an (approximately) representative sample of the UK population of 400 people. A

representative German sample was not possible using Prolific Academic, therefore we planned to recruit a gender-balanced sample of 200 men and 200 women.

Questionnaire. After providing informed consent, demographic information and health-related information (i.e., past influenza vaccinations), participants completed items assessing social-cognitive variables derived from the TPB and HBM. Unless stated otherwise all items used a 7-point Likert scales from 1 (strongly disagree) to 7 (strongly agree).

Attitudes were measured by drawing on affective and cognitive components. For the affective component, participants were asked to imagine that they could receive a vaccination against COVID-19 now, followed by the prompt “what feelings would you experience?”. Then, four positive (relief, joy, hope, confidence) and four negative affective (ambivalence, suspicion, worry, fear) states had to be rated. A two-factor structure of this affective attitude scale was confirmed by principal component analysis using varimax rotation. *Positive affect* (as first factor) explained 55.04% of the variance, and *negative affect* (as second factor) an additional proportion of 15.59%. Cronbach’s α was .93 for positive and .84 for negative affect. For the cognitive component of attitudes, six adjectives (reasonable, necessary, unnecessary, responsible, patronizing, exaggerated) were assessed following the intro “I perceive vaccinations against the coronavirus as...”. As a single-factor structure was indicated by principal component analysis explaining 75.89% of variance, negative cognitions were recoded and a unidimensional scale *cognitions* was formed (Cronbach’s α =.87). *Subjective norm* was assessed with two items (“My family/friends and acquaintances think(s) I should get vaccinated against the coronavirus”; Cronbach’s α =.89). *Descriptive norm* was also measured with two items (“How high do you estimate the percentage of people of your gender and age/from your circle of friends and acquaintances that would get vaccinated against coronavirus?”, 0–100%; Cronbach’s α =.83). Perceived behavioral control (PBC) was assessed using two items following the intro “given that there is an officially approved vaccination available...”, namely, “I find getting vaccinated against the coronavirus: not easy at all (1) to

very easy (7) (Cronbach's $\alpha=.83$) and "I am sure I can obtain a coronavirus vaccination even if the people that I know decide against a vaccination". *Behavioral intention* was measured using two items following Sieverding et al. (2010), namely "Imagine an officially approved vaccination against COVID-19 is available and the costs are paid for. Do you intend to get vaccinated?" (1=no, definitely not–7=yes, definitely) and the subjective probability for realizing this goal ("Not in all instances people put intentions into practice. What do you think - how likely is it that you will get vaccinated when an officially approved COVID-19 vaccination is available?", 0–100%; Cronbach's $\alpha=.96$). For the mean score, items were aggregated with values ranging from 0-100.

Derived from the HBM, *perceived susceptibility* was assessed with the item "Should you get infected: How high do you estimate your chance of developing severe or very severe symptoms?" (0–100%) and *perceived severity* by "To what extent would an infection with COVID-19 be a threat to your health?" (0=No threat, 100=high threat). *Perceived benefits* were assessed following the intro "If I (would) get vaccinated ..." by presenting four statements, i.e. "my daily life would be more normal again." (Cronbach's $\alpha=.90$). For *perceived barriers*, participants were asked to rate three statements regarding the extent that these aspects would keep them from getting vaccinated, i.e. "The vaccination could have side effects." (Cronbach's $\alpha=.83$).

In addition to the TPB and HBM variables, we assessed three subscales (confidence, complacency, and collective responsibility) of the 5C scale (Betsch et al., 2018) measuring attitudes towards vaccination in general. In the first assessment undertaken in Summer 2021 in Germany the other two 5C-subscales constraints and calculation had been assessed as well. As these did not show relevant associations with the intention to get vaccinated against COVID-19, these two 5C-subscales were not included in the later assessments.

Statistical Analyses.

All analyses were performed using SPSS version 25.0. A regression analysis on behavioral intention to receive a COVID-19 vaccination was conducted followed by a relative weight analysis (RWA, **SPSS macro**) to provide partitioning of the explained variance among multiple predictors (Tonidandel & LeBreton, 2011) as opposed to the indices commonly produced by multiple regression which fail to appropriately partition variance to correlated predictors. Hence, the relative weights of the predictors are not dependent on the order, in which they were entered. A statistical power analysis was performed for sample size estimation. If assuming a small effect size of $f^2 = 0.02$, an $\alpha = .05$ and power = .95, the projected sample size needed was $N = 1229$ for our hierarchical regression analysis. **Key assumptions regarding regression analyses were met (linear relationship, multivariate normality, no multicollinearity or auto-correlation, homoscedasticity). Additional mediation analyses were performed using the PROCESS macro by Hayes (2018), which uses ordinary least squares regression, yielding unstandardized path coefficients for total, direct, and indirect effects. Bootstrapping with 5000 samples together with heteroscedasticity consistent standard errors (Davidson & MacKinnon, 1993) was applied to compute confidence intervals and inferential statistics.**

Results

After excluding 51 participants due to missing information or being under 18 years of age, the final sample consisted of $N=1428$ participants ($N_{UK}=399$, $N_{Germany}=1029$), a sample size that was more than adequate for the main objective of this study. The age range was 18 to 88 years ($M=40.6$, $SD=16.7$), with a majority of participants being 40 years or younger (59%). 57% were female, 56% held a college degree or higher, 54% reported that they received an influenza vaccination at least once and 50% stated knowing someone with a (past) COVID-19 infection. Mean vaccination intention for the total sample was 76.7 ($SD=28.7$) and did not differ significantly by the country in which the survey was hosted (Germany vs. UK) or

survey period (summer or autumn). Means, standard deviations and correlations are depicted in Table S1 in the supplement.

Examining the intention to receive a COVID-19 vaccination

A hierarchical regression model of vaccination intention is presented in Table 1, with relative weights (RW) indicating the respective amount of explained variance per predictor. Socio-demographic variables, country, and survey period were entered in the first step. Prior influenza vaccination behavior and knowing a person with (past) COVID infection were entered in the second, and the 5C subscales in the third step. In the fourth and fifth step, TBP and HBM variables were added respectively. The overall model explained 88% of variance in vaccination intention. According to RWA, the TPB variables together accounted for 58.7% and the HBM variables for 18.9% of the total variance **explained in vaccination** intention, confirming our hypothesis. **Attitudes towards vaccinations in general (5C subscales) accounted for 15.9% of total variance.** Predictors with highest explanatory power were PBC, social norms, attitudes (especially positive affect and cognitions) from the TPB as well as perceived benefits from the HBM. We re-ran the analyses to test for varying patterns among the subsample of persons aged 40 years and younger and did not find differences in significances, beta weights nor relative weights of predictors.

Women reported lower vaccination intentions, although the effect size was small (Cohen's $d=.13$; 95%-CI [-.231; -.021]). Among the explaining factors derived from the TBP and HBM, women reported more negative affect ($d=.27$, 95%-CI [.168; .378]), lower PBC ($d=-.21$, 95%-CI [-.316; -.106]), lower subjective norm ($d=-.16$, 95%-CI [-.262; -.052]), higher perceived severity ($d=.17$, 95%-CI [.061; .271]), and higher susceptibility ($d=.26$, 95%-CI [.151; .362]) after Bonferroni adjustments due to multiple tests. A multiple mediation analysis including bootstrapping is depicted in Figure S1 in the supplement. We found that the relationship between gender and intention is fully mediated by PBC, subjective norm and

negative affect (indirect effects $ab_{PBC} = -1.773$, 95%-CI[-2.548, -1.064]; $ab_{subj. norm} = -1.2658$, 95%-CI[-2.007; -.563]; $ab_{neg. affect} = -.854$, 95%-CI[-1.269; -.508]).

Discussion

The present study investigated the intention to receive a COVID-19 vaccine by drawing on antecedents from the TPB and the HBM. A multiple regression analysis alongside relative weight analysis indicated that contributions by socio-demographic factors, past influenza vaccines as well as knowing someone with COVID were negligibly small, whereas the general vaccination attitudes confidence and collective responsibility from the 5C-model explained substantial shares of variance. In addition, and supporting our hypothesis, particularly the TPB variables as well as perceived benefits and barriers from the HBM were important predictors of the intention to receive a COVID-19 vaccine. Total variance explanation (adjusted $R^2 = .88$) was very high, **but comparable to previous studies (e.g. $R^2 = .82$ in the study by Chu and Liu (2021))**, as was the aggregated intention measure with a mean of 76.7 (SD=28.7) on a scale from 0 to 100. Moreover, 15% of our participants exhibited an intention score below the scale mid-point and thereby to some degree of unwillingness to receive a vaccination, which is comparable to a study from the US (approx. 20% below midpoint) (Chu & Liu, 2021). Usually, intention does not always translate into action (Sheeran & Webb, 2016). In the case of COVID-19 vaccination however, the actual vaccination rate in Germany and UK with approximately 15% unvaccinated/not fully vaccinated people, reflects our findings.

Our study provides several starting points **for the evaluation of vaccination campaigns**. Regarding the TPB variables, affective as well as cognitive components of attitudes should be addressed through public health messaging campaigns. Given the importance of positive affective attitudes highlighting the positive emotions associated with the return to normal life and personal freedoms is important. **Vaccination campaigns in Germany and UK rarely target**

this aspect. The title of the UK campaign “every vaccination gives us hope” might suggest it, but rather focuses on other aspects (Government UK, 2021).

Social norms can be increased by making the target behavior observable (Rivis & Sheeran, 2003) in order to motivate others and offering cues to action. This would also serve as a means to increase self-efficacy or perceived behavioral control (Bandura, 1977), as others are considered as role models. These constructs are used frequently in the UK and German vaccination campaign. The “Ärmel hoch” (“Sleeves up”) campaign in Germany displays a diverse range of people already vaccinated including popular people functioning as role models (Bundesministerium für Gesundheit, 2022a). The UK slogan “Join the millions already vaccinated” goes into the same direction. Derived from the HBM, the individual benefits of COVID-19 vaccines should be communicated effectively, which is partly seen in German campaign slogans like “Vaccination protects from severe disease” or “Vaccination protects from quarantine too”. In addition, it is important to reduce perceived barriers in making appointments, or the ability to travel to the vaccination site. Still, in contrast to the USA, there are no low-threshold offers of vaccines e.g. at malls or supermarkets neither in Germany nor in the UK. In the UK, there are walk-in sites for vaccines at e.g. pharmacies. In Germany, vaccines are still only disseminated at GP practices or at vaccination centers. Barriers like having to schedule an appointment or travelling to the vaccine destination are therefore partly still in place.

We have seen that next to the TPB and HBM constructs, collective responsibility regarding vaccines in general plays a role in explaining vaccination intention. It is a factor especially targeted by the German vaccination campaign “Impfen hilft” (“Vaccination helps”) and plays an essential part in the UK vaccination advert “every vaccination gives us hope”(Bundesministerium für Gesundheit, 2022b; Government UK, 2021).

The COVID-19 vaccine is not the only vaccine people have to be motivated to get. Improving general vaccine acceptance will be an ongoing topic, either for further booster

doses of COVID-19, for the seasonal influenza vaccine or for vaccines against other diseases coming up. This is also supported by our findings, that general (not COVID related) attitudes as captured by the 5C subscales contributed 15.9% to total variance explanation. Bearing all the factors important for vaccination intention in mind, as well as doing further research on actual vaccination behaviour, should inform further actions undertaken to improve vaccination rates. Rather than focusing on single factors, multi-faceted approaches seem promising. We could not identify one single factor but several factors almost equally important for the COVID-19 vaccination intention.

Additionally, we found a small but significant gender difference with women reporting lower intentions compared with men. Results of an additional multiple mediation analysis indicate that the association of gender and intention is fully mediated by the TPB variables PBC, subjective norm and negative affect/attitude, **with women reporting less favorable scores on all three variables**. Hence, a special focus on reducing fears and enhancing positive emotions and confidence **in women** might be required in campaigns, i.e. via personal case reports in media.

Several limitations have to be considered. Firstly, due to the cross-sectional design, causal relationships cannot be identified. Secondly, compared with the representative UK sample, we only collected two convenience samples from Germany. **This may bias our results, since we cannot assume that our results are representative for the German population as a whole. However, we** controlled for possible effects of country and time of assessment. Thirdly, data during all the three surveys were collected before the start of the COVID-19 vaccination programmes in the UK and Germany. Since the start of the programmes, there has been heightened attention and media coverage focusing on additional findings about the efficacy of the vaccinations, their side effects and changes in recommendations by respective health authorities, particularly in Germany. This is likely to have affected perceptions of

COVID-19 vaccinations in a way that we were unable to capture and needs to be borne in mind when interpreting our results.

In conclusion, the present study integrates predictors of COVID-19 vaccination intention derived from two established models in health psychology alongside measures of general vaccination attitudes. Results indicate that above general confidence in vaccines and a sense of collective responsibility from the 5C-model, all TPB components as well as perceived benefits and barriers from the HBM were highly predictive for vaccination intentions. Hence, our findings stress the importance of sustained efforts in addressing those (health-)psychological factors in public campaigns.

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Table 1: Hierarchical regression analysis and relative weight analysis explaining COVID-19 vaccination intention

Step	Predictor	$\beta_{\text{step 1}}$	$\beta_{\text{step 2}}$	$\beta_{\text{step 3}}$	$\beta_{\text{step 4}}$	$\beta_{\text{step 5}}$	RW%
1	Gender ^a	-.08*	-.08*	-.06**	-.01	-.01	0.2
	Age	.11**	.06*	.09**	.01	.00	0.2
	Education	.09*	.07*	-.02	-.02*	-.02	0.1
	Country ^b	.05	.04	-.08**	-.07**	-.06**	0.3
	Time of assessment ^c	-.02	-.03	-.06*	-.05**	-.06**	0.3
2	Know s.o. with COVID19 ^d		.08*	.03*	.02	.02	0.2
	Influenza vaccination ^e		.22**	.08**	.04**	.03*	1.1
3	Confidence ^{f,g}			.54**	.07**	.04*	8.4
	Complacency ^{f,g}			-.08**	-.01	-.01	0.2
	Collective responsibility ^{f,g}			.27**	.06**	.05*	7.3
4	<i>TBP variables</i>						
	Perceived behavioral control ^g				.22**	.20**	11.6
	Subjective norm ^g				.16**	.15**	10.8
	Descriptive norm ^h				.13**	.12**	9.0
	Attitudes – positive affect ^g				.13**	.10**	9.4
	Attitudes – negative affect ^g				-.06**	-.04*	6.0
	Attitudes – cognitions ^g				.29**	.25**	11.9
5	<i>HBM variables</i>						
	Perceived susceptibility ^h					.01	0.9
	Perceived severity ^h					.03*	1.9
	Perceived barriers ^g					-.06**	6.3
	Perceived benefits ^g					.11**	10.7
ΔR^2		.03**	.05**	.59**	.21**	.01**	
$adjR_{cum}^2$.02	.07	.66	.88	.88	

Notes. N = 1428; method = stepwise;

RW% = relative weights; relative contribution (in percentage) of each predictor to the total explained variance;

^a 1=male (including transmen), 2=female (including transwomen); ^b 1=UK, 2=Germany; ^c 1=summer, 2=autumn;

^d 1=no, 2=yes; ^e 1=never, 2=at least once;

^f subscales from the 5C scale [10] measuring general attitudes towards vaccinations;

^g possible values from 1 to 7, with higher scores indicating higher agreement; ^h 0 – 100%;

* $p < .05$, ** $p < .001$.

Supplementary Table S2. Description of study items

Theorie	Konstrukt	Items	M (Range)	SD	α	source
Theory of planned behavior	Attitudes	Affect: „Imagine you could receive a vaccination against COVID-19 now. What feelings would you experience?“ Positive affect: „Relief“, „Joy“, „Hope“, „Confidence“ 1 strongly disagree to 7 strongly agree	5.07 (1-7)	1.61	.93	elicitation study
		Negative affect: „Ambivalence“, „Suspicion“, „Worry“, „Fear“ 1 strongly disagree to 7 strongly agree	3.14 (1-7)	1.56	.84	elicitation study
		Cognitions: „I perceive vaccinations against the coronavirus“ „reasonable“, „necessary“, „unnecessary“, „responsible“, „patronizing“, „exaggerated“ 1 strongly agree to 7 strongly disagree	6.07 (1-7)	1.29	.87	elicitation study, adapted from Sieverding et al., 2010
	Subjective norm	1) „My family thinks...“ 2) „My friends and acquaintances think I should get vaccinated against the coronavirus.“ 1 strongly agree to 7 strongly disagree	5.03 (1-7)	1.75	.89	adapted from Sieverding et al., 2010
		Descriptive norm 1) „How high do you estimate the percentage of people of your generation and age that would get vaccinated against coronavirus?“ 2) „How high do you estimate the percentage of people from your circle of friends and acquaintances that would get vaccinated against coronavirus?“ 0-100%	66.49 (0-100)	21.84	.83	adapted from Sieverding et al., 2010
	Perceived behavioral control (PBC)	„Given that there is an officially approved vaccination available...“ 1) „I find getting vaccinated against the coronavirus“ 1 no easy at all to 7 very easy 2) „I am sure I can obtain a coronavirus vaccination even if the people that I know decide against a vaccination.“ 1 strongly disagree to 7 strongly agree	5.31 (1-7)	1.64	.83	elicitation study
	Behavioral intention	1) „Imagine, an officially approved vaccination against COVID-19 was available and the costs are paid for. Do you intend to get vaccinated?“ 1 no, definitely not to 7 yes, definitely 2) „Not in all instances people put intentions into practice. What do you think - how likely is it that you will get vaccinated when an officially approved COVID-19 vaccination is available?“ 0-100%	76.66 (0-100)	28.67	.96	adapted from Sieverding et al., 2010
Health Belief Model	Perceived susceptibility	“Should you get infected: How high do you estimate your chance of developing severe or very severe symptoms?“ 0-100%	36.97 (0-100)	26.12		elicitation study, in the style of Champion, 1984
	Perceived severity	“To what extent would an infection with COVID-19 be a threat to your health?“ 0 = No Threat, 100 = high threat	52.52 (0-100)	29.18		elicitation study, in the style of Champion, 1984
	Perceived benefits	1) “I am convinced, that a vaccination against coronavirus would protect me from falling ill with COVID-19.” 2) “If many people get vaccinated against coronavirus, the pandemic can be contained.” 3) “If I (would) get vaccinated, my daily life would be normal again.” 4) “If I (would) get vaccinated against the coronavirus, I can protect other people.” 1 strongly disagree to 7 strongly agree	5.38 (1-7)	1.39	.90	elicitation study