Influence of Age and Message Frame on COVID-19 Vaccination Willingness Early in the Pandemic

Nikita C. Spalvins, GradDipPsych[1, 2], Tarren Leon, BPsych (Hons)[2], & Phoebe E. Bailey, PhD[2]

[1]School of Psychology, Western Sydney University, Australia

[2]Graduate School of Health, University of Technology Sydney, Australia

Phoebe E. Bailey ORCID 0000-0001-8960-1897; Tarren Leon ORCID 0000-0003-4976-758X

Corresponding author: Phoebe E. Bailey, Graduate School of Health, University of Technology Sydney, P. O. Box 123, Broadway NSW 2007, Australia. E-mail: phoebe.bailey@uts.edu.au

Running Head: Age, Message Framing & Vaccination Willingness

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Abstract

Objective: This study examined whether age would moderate the association between a brief message frame intervention and COVID-19 vaccine willingness.

Methods: Data were collected in Australia between 25 June and 5 July 2021. Participants (*N* = 187) aged 18 to 85 years had not yet received a dose of COVID-19 vaccine. After random assignment to a gain- or loss-framed message, participants reported COVID-19 vaccine willingness, general anti-vaccine attitudes, approach and avoidance motivation, and COVID-19 illness risk perception.

Results: Message frame did not influence COVID-19 vaccine willingness. However, greater COVID-19 illness risk perception and older age increased the odds of Pfizer vaccine willingness, while lower avoidance motivation increased the odds of AstraZeneca vaccine willingness. Greater anti-vaccine ideology decreased the odds of willingness to receive either of the COVID-19 vaccines.

Conclusions: A brief message frame intervention did not influence COVID-19 vaccine willingness across the adult lifespan.

Keywords: vaccine willingness, risk perception, ageing, message frame, motivational orientation

What this paper adds

- This study is the first to examine the combined effects of age and message frame on vaccination willingness.
- The paper provides rare insight into COVID-19 vaccine willingness early in the pandemic in Australia.

Application of study findings

- A brief gain- or loss-framed message intervention may not be an effective tool to influence COVID-19 vaccination behaviour in adulthood and older age.

Influence of Age and Message Frame on COVID-19 Vaccination Willingness Early in the Pandemic

In August 2020, 36% of Australians were hesitant and 6% were resistant to receiving any future safe and effective severe acute respiratory syndrome coronavirus 2 vaccine to reduce coronavirus-19 (COVID-19) disease severity (Edwards et al., 2021a). It was suggested that public health messaging may help to solve this problem, particularly among older adults (65+ years) for whom the COVID-19 pandemic presented an increased risk of illness. The current study was conducted in Australia in June to July 2021 when community transmission of the highly contagious Delta variant was first identified and vaccine hesitancy remained high (Edwards et al., 2021b).

Health promotion messages can be framed in terms of either the benefits of engaging in recommended behaviors (gain-framed) or the costs of not performing such behaviors (loss-framed) (Gallagher & Updegraff, 2012). A meta-analysis reported no difference in effectiveness of gain- versus loss-framed messages in the promotion of vaccination, but emphasised that further research is required (O'Keefe & Nan, 2012). It was suggested that confounding variables may moderate framing effects (Covey, 2014). According to prospect theory, potential losses promote risk-seeking behaviour, while potential gains increase risk aversion (Kahneman & Tversky, 1979). Therefore, gain-frames may promote prevention behaviors (e.g., exercise**,** vaccination), while loss-frames may encourage detection behaviors (e.g., screening) (Rothman & Salovey, 1997). Empirical research validates this extension of prospect theory (Gerend & Shepherd, 2007).

Research to date has failed to consider the combined effects of age and message frame on vaccination willingness. According to socioemotional selectivity theory, a developmental shift in motivation alters the processing of emotional stimuli (Carstensen et al., 1999). This is consistent with a well-documented age-related positivity effect whereby, compared to young adults, older adults attend to and recall more positive relative to negative

stimuli (Reed et al., 2014). For example, relative to young adults, older adults searched for and recalled more positively-framed than negatively-framed health information (Lockenhoff & Carstensen, 2007), and scored positively-framed health messages as more informative than negatively-framed messages (Shamaskin et al., 2010).

Message framing effects may also be moderated by individual differences in motivational orientation (Gerend & Shepherd, 2007). According to reinforcement sensitivity theory (Gray, 1990), an approach-orientation regulates appetitive behavior toward potential rewards, whereas an avoidance-orientation regulates behavior away from potential threats or punishments. Two studies have shown that persuasion to be vaccinated against the human papillomavirus was greater among those with high avoidance (but not approach) motivation following a loss-frame relative to gain-frame message (Gerend & Shepherd, 2007; Nan, 2012). Both avoidance- and approach-orientation are lower in older than young adults (Jorm et al., 1998).

The present study aimed to examine the role of age in moderating the effect of a brief message frame intervention on vaccination willingness, controlling for general vaccination hesitancy and risk perception. It was hypothesized that, in line with prospect theory and the age-related positivity effect, gain-framed messages would be associated with greater COVID-19 vaccination willingness, and that this effect would be amplified among older adults as compared to younger adults. A further prediction was that lower approach and avoidance motivations among older adults would be associated with lesser influence of message frames on vaccination willingness.

Method

Participants

The study included 187 participants recruited using Qualtrics Panels. This is an opt-in (non-probability) convenience sample. Exclusion criteria included having previously received

a dose of a COVID-19 vaccine, self-reporting a neurological disorder, or failing an attention check. Table 1 displays participant demographics as a function of message frame and age group: young (*M* age = 29 years; *SD* = 6.29), middle-aged (*M* age = 50 years; *SD* = 7.19), and older (*M* age = 71 years; *SD* = 4.42). Recruitment occurred in Australia between June 25th and July 5th, 2021. The study was approved by Western Sydney University's Human Research Ethics Committee [H12559]. Refer to supplemental materials for the power analysis, and links to the pre-registration, data, and reproducible code.

Materials

Message Frames

Message frames were modified from Gerend and Shepherd (2007). Similar information was presented in each condition (see Table 2). However, the frame of the message differed, such that the gain-frame focused on the benefits of getting vaccinated for COVID-19, and the loss-frame focused on the costs of not getting vaccinated.

COVID-19 Illness Risk Perceptions

One item assessed perceived risk of illness severity asking, "How unwell do you believe you would become if you contracted COVID-19 without being vaccinated?" Ratings were made on a 5-point Likert scale ranging from 1 (*not unwell at all*) to 5 (*extremely unwell*), with higher scores inferring a greater risk perception.

Vaccination Willingness

All participants responded to all three items measuring willingness to receive a COVID-19 vaccine, the Oxford AstraZeneca (AstraZeneca) vaccine, and the Pfizer-BioNTech (Pfizer) vaccine, on a 5-point Likert scale ranging from 1 (*definitely would not*) to 5 (*definitely would*). The questions asked, "If you were eligible to receive [a COVID-19 vaccine / the Pfizer vaccine / the AstraZeneca vaccine] right now, how willing would you be to get it?". Higher scores represent greater vaccine willingness.

The Anti-Vaccination Attitudes Examination (VAX) Scale

The 12-item VAX Scale (Martin & Petrie, 2017) measured general anti-vaccination attitudes on a 6-point Likert scale ranging from 1 (*strongly disagree)* to 6 (*strongly agree)*. Higher scores indicate stronger anti-vaccination attitudes and vaccine hesitancy. The VAX scale has four subscales, each with acceptable to excellent internal consistency in the current sample ($\alpha \geq .77$).

The Behavioural Inhibition/Activation Systems Questionnaire

The 7-item Behavioural Inhibition System (BIS) scale measures general propensity to avoid negative outcomes, and the 13-item Behavioural Activation System (BAS) scale measures tendency to approach appetitive stimuli ($\alpha = .73$ and $\alpha = .87$, respectively, in the current sample) (Carver & White, 1994). There are four filler items, all ratings range from 1 (very true for me) to 4 (very false for me), all are reverse scored except two, and higher scores on each scale reflect greater motivational orientation.

Procedure

Participants provided informed consent and accessed the online survey via Qualtrics Systems (https://www.qualtrics.com). They answered the demographic questions, the COVID-19 illness risk perception question, and the attention check prior to their random allocation to either the ‘gain-frame’ or ‘loss-frame’ condition. Allocation was stratified by age and gender. Participants were exposed to their respective message frame for a minimum of 15 seconds. After viewing the given framed message, participants answered the three vaccination willingness questions, of which the AstraZeneca- and Pfizer-specific questions were counterbalanced. They then completed the VAX Scale, followed by the BIS/BAS Scale, before reading the debrief.

Results

R-Studio (RStudio Team, 2020) packages used for conducting analyses are reported in the supplemental materials.

Preliminary Analyses

A Wilcoxon signed-rank test for ordinal data revealed greater willingness to receive the Pfizer than AstraZeneca vaccine, $Z = 8.60$, $p < .001$ (see Figure 1). Therefore, the two vaccines were analysed separately, and the general question about willingness to receive a COVID-19 vaccine was omitted. Refer to supplemental materials and Table 3 for intercorrelations assessing the influence of potential predictor variables on vaccination willingness.

Primary Analyses

The data were fitted with two ordinal logistic regression models to examine the influence of predictors (frame, age, motivational orientation), control variables (gender, education, general vaccine hesitancy and COVID-19 illness risk perception) and interaction terms (Age x Frame, Age x Approach, Age x Avoidance, Frame x Approach, Frame x Avoidance) on the two outcome variables (willingness to receive either the Pfizer or AstraZeneca vaccine). Continuous variables were grand-mean centred. Both models violated the proportional odds assumption, as assessed by the Brant test, but this assumption has been deemed anti-conservative (O'Connell, 2006). Nonetheless, results should be interpreted with caution.

Pfizer Vaccine Willingness

We ran Hosmer-Lemeshow and Lipsitz goodness-of-fit tests, as well as the Pulkstenis-Robinson deviance test, on the analysis of Pfizer vaccine willingness. Results indicated the model was a good fit to the observed data ($\chi^2(35) = 51.49$, $p = .036$; $\chi^2(9) = 8.75$, $p = .460$; and $\chi^2(73) = 79.72$, $p = .276$ respectively).

The analysis showed that each year older than the average age was associated with 1.05 odds of Pfizer vaccine willingness (i.e., 5% higher odds of willingness; see Table 4). Each one-unit higher score on the anti-vax ideology scale was associated with .29 odds of Pfizer vaccine willingness (i.e., 71% lower odds of willingness). Reporting feeling 'very unwell' (relative to 'not unwell at all') if COVID-19 was contracted was associated with 7.25 odds of Pfizer vaccine willingness (i.e., 625% higher odds of willingness). Message frame, motivational orientation, and the interactions were not predictors of Pfizer willingness.

AstraZeneca Vaccine Willingness

We ran Hosmer-Lemeshow and Lipsitz goodness-of-fit tests, as well as the Pulkstenis-Robinson deviance test, on the analysis of AstraZeneca vaccine willingness. Results indicated the model was a good fit to the observed data ($\chi^2(35) = 32.23$, $p = .602$; $\chi^2(9) = 3.03$, $p = .963$; and $\chi^2(73) = 91.14$, $p = .074$ respectively).

The analysis showed that each one-unit higher on the BIS scale (i.e., increased avoidance-orientation) was associated with .26 odds of willingness to receive the AstraZeneca vaccine (i.e., 74% lower odds of willingness). Each one-unit higher score on the anti-vax ideology scale was associated with .45 odds of willingness to receive the AstraZeneca vaccine (i.e., 55% lower odds of willingness) (see Table 5). Age, frame, COVID-19 illness risk perception, and the interaction terms were not significant predictors of AstraZeneca vaccination willingness.

Discussion

The present study aimed to examine whether age would moderate the influence of a brief message frame intervention on willingness to receive a COVID-19 vaccine early in the pandemic. However, there was no evidence for the predicted effect of message frame on COVID-19 vaccine willingness. The data revealed that older age and greater COVID-19 illness risk perception increased the odds of willingness to receive the Pfizer vaccine. Greater

avoidance motivation lowered the odds of AstraZeneca vaccine willingness, while higher scores on the anti-vax ideology scale lowered the odds of willingness to receive either vaccine.

The current data provided no evidence consistent with the age-related positivity effect (Carstensen et al., 1999; Reed et al., 2014) and prospect theory (Kahneman & Tversky, 1979) that a brief gain-framed message would be associated with greater COVID-19 vaccine willingness, particularly among older individuals. Some studies have provided evidence for the counterargument that personal relevance can moderate message framing effects, leading to greater effectiveness of loss-framed than gain-framed messages (Gallagher & Updegraff, 2012; Rothman et al., 1993). One possibility is that the association between older age and greater perceived risk of illness due to COVID-19 enhanced personal relevance of vaccination among older adults, increasing the effectiveness of the loss-framed message and cancelling out and any gain-frame effect for that age group.

Consistent with Jorm et al. (1998), the current study found that approach and avoidance motivation were reported to be lower with older age (see Table 3 and supplemental material). However, people were not more responsive to message frames that aligned with their motivational orientation, as found in previous research (Gerend & Shepherd, 2007; Nan, 2012). Averaged across age and message frame, greater avoidance orientation lowered the odds of being willing to receive the AstraZeneca vaccine, but not the Pfizer vaccine. Future research should examine whether people higher in avoidance orientation viewed receiving AstraZeneca akin to a potential threat. In addition, a larger and more representative sample may overcome the potential limitations of the current opt-in convenience sample, and sufficient power to detect whether age moderates the effect of message frame on vaccination willingness.

Although perceptions of potential COVID-19 illness were assessed, risk perceptions associated with receiving the Pfizer and AstraZeneca vaccines should also be assessed at a time when there is limited risk associated with potentially discouraging vaccination. In addition, future studies should follow up with participants to determine whether willingness was associated with vaccination behavior. Nevertheless, the current data indicate that, regardless of age, a brief message framing intervention did not influence COVID-19 vaccination willingness during the early stages of the pandemic.

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Table 1

Count of Participants (N = 187) in each Demographic Category as a Function of Message Frame (Gain, Loss) and Age (18-39 years (n = 73), 40-64 years (n = 60), and 65-85 years (n = 54))

Variable	Loss-Frame			Gain-Frame		
	18-39 years	40-64 years	65-85 years	18-39 years	40-64 years	65-85 years
Gender						
Female	15	13	14	30	14	14
Male	14	15	12	14	18	14
Location (State)						
New South Wales	8	10	4	16	8	12
Northern Territory	0	0	0	0	0	1
Queensland	7	8	8	10	11	2
South Australia	2	1	3	1	3	1
Tasmania	0	1	2	1	0	2
Victoria	9	3	8	15	7	7
Western Australia	3	5	1	1	3	3
Education Level						
Did not complete high school	0	2	6	3	4	6
Year 12 HSC/IB or equivalent	11	6	7	13	7	8
TAFE or trade school	5	12	9	13	9	8
Bachelor's Degree	11	6	3	12	8	5
Master's Degree	1	2	1	1	4	1
PhD	1	0	0	2	0	0
Ethnicity						
Anglo-Australian	21	16	19	29	25	22
East and South-East Asian	4	3	0	2	3	0
Indigenous Australian	1	0	0	2	0	0
Middle Eastern	0	2	0	2	0	0
South Asian	0	0	1	2	0	0
Other	3	7	6	7	4	6
Religion						
Buddhism	1	2	0	0	0	0
Christianity	11	12	11	13	13	21
Islam	1	1	1	4	0	0
No religion	16	10	11	25	17	7
Other religion	0	3	3	2	2	0
Marital Status						
Married	12	12	15	18	15	15
De facto	7	3	2	12	3	1
Widowed	0	0	3	0	0	4
Divorced	1	5	4	0	1	4
Separated	0	2	2	1	4	4
Single	9	6	0	13	9	0

Table 2

COVID-19 Vaccination Statements by Message Frame

Gain-framed Message	Loss-framed Message
There are many benefits you may experience if you get the COVID-19 vaccine.	There are many risks you may experience if you don't get the COVID-19 vaccine.
• If you decide to get the vaccine you may decrease your chances of contracting COVID-19 and getting ill.	• If you decide not to get the vaccine you may increase your chances of contracting COVID-19 and getting ill.
• By receiving the vaccine, you are helping to protect more vulnerable people.	• If you don't get the vaccine, you may be putting more vulnerable people at risk.
• If you get the COVID-19 vaccine it may allow you to travel more freely interstate or overseas in the near future.	• If you do not get the COVID-19 vaccine you may not be permitted to travel interstate or overseas in the near future.

Table 3

Descriptive Statistics and Kendall's τ Correlations Between Variables

Predictors	Pfizer Willingness	AstraZeneca Willingness	1	2	3	4	5	6	7	8
1. Age	.13*	-.07	-							
2. Gender	-.13*	-.14*	-.09	-						
3. Education	.11	.13*	-.10	-.09	-					
4. Frame	-.06	.01	-.06	.05	.00	-				
5. Risk	.17**	-.02	.17**	.10	-.07	-.03	-			
6. BIS	.03	-.07	-.12*	.20**	.09	.03	.06	-		
7. BAS	.11	.18**	-.21**	.06	.13*	.00	-.06	.11	-	
8. VAX Score	-.36**	-.25**	.06	.08	-.09	-.03	-.10	-.07	-.08	-
M	3.71	2.38	47.72	1.54	2.90	0.56	3.32	2.87	2.88	3.54
SD	1.37	1.36	18.09	0.50	1.15	0.50	1.17	0.47	0.46	1.02

Note. Age in years; Gender refers to 1 for male and 2 for female; Education refers to 1 for "Did not complete high school", 2 for "Year 12 HSC or equivalent", 3 for "TAFE or Trade School", 4 for "Bachelor degree", 5 for "Masters degree", and 6 for "PhD"; Frame refers to 1 for gain-frame and 0 for loss-frame; BAS = approach-orientation score; BIS = avoidance-orientation score; Risk refers to COVID-19 illness severity perceptions; VAX = vaccine hesitancy; *M* = Mean; *SD* = Standard Deviation;. *$p < .05$, ** $p < .01$.

Table 4

Logistic Regression Predicting Pfizer Vaccination Willingness

Predictors	*B*	*SE(B)*	t-value	p-value	Odds Ratio	95% CI for Odds Ratio	
						LL	UL
Gender - Female	-.44	.32	1.39	.166	.64	.34	1.20
Gender – Male	0[a]				1.00		
Education							
None/did not finish	0[a]				1.00		
Year 12/HSC	-.16	.58	.28	.782	.85	.27	2.63
TAFE/Trade	-.32	.54	.59	.555	.73	.25	2.09
Bachelor degree	.19	.58	.33	.745	1.21	.38	3.81
Masters degree	1.07	.93	1.16	.247	2.92	.50	20.16
PhD	.07	1.29	.06	.954	1.08	.08	14.57
Age	**.05**	.01	3.16	**.002**	1.05	1.02	1.08
Frame							
Gain	-.57	.31	1.85	.065	.56	.31	1.03
Loss	0[a]	.	.		1.00	.	.
Risk Perceptions							
Not unwell at all	0[a]	.	.		1.00	.	.
Slightly unwell	1.26	.78	1.63	.104	3.54	.81	17.54
Moderately unwell	.81	.78	1.04	.299	2.25	.51	11.20
Very unwell	**1.98**	.77	2.58	**.010**	7.25	1.69	35.29
Extremely unwell	1.10	.82	1.35	.178	3.01	.63	15.93
BIS Score	.55	.54	1.01	.311	1.73	.60	5.09
BAS Score	.78	.52	1.50	.133	2.18	.79	6.09
VAX Score	**-1.22**	.17	7.01	**.000**	.29	.21	.41
AgexFrame	-.02	.02	1.14	.180	.98	.94	1.01
AgexBIS	.00	.02	.18	.855	1.00	.96	1.04
AgexBAS	.01	.02	.43	.669	1.01	.97	1.05
BISxFrame	-.53	.70	.75	.454	.59	.15	2.33
BASxFrame	-.51	.70	.73	.466	.60	.15	2.36

Note. Age in years, *B* = standardised coefficient, BAS = approach-orientation, BIS = avoidance-orientation, Risk refers to COVID-19 illness severity perceptions, *SE(B)* = standard error of the coefficient, VAX = vaccine hesitancy. [a] set to zero because this parameter is redundant.

Table 5

Logistic Regression Predicting AstraZeneca Vaccination Willingness

Predictors	*B*	*SE(B)*	t-value	p-value	Odds Ratio	95% CI for Odds Ratio	
						LL	UL
Gender - Female	-.23	.31	.76	.446	.79	.44	1.45
Gender – Male	0[a]				1.00		
Education							
None/did not finish	0[a]				1.00		
Year 12/HSC	.20	.52	.38	.706	1.23	.44	3.44
TAFE/Trade	.42	.50	.83	.409	1.52	.57	4.13
Bachelor degree	.37	.53	.69	.488	1.44	.52	4.09
Masters degree	.28	.77	.36	.719	1.32	2.90	5.99
PhD	1.15	1.06	1.08	.279	3.14	.38	26.28
Age	.00	.01	.17	.867	1.00	.98	1.03
Frame							
Gain	-.06	.29	.20	.842	.94	.53	1.68
Loss	0[a]	.	.		1.00	.	.
Risk Perceptions							
Not unwell at all	0[a]	.	.		1.00	.	.
Slightly unwell	-.08	.70	.12	.907	.92	.24	3.87
Moderately unwell	-.10	.69	.14	.938	.91	.24	3.77
Very unwell	-.05	.67	.08	.938	.95	.26	3.81
Extremely unwell	-.36	.76	.60	.617	.70	.17	3.05
BIS Score	**-1.35**	.52	2.59	**.010**	.26	.09	.71
BAS Score	1.05	.53	1.82	.069	2.72	.94	8.24
VAX Score	**-.79**	.17	4.67	**.000**	.45	.32	.63
AgexFrame	-.00	.02	.11	.911	1.00	.97	1.03
AgexBIS	.03	.02	1.47	.141	1.03	.99	1.07
AgexBAS	.01	.02	.54	.588	1.01	.97	1.05
BISxFrame	.96	.69	1.40	.162	2.62	.69	10.32
BASxFrame	-.08	.72	.11	.909	.92	.22	3.77

Note. Age in years, *B* = standardised coefficient, BAS = approach-orientation, BIS = avoidance-orientation, Frame refers to 1 for gain-frame and 0 for loss-frame, Risk refers to COVID-19 illness severity perceptions, *SE(B)* = standard error of the coefficient, VAX = vaccine hesitancy. [a] set to zero because this parameter is redundant.

Figures

Figure 1

Frequency of Pfizer and AstraZeneca Vaccine Willingness