Received: 29 November 2023 | Revised: 14 March 2024 | Accepted: 17 April 2024

DOI: 10.1002/hpja.868

RESEARCH ARTICLE

Health Promotion Journal of Australia | Australian Health Promotion Association | WILEY

Identifying key beliefs underlying QR code check-in and compliance behaviours in the COVID-19 pandemic

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Funding information
Australian Government Research Training Program

Handling editor: Joshua Trigg

Abstract

Issue Addressed: The implementation of quick response (QR) code check-in compliance behaviour during the COVID-19 pandemic featured in infection control strategies in several global jurisdictions, but was of particular interest in the Australian context, where it became mandated on a nationwide scale. We aimed to identify the salient beliefs people hold toward complying with the QR code check-in using a Theory of Planned Behaviour belief-based framework.

Methods: An elicitation study using open-ended questions (Queensland; $N = 93$, $M_{age} = 4.77$ years, $SD = 13.62$ and Victoria; $N = 76$, $M_{age} = 44.92$ years, $SD = 11.63$) and a prospective correlational study using a two-wave online survey (Queensland; $N = 290$, $M_{age} = 38.99$, 46.6% female and Victoria; $N = 290$, $M_{age} = 38.27$, 53.4% female) were conducted.

Results: Qualitative data were coded through an iterative content analysis, while quantitative data were analysed using linear multiple regression. Behavioural, normative and control beliefs were associated with intention and behaviour in both samples. Variation in beliefs across the states also were observed.

Conclusions: Across both samples, beliefs in positive outcomes consistently exhibited stronger associations with both intention and behaviour than the reported negative outcomes. Distinct differences emerged between the two samples in terms of regression effects.

So What? Results indicate individual experience may affect the beliefs which guide behaviour, supporting the potential efficacy of health promotion campaigns tapping into context specific beliefs and experiences if QR code check-in is to be implemented as an infection control measure in future.

KEYWORDS
COVID-19, QR code check-in, salient beliefs, theory of planned behaviour

1 | INTRODUCTION

The rapid spread of the SARS-CoV-2 virus and the associated declared COVID-19 pandemic had an unprecedented impact on societies, health systems and economies on a global scale.[1,2] For example, the pandemic accounted for more than 6.9 million deaths worldwide,[3] and 768 million confirmed cases,[3] placing an extreme strain on healthcare resources and infrastructure.[4,5] The economic

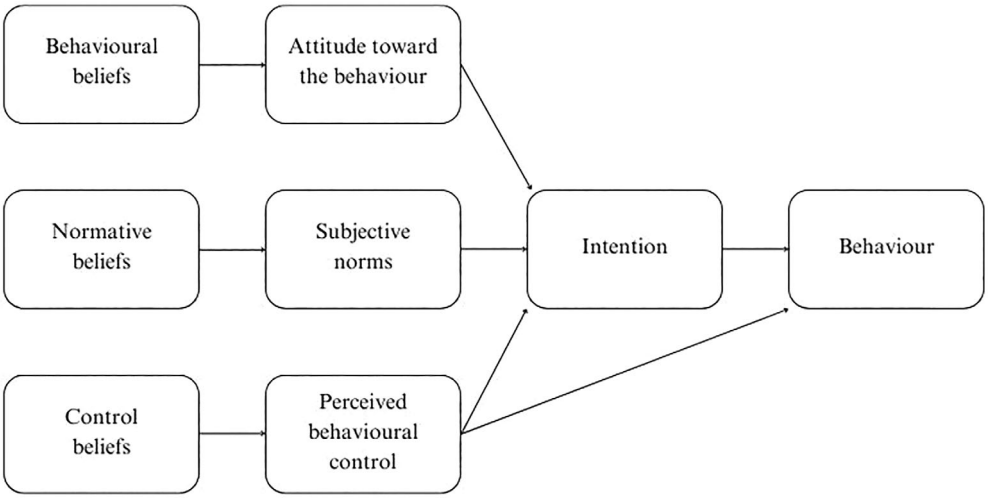

FIGURE 1 The theory of planned behaviour.[22]

ramifications of the pandemic have been far-reaching, causing disruptions to various sectors and triggering recessions across the world.[6] In light of these significant and widespread impacts of the COVID-19 pandemic, and as the pandemic transitions to endemic, strategies used to minimise the impact of COVID-19 need thorough review. That is, while governments worldwide begin to declare an end to the pandemic, research indicates pandemic level events may become increasingly likely over coming decades, whether from new coronavirus variants or other highly transmissible infectious diseases.[7,8] Thus, a clear need exists to review the factors associated with successful infection control strategies as part of a proactive approach to mitigate potential impacts of any future pandemics on public health and the global community.[9]

In the early stages of the pandemic, preventive strategies were, for the most part, based on large-scale restrictions on movement, with the ultimate goal of flattening the infection curve, in order to minimise the peak infection rate and reduce the strain on healthcare resources.[10] However, as the pandemic developed and infection peaks passed, authorities began to seek strategies to enable the resumption of normality, while still minimising the rate of uncontrolled community spread. While globally a range of strategies[11,12] were implemented, one novel strategy to control the pandemic amid returning to daily life was centred around mandated venue check-in systems to track likely infections and spread. For the most part, such systems were based upon using quick response (QR) codes as a method for registering attendance or verifying entry into various establishments or venues in an efficient and contactless way.[13,14]

The implementation of QR code check-ins featured in infection control strategies in several global jurisdictions, but was of particular interest in the Australian context, where it became a mandated preventive behaviour implemented on a nationwide scale. Each state government within Australia developed dedicated websites, mobile applications, regulations, and procedures to streamline, encourage, and enforce QR code check-in mandates.[15–18] Yet, despite attempts to streamline the check-in process and repeated campaigns from governments and health authorities emphasising the importance of QR code check-ins in minimising the impact of the virus,[19] compliance rates were often suboptimal.[20] While non-compliance with COVID-19 control strategies was commonplace, it presents a particular concern in regard to venue check-ins, which rely upon tracing infection chains to track and inform potential infections. It seems valuable, therefore, that investigations of the beliefs people hold toward compliance with this behaviour are undertaken in order to inform strategies which may prove useful in future campaigns adopting this strategy to control infection rates more broadly.

One prominent framework for understanding the determinants of volitional behaviour is the theory of planned behaviour (TPB) as Figure 1, which has been used to explain and predict various health-related behaviours, including compliance with preventive behaviours during infectious disease outbreaks.[21] The TPB is built on the assumption that behaviours are shaped by intentions, which are in turn determined by three factors: (1) attitudes, underpinned by behavioural beliefs on possible positive or negative consequences of engaging in a behaviour; (2) subjective norms, underpinned by normative beliefs about whether important others would approve or disapprove of a behaviour and (3) perceived behavioural control (PBC), underpinned by beliefs around the presence of facilitators or barriers to a behaviour.[22]

To date, the majority of COVID-19 TPB research has focused on the overall impact of the global belief-based constructs (i.e., attitude, subjective norm and perceived behavioural control).[23] However, a key strength of the model stems from belief elicitation; that is, the elicitation of the salient beliefs which underpin attitude, subjective norm, and perceived behavioural control, rather than the direct assessment of these constructs themselves.[22] Such a process of identifying salient beliefs and assessing their individual relationships to intention and behaviour is notably more involved, yet presents a key step for the development of empirically grounded behaviour change strategies.[24] Intervention strategies drawn from the TPB typically focus on messages to change attitude, subjective norm and perceived behavioural control by targeting the underlying beliefs. Thus, by identifying the most salient of these beliefs, elicitation studies provide specific

targets for empirically grounded health and behaviour change messages. Considering the current context of QR code check-in compliance, the identification of these salient beliefs provides an opportunity to understand the drivers of QR code check-in compliance during the COVID-19 pandemic. It also allows for the types of drivers of compliance behaviours that may be particularly efficacious targets for strategies encouraging infection control compliance in future to be identified.

The objective of this study was to investigate the salient beliefs that motivate people to comply with QR code check-in requirements during the COVID-19 pandemic in two Australian states: Queensland and Victoria. That is, compliance with the legal mandate for individuals to scan a QR-code using a dedicated check-in app when entering hospitality and entertainment venues. In addition, for a more nuanced examination of the findings, our study extended its scope to encompass two distinct Australian states, each characterised by varying encounters with the COVID-19 pandemic. Specifically, prior to the second data collection period, Victoria underwent a series of seven lockdowns, with Melbourne, the state capital, achieving the unprecedented status of having the lengthiest cumulative time in lockdown globally.[25] In contrast, Queensland, following the initial wave of the pandemic, witnessed a minimal rate of community transmission and enforced brief lockdown periods, consisting of three three-day lockdowns and one nine-day lockdown. Notably, these measures were confined to specific local government areas where instances of community COVID-19 transmission were identified. This exploration sought to illuminate variations in the factors influencing compliance behaviour, taking into account the distinctive circumstances, regulatory approaches, and public perceptions related to the pandemic in each state. By comparing these contrasting experiences, we aimed to provide deeper insights into how contextual factors may shape compliance behaviours in diverse pandemic scenarios. The researchers employed a TPB-based elicitation framework to identify salient beliefs related to behavioural, normative and control factors. In a separate sample, the extent to which elicited beliefs were related to intention and compliance behaviour was assessed. It was expected that the three types of beliefs would predict an individual's intention and behaviour regarding compliance with the check-in process, and that a range of beliefs would present as key for understanding this behaviour.

2 | METHODS

2.1 | Elicitation study

An elicitation study was employed to identify significant behavioural, normative, and control beliefs that contributed to compliance with QR code check-in requirements. Data were collected from 12 August to 19 December 2021 via an online survey in a convenience sample of 76 participants from Victoria ($M_{Age} = 44.92$ years, $SD = 11.63$) and 93 participants from Queensland ($M_{Age} = 4.77$ years, $SD = 13.62$; see Table 1 for detailed demographic data). Participants were recruited via email broadcasts and social media advertisements. After completing informed consent procedures, participants were asked a series of open-ended questions that were used to elicit their beliefs regarding compliance with QR code check-in requirements. Specifically, questions aimed to tap behavioural beliefs (What are the advantages/disadvantages of following the QR code check-in compliance behaviour?), normative beliefs (Who are the individuals or groups that would approve or think one should follow/disapprove or think one should not follow the QR code check-in compliance behaviour?) and control beliefs (Please list any factors or circumstances that would make it easy or enable you/make it difficult or prevent to follow the QR code check-in compliance behaviour).

Responses to the elicitation study were then subject to content analysis, where the research team extracted repeated behavioural, normative, and control beliefs for further analysis in a larger, quantitative sample (refer to Table 2 for details). A total of nine behavioural beliefs (e.g., having quick, efficient contact tracing), nine normative beliefs (e.g., government authorities) and seven control beliefs (e.g., difficulties accessing or finding the QR code) were identified.

2.2 | Participants and procedures

Data for the larger, correlational phase of the study was collected between 21 February and 28 March, 2022, via an online survey. A total of 580 Australian residents were recruited from the two states of Queensland ($N = 290$, $M_{Age} = 38.99$, 46.6% female) and Victoria ($N = 290$, $M_{Age} = 38.27$, 53.4% female), via an online research panel company. After providing informed consent, participants were provided with a comprehensive definition of QR code check-in compliance behaviour, and then asked to complete measures that assessed their endorsement of the beliefs identified in the elicitation study, and their intention to comply with QR code check-in requirements in the coming 2 weeks. Two weeks later, participants were recontacted via the panel company to report on their compliance with check-in requirements during the previous 2 weeks. From the initial sample, 128 participants from Queensland and 109 participants from Victoria did not return to complete follow-up measures, resulting in a final total sample of 343; 162 from Queensland ($M_{Age} = 43.26$, 47.5% female) and 181 from Victoria ($M_{Age} = 41.88$, 56.4% female). Participants received a fixed sum of compensation, which was based on the expected time taken to complete the study and was commensurate with the panel company's published rates. A detailed analysis of the demographic information for both Australian states is presented in Table 1.

2.3 | Measures

Items and response scales for variables are illustrated in Appendix A.

2.3.1 | Behavioural beliefs

Using the elicited behavioural beliefs from Phase 1, participants rated how five advantages and four disadvantages would result if they

TABLE 1 Sample characteristics and descriptive statistics for study variables at elicitation, baseline and at 2-week follow-up.

	Elicitation				Baseline				Follow-up			
Variable	**Queensland**		**Victoria**		**Queensland**		**Victoria**		**Queensland**		**Victoria**	
Participants	93		76		290		290		162		181	
Age, *M* years (SD)	40.77 (13.62)		44.92 (11.63)		38.99 (12.26)		38.27 (12.42)		43.26 (11.31)		41.88 (11.51)	
Gender												
Male	26	28%	23	30%	154	53%	134	46%	84	52%	78	43%
Female	63	68%	52	68%	135	47%	155	53%	77	48%	102	56%
Non-binary / third gender	4	4%	1	1%	1	0%	0	0%	1	1%	0	0%
Prefer not to say	-		-		0	0%	1	<1%	0	0%	1	1%
Current relationship status												
Married registered	46	49%	29	38%	95	33%	82	28%	59	36%	59	33%
Married de facto	15	16%	7	9%	60	21%	48	17%	31	19%	33	18%
Widowed	1	1%	3	4%	1	0%	1	0%	1	1%	1	1%
Divorced	3	3%	14	18%	22	8%	25	9%	18	11%	19	10%
Never Married	28	30%	23	30%	112	39%	134	46%	53	33%	69	38%
Employment status												
Full-time work	35	38%	35	46%	166	57%	144	50%	90	56%	87	48%
Part-time/Casual work	28	30%	19	25%	62	21%	76	26%	32	20%	47	26%
Full-time student	23	25%	3	4%	9	3%	11	4%	5	3%	5	3%
Part-time student	3	3%	1	1%	0		3	1%	0	0%	1	1%
Unemployed/ Retired	4	4%	18	24%	53	18%	56	19%	35	22%	41	23%
Highest educational achievement												
Year 10	2	2%	4	5%	28	10%	17	6%	14	9%	14	8%
Year 12	10	11%	5	7%	47	16%	59	20%	19	12%	32	18%
TAFE certificate/ diploma	20	22%	18	24%	98	34%	72	25%	61	38%	43	24%
Undergraduate degree	32	34%	19	25%	77	27%	96	33%	47	29%	60	33%
Postgraduate degree	29	31%	30	39%	40	14%	46	16%	21	13%	32	18%
Family taxable income range												
Nil–$18 200	11	12%	6	8%	4	1%	10	3%	4	2%	4	2%
$18 201–$37 000	9	10%	11	14%	32	11%	35	12%	19	12%	20	11%
$37 001–$80 000	22	24%	19	25%	65	22%	85	29%	38	23%	51	28%
$80 001–$180 000	43	46%	29	38%	110	38%	99	34%	53	33%	67	37%
>$180 001	8	9%	11	14%	54	19%	31	11%	31	19%	19	10%
Prefer not to say	-	-	-		25	9%	30	10%	17	10%	20	11%

engaged in COVID-19 QR code check-in and reporting compliance behaviours, scored '1' (slightly valuable) to '7' (extremely valuable) and '7' (slightly bad) to '1' (extremely bad) for advantages and disadvantages respectively, as well as the likelihood of each of these outcomes, scored '1' (extremely unlikely) to '7' (extremely likely). Each item was scored as the multiplied value of the perceived likelihood and outcome for each elicited belief.

2.3.2 | Normative beliefs

Using the normative beliefs obtained in Phase 1, participants rated how likely these nine individuals or groups would approve of them engaging in COVID-19 QR code check-in and reporting compliance behaviours; scored '1' (extremely unlikely) to '7' (extremely likely), as well as how much they cared about the approval of each group;

TABLE 2 QR code check-in beliefs.

	Queensland		Victoria	
	N	%	*N*	%
Having quick, efficient contact tracing	70	75.26	45	48.38
Preventing new outbreaks	14	15.05	11	11.82
Keeping the community safe	8	8.6	9	9.67
Notifying myself and others of exposure sites	18	19.35	12	12.9
Helping venues and businesses to remain open	7	7.52	9	9.67
Feeling inconvenienced	29	31.18	34	36.55
Risking data privacy breaches	34	36.55	22	23.65
Risking being asked to quarantine	4	4.3	0	0
Causing increased effort for businesses	9	9.67	3	3.22
Government authorities	47	5.53	37	39.78
Family members	20	21.5	12	12.9
Friends	16	17.2	7	7.52
The community	53	56.98	39	41.93
Healthcare professionals	13	13.97	17	18.27
Business owners and managers	21	22.58	16	17.2
Colleagues and workmates	8	8.6	4	4.3
Vulnerable and high-risk groups	9	9.67	0	0
Venue staff	9	9.67	5	5.37
Difficulties accessing or finding the QR code	31	33.33	44	47.31
Not having a smartphone accessible	43	46.23	21	22.58
Difficulties using the check-in software or app	5	5.37	9	9.67
Checking in takes time	27	29.03	23	24.73
Reminders from staff	8	8.6	4	4.3
Reliable internet	4	4.3	1	1.07
A simplified check in process	4	4.3	4	4.3

scored '1' (not at all) to '7' (a great deal). Each item was scored as the multiplied value of the perceived likelihood and value placed on approval from each group.

2.3.3 | Control beliefs

Using the control beliefs obtained in Phase 1, participants rated how likely 2 internal and 5 external factors were to prevent/discourage them from engaging in COVID-19 QR code check-in and reporting compliance behaviours; scored '1' (extremely unlikely) to '7' (extremely likely).

2.3.4 | Intention

Participants responded to three items (e.g., 'It is likely that I will follow COVID-19 QR code check-in and reporting compliance behaviours every time I enter a venue that requires me to check-in'); scored '1' strongly disagree to '7' strongly agree.

2.3.5 | Time 2 Follow-Up Questionnaire

Self-reported behaviour

Two weeks later, participants responded to two items (e.g., 'In the past two weeks, to what extent did you follow COVID-19 QR code check-in and reporting compliance behaviours every time you entered a venue that requires you to check-in?'); scored '1' a small extent to '7' a large extent and '1' never to '7' always.

3 | RESULTS

All analyses were conducted using SPSS version 28. Descriptive statistics for each elicited belief are available in Appendix B. Each beliefs relationship with intention and behaviour as a bivariate correlation and when regressed simultaneously on intention and behaviour is presented in Table 3. Correlational analysis found the majority of beliefs identified in the elicitation study were correlated with intention and behaviour. Exceptions for the Queensland sample were 1 and 2 behavioural beliefs and 3 and 6 control beliefs for intention and behaviour, respectively. Exceptions for the Victoria sample were 2 and

TABLE 3 Descriptive statistics for key beliefs and their relationship with intention in bivariate and univariate models.

	Queensland								Victoria							
	Intention				Behaviour				Intention				Behaviour			
	r	*β*	CI	*p*	*R*	*β*	CI	*p*	*r*	*β*	CI	*p*	*r*	*β*	CI	*p*
Having quick, efficient contact tracing	.66***	.26	.05, .46	.014	.44***	.12	−.15, .39	.372	.69***	.32	.07, .58	.014	.50***	.26	−.07, .59	.118
Preventing new outbreaks	.64***	−.12	−.40, .17	.417	.46***	.34	−.03, .71	.072	.64***	−.06	−.34, .23	.692	.49***	.09	−.27, .45	.635
Keeping the community safe	.71***	.51	.29, .74	<.001	.41***	−.07	−.37, .23	.636	.72***	.49	.18, .8	.002	.51***	.24	−.16, .63	.239
Notifying myself and others of exposure sites	.59***	−.07	−.3, .15	.510	.41***	−.08	−.38, .21	.573	.61***	−.29	−.56, −.02	.037	.46***	−.13	−.47, .21	.454
Helping venues and businesses to remain open	.65***	.18	−.01, .37	.062	.44***	.21	−.04, .45	.096	.68***	.27	.06, .48	.012	.47***	.11	−.17, .38	.443
Feeling inconvenienced	−.17*	−.16	−.27, −.05	.005	−.17*	−.16	−.31, −.02	.029	−.04				.03			
Risking data privacy breaches	.07				−.04				−.03				−.07			
Risking being asked to quarantine	.34***	.00	−.14, .14	.986	.22**	.00	−.18, .17	.992	.40***	.02	−.12, .16	.759	.25***	−.05	−.23, .13	.564
Causing increased effort for businesses	.26***	.07	−.06, .19	.324	.12				.23**	.00	−.13, .12	.965	.16*	.03	−.13, .19	.730
Government authorities	.47***	.33	.09, .56	.006	.27***	.12	−.13, .37	.353	.43***	.02	−.17, .21	.857	.38***	.22	.00, .43	.046
Family members	.39***	−.03	−.41, .35	.883	.27***	.20	−.21, .62	.341	.59***	.41	.12, .7	.006	.41***	.46	.14, .79	.006
Friends	.41***	.23	−.24, .69	.342	.26***	−.07	−.58, .44	.793	.53***	.00	−.31, .32	.985	.33***	−.27	−.62, .08	.132
The community	.35***	−.12	−.41, .16	.391	.20*	−.22	−.53, .09	.164	.49***	−.23	−.51, .05	.103	.33***	−.20	−.52, .11	.205
Healthcare professionals	.44***	.12	−.18, .42	.448	.29***	.20	−.12, .53	.222	.56***	.28	.01, .54	.040	.42***	.32	.02, .61	.035
Business owners and managers	.41***	.18	−.10, .46	.203	.28***	.20	−.11, .51	.203	.52***	−.05	−.32, .22	.714	.34***	−.25	−.55, .05	.099
Colleagues and workmates	.36***	−.14	−.42, .14	.328	.25***	.04	−.26, .35	.787	.53***	.11	−.12, .34	.343	.37***	.12	−.13, .38	.341
Vulnerable and high-risk groups	.39***	−.01	−.28, .25	.920	.24***	−.11	−.40, .18	.469	.50***	−.05	−.28, .18	.676	.36***	−.03	−.29, .22	.799
Venue staff	.40***	−.01	−.29, .27	.935	.25***	−.03	−.34, .27	.830	.55***	.19	−.09, .47	.192	.39***	.13	−.19, .45	.416
Difficulties accessing or finding the QR code	.08				−.02				−.14				−.12			
Not having a smartphone accessible	−.01				−.14				−.13				−.13			

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TABLE 3 (Continued)

	Queensland								Victoria							
	Intention				Behaviour				Intention				Behaviour			
	r	β	CI	p	R	β	CI	p	r	β	CI	p	r	β	CI	p
Difficulties using the check-in software or app	−.07				−.14				−.29***	−.13	−.26, .00	.051	−.16*	.02	−.13, .17	.781
Checking in takes time	−.26***	−25	−.39, −.11	.001	−.27***	−.27	−.42, −.12	<.001	−.48***	−.34	−.47, −.20	<.001	−.46***	−.44	−.59, −.29	<.001
Reminders from staff	.28***	.11	−.07, .3	.224	.13				.41***	.05	−.09, .19	.507	.22**	−.07	−.23, .09	.380
Reliable internet	.30***	.17	−.02, .36	.083	.04				.51***	.31	.13, .49	.001	.34***	.18	−.02, .39	.074
A simplified check in process	.31***	.12	−.09, .32	.264	.05				.43***	.16	−.01, .33	.067	.30***	.15	−.04, .35	.121

Note: Behavioural beliefs models for Queensland (intention $F(8,153) = 26.04$, $p < .001$, $R^2 = .580$; behaviour $F(7,154) = 7.79$, $p < .001$, $R^2 = .261$) and Victoria (intention $F(7,173) = 3.65$, $p < .001$, $R^2 = .554$; behaviour $F(7,174) = 9.34$, $p < .001$, $R^2 = .273$). Normative beliefs model for Queensland (intention $F(9,152) = 5.77$, $p < .001$, $R^2 = .255$; behaviour $F(9,152) = 7.79$, $p = .025$, $R^2 = .115$) and Victoria (intention $F(9,171) = 12.61$, $p < .001$, $R^2 = .399$; behaviour $F(9,172) = 6.27$, $p < .001$, $R^2 = .247$). Control beliefs model for Queensland (intention $F(4,157) = 8.86$, $p < .001$, $R^2 = .184$; behaviour $F(1,160) = 12.77$, $p < .001$, $R^2 = .074$) and Victoria (intention $F(5,175) = 28.19$, $p < .001$, $R^2 = .446$; behaviour $F(5,176) = 14.32$, $p < .001$, $R^2 = .289$). * $p < .05$, ** $p < .01$, *** $p < .001$.

2 behavioural beliefs and 2 and 2 control beliefs for intention and behaviour, respectively.

Using multiple regression, behavioural beliefs predicted a significant proportion of variance in both intention and behaviour in the Queensland (intention $F(8,153) = 26.04$, $p < .001$, $R^2 = .580$; behaviour $F(7,154) = 7.79$, $p < .001$, $R^2 = .261$) and Victoria (intention $F(7,173) = 3.65$, $p < .001$, $R^2 = .554$; behaviour $F(7,174) = 9.34$, $p < .001$, $R^2 = .273$) samples. In the Queensland sample, intention was predicted by the belief that QR code check-ins would enable quick and efficient contract tracing, keep the community safe, and not cause feelings of inconvenience, with low endorsement that check-ins would cause feelings of inconvenience predicting behaviour. In the Victoria sample, the belief that QR codes would enable quick and efficient contact tracing, keep the community safe, and help keep businesses open predicted intentions, while the belief that check-in would notify oneself of exposure to the virus predicted intention in an unexpected negative direction, most likely due to a suppression effect. No belief predicted behaviour in the Victoria sample.

Normative beliefs predicted a significant proportion of variance in both intention and behaviour in the Queensland (intention $F(9,152) = 5.77$, $p < .001$, $R^2 = .255$; behaviour $F(9,152) = 7.79$, $p = .025$, $R^2 = .115$) and Victoria (intention $F(9,171) = 12.61$, $p < .001$, $R^2 = .399$; behaviour $F(9,172) = 6.27$, $p < .001$, $R^2 = .247$) samples. In the Queensland sample, endorsing the belief that Government authorities would approve predicted a unique portion of variance above other normative groups in the regression model, while no normative group predicted a unique portion of variance in behaviour. In the Victoria sample, the endorsement of family members and healthcare professionals predicted a unique portion of variance for both intention and behaviour, while the endorsement of approval by Government authorities predicted behaviour, but not intention.

Control beliefs predicted a significant proportion of variance in both intention and behaviour in the Queensland (intention $F(4,157) = 8.86$, $p < .001$, $R^2 = .184$; behaviour $F(1,160) = 12.77$, $p < .001$, $R^2 = .074$) and Victoria (intention $F(5,175) = 28.19$, $p < .001$, $R^2 = .446$; behaviour $F(5,176) = 14.32$, $p < .001$, $R^2 = .289$) samples. In the regression models, the belief that checking in takes time was a negative predictor of intention and behaviour in both the Queensland and Victoria samples, while reliable internet predicted intention only in Victoria.

4 | DISCUSSION

The aim of this research was to explore the underlying beliefs that were associated with individuals' compliance with QR code check-in requirements during the COVID-19 pandemic in two Australian states: Queensland and Victoria. Results revealed a range of behavioural, normative and control beliefs were associated with intention and behaviour; that is, the beliefs people hold salient with regard to adhering to the legal obligation of scanning a QR code using a designated check-in app when visiting hospitality and entertainment venues. To achieve this, the study employed the TPB-based elicitation

framework to identify the salient beliefs associated with behavioural, normative and control factors for the target behaviour. Subsequently, in a separate sample, model tests were conducted to examine those beliefs which significantly predicted people's intention and reported compliance behaviour. The findings of this study demonstrate that behavioural beliefs, normative beliefs and control beliefs exerted a significant influence on both intention and behaviour in both the Queensland and Victoria samples, significantly accounting for explained variance observed in individuals' intention and compliance behaviour regarding the QR code check-in requirements. These findings are in line with other health preventive behaviour research that used the TPB belief-based approach and found people's beliefs significantly predict their intention and behaviour.[26,27]

In regard to the behavioural beliefs, results were largely in line with our expectations as the majority of elicited beliefs showed significant correlations with intention and behaviour in both the Victoria and Queensland samples. The notable exception was beliefs regarding the risks to data privacy breaches, which was found to have no association with intention or behaviour in either sample. Importantly, in both samples, positive outcome beliefs (e.g., having quick, efficient contact tracing, preventing new outbreaks, keeping the community safe, notifying myself and others of exposure sites, and helping venues and businesses to remain open) had consistently higher associations with intention and behaviour than negative outcome beliefs (e.g., feeling inconvenienced, risking data privacy breaches, risking being asked to quarantine and causing increased effort for businesses). Such a result is reflected in regression models predicting intention, where the endorsement of the belief that QR code check-in compliance would keep the community safe had the strongest unique effect on intention in both states. This may be reflective of the general belief that contact tracing is a crucial public health strategy for identifying and isolating potential COVID-19 cases,[28] with clear benefits to the community and one's own personal motives[29] which was a key discussion point in messaging.

As for predicting behaviour, however, results are less clear. Despite strong correlations between all positive outcome beliefs and behaviour, no one positive belief displayed a unique effect on behaviour in regression modelling in either state. This result, while in contrast to our expectations, is most likely explained by the strong correlations between positive outcome beliefs. Thus, because those who endorsed anyone given positive outcome as likely were also likely to endorse other positive outcome beliefs, no single belief can be flagged here as a particularly important target for intervention development. Noteworthily, despite the differences between the two states in their experience of managing the COVID-19 pandemic, effect sizes were largely similar in Queensland and Victoria. The sole exception to this was the endorsement of the belief that following QR code requirements would evoke feelings of being inconvenienced, which had small but statistically significant effects on intention and behaviour in Queensland, but near zero effects in Victoria. Varying public attitudes and perceptions towards the implementation of QR code requirements in these two states may explain this effect. Specifically, regional variations in the severity of COVID-19 outbreaks might have influenced the perceived urgency and necessity of following QR code mandates.[30] In Queensland, where the impact of the pandemic might have been comparatively milder during the observed period, individuals might have perceived the inconvenience of QR code usage as more pronounced due to a perceived lower threat level.[31] Conversely, in Victoria, which experienced more sustained outbreaks, the perceived inconvenience might have been overshadowed by a stronger sense of communal responsibility and the immediate health risks posed by the virus.[15]

All normative beliefs elicited were significantly correlated with intention and behaviour in both samples. Importantly, however, several differences were observed between samples in terms of regression effects. In the Queensland sample, endorsing the belief that Queensland Government authorities would approve was a significant predictor of intention beyond other normative groups. On the other hand, in the Victorian sample, the endorsement of family members and healthcare professionals predicted a unique portion of variance for both intention and behaviour, and endorsement of the Victorian Government as a normative group had only a small effect on behaviour. A potential explanation for this may be the prolonged lockdowns and significantly higher caseload faced by the Victorian healthcare sector during the peak stages of the COVID-19 pandemic.[32] That is, as Victoria faced a greater risk of contracting and spreading a COVID-19 infection, pressure from ones' family or doctor to take steps to avoid this outcome may have been a more salient and impactful belief. In contrast, because the healthcare caseload in Queensland remained relatively low, so did the risk of spreading the virus to ones' family. Thus, those in the Queensland sample may have felt less direct pressure from their family to take active steps to avoid potentially spreading a COVID-19 infection.[33]

Control beliefs were also found to significantly correlate with both intention and behaviour in the Queensland and Victoria samples. All facilitator beliefs showed correlations with intention and behaviour in both samples. In contrast, of the elicited barriers, only the belief that check-in takes time was associated with intention and behaviour in both samples, while difficulty using the check-in app was only correlated with intention and behaviour in the Victorian sample. Regarding regression models, the beliefs that checking-in takes time was the most consistent effect predicting a unique portion of variance in intention and behaviour in both samples. Such a finding suggests that those who perceive following the QR code check-in system as overly time consuming may be, in turn, less likely to comply with requirements to use the system and flags the value of ensuring infection control strategies employed in future are as streamlined and non-intrusive as possible.

5 | IMPLICATIONS, LIMITATIONS AND FUTURE DIRECTIONS

The current study had several notable implications for the review of COVID-19 control strategies and for informing potential infection control strategies in future. In line with theory, the findings presented here indicate behavioural beliefs, normative beliefs and control beliefs exerted a significant influence on both intention and behaviour and, therefore, support the potential efficacy of campaigns tapping into

those beliefs. This assists health promotion practitioners when developing strategies for these types of compliance behaviours, enabling them to develop strategies that consider behavioural beliefs, normative beliefs, and control beliefs, and where there is misalignment, strategies to change these beliefs can be developed. Given the increasing use of technology for health-related behaviours, by identifying the salient beliefs that influence compliance with QR code check-ins, our study provides a nuanced understanding of how communities perceive and respond to technological solutions in the context of public health. These insights can assist in tailoring community engagement initiatives to address specific concerns, eliminate misconceptions, and promote a shared sense of responsibility towards public health measures. Integrating insights from QR code compliance beliefs into educational and awareness programs ensures that communities are not only aware of the technology, but also understand its relevance and significance in the broader context of public health.

In contrast to previous research applying the TPB framework to understanding health beliefs, we observed few unique effects in regression modelling, in particular for behavioural and normative beliefs, despite observing modest sized bivariate correlation effects. The strong relationship between each of these beliefs is the best explanation for this. One possible reason behind this may be that infection control strategies worldwide were often viewed as polarising.[34] Thus, it may be that participants beliefs were clustered with approvers positively endorsing all beliefs, rather than being driven by any singular belief or normative group, and similarly those against infection control measures reporting consistent negative opinions, rather than being dissuaded by any particular potential outcome. Further, the current study provides a preliminary indication that individual experience may affect the normative beliefs that guide their behaviour, due to their intrinsic connection to personal learning and adaptation processes.[35] When individuals encounter various situations and engage in specific activities, they gather firsthand information that influences their perceptions of what is socially acceptable within those contexts. For instance, positive experiences related to adhering to certain norms, such as QR code check-in compliance, can reinforce the belief that such behaviours are not only expected but also rewarding or beneficial.[36] On the contrary, negative experiences might lead individuals to question or reject certain norms if they perceive them as hindrances or sources of discomfort.

However, while the study had notable implications, it is important to consider the presented findings in light of their inherent limitations. First, the data were gathered during a comparatively later phase of the pandemic and individuals' beliefs might have undergone shifts as the pandemic unfolded. The evolving nature of the crisis, changing information and the gradual adaptation to new circumstances could have contributed to alterations in peoples' perceptions and attitudes. Additionally, the concept of compliance burnout emerges as a relevant factor in this context.[37] As the pandemic prolonged, individuals may have experienced a sense of fatigue[38] from consistently adhering to safety measures and regulations. This fatigue, commonly referred to as compliance burnout, could have influenced their willingness to continue following the norms and beliefs established earlier in the pandemic.[38] Consequently, it becomes crucial to explore the interplay between the temporal progression of the pandemic, the evolving beliefs of individuals and the potential effects of compliance burnout on normative behaviours. Second, QR code check-in behaviour is not a one-size-fits-all phenomenon; rather, it involves a multitude of contextual intricacies that shape its expression. The distinction between urban and rural environments holds significant weight.[39] Urban areas tend to be more densely populated, potentially impacting the efficiency of QR code check-in processes due to higher foot traffic. In contrast, rural settings might present different logistical challenges, such as limited access to smartphones or fewer venues that require check-ins. The nature of venues also plays a pivotal role. QR code check-in requirements vary from one type of establishment to another, with nuances in rules and regulations. For instance, while entertainment venues might see a surge in check-in compliance during peak hours, dining times and occupancy rates might cause fluctuations in check-ins in restaurants. Failure to discern these variations could lead to oversimplification of the complex reality of QR code check-in behaviour. Future research could explore the influence of demographic variables more comprehensively, allowing for a nuanced examination of their potential impact on beliefs and behaviours related to QR code check-in. This approach would contribute valuable insights to the broader understanding of the factors shaping compliance behaviours during public health crises.

6 | CONCLUSION

The current research identified the underlying beliefs linked with individuals' adherence to QR code check-in requirements during the COVID-19 pandemic in two Australian states—Queensland and Victoria—using an elicitation framework grounded in the TPB. The findings highlighted that behavioural, normative and control beliefs were significantly associated with both intention and behaviour. Across the two samples, beliefs in positive outcomes consistently exhibited stronger associations with both intention and behaviour than their negative outcome counterparts. Nonetheless, distinct differences emerged between the two samples in terms of regression effects. A consistent finding revolved around the perception of the QR code check-in system being overly time consuming. This perception appeared to correlate with decreased likelihood of compliance with the system's requirements. This observation underscores the importance of designing future infection-control strategies that are streamlined and minimally intrusive, ensuring greater acceptance and adherence. Future research should strive to mitigate the potential impact of compliance burnout and further illuminate variances between urban and rural settings, as well as across different venue types. A more comprehensive understanding of compliance behaviour literature can be forged, providing valuable insights into the dynamics of adherence to such regulatory measures.

ACKNOWLEDGEMENT

The authors would like to thank HAPI lab members for their support during the data collection process. Open access publishing facilitated

by Griffith University, as part of the Wiley - Griffith University agreement via the Council of Australian University Librarians.

FUNDING INFORMATION

This research was supported by the Australian Government Research Training Program as part of Thi Nhung Mac's PhD project.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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How to cite this article: Mac TN, Phipps DJ, Parkinson J, Hamilton K. Identifying key beliefs underlying QR code check-in and compliance behaviours in the COVID-19 pandemic. Health Promot J Austral. 2024. https://doi.org/10.1002/hpja.868

APPENDIX A

A QR code is a link that your smartphone camera can recognise. When you check-in, you create a record of the time and date you visited a venue or show evidence of your vaccination status. This means that if there is a COVID-19 outbreak, contact tracers can quickly access your contact information and get in touch with you if you have visited a public exposure site or venue staff can check that you are fully vaccinated.

A.1. | ITEMS AND RESPONSE SCALES FOR VARIABLES

Variable	Item(s)/measure	Scale
Behavioural Beliefs	If I follow COVID-19 QR code check-in and reporting compliance behaviours *every time* I enter a venue that requires me to check-in, it will… Having quick, efficient contact tracing (1) Preventing new outbreaks (2) Keeping the community safe (3) Notifying myself and others of exposure sites (4) Helping venues and businesses to remain open (5) Feeling inconvenienced (6) Risking data privacy breaches (7) Risking being asked to quarantine (8) Causing increased effort for businesses (9)	Extremely unlikely 1 (1)—Extremely likely 7 (7)
Normative Beliefs	How likely do you think the below individuals/groups would approve of you following COVID-19 QR code check-in and reporting compliance behaviours *every time* you enter a venue that requires you to check-in? Government authorities (1) Family members (2) Friends (3) The community (4) Healthcare professionals (5) Business owners and managers (6) Colleagues and workmates (7) Vulnerable and high-risk groups (8) Venue staff (9)	Extremely unlikely 1 (1)—Extremely likely 7 (7)
Control Beliefs	How likely would each of the below prevent you from following COVID-19 QR code check-in and reporting compliance behaviours *every time* you enter a venue that requires you to check-in in the next 2 weeks? Difficulties accessing or finding the QR code (1) Not having a smartphone accessible (2) Difficulties using the check-in software or app (3) Checking in takes time (4) How likely would each of the below make it easier for you to follow COVID-19 QR code check-in and reporting compliance behaviours *every time* you enter a venue that requires you to check-in in the next 2 weeks? Reminders from staff (1) Reliable internet (2) A simplified check in process (3)	Extremely unlikely 1 (1)—Extremely likely 7 (7)

APPENDIX B

B.1 | DESCRIPTIVE STATISTICS FOR THE ELICITED BELIEFS AND VALUES

		Victoria		Queensland	
Elicited belief		***M***	***SD***	***M***	***SD***
Likelihood	Having quick, efficient contact tracing	4.33	2.20	4.53	2.01
	Preventing new outbreaks	3.88	2.21	3.99	2.10
	Keeping the community safe	4.38	2.08	4.39	2.05
	Notifying myself and others of exposure sites	4.38	2.18	4.30	2.03
	Helping venues and businesses to remain open	4.65	2.10	4.56	2.00
	Feeling inconvenienced	3.90	2.07	3.98	1.98
	Risking data privacy breaches	3.98	2.07	3.86	1.81
	Risking being asked to quarantine	4.33	1.91	4.26	1.76
	Causing increased effort for businesses	4.63	1.86	4.49	1.75
Importance	Having quick, efficient contact tracing	5.03	1.93	4.81	1.91
	Preventing new outbreaks	5.16	1.89	4.99	1.85
	Keeping the community safe	5.36	1.79	5.17	1.85
	Notifying myself and others of exposure sites	5.20	1.88	4.85	1.90
	Helping venues and businesses to remain open	5.38	1.77	5.15	1.78
	Feeling inconvenienced	4.39	1.97	4.52	1.76
	Risking data privacy breaches	3.80	1.97	3.85	1.87
	Risking being asked to quarantine	4.21	1.95	4.16	1.91
	Causing increased effort for businesses	4.34	1.87	4.27	1.71
Likelihood of approval	Government authorities	5.63	1.73	5.76	1.57
	Family members	4.67	1.85	4.75	1.72
	Friends	4.63	1.84	4.65	1.70
	The community	4.76	1.69	4.67	1.54
	Healthcare professionals	5.57	1.65	5.46	1.53
	Business owners and managers	4.97	1.85	4.98	1.72
	Colleagues and workmates	4.82	1.83	4.60	1.75
	Vulnerable and high-risk groups	5.58	1.71	5.49	1.61
	Venue staff	5.29	1.69	5.11	1.57
Value of approval	Government authorities	3.53	2.23	3.71	2.10
	Family members	4.29	2.18	4.33	1.98
	Friends	4.12	2.15	4.25	1.98
	The community	3.85	2.11	3.99	1.91
	Healthcare professionals	4.21	2.21	4.57	1.98
	Business owners and managers	4.02	2.10	4.21	1.91
	Colleagues and workmates	3.99	2.09	4.06	1.90
	Vulnerable and high-risk groups	4.48	2.21	4.69	1.96
	Venue staff	4.17	2.07	4.37	1.85
Likelihood of preventing	Difficulties accessing or finding the QR code	3.90	2.05	4.23	2.07
	Not having a smartphone accessible	4.06	2.27	4.35	2.28
	Difficulties using the check-in software or app	3.79	2.19	4.08	2.09
	Checking in takes time	3.54	2.11	3.22	1.90

(Continues)

Elicited belief		Victoria		Queensland	
		M	*SD*	*M*	*SD*
Likelihood of facilitating	Reminders from staff	4.55	1.93	4.74	1.97
	Reliable internet	4.99	1.94	4.97	1.81
	A simplified check in process	5.13	1.88	5.07	1.71